CLCnet

GCSE

Mathematics

Revision 2006/7

Useful Web Sites

Listed below are some useful websites to assist in the revision of subjects. There is also space for you to make a note of any websites that you use or have been suggested by your school.

Number

School suggestions/favourites

http://www.bbc.co.uk/schools/gcsebitesize/maths/numberf/

http://www.bbc.co.uk/schools/gcsebitesize/maths/numberih/

http://www.s-cool.co.uk/topic_index.asp?subject_id=15&d=0

http://www.mathsrevision.net/gcse/index.php

http://www.gcseguide.co.uk/number.htm

http://www.gcse.com/maths/

http://www.easymaths.com/number_main.htm

Algebra

http://www.bbc.co.uk/schools/gcsebitesize/maths/algebrafi/

http://www.bbc.co.uk/schools/gcsebitesize/maths/algebrah/

http://www.s-cool.co.uk/topic_index.asp?subject_id=15&d=0

http://www.mathsrevision.net/gcse/index.php

http://www.gcseguide.co.uk/algebra.htm

http://www.gcse.com/maths/

http://www.easymaths.com/algebra_main.htm

Shape, Space and Measures

http://www.bbc.co.uk/schools/gcsebitesize/maths/shape/

http://www.bbc.co.uk/schools/gcsebitesize/maths/shapeih/

http://www.s-cool.co.uk/topic_index.asp?subject_id=15&d=0

http://www.mathsrevision.net/gcse/index.php

http://www.gcseguide.co.uk/shape_and_space.htm

http://www.gcse.com/maths/

http://www.easymaths.com/shape_main.htm

Handling Data

http://www.bbc.co.uk/schools/gcsebitesize/maths/datahandlingih/

http://www.bbc.co.uk/schools/gcsebitesize/maths/datahandlingh/

http://www.s-cool.co.uk/topic_index.asp?subject_id=15&d=0

http://www.mathsrevision.net/gcse/index.php

http://www.gcse.com/maths/

http://www.easymaths.com/stats_main.htm

How To Use This Booklet

Welcome to the Salford CLCnet guide to GCSE Maths revision.

This guide is designed to help you do as well as you can in your GCSE Maths. It doesn't matter which examination board or tier you are revising for – the way the guide is laid out will help you to cover the material you need to revise.

If possible, you should use this guide with help from your Maths teacher or tutor. If you are revising for GCSE Maths without the support of a teacher, though, the guide should still be useful. Just follow the instructions as you go along and the way it works will soon be clear to you.

Contents and easy reference.

Over the page you will find the contents section which is also important in showing you and your teacher how you are progressing with your revision. In the tables on these pages you can see how the whole guide is laid out. The pages and topics are on the left. On the right are the grades at which there are questions to do. So, for example, there is a smiley face below the grades G, F, E, D and C for the topic 'Fractions' in Number. This means that there are questions at those 5 grades for this topic.

How to use the contents pages.

When you have completed the questions in the guide, and you are happy that you know how they work, you can come back to this contents section and record that you have covered the question. Do this by ticking the smiley face for the question.

The example below shows that someone has covered the G and F grades of the 'Negative numbers' topic, with just the E and D grade questions left to do:

Page	Topic Title	Equivalent Grade	G	F	E	D	C	B	A	A*
20-23	**4.** Negative numbers		☑	☑	☺	☺				
24-28	**5.** Fractions		☺	☺	☺	☺	☺			

By completing this, you and your teacher will quickly see how much progress you are making and on what subject areas you should be concentrating.

Contents

Number
Section 1

Page		Topic Title	Equivalent Grade	G	F	E	D	C	B	A	A*
8-11	1.	Place value		☺	☺	☺		☺			
12-14	2.	Types of number		☺	☺			☺			
15-19	3.	Rounding, estimating and bounds		☺	☺	☺	☺	☺	☺	☺	☺
20-23	4.	Negative numbers		☺	☺	☺	☺				
24-28	5.	Fractions		☺	☺	☺	☺	☺			
29-32	6.	Decimals		☺	☺	☺					
33-37	7.	Percentages		☺	☺	☺	☺	☺	☺		
38-40	8.	Long multiplication and division		☺	☺	☺	☺	☺			
41-45	9.	Ratio and proportion		☺	☺	☺	☺	☺	☺	☺	
46-49	10.	Powers and standard index form			☺	☺	☺	☺	☺	☺	☺
50-51	11.	Surds								☺	☺

Algebra
Section 2

Page		Topic Title	Equivalent Grade	G	F	E	D	C	B	A	A*
54-57	12.	Basic algebra			☺	☺	☺	☺	☺	☺	☺
58-61	13.	Solving equations		☺	☺	☺	☺	☺			☺
62-64	14.	Forming and solving equations from written information					☺	☺	☺		
65-67	15.	Trial and improvement						☺			
68-72	16.	Formulae		☺	☺		☺	☺	☺	☺	☺
73-76	17.	Sequences		☺	☺	☺	☺	☺			
77-83	18.	Graphs			☺	☺	☺	☺	☺		
84-86	19.	Simultaneous equations						☺	☺		
87-89	20.	Quadratic equations							☺	☺	
90-93	21.	Inequalities					☺	☺	☺		
94-99	22.	Equations and graphs						☺	☺	☺	☺
100-103	23.	Functions									☺

Shape, Space and Measures

Section 3

Page	Topic Title	Equivalent Grade	G	F	E	D	C	B	A	A*
106-111	24.	Angles	☺	☺	☺	☺	☺	☺		
112-121	25.	2D and 3D shapes	☺	☺	☺	☺				
122-125	26.	Measures	☺	☺		☺				
126-131	27.	Length, area and volume	☺	☺	☺	☺	☺	☺		
132-135	28.	Symmetry	☺	☺	☺					
136-145	29.	Transformations	☺	☺	☺	☺	☺	☺	☺	
146-150	30.	Loci			☺	☺	☺	☺		
151-155	31.	Pythagoras' Theorem and Trigonometry					☺	☺	☺	☺
156-159	32.	Vectors						☺	☺	☺
160-163	33.	Circle theorems						☺	☺	

Data Handling

Section 4

Page	Topic Title	Equivalent Grade	G	F	E	D	C	B	A	A*
166-169	34.	Tallying, collecting and grouping data	☺	☺	☺					
170-179	35.	Averages and measures of spread	☺	☺	☺	☺	☺	☺		
180-182	36.	Line graphs and pictograms	☺	☺						
183-186	37.	Pie charts and frequency diagrams		☺		☺	☺			
187-195	38.	Scatter diagrams and cumulative frequency diagrams				☺	☺	☺		
196-201	39.	Bar charts and histograms	☺	☺	☺				☺	☺
202-205	40.	Questionnaires				☺	☺			
206-208	41.	Sampling							☺	
209-217	42.	Probability	☺	☺	☺	☺	☺	☺	☺	☺

Section 1

Number

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8-11	**1.**	Place value
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46-49	**10.**	Powers and standard index form
50-51	**11.**	Surds

Revision Websites

http://www.bbc.co.uk/schools/gcsebitesize/maths/numberf/

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http://www.gcseguide.co.uk/number.htm

http://www.gcse.com/maths/

http://www.easymaths.com/number_main.htm

Add your favourite websites and school software here.

This section of the Salford GCSE Maths Revision Package deals with *Number*. This is how to get the most out of it:

1 Start with any topic within the section – for example, if you feel comfortable with *Percentages*, start with Topic 7 on page 33.

2 Next, choose a grade that you are confident working at.

3 Complete each question at this grade and write your answers in the answer column on the right-hand side of the page.

4 Mark your answers using the page of answers at the end of the topic.

5 If you answered all the questions correctly, go to the topic's smiley face on pages 4/5 and colour it in to show your progress.

Well done! Now you are ready to move onto a higher grade, or your next topic.

6 If you answered any questions incorrectly, visit one of the websites listed left and revise the topic(s) you are stuck on. When you feel confident, answer these questions again.

When you answer all the questions correctly, go to the topic's smiley face on pages 4/5 and colour it in to show your progress.

Well done! Now you are ready to move onto a higher grade, or your next topic.

Number
1. Place Value

Grade	Learning Objective	Grade achieved
G	• Write numbers using figures and words (up to tens of thousands) • Write money using £'s • Understand place value in numbers (up to tens of thousands) • Order postive whole numbers (up to tens of thousands)	
F	• Understand the effect of and be able to multiply and divide by 10, 100 and 1 000 (no decimals) • Write numbers using figures and words (up to millions) • Understand place value in numbers (up to millions) • Order positive whole numbers (up to millions) • Order decimals up to and including two decimal places	
E	• Order decimals up to and including three decimal places • Understand the effect of and be able to multiply and divide by 10, 100 and 1 000 (decimal answers) • Multiply decimal numbers accurately (one decimal place multiplied by 2 decimal places), checking the answer using estimation	
D	• Make sure you are able to meet **ALL** the objectives at lower grades	
C	• Understand the effects upon the place value of an answer when a sum is multiplied or divided by a power of 10	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Write numbers using figures and words (up to tens of thousands)**

1. (a) Write these words as numbers:
   (i) Eight hundred and sixty
   (ii) Five thousand and ninety-seven
   (iii) Forty-one thousand, two hundred and three *(Total 3 marks)*
   (b) Write these numbers as words:
   (i) 308
   (ii) 6 489
   (iii) 75 631 *(Total 3 marks)*

- **Write money using pound signs.**

2. Peter had three thousand and forty-two pounds. Martha had six pounds and five pence.
   Write down, in figures, how much money Peter and Martha each had. *(Total 2 marks)*

- **Understand place value in numbers (up to tens of thousands)**

3. 64 972 teenagers watched a concert.
   (a) Write down the value of the 6
   (b) Write down the value of the 9 *(Total 2 marks)*

- **Order positive whole numbers (up to tens of thousands)**

4. Write these numbers in order of size. Start with the smallest number.
   76; 65; 7 121; 842; 37; 10 402; 9; 59; 25 310; 623 *(2 marks)*

Grade F

- **Understand the effect of and be able to multiply and divide by 10, 100 and 1 000 (no decimals)**

1. Work out the following:
   (a) 12 students had 10 books each. Write down the total number of books.
   (b) Jerry ordered 43 bags of balloons. Each bag contained 100 balloons.
   Write down the total number of balloons.
   (c) A company bought 96 boxes of blank CDs. Each box contained 1 000 blank CDs.
   Write down the total of CDs.
   (d) Ambrin had 60 sweets to share among 10 friends. How many sweets did they each receive?
   (e) 7 800 divided by 100
   (f) 975 000 divided by 1 000 *(Total 6 marks)*

- **Write numbers using figures and words (up to millions)**

2. (a) Write these words as numbers:
   (i) Fourteen thousand and sixty-nine
   (ii) Two hundred and eighty thousand, seven hundred and three
   (iii) Six hundred and four thousand, nine hundred and twenty-five *(Total 3 marks)*
   (b) Write these numbers as words:
   (i) 11 492
   (ii) 25 600
   (iii) 370 000 *(Total 3 marks)*

answers

Grade G

1.
(a) (i)
(ii)
(iii)
(b) (i)
(ii)
(iii)

2. Peter £
Martha £

3.
(a)
(b)

4.

Grade F

1.
(a)
(b)
(c)
(d)
(e)
(f)

2.
(a) (i)
(ii)
(iiI)
(b) (i)
(ii)
(iii)

Grade F

- **Understand place value in numbers (up to millions)**

3. 468 972 football supporters watched a match.
   (a) Write down the value of the 4
   (b) Write down the value of the 8 *(Total 2 marks)*

- **Order positive whole numbers (up to millions)**

4. Write these numbers in order of size. Start with the smallest number.
   4 200; 901 000; 362; 398 006; 900 123; 420; 398 000; 400 *(2 marks)*

- **Order decimals up to and including two decimal places**

5. 0.7; 0.01; 0.15; 0.9; 0.64; 0.2 *(2 marks)*

Grade E

- **Order decimals up to and including three decimal places**

1. Write these decimal numbers in order of size. Start with the smallest number first.
   0.5; 0.45; 0.056; 0.54; 0.504 *(1 mark)*

- **Understand the effect of and be able to multiply and divide by 10; 100 and 1 000**

2. Calculate the following:
   (a) 6.91 × 10
   (b) 4.736 × 100
   (c) 9.8425 × 1000
   (d) 5.8 divided by 10
   (e) 71.5 divided by 100
   (f) 94.6 divided by 1 000 *(Total 6 marks)*

- **Multiply decimal numbers accurately (one decimal place multiplied by 2 decimal places), checking the answer using estimation.**

3. (i) Estimate the answer to 2.34 × 3.6
   (ii) Work out the actual value of 2.34 × 3.6
   Use your estimate in part (i) to check your answer in part (ii) *(Total 3 marks)*

Grade C

- **Understand the effects upon the place value of an answer when a sum is multiplied or divided by a power of 10.**

1. Using the information that 87 × 123 = 10 701 write down the value of
   (i) 8.7 × 12.3
   (ii) 0.87 × 123 000
   (iii) 10.701 ÷ 8.7 *(Total 3 marks)*

answers

Grade F

3.
(a)
(b)

4.

5.

Grade E

1.

2.
(a)
(b)
(c)
(d)
(e)
(f)

3. (i)
(ii)

Grade C

1.
(i)
(ii)
(iii)

Grade G

1. (a) (i) 860
   (ii) 5 097
   (iii) 41 203

   (b) (i) Three hundred and eight
   (ii) Six thousand, four hundred and eighty-nine
   (iii) Seventy-five thousand, six hundred and thirty-one

2. Peter has £3 042.00
   Martha has £6.05

3. (a) 60 000
   (b) 900

4. 9; 37; 59; 65; 76; 623; 842; 7 121; 10 402; 25 310

Grade F

1. (a) 12 × 10 = 120
   (b) 43 × 100 = 4 300
   (c) 96 × 1000 = 96 000
   (d) 60 divided by 10 = 6
   (e) 7 800 divided by 100 = 78
   (f) 975 000 divided by 1 000 = 975

2 (a) (i) 14 069
   (ii) 280 703
   (iii) 604 925

   (b) (i) Eleven thousand, four hundred and ninety-two
   (ii) Twenty-five thousand, six hundred
   (iii) Three hundred and seventy thousand

3 (a) 400 000
   (b) 8 000

4. 362; 400; 420; 4 200; 398 000; 398 006; 900 123; 901 000

5. 0.01; 0.15; 0.2; 0.64; 0.7; 0.9

Grade E

1. 0.056; 0.45; 0.5; 0.504; 0.54

2. (a) 69.1
   (b) 473.6
   (c) 9 842.5
   (d) 0.58
   (e) 0.715
   (f) 0.0946

3. (i) 2 × 4 = 8
   (2.34 is rounded down to 2 and 3.6 is rounded up to 4)

   (ii) 2.34 × 3.6 = 8.424
   Any method of multiplication, eg. traditional

$$\begin{array}{r} 2.34 \\ \times\ 3.60 \\ \hline 14040 \\ 70200 \\ \hline 8.4240 \end{array}$$

TIP: There are 4 decimal places in the question, so there will be 4 decimal places in the answer.

Grade C

1. (i) 107.01
   (87 and 123 are ÷ by 10, so answer = 10 701 divided by 100)

   (ii) 107 010
   (87 is ÷ by 100 and 123 × by 1 000, so answer = 10 701 × 10)

   (iii) 1.23
   (10 701 is ÷ by 1 000 and 87 ÷ by 10, so answer = 123 ÷ by 100)

Number
2. Types of Number

Grade	Learning Objective	Grade achieved
G	• Recognise odd and even, square roots, cube and primes from a list of numbers, less than 100 • Recognise factors and multiples from a list of numbers, less than 100 • Know and use tests of divisibility for 2, 3, 5 and 10	
F	• Know how to find squares, square roots, cubes and primes	
E	• Make sure you are able to meet **ALL** the objectives at lower grades	
D	• Make sure you are able to meet **ALL** the objectives at lower grades	
C	• Use powers to write down numbers as products of their prime factors • Find the Highest Common Factor (HCF) and Lowest Common Multiple (LCM) of two numbers	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Recognise odd and even numbers, square roots, cube and prime numbers from a list of numbers smaller than 100.**
- **Recognise factors and multiples from a list of numbers smaller than 100**

1. Below is a list of numbers.

   5 6 15 21 27 36 33 50 56

   From the list, write down

   (a) the odd numbers

   (b) a square number and its square root

   (c) a cube number

   (d) a prime number

   (e) two numbers that are factors of 60

   (f) two multiples of 7 *(Total 7 marks)*

- **Know and use tests of divisibility for 2, 3, 5 and 10**

2. Here is a list of numbers.

   14 30 18 55 17 15 9 40

   (a) Write down all the numbers that:

   (i) 3 will divide into exactly *(2 marks)*

   (ii) 5 will divide into exactly *(2 marks)*

   (b) Fill in the gaps in these sentences:

   (i) "10 divides exactly into all whole numbers that end with a ...." *(1 mark)*

   (ii) "2 divides into all ..... numbers." *(1 mark)*

Grade F

- **Know how to find squares, square roots, cubes and primes**

1. (a) List all the prime numbers between 13 and 30 *(2 marks)*

   (b) List all the square numbers between 3 and 30 *(2 marks)*

   (c) Write down the square roots of the square numbers in (b) *(2 marks)*

   (d) Work out the cube of 5 *(1 mark)*

Grade C

- **Use powers to write numbers as products of their prime factors**
- **Find the Highest Common Factor (HCF) and Lowest Common Multiple (LCM) of two numbers**

1. The number 196 can be written as a product of its prime factors

   $196 = 2^2 \times 7^2$

   (a) Express the following numbers as products of their prime factors.

   (i) 72

   (ii) 96 *(4 marks)*

   (b) Find the Highest Common Factor of 72 and 96. *(1 mark)*

   (c) Work out the Lowest Common Multiple of 72 and 96. *(2 marks)*

answers

Grade G

1.

(a)

(b)

(c)

(d)

(e)

(f)

2.

(a)

(i)

(ii)

(b)

(i)

(ii)

Grade F

(a)

(b)

(c)

(d)

Grade C

1.

(a)

(i)

(ii)

(b)

(c)

Grade G

1. (a) 5; 15; 21; 27; 33
   (b) 36; 6
   (c) 27
   (d) 5
   (e) 5; 6; 15 (any 2)
   (f) 21; 56

2. (a) (i) 30; 18; 15; 9
   (ii) 30; 55; 15; 40
   (b) (i) 0 or zero or nought
   (ii) even

Grade F

1. (a) 17; 19; 23; 29
   (b) 4; 9; 16; 25
   (c) 2; 3; 4; 5
   (d) $5 \times 5 = 25 \times 5 = 125$

Grade C

1. (a) (i) $2^3 \times 3^2$ or $2 \times 2 \times 2 \times 3 \times 3$

Divide by smallest prime factor until you reach 1

72 ÷ 2 = 36
÷ 2 = 18
÷ 2 = 9
÷ 3 = 3
÷ 3 = 1

There are three lots of 2 and 2 lots of 3 therefore the answer = $2^3 \times 3^2$

(ii) $2^5 \times 3$ or $2 \times 2 \times 2 \times 2 \times 2 \times 3$

96 ÷ 2 = 48
÷ 2 = 24
÷ 2 = 12
÷ 2 = 6
÷ 2 = 3
÷ 3 = 1

There are five lots of 2 and one 3 therefore the answer = $2^5 \times 3$

(b) 24

Find factor pairs for 96 and 72. The highest factor in both is the HCF.

96 (1, 96) (2, 48) (3, 32) (4, 24) (6, 16) (8, 12)

72 (1, 72) (2, 36) (3, 24)

(c) 288

96 192 288

72 144 216 288

(LCM: go through the times tables for 92 and 72 and the first shared number is the LCM)

Grade	Learning Objective	Grade achieved
G	• Round numbers to the nearest whole number 10, 100 and 1 000	
F	• Use estimating to the nearest 10 and 100 to solve word problems	
E	• Round to a given number of significant figures (whole numbers)	
D	• Round to a given number of significant figures (decimals)	
C	• Use a calculator efficiently • Round answers to an appropriate degree of accuracy • Recognise the upper and lower bounds of rounded numbers (nearest integer) • Use rounding methods to make estimates for simple calculations	
B	• Calculate upper and lower bounds (involving addition or subtraction)	
A	• Recognise the upper and lower bounds of rounded numbers (decimals) • Calculate the upper and lower bounds (involving multiplication or division) • Select and justify appropriate degrees of accuracy for answers to problems	
A*	• Select and justify appropriate degrees of accuracy for answers to problems involving compound measures • Calculate the upper and lower bounds of formulae by using substitution	

Grade G

- **Round numbers to the nearest whole number 10, 100 and 1 000**

1. (a) 5 738 people watched a rock concert. Round 5 738 to the nearest:
   (i) 10
   (ii) 100
   (iii) 1 000
   (b) Round 5 738.6 to the nearest whole number. *(Total 4 marks)*

Grade F

- **Use estimating to the nearest 10 and 100 to solve word problems**

1. Mr Williams is organising a trip to Euro Disney. 570 pupils are going on the trip.
   The pupils will travel by coach. Each coach carries 48 pupils.
   (a) Work out an estimate of the number of coaches Mr Williams needs to book. *(2 marks)*
   (b) Each pupil has to pay a deposit of £8.00 for the trip.
   485 pupils have paid the deposit so far.
   Work out an estimate of the amount of money paid so far. *(2 marks)*

Grade E

- **Round to a given number of significant figures (whole numbers)**

1. 5 748 people watched a surfing competition in Newquay. Round 5 748 to:
   (a) 3 significant figures
   (b) 2 significant figures
   (c) 1 significant figure *(Total 3 marks)*

Grade D

- **Round to a given number of significant figures (decimals)**

1. (a) Work out the value of $3.9^2 - \sqrt{75}$
   Write down all the numbers on your calculator display. *(2 marks)*
   (b) Write your answer to part (a) to:
   (i) 3 significant figures
   (ii) 2 significant figures
   (iii) 1 significant figure *(3 marks)*

answers

Grade G

1.
(a) (i)
(ii)
(iii)
(b)

Grade F

1.
(a)
(b)

Grade E

1.
(a)
(b)
(c)

Grade D

1.
(a)
(b)
(i)
(ii)
(iii)

Grade C

- **Use a calculator efficiently**
- **Round answers to an appropriate degree of accuracy**

1. Use your calculator to evaluate $\frac{36.2 \times 14.6}{22.4 - 12.9}$

   (a) Write down all the figures on your calculator display *(2 marks)*

   (b) Write your answer to part (a) to an appropriate degree of accuracy. *(1 mark)*

- **Recognise the upper and lower bounds of rounded numbers (nearest integer)**

2. A sports commentator reported that 25 000 people attended a snowboarding competition.
   The number of people had been rounded to the nearest 1 000.

   (a) Write down the least possible number of people in the audience.

   (b) Write down the greatest possible number of people in the audience. *(Total 2 marks)*

- **Use rounding methods to make estimates for simple calculations**

3. Juana walks 17 000 steps every day, on average.
   She walks approximately 1 mile every 3 500 steps.
   Work out an estimate for the average number of miles that Juana walks in one year. *(3 marks)*

Grade B

- **Calculate upper and lower bounds (involving addition or subtraction)**

1. The maximum temperature in Salford last year was 25°C to the nearest °C ,
   and the minimum temperature was 7°C to the nearest °C.
   Calculate the range of temperatures. *(3 marks)*

answers

Grade C

1.

(a)

(b)

2.

(a)

(b)

3.

Grade B

1.

Grade A

- **Recognise the upper and lower bounds of rounded numbers (decimals)**

1. $x = \dfrac{5.49 \times 12.28}{6.8}$

   5.49 and 12.28 are correct to 2 decimal places.

   6.8 is correct to 1 decimal place.

   Which of the following calculations gives the lower bound for x and which gives the upper bound for x? Write down the letters. *(2 marks)*

   A $\dfrac{5.485 \times 12.285}{6.8}$ B $\dfrac{5.49 \times 12.28}{6.8}$ C $\dfrac{5.495 \times 12.285}{6.75}$

   D $\dfrac{5.485 \times 12.275}{6.75}$ E $\dfrac{5.495 \times 12.285}{6.85}$ F $\dfrac{5.485 \times 12.275}{6.85}$

- **Calculate upper and lower bounds (involving multiplication or division)**
- **Select and justify appropriate degrees of accuracy for answers to problems**

2. The area of a rectangle, correct to 2 significant figures, is 460 cm².
   The length of the rectangle, correct to 2 significant figures, is 22 cm.
   Writing your answers correct to an appropriate degree of accuracy:
   (a) Calculate the upper bound for the width of the rectangle *(2 marks)*
   (b) Calculate the lower bound for the width of the rectangle *(2 marks)*
   (c) Give a reason for your choice of degree of accuracy. *(1 mark)*

Grade A•

- **Select and justify appropriate degrees of accuracy for problems involving compound measures**

1. The density of kryptonite is 2489 kg/m³.
   Writing your answers correct to an appropriate degree of accuracy, work out:
   (a) The mass of a piece of kryptonite which has a volume of 2.49 m³
   (b) The volume of a piece of kryptonite whose mass is 1 199 kg.
   (c) Give a reason for your choice of degree of accuracy. *(Total 5 marks)*

- **Calculate upper and lower bounds of formulae by using substitution**

2. The time period, T seconds, of a clock's pendulum is calculated using the formula

   $$T = 5.467 \times \sqrt{\frac{L}{g}}$$

   where L metres is the length of the pendulum and g m/s² is the acceleration due to gravity.
   L = 2.36 correct to 2 decimal places.
   g = 8.8 correct to 1 decimal place.
   (a) Find the upper bound of T, giving your answer to 2 decimal places
   (b) Find the lower bound of T, giving your answer to 2 decimal places *(Total 5 marks)*

Grade A

answers

1.

2.

(a)

(b)

(c)

Grade A•

1.

(a)

(b)

(c)

2.

(a)

(b)

Grade G

1. (a) (i) 5 740
   (ii) 5 700
   (ii) 6 000

   (b) 5 739

Grade F

1. (a) $\frac{600}{50} = 12$

   (b) 500 × 10 = £5 000

Grade E

1. (a) 5 750
   (b) 5 700
   (c) 6 000

Grade D

1. (a) 6.549745962
   (b) (i) 6.55
   (ii) 6.5
   (iii) 7

Grade C

1. (a) 55.63368421
   (b) 55.63

2. (a) 24 500
   (b) 25 500 (or 24 499)

3. $\frac{20\,000 \times 400}{4\,000}$

   $\frac{8\,000\,000}{4\,000}$

   = 2 000 miles

Grade B

1. 17 - 19°C
   25.5 – 6.5 = 19 (upper range)
   24.5 – 7.5 = 17 (lower range)

Grade A

1 F = lower
C = upper

2 (a) $\frac{465}{21.5} = 21.627\ldots$

= 21.6 cm

(b) $\frac{455}{22.5} = 20.222\ldots$

= 20.2 cm

(c) Answers rounded to 1 decimal place as they involve measurements of centimetres and millimetres.

Grade A•

1 (a) 2 489 × 2.49 = 6 197.61
= 6 200 kg or 6 198 kg

(b) $\frac{1\,199}{2\,489} = 0.481719566\ m^3$

= 0.482 m^3

(c) Pupils' own answers,
eg (a) 6 197.61 kg is extremely heavy therefore rounded to nearest hundred (or whole number) with little loss of accuracy.
With (b) the measurement is much smaller so rounded to 3 decimal places. This takes account of the 7 in the long, unmanageable answer to reduce loss of accuracy.

2 L = 2.355 - 2.365
g = 8.75 - 8.85

(a) Upper bound

$$T = 5.467 \times \sqrt{\frac{2.365}{8.75}}$$

= 2.84223… = 2.84

(b) Lower bound

$$T = 5.467 \times \sqrt{\frac{2.355}{8.85}}$$

= 2.82015… = 2.82

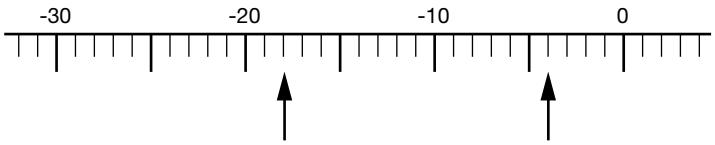
Number
4. Negative Numbers

Grade	Learning Objective	Grade achieved
G	• Understand and use negative numbers as positions on a number line (up to one decimal place) • Understand and work with negative numbers in real-life situations, including temperatures	
F	• Solve word problems involving negative numbers in real-life situations, including temperatures	
E	• Order a list of positive and negative numbers	
D	• Solve word problems involving negative numbers, up to 100, in real-life situations	
C	• Make sure you are able to meet **ALL** the objectives at lower grades	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

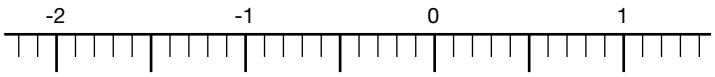
- **Understand and use negative numbers as positions on a number line**

1.

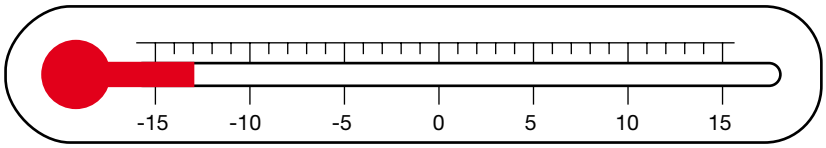


(a) Write down the numbers marked with an arrow. *(2 marks)*

(b) Find the number -1.7 on the number line below. Mark it with an arrow. *(1 mark)*



2.



(a) Write down the temperature shown on the picture of the thermometer. *(1 mark)*

(b) At 5 a.m., the temperature in Julian's kitchen was -5°C.
By noon, the temperature had risen by 15°C.
Work out the temperature at noon. *(2 marks)*

(c) By midnight, the temperature in Julian's kitchen had fallen to -8°C.
Work out the fall in temperature from noon to midnight. *(2 marks)*

- **Understand and work with negative numbers in real-life situations, including temperatures**

3. The table shows the temperature in six towns at midnight on one day

Town	Ashton	Stoke	Bury	Huntley	Crewe	Rhyl
Temperature °C	6	-2	4	-5	8	-3

(a) Which town had the lowest temperature? *(1 mark)*

(b) List the temperatures in order of size. Start with the lowest temperature. *(2 marks)*

(c) Work out the difference in temperature between Crewe and Rhyl. *(1 mark)*

(d) In the next twelve hours the temperature in Stoke increased by 6°C.
Work out the new temperature in Stoke. *(1 mark)*

Grade G

answers

1.

(a)

(b)

2.

(a)

(b)

(c)

3.

(a)

(b)

(c)

(d)

Grade F

- **Solve word problems involving negative numbers in real-life situations.**

1. This table gives information about the midday temperatures in four cities on one day in September.

City	Temperature °C
Manchester	-12
New York	10
Sydney	25
Toronto	-10

(a) How many degrees higher was the temperature in New York than the temperature in Toronto? *(2 marks)*

(b) Work out the difference in temperature between Manchester and Toronto. *(1 mark)*

(c) For which two cities was there the greatest difference in temperature? *(2 marks)*

Grade E

- **Order a list of positive and negative numbers.**

1. Write these numbers in order of size.
Start with the smallest number.

6; -7; -12; 3; 0; 10; -5 *(1 mark)*

Grade D

- **Solve word problems involving negative numbers, up to 100, in real-life situations.**

1. This table shows the maximum and minimum temperatures for five cities last year.

City	Maximum	Minimum
Dublin	25°C	-15°C
Palma	34°C	12°C
London	32°C	-12°C
Paris	27°C	-17°C
Salford	17°C	-14°C

(a) Which city had the lowest temperature? *(1 mark)*

(b) Work out the difference between the maximum temperature and the minimum temperature for Dublin. *(2 marks)*

answers

Grade F

1.

(a)

(b)

(c)

Grade E

1.

Grade D

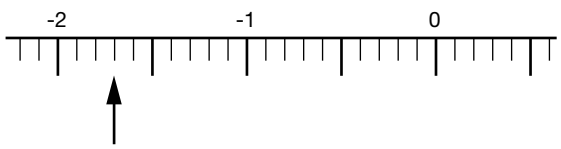
1.

(a)

(b)

Grade G

1. (a) -18 and -4

   (b) 

2. (a) -13°C
   (b) 10°C
   (c) 18°C

3. (a) Huntley
   (b) -5; -3; -2; 4; 6; 8
   (c) 11°C
   (d) 4°C

Grade F

1. (a) 20ºC
   (b) 2ºC
   (c) Sydney and Manchester

Grade E

1. -12; -7; -5; 0; 3; 6; 10

Grade D

1. (a) Paris
   (b) -15 to 25 = 40ºC

Number
5. Fractions

Grade	Learning Objective	Grade achieved
G	• Work out a simple fraction of an amount • Understand positive numbers as a position on a number line • Use fractions to describe simple proportions of a whole by shading	
F	• Know some simple fraction / decimal / percentage equivalents • Write simple decimals and percentages as fractions in their simplest form	
E	• Order a set of fractions • Express a given number as a fraction of another number in its simplest form • Know some more difficult fraction / decimal / percentage equivalents • Know how to work out more difficult fractions of amounts	
D	• Solve word problems which involve finding fractions of amounts • Add and subtract fractions (including mixed numbers)	
C	• Multiply and divide fractions (including mixed numbers) • Use BODMAS and be able to estimate, to simplify more difficult fractions	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

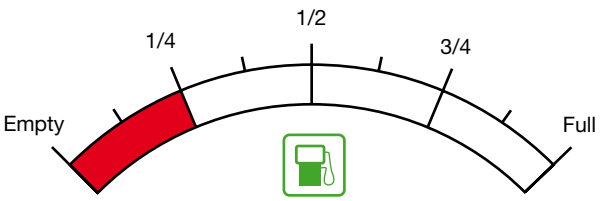
Grade G

- **Work out a simple fraction of an amount**

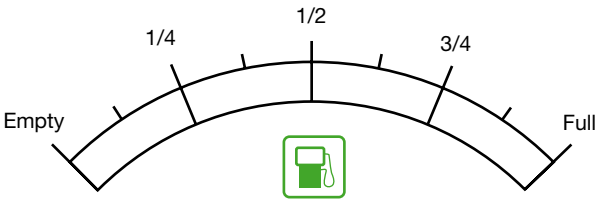
1. Work out ¾ of £16 *(2 marks)*

- **Understand positive fractions as a position on a number line**

2. The diagram shows the measuring scale on a petrol tank.



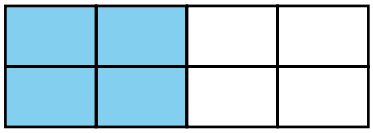
(a) What fraction of the petrol tank is empty? *(1 mark)*



(b) Indicate on the measuring scale when the tank is ⅝ full. *(1 mark)*

- **Use fractions to describe simple proportions of a whole by shading**

3.



(a) What fraction of the rectangle is shaded? Write your fraction in its simplest form.

(b) Shade ¾ of this shape.

(3 marks)

Grade F

- **Know some simple fraction/decimal/percentage equivalents**

1. Express

(a) $\frac{3}{10}$ as a decimal,

(b) 0.8 as a percentage,

(c) 75% as a decimal *(3 marks)*

- **Write simple decimals and percentages as fractions in their simplest form**

2. Express the following as fractions. Give your answers in their simplest form.

(a) 0.25

(b) 0.8

(c) 75%

(d) 40% *(4 marks)*

Grade G

1.

2.

(a)

(b)

3.

(a)

(b)

Grade F

1.

(a)

(b)

(c)

2.

(a)

(b)

(c)

(d)

answers

Grade E

- **Order a set of fractions**

1. Write these fractions in order of size. Start with the smallest fraction.

   ½ ⅔ ¾ ⅞ *(2 marks)*

- **Express a given number as a fraction of another number in its simplest form**

2. There are 225 Year 11 students at Salford High School.

   Mrs Pickup's register showed that 75 were absent.

   What fraction of pupils were present?

   Write your answer as a fraction in its simplest form. *(3 marks)*

- **Know some more difficult fraction / decimal / percentage equivalents**

3. (a) Write ⅞ as a percentage. *(1 mark)*

   (b) Write ⅘ as a decimal. *(1 mark)*

   (c) Write 55% as a fraction in its simplest form. *(1 mark)*

- **Know how to work out more difficult fractions of amounts**

4. Barry wins £320. He gives:

   ¼ of £320 to Laura, ⅜ of £320 to Jennie and £56 to Suzy.

   (a) How much does Laura receive? *(1 mark)*

   (b) How much does Jennie receive? *(1 mark)*

   (c) What fraction of the £320 does Barry keep? *(2 marks)*

Grade D

- **Solve word problems which involve finding fractions of amounts**

1. In September, Julia sends 420 text messages.

   (a) In October she reduces this by ⅞.

   How many messages does she send in October? *(2 marks)*

   (b) In November, Julia sends ⅗ more messages.

   How many messages does she send in November? *(2 marks)*

   (c) How many more messages does she send in November than September?

   Give your answer as a fraction in its simplest form. *(2 marks)*

- **Add and subtract fractions (including mixed numbers)**

2. (a) Work out 1⅔ + 2⅗

   Give your answer as a fraction in its simplest form. *(3 marks)*

   (b) Work out 2¾ - 1⅖

   Give your answer as a fraction in its simplest form. *(3 marks)*

answers

Grade E

1.

2.

3. (a)

   (b)

   (c)

4.

   (a)

   (b)

   (c)

Grade D

1.

   (a)

   (b)

   (c)

2. (a)

   (b)

Grade C

- **Multiply and divide fractions (including mixed numbers)**

1. (a) Work out the value of $3\frac{3}{4} \times 2\frac{2}{5}$ *(3 marks)*

   (b) Using your answer to part (a)

   Work out $3\frac{3}{4} \div 2\frac{2}{5}$

   Write your answer as a fraction in its simplest form. *(3 marks)*

- **Use BODMAS and be able to estimate, to simplify more difficult fractions**

2. Estimate the answer to this fraction

$$\frac{5\,(3.6^3 - 4.4) + 7^2}{6^2 + (41 - 5^2)}$$

(3 marks)

Grade C

1. (a)

   (b)

2.

answers

Grade G

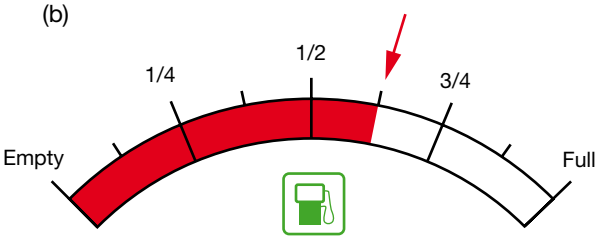
1. £12

   16 ÷ 4 = 4

   4 × 3 = 12

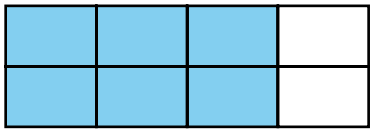
2. (a) 3/4

   (b)



3. (a) ⅜ = ¾ = ½

   (b) Any six shaded sections



Grade F

1. (a) 0.3

   (b) 0.8 × 100 = 80%

   (c) 75% divided by 100 = 0.75

2. (a) 0.25 = $^{25}/_{100}$ = ¼

   (b) 0.8 = $^{8}/_{10}$ = ⅘

   (c) 75% = $^{75}/_{100}$ = ¾

   (d) 40% = $^{40}/_{100}$ = $^{4}/_{10}$ = ⅖

Grade E

1. ⅔ ½ ⅔ ¾

2. ⅔

   $^{75}/_{225}$ = $^{15}/_{45}$ = $^{3}/_{9}$ = ⅓

   1 - ⅓ = ⅔

3. (a) ⅞ = 87.5%

   $^{100}/_{8}$ = 12.5

   100 - 12.5 = 87.5

   (b) ⅘ = 0.8

   ⅘ = $^{80}/_{100}$ = 0.80 (or 0.8)

   (c) 55% = $^{55}/_{100}$ = $^{11}/_{20}$

Grade E

4. (a) £80

   $^{320}/_{4}$ = 80

   (Calculator: 420 × 2 a$^{b}/_{c}$ 7)

   (b) £120

   $^{320}/_{8}$ = 40

   40 × 3 = 120

   (c) ⅕

   320 - (80 + 120 + 56)

   = 320 - 256 = 64

   $^{64}/_{320}$ = $^{32}/_{160}$ = $^{8}/_{40}$ = $^{4}/_{20}$ = $^{2}/_{10}$ = ⅕

Grade D

1. (a) 300

   420 ÷ 7 × 2 = 300

   (b) 480

   (300 ÷ 5) × 3 =180

   (Calculator: 60 a$^{b}/_{c}$ 420)

   (c) ⅐

   $^{60}/_{420}$ = ⅐

2. (a) 4$^{4}/_{15}$

   1⅔ + 2⅖

   = 1$^{10}/_{15}$ + 2$^{9}/_{15}$

   = 1 + 2 + $^{10}/_{15}$ + $^{9}/_{15}$

   = 3$^{19}/_{15}$ = 4$^{4}/_{15}$

   (b) 1$^{7}/_{20}$

   2¾ - 1⅖

   = 2$^{15}/_{20}$ - 1$^{8}/_{20}$

   = 1$^{7}/_{20}$

Grade C

1. (a) 9

   3¾ × 2⅖

   = $^{12+3}/_{4}$ × $^{10+2}/_{5}$

   = $^{15}/_{4}$ × $^{12}/_{5}$ = $^{180}/_{20}$ = 9

   (b) 1$^{9}/_{16}$

   3¾ ÷ 2⅖

   = $^{15}/_{4}$ ÷ $^{12}/_{5}$

   = $^{15}/_{4}$ × $^{5}/_{12}$ = $^{75}/_{48}$

   = 1$^{27}/_{48}$ = 1$^{9}/_{16}$

2. 7

$$\frac{5\,(4^3 - 4) + 7^2}{6^2 + (41 - 5^2)}$$

$$\frac{5\,(64 - 4) + 49}{36 + (41 - 25)}$$

$$\frac{(5 \times 60) + 49}{36 + 16}$$

$^{349}/_{52}$ = $^{350}/_{50}$

= 7

Grade	Learning Objective	Grade achieved
G	• Use written methods to solve money problems involving addition, short multiplication, subtraction and short division • Understand calculator display showing money values • Use a calculator effectively to solve money problems	
F	• Order decimals up to and including two decimal places • Know some simple fraction / decimal / percentage equivalents • Use a calculator effectively to solve more complex money problems	
E	• Order decimals up to and including three decimal places • Know some more difficult fraction / decimal / percentage equivalents and use these to solve problems	
D	• Make sure you are able to meet **ALL** the objectives at lower grades	
C	• Make sure you are able to meet **ALL** the objectives at lower grades	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Convert a recurring decimal into a fraction	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Use written methods to solve money problems, involving addition, short multiplication, subtraction and short division**

1. Jack goes shopping. He buys:
   5 cans of beans at 43p each
   1½ kg of potatoes at 66p per kg
   1 loaf of bread at 73p
   4 buns at 34p each.
   He pays with a £10 note.
   (a) Work out how much his change will be. *(5 marks)*
   (b) Jack's favourite chocolate bars are 60p each. Use your answer to part (a) to work out how many bars can he afford to buy with his change. *(2 marks)*

- **Understand calculator display showing money values**
- **Use a calculator effectively to solve money problems**

2. Lois needs some items for school. She buys:
   A pencil case costing £1.62
   Two pens costing 58p each
   A pencil sharpener costing 24p
   A calculator costing £4.95
   She pays with a £10 note.
   (a) Work out how much her change will be. *(3 marks)*
   (b) Pencils cost 12p each. Using your answer to part (a), work out how many pencils Lois can afford to buy with her change. *(2 marks)*

Grade F

- **Know some simple fraction/decimal/percentage equivalents**

1. Write 60% as a:
   (a) decimal
   (b) fraction *(2 marks)*

- **Order decimals up to and including two decimal places**

2. Write these five numbers in order of size. Start with the largest number.
   2.2; 0.52; 0.5; 2.5; 0.25 *(2 marks)*

- **Use a calculator effectively to solve more complex money problems**

3. Rachel's taxi company charges £2.75 for the first mile of a journey and £1.59 for each extra mile travelled.
   (a) Work out how much a 16 mile journey would cost. *(2 marks)*
   Rachel charges a customer £64.76 for a journey to Piccadilly train station.
   (b) How many miles was the journey? *(2 marks)*

Grade G

answers

1.

(a)

(b)

2.

(a)

(b)

Grade F

1.

(a)

(b)

2.

3.

(a)

(b)

Grade E

- **Order decimals up to and including three decimal places**

1. Write these numbers in order of size. Start with the smallest number.
   0.49; 0.5; 0.059; 0.59; 0.509 *(1 mark)*

- **Know some more difficult fraction/decimal/percentage equivalents, and use these to solve problems**

2. (a) Express these numbers as decimals:
   (i) 70%
   (ii) $\frac{7}{8}$
   (iii) $\frac{1}{3}$ *(3 marks)*
   (b) Write these numbers in order of size, smallest first
   0.8; 70%; $\frac{7}{8}$; $\frac{3}{4}$ *(1 mark)*

Grade A

- **Convert a recurring decimal into a fraction**

1. (a) Convert recurring decimal $0.\dot{3}\dot{8}$ into a fraction *(2 marks)*
   (b) Convert recurring decimal $4.2\dot{3}\dot{7}$ into a mixed number.
   Give your answer in its simplest form. *(3 marks)*

answers

Grade E

1.

2.

(a) (i)

(ii)

(iii)

(b)

Grade A

1. (a)

(b)

Grade G

1. (a) £4.77

   (b) 7

2. (a) £2.03

   (b) 16

Grade F

1. (a) 0.6

   (b) $^{60}/_{100} = {}^{3}/_{5}$

2. 2.5; 2.2; 0.52; 0.5; 0.25

3. (a) £26.60

   $(15 \times 1.59) + 2.75$

   (b) 40 miles

Grade E

1. 0.059; 0.49; 0.5; 0.509; 0.59

2. (a) (i) 70% = 0.7

   (ii) $^{7}/_{8} = 0.875$

   (iii) $^{1}/_{3} = 0.3\dot{3}$ or $0.\dot{3}$

   (b) 0.7; 0.75; 0.8; 0.875

Grade A

1. (a) $^{38}/_{99}$

   $x = 0.383838\ldots$

   $100x = 38.3838\ldots$

   $100x - x = 99x$

   $38.3838\ldots - 0.383838\ldots = 38$

   $99x = 38$

   $\therefore \quad 0.\dot{3}\dot{8} = {}^{38}/_{99}$

   (b) $4^{47}/_{198}$

   $y = 0.237\ldots$

   $10y = 2.373737\ldots$

   $1\,000y = 237.373737\ldots$

   $1\,000y - 10y = 990y$

   $237.373737\ldots - 2.373737\ldots = 235$

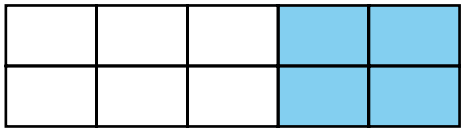
   $990y = 235$

   $\therefore \quad 4.2\dot{3}\dot{7} = 4^{235}/_{990} = 4^{47}/_{198}$

Grade	Learning Objective	Grade achieved
G	• Use percentages to describe simple proportions of a whole	
F	• Know some simple fraction/decimal/percentage equivalents • Use a written method to find a percentage of an amount (multiples of 10) • Use a written method to write one number as a percentage of another	
E	• Know some more difficult fraction/decimal/percentage equivalents • Describe a profit or loss as a percentage of an original amount • Use a percentage to find a value for the amount of profit or loss • Describe an increase or decrease as a percentage of an original amount • Use a percentage to find a value for the amount of increase or decrease • Calculate VAT on a given amount (with and without a calculator) • Calculate bills and taxations from a given amount • Calculate simple interest	
D	• Use a written method to find a percentage of an amount (decimal answers) • Solve increasingly more difficult word problems to those found in Grade E objectives	
C	• Find what the original price must have been when given the sale price • Use repeated proportional percentage changes. eg. compound interest and depreciation (maximum of 3 time periods)	
B	• Calculate the original amount when given the transformed amount after a percentage change • Use repeated proportional percentage changes. eg. compound interest and depreciation	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Use percentages to describe simple proportions of a whole**

1. 

(a) What fraction of the shape is shaded? *(1 mark)*

(b) What percentage of the shape is shaded? *(1 mark)*

Grade F

- **Know some simple fraction/decimal/percentage equivalents**

1. (a) Write 40% as a decimal. *(1 mark)*

(b) Write ¼ as a percentage. *(1 mark)*

- **Use a written method to find a percentage of an amount (multiples of 10)**

2. A shop offers a 25% reduction if you spend £120 or more.

Work out 25% of £120. *(2 marks)*

- **Use a written method to write one number as a percentage of another**

3. Scott scored 20 out of 25 in a test.

Write this score as a percentage. *(2 marks)*

Grade E

- **Know some more difficult fraction/decimal/percentage equivalents**

1. (a) Write 35% as a fraction. *(1 mark)*

(b) Write 0.375 as a percentage. *(1 mark)*

(c) Write 8% as a decimal. *(1 mark)*

- **Describe a profit or loss as a percentage of an original amount**

2. Mrs. Shaw decides to take some students on a trip to Paris.

Each student has to pay £37 for the trip. 745 students decide to go on the trip.

(a) How much money is collected if all 745 students pay £37 each? *(2 marks)*

The trip actually cost £25 000

(b) Use your calculator to work out the percentage profit

that Mrs. Shaw will make on the trip. *(3 marks)*

- **Use a percentage to find a value for the amount of profit or loss**

3. PCHow is a shop that repairs computers.

Yesterday PCHow bought a computer for £269.00.

They want to sell it at a profit of 15%.

(a) Work out how much 15% profit will be. *(2 marks)*

answers

Grade G

1.

(a)

(b)

Grade F

1. (a)

(b)

2.

3.

Grade E

1. (a)

(b)

(c)

2.

(a)

(b)

3.

(a)

Grade E

- **Describe an increase or decrease as a percentage of an original amount**

4. A television set that costs £239 is sold in a sale for £200.
   What percentage is the television set reduced by? *(2 marks)*

- **Use a percentage to find the value for the amount of increase or decrease**

5. A taxi firm charges £2.65 for the first mile of the journey and £1.53 for each extra mile.
   On New Year's Eve the taxi firm charges 24% more.
   Work out how much the taxi firm charges for a 6 mile journey on New Year's Eve. *(2 marks)*

- **Calculate VAT on a given amount (with calculator)**

6. Helen is a hairdresser. She buys some wholesale products.
   The cost of the products was £64.00 plus VAT at 17½%.
   Work out the total cost of the products. *(2 marks)*

- **Calculate VAT on a given amount (without calculator)**

7. Jim manages a restaurant. He buys some equipment costing £160.
   VAT is 17½%.
   Work out how much VAT he paid on £160. *(2 marks)*

- **Calculate bills and taxations from a given percentage**

8. Joan pays Income Tax at 23%.
   She is allowed to earn £3 500 before he pays any Income Tax.
   She earns £12 500 in one year.
   Work out how much Income Tax she pays in that year. *(3 marks)*

- **Calculate simple interest**

9. The rate of simple interest is 6% per year.
   Work out the simple interest paid on £500 in 3 years. *(3 marks)*

Grade D

- **Use a written method to find a percentage of an amount**

1. In a sale, all the normal prices are reduced by 15%.
   The normal price of a suit is £145.
   Ahmed buys the suit in the sale.
   Work out the sale price of the suit. *(2 marks)*

answers

Grade E

4.

5.

6.

7.

8.

9.

Grade D

1.

Grade C

- **Find what the original price must have been when given the sale price**

1. Simon buys a coat in a sale.
   The original price of the coat is reduced by 20%.
   The sale price is £34.40 Work out the original price of the coat. *(3 marks)*

- **Use repeated proportional percentage changes, eg compound interest and depreciation (maximum of 3 time periods)**

2. Anne put £485 in a new savings account. At the end of every year, interest of 4.9% was added to the amount in her savings account at the start of that year.
   Calculate the total amount in Anne's savings account at the end of 2 years. *(3 marks)*

Grade B

- **Calculate the original amount when given the transformed amount after a percentage change**
- **Use repeated proportional percentage changes, eg compound interest and depreciation** *(use formula)*

1. Each year the value of a washing machine falls by 7% of its value at the beginning of that year.
   Sally bought a new washing machine on 1st January 2001.
   By 1st January 2002 its value had fallen by 7% to £597.
   (a) Work out the value of the new washing machine on 1st January 2001. *(3 marks)*
   (b) Work out the value of the washing machine by 1st January 2005.
   Give your answer to the nearest pound. *(3 marks)*

answers

Grade C

1.

2.

Grade B

1.

(a)

(b)

Grade G

1. (a) $\frac{4}{10} = \frac{2}{5}$
   (b) 40%

Grade F

1. (a) 40% = 0.4 or 0.40
   (b) $\frac{1}{4}$ = 0.25 = 25%
2. £30 (120 ÷ 4)
3. $\frac{20}{25} = \frac{80}{100}$ = 80%

Grade E

1. (a) 35% = $\frac{35}{100} = \frac{7}{20}$
   (b) 0.375 = 37.5%
   (c) 8% = 0.08
2. (a) 745 × £37 = £27 565
   (b) 10%
   Profit = £27 565 - £25 000 = £2 565
   % Profit = $\frac{2565}{25000} \times 100 = 10.26\%$
   ≈ 10% profit
3. £40.35
   (£269.00 ÷ 100) × 15 = £40.35
4. 16.3%
   $\frac{200}{239} \times 100 = 83.7\%$
   Reduced by 100 - 83.7 = 16.3%
5. £12.77
   £2.65 + (5 × £1.53) = £10.30
   £10.30 × 24% (or 0.24) = £2.47
   £10.30 + £2.47 = £12.77
6. £75.20
   £64 × 17.5% = £11.20 (or 64 × 0.175 = 11.20)
   £64 + £11.20 = £75.20
7. £28
   10% of £160 = £16.00
   So 5% of £160 = £8.00
   So 2.5% of £160 = £4.00
   ∴ 17.5% = £16.00 + £8.00 = £4.00 = £28.00
8. £2 070
   £12 500 - £3 500 = £9 000
   £9 000 × 23% (or 0.23) = £2 070
9. £90
   £500 × 6% (or 0.06) = £30
   £30 × 3 years = £90

Grade D

1. (£145.00 ÷ 100) × 15 = £21.75
   Reduced by 145 - 21.75 = £123.25

Grade C

1. $0.8x$ = £34.40
   x = £34.40 ÷ 0.8 = £43
2. 1st year: 4.9% of £485 = £23.77
   2nd year: 4.9% of £508.77 = £24.93
   Total interest = £48.70
   Savings = £485 + £48.70 = £533.70

Grade B

1. (a) 597 ÷ 0.93 = 641.935
   = £641.94

(Formula: Existing amount × (1 – 0.07 depreciation) to the power of 4 (because it's over 4 years)

(b) 641.94 $(0.93)^4$ = 480.2045
= £480

Number
8. Long Multiplication and Division

Grade	Learning Objective	Grade achieved
G	• Interpret a remainder when solving word problems	
F	• Use written methods to do long multiplication and long division	
E	• Use written methods to do multiplication of a whole number by a decimal • Use written methods to do division of a whole number by a decimal	
D	• Use checking procedures to check if an answer is of the right size • Use written methods to multiply a decimal by a decimal (up to 2 decimal places)	
C	• Use a calculator effectively	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Interpret a remainder when solving word problems**

1. Sarah buys bananas at 29p each. She pays with a £5 note.
   (a) Work out the greatest number of 29p bananas Sarah can buy. *(2 marks)*
   (b) Work out the change she should get. *(1 mark)*

Grade F

- **Use written methods to do long multiplication and long division**

1. (a) Work out 236 × 53 *(3 marks)*
   (b) Calculate 184 ÷ 8 *(3 marks)*

Grade E

- **Use written methods to multiply whole numbers by a decimal**
- **Use written methods to divide a whole number by a decimal**

1. Raj bought 48 teddy bears at £8.95 each.
   (a) Work out the total amount he paid. *(3 marks)*
   (b) Raj sold all the teddy bears for a total of £696.
   He sold each teddy bear for the same price.
   Work out the price at which Raj sold each teddy bear. *(3 marks)*

Grade D

- **Use checking procedures to check if an answer is of the right size**

1. (a) Which of the following is the correct value of $\frac{12 \times 19}{9}$?

   Use estimation to choose the correct answer
   (i) 235 (ii) 253 (iii) 25.3 (iv) 2 530

   (b) Which of the following answers is the correct value of 79 × 19?
   (i) 1 500 (ii) 1 501 (iii) 1 502 (iv) 1 503 *(3 marks)*

- **Use written methods to multiply a decimal by a decimal**

2. (a) Moira buys 6½ bags of pet food costing £2.30 each.
   How much does she pay? *(3 marks)*

Grade C

- **Use a calculator efficiently**

1. (a) Work out the value of $4.5^2 - \sqrt{4.9}$
   Write down all the figures on your calculator display. *(2 marks)*
   (b) Write your answer to part (a) correct to 4 significant figures. *(1 mark)*

answers

Grade G

1.
   (a)
   (b)

Grade F

1. (a)
   (b)

Grade E

1.
   (a)
   (b)

Grade D

1. (a)
   (b)

2. (a)

Grade C

1. (a)
   (b)

Grade G

1. (a) 17 bananas

$$\begin{array}{r} 17 \\ 29\overline{)500} \\ 29 \\ \hline 210 \\ 203 \\ \hline 7 \end{array}$$ (remainder)

(b) 7p

Informal method

10 bananas cost 290p

5 bananas cost 145p

∴ 15 bananas cost 235p

2 bananas cost 58p

∴ 17 bananas cost 290 + 145 + 58 = 493p

500 - 493 = 7p (remainder)

Grade F

1. (a) 12 508

$$\begin{array}{r} 236 \\ \times\ 53 \\ \hline 708 \\ 11\,800 \\ \hline 12\,508 \end{array}$$

(b) 23

$$\begin{array}{r} 23 \\ 8\overline{)184} \\ 16 \\ \hline 24 \\ 24 \end{array}$$

Grade E

1. (a) £429.60

$$\begin{array}{r} 895 \\ \times\ 48 \\ \hline 7160 \\ 35\,800 \\ \hline 42\,960 \end{array}$$

Estimate: 50 × 9 = 450 ∴ Answer £429.60

(b) £14.50

$$\begin{array}{r} 1450 \\ 48\overline{)696} \\ 48 \\ \hline 216 \\ 192 \\ \hline 240 \\ 240 \end{array}$$

Estimate: 700 ÷ 50 = 14 ∴ Answer £14.50

Grade D

1. (a) (iii) 25.3

$$\frac{12 \times 19}{9} \approx \frac{10 \times 20}{10} = 20$$

Nearest answer to 20 is 25.3

(b) (ii) 1 501

79 × 19: Both numbers end in 9, and 9 × 9 = 81,
∴ answer must end with a 1

2. £14.95

2.30 × 6 = 13.80
\+ 2.30 × 0.5 = 1.15

or

$$\begin{array}{r} 230 \\ \times\ 650 \\ \hline 115 \\ 1380 \\ \hline 1495 \end{array}$$

Estimate: 2 × 7 = 14 ∴ Answer £14.95

Grade C

1. (a) 18.036405637882

(b) 18.04

(Need 4 significant figures so look at the fifth number.

This is a 6, so round the fourth figure up by one.

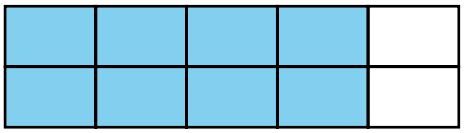
The 3 becomes 4).

Grade	Learning Objective	Grade achieved
G	• Use percentages and fractions to describe simple proportions of a whole	
F	• Know some simple fraction/decimal/percentage equivalents • Understand that ratio is a way of showing the relationship between two numbers and write down a simple ratio	
E	• Use direct proportion to solve simple problems (written methods) • Share an amount in a given ratio (written methods - two parts only) • Convert between a variety of units and currencies (calculator methods)	
D	• Simplify a ratio to its simplest terms by using a common factor • Share an amount in a given ratio (written methods - more than two parts) • Use direct proportion to solve word problems using a calculator	
C	• Use one part of a ratio to work out other parts of the original amount • Share an amount in a given ratio (calculator methods - more than two parts) • Use inverse proportion to solve simple problems (written and calculator methods)	
B	• Use direct proportion to find missing lengths in mathematically similar shapes	
A	• Calculate unknown quantities from given quantities using direct or inverse proportion	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

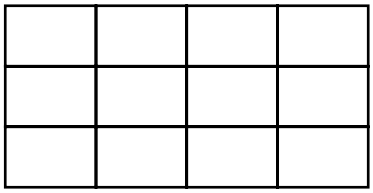
Grade G

- **Use percentages and fractions to describe simple proportions of a whole**

1. (a) Write down the percentage of this shape that is shaded. *(1 mark)*



(b) Shade ⅔ of this shape. *(1 mark)*



Grade F

- **Know simple fraction/decimal/percentage equivalents**
- **Understand that ratio is a way of showing the relationship between two numbers and write down a simple ratio**

1. A jacket is 80% wool and 20% lycra.
   (a) Write 80% as a decimal. *(1 mark)*
   (b) Write 20% as a fraction. Give your answer in its simplest form. *(2 marks)*
   (c) Write down the ratio of wool to lycra. Give your answer in its simplest form. *(2 marks)*

Grade E

- **Use direct proportion to solve simple problems (written methods)**

1. Here is a list of ingredients for making an apple and sultana crumble for 2 people.
   40g Plain Flour
   50g Sugar
   30g Butter
   30g Sultanas
   2 Ripe Apples
   Work out the amount of each ingredient needed to make an apple and sultana crumble for 6 people. *(Total 3 marks)*

- **Share an amount in a given ratio**

2. Mrs. Parekh shared £40 between her two children in the ratio of their ages.
   Bharati is 7 years old and her brother is 3 years old.
   Work out how much money Bharati received from her mother *(3 marks)*

answers

Grade G

1.

(a)

(b)

Grade F

1.

(a)

(b)

(c)

Grade E

1.

2.

Grade E

- **Convert between a variety of units and currencies**

3. Nick goes on holiday to New York. The exchange rate is £1 = 1.525 dollars
   (a) He changes £600 into dollars. How many dollars should he get? *(2 marks)*
   (b) When he comes back, Nick changes 125 dollars back into pounds.
   The exchange rate is the same.
   How much money should he get? Give your answer to the nearest penny. *(2 marks)*

Grade D

- **Simplify a ratio to its simplest form by using a common factor**

1. A pet shop sells guinea pigs and goldfish.
   The ratio of the number of guinea pigs to goldfish is 20: 28.
   (a) Give this ratio in its simplest form. *(2 marks)*
   (b) The shop has a total of 120 guinea pigs and fish.
   Work out the number of guinea pigs the shop has. *(2 marks)*

- **Share an amount in a given ratio**

2. Madeeha's father won £149.
   He shared the £149 between his three children in the ratio 6:3:1.
   Madeeha was given the biggest share.
   (a) Work out how much money Madeeha received.
   (b) Madeeha saved ¾ of her share.
   Work out how much Madeeha saved.

- **Use direct proportion to solve word problems using a calculator**

3. It takes 30 litres of fruit drink to fill 50 cups.
   Work out how many litres of fruit drink are needed to fill 70 cups. *(2 marks)*

Grade E

3.
(a)
(b)

Grade D

1.
(a)
(b)

2.
(a)
(b)

3.

answers

Grade C

- **Use one part of a ratio to work out other parts of the original amount**

1. Amanda, Sarah and Bethany share the total cost of a holiday in the ratio 5:4:3.
   Amanda pays £235.
   (a) Work out the total cost of the holiday. *(2 marks)*
   (b) Work out how much Bethany pays. *(2 marks)*

- **Share an amount in a given ratio**

2. Andrew gave his three daughters a total of £134.40
   The money was shared in the ratio 6:5:4. Vanessa had the largest share.
   Work out how much money Andrew gave to Vanessa. *(3 marks)*

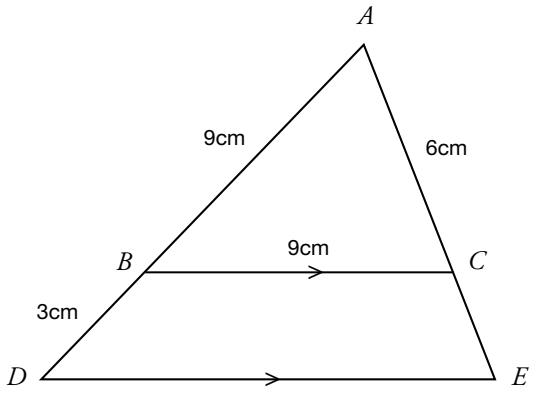
- **Use inverse proportion to solve word problems**

3. It takes 9 builders 12 days to build a wall.
   All the builders work at the same rate.
   How long would it take 6 builders to build a wall the same size? *(3 marks)*

Grade B

- **Use direct proportion to find missing lengths in mathematically similar shapes**

1. In the triangle ADE
   BC is parallel to DE
   AB = 9 cm, AC = 6 cm,
   BD = 3 cm, BC = 9 cm.



   (a) Work out the length of DE. *(2 marks)*
   (b) Work out the length of CE. *(2 marks)*

Grade A

- **Calculate unknown quantities from given quantities using direct or inverse proportion**

1. y is directly proportional to the square of x.
   When x = 3, y = 25.
   (a) Find an expression for y in terms of x. *(3 marks)*
   (b) Calculate y when x = 4.
   Give your answer to 2 decimal places. *(1 mark)*
   (c) Calculate x when y = 9. *(2 marks)*

answers

Grade C

1.
(a)
(b)

2.

3.

Grade B

1.
(a)
(b)

Grade A

1.
(a)
(b)
(c)

Grade G

1. (a) 80%
   (b) Any 8 squares shaded.

Grade F

(a) 0.8 (or 0.80)
(b) 2/10 = 1/5 (simplest form)
(c) 8:2 = 4:1 (simplest form)

Grade E

1. 120g plain flour
   150g sugar
   90g butter
   90g sultanas
   6 ripe apples
2. Ratio = 7:3
   7 + 3 = 10 (number of shares)
   40 ÷ 10 = 4 (value of 1 share)
   Bharati gets 7 × 4 = £28
3. (a) 600 × 1.525 =915
   (b) 125 ÷ 1.525 = 81.967…
   = £81.97

Grade D

1. (a) 5:7
   (b) 5 + 7 = 12 (number of shares)
   120 ÷ 12 = 10 (value of 1 share)
   5 × 10 = 50 guinea pigs
2. (a) 6 + 3 + 1 = 10
   149 divided by 10 = £14.90
   £14.90 × 6 = £89.40
   (b) £67.05
3. $^{30}/_{50}$ = 0.6
   0.6 × 70 = 42 litres

Grade C

1. (a) $^{235}/_{5}$ = 47 (value of 1 share)
   5 + 4 + 3 = 12 (number of shares)
   12 × 47 = £564
   (b) 3 × 47 = £141
2. Ratio = 6:5:4
   6 + 5 + 4 = 15 (number of shares)
   $^{34.40}/_{15}$ = 8.96 (value of 1 share)
   8.96 × 6 = £53.76
3. 9 builders reduced to 6 = divider of 1.5
   1.5 becomes multiplier for number of days
   12 × 1.5 = 18 days

   or

   9 builders take 12 days
   9 × 12 = 108 days off work
   so 6 builders $\frac{108 \text{ days}}{6}$ = 18 days

Grade B

1. Multiplier = $^{12}/_{9}$
   (a) 9 × $^{12}/_{9}$ = 12
   DE = 12cm
   (b) CE 6 × $^{12}/_{9}$ = 8
   8 – 6 = 2
   CE = 2 cm

Grade A

1. (a) $y = {}^{25}/_{9}\, x^2$
   $y = kx^2$
   25 = 9k
   (b) 44.44 to 2 decimal places
   (c) ± 1.08
   $9 = {}^{25}/_{9}\, x^2$

Number
10. Powers & Standard Index Form

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• Understand index notation and work out simple powers with and without a calculator (whole numbers only)	
E	• Use a calculator and BIDMAS (or BODMAS) to work out sums which include powers and decimals	
D	• Use written methods to work out expressions with powers (whole numbers only, with positive powers)	
C	• Use powers to write numbers as products of their prime factors • Convert between standard form and ordinary numbers • Multiply and divide numbers written in standard form using written methods (positive powers of 10 only) • Multiply and divide numbers written in standard form using a calculator (positive and negative powers of 10) • Know that $x^0 = 1$, $x^1 = x$ • Evaluate simple instances of negative powers	
B	• Substitute numbers written in standard form into formulae and evaluate • Solve word problems involving standard form • Know the rules of indices and use them to simplify expressions (integer powers) • Evaluate fractional indices using written methods	
A	• Evaluate simple surds • Use the 'powers' key on a calculator to evaluate fractional and negative powers (of decimals and fractions) • Know the rules of indices and use them to simplify expressions (fractional powers) • Express one number as a power of another number in order to compare them	
A*	• Solve complex problems involving surds • Solve complex problems involving generalising indices	

Grade F

- **Understand index notation and work out simple powers with and without a calculator (whole numbers only), eg $3^2 =$; $\sqrt{81} =$**

1. Write down the value of

   (a) 3^3

   (b) $\sqrt{81}$ *(2 marks)*

Grade E

- **Use a calculator and BIDMS (or BODMAS) to work out sums which include powers and decimals, eg $\sqrt{(4.5^2 - 0.5^3)}$**

1. Work out

   $\sqrt{(4.6^2 - 0.5^3)}$

   Write down all the figures on your calculator display. *(2 marks)*

Grade D

- **Use written methods to work out expressions with powers, eg $4^2 \times 6^3 =$ (whole numbers only with positive powers)**

1. Work out the value of $4^2 \times 10^3$ *(2 marks)*

Grade C

- **Use powers to write numbers as products of their prime factors**

1. The number 196 can be written as a product of its prime factors

   $196 = 2^2 \times 7^2$

   (a) Express the following numbers as products of their prime factors.

   (i) 72

   (ii) 96 *(4 marks)*

   (b) Find the Highest Common Factor of 72 and 96. *(1 mark)*

   (c) Work out the Lowest Common Multiple of 72 and 96. *(2 marks)*

- **Convert between standard form and ordinary numbers**

2. (a) Write 48 500 000 in standard form. *(1 mark)*

   (b) Write 0.000008 in standard form. *(1 Mark)*

- **Multiply and divide numbers written in standard form using written methods (+ve powers of 10 only)**

3. Work out $(1.2 \times 10^8) \div (0.02 \times 10^3)$ Give your answer in standard form. *(2 marks)*

- **Multiply and divide numbers written in standard form using a calculator**

4. Work out $(8.46 \times 10^8) \div (1.8 \times 10^2)$

   Give your answer in standard form. *(2 marks)*

answers

Grade F

1.

(a)

(b)

Grade E

1.

Grade D

1.

Grade C

1.

(a)

(i)

(ii)

(b)

(c)

2.

(a)

(b)

3.

4.

Grade C

- Know that $x^0 = 1$
- Evaluate simple instances of negative powers

5. Evaluate

   (i) 6^0

   (ii) 5^{-2} *(2 Marks)*

Grade B

- Substitute numbers written in standard form into formulae and evaluate

1. $x = \dfrac{p - q}{pq}$

   $p = 4 \times 10^5$

   $q = 1.25 \times 10^4$

   Calculate the value of x. Give your answer in standard form. *(2 marks)*

- Solve word problems involving standard form.

2. A spaceship travelled for 7×10^2 hours at a speed of 8×10^4 km/h.

   (a) Calculate the distance travelled by the spaceship.

   Give your answer in standard form. *(3 marks)*

   (b) One month an aircraft travelled 3×10^4 km. The next month the aircraft travelled 4×10^6 km.

   Calculate the total distance travelled by the aircraft in the two months.

   Give your answer as an ordinary number. *(2 marks)*

- Know the rules of indices and use them to simplify expressions (whole number powers)

3. Simplify

   (i) $p^3 \times p^4$

   (ii) $x^9 \div x^4$

   (iii) $\dfrac{y^4 \times y^3}{y^5}$ *(3 marks)*

- Evaluate fractional indices using written methods

4. Simplify

   (i) $4^{½}$ *(1 mark)*

Grade A

- Use the 'powers' key on a calculator to evaluate fractional and negative powers (of decimals and fractions)

1. Find the value of

   (i) $36^{½}$ *(1 mark)*

   (ii) 4^{-2} *(2 marks)*

Grade A*

- Solve complex problems involving generalising indices

1. Simplify fully $5s^3t^4 \times 7st^2$ *(2 marks)*

answers

Grade C

5.

(i)

(ii)

Grade B

1.

2.

(a)

(b)

3.

(i)

(ii)

(iii)

4.

(i)

Grade A

1.

(i)

(ii)

Grade A*

1.

Grade F

1. (a) 27
   (b) 9

Grade E

1. ± 4.586392918

Grade D

1. 16 × 1000 = 16000

Grade C

1. (a) (i) $2^3 \times 3^2$ or 2 × 2 × 2 × 3 × 3
   Divide by smallest prime factor until you reach 1
   72 ÷ 2 = 36
   ÷ 2 = 18
   ÷ 2 = 9
   ÷ 3 = 3
   ÷ 3 = 1
   There are three lots of 2 and 2 lots of 3 therefore the answer = $2^3 \times 3^2$
   (ii) $2^5 \times 3$ or 2 × 2 × 2 × 2 × 2 × 3
   96 ÷ 2 = 48
   ÷ 2 = 24
   ÷ 2 = 12
   ÷ 2 = 6
   ÷ 2 = 3
   ÷ 3 = 1
   There are five lots of 2 and one 3 therefore the answer = $2^5 \times 3$

   (b) 24
   Find factor pairs for 96 and 72. The highest factor in both is the HCF.
   96 (1, 96) (2, 48) (3, 32) (4, 24) (6, 16) (8, 12)
   72 (1, 72) (2, 36) (3, 24)

   (c) 288
   96 192 288
   72 144 216 288
   (LCM: go through the times tables for 92 and 72 and the first shared number is the LCM)

2. (a) 4.85×10^7
   (Put a decimal point after the first number and count the number of decimal places)

   (b) 8×10^{-6}
   (As above, but when the number is a decimal, the power is negative)

3. 1.2 ÷ 0.02 = 60
   $10^8 \div 10^3 = 10^5$
   (when dividing indices, subtract one from the other)
   = $10^6 \times 6$

4. 8.46 ÷ 1.8 = 4.7
   $10^8 \div 10^2 = 10^6$
   = $10^6 \times 4.7$

5. (i) $6^0 = 1$
   (ii) $5^{-2} = 1/25$ or 0.04

Grade B

1. $$\frac{400\,000 - 12\,500}{400\,000 \times 12\,500}$$
   $$= \frac{387\,500}{5\,000\,000\,000} = 7.75 \times 10^{-5}$$

2. Distance = Speed × Time
   (a) $7 \times 10^2 \times 8 \times 10^4$
   $= 56 \times 10^6$
   $= 5.6 \times 10^7$

   (b) $3 \times 10^4 + 4 \times 10^6$
   30 000 + 4 000 000 = 4 030 000

3. (i) $p^3 \times p^4 = p^7$
   (ii) $x^9 \div x^4 = x^5$
   (iii) $\frac{y^4 \times y^3}{y^5}$
   $= y^7 \div y^5$
   $= y^2$

4. 2

Grade A

1. (i) 6
   (ii) 1/16

Grade A*

1. $35s^4t^6$

Number
11. Surds

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• No objectives at this grade	
C	• No objectives at this grade	
B	• No objectives at this grade	
A	• Understand the concept of a root being an irrational number and leave the answer to problems in surd form	
A*	• Solve numeric calculations by manipulating surds	

Grade A

- Understand the concept of a root being an irrational number

1. Show $\frac{6}{\sqrt{2}} = 3\sqrt{2}$ *(2 marks)*

Grade A*

- Solve numeric calculations by manipulating surds

1. If, $a = 5 + \sqrt{3}$ and $b = 3 - 2\sqrt{3}$

   Simplify

   (a) $a + b$

   (b) ab *(2 marks)*

2. Simplify

$$\frac{2 + 3\sqrt{3}}{2 - \sqrt{3}}$$

Grade A

1.

Grade A*

1.

(a)

(b)

2.

Grade A

1. $\frac{6}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{6\sqrt{2}}{2} = 3\sqrt{2}$

Grade A*

1. (a) $a + b = 5 + \sqrt{3} + 3$

   $= 5 + 3 + \sqrt{3} - 2\sqrt{3}$

   $= 8 - \sqrt{3}$

   (b) $ab = (5 + \sqrt{3})(3 - 2\sqrt{3})$

   $= 15 - 10\sqrt{3} + 3\sqrt{3} - 2\sqrt{3}\sqrt{3}$

   $= 15 - 7\sqrt{3} - 6$

   $= 9 - 7\sqrt{3}$

Grade A*

2.

$$\frac{(2 + 3\sqrt{3}) \times (2 + \sqrt{3})}{(2 - \sqrt{3}) \times (2 + \sqrt{3})}$$

$$\frac{4 + 2\sqrt{3} + 6\sqrt{3} + 9}{4 - 3}$$

$$= 13 + 8\sqrt{3}$$

TIP: If denominator is in $(a + b\sqrt{c})$ form, multiply top and bottom by $(a - b\sqrt{c})$, this gets rid of the root in the denominator.

Section 2

Algebra

Page		Topic Title
54-57	**12.**	Basic algebra
58-61	**13.**	Solving equations
62-64	**14.**	Forming and solving equations from written information
65-67	**15.**	Trial and improvement
68-72	**16.**	Formulae
73-76	**17.**	Sequences
77-83	**18.**	Graphs
84-86	**19.**	Simultaneous equations
87-89	**20.**	Quadratic equations
90-93	**21.**	Inequalities
94-99	**22.**	Equations and graphs
100-103	**23.**	Functions

Revision Websites

http://www.bbc.co.uk/schools/gcsebitesize/maths/algebrafi/

http://www.bbc.co.uk/schools/gcsebitesize/maths/algebrah/

http://www.s-cool.co.uk/topic_index.asp?subject_id=15&d=0

http://www.mathsrevision.net/gcse/index.php

http://www.gcseguide.co.uk/algebra.htm

http://www.gcse.com/maths/

http://www.easymaths.com/algebra_main.htm

Add your favourite websites and school software here.

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This section of the Salford GCSE Maths Revision Package deals with *Algebra*. This is how to get the most out of it:

1 Start with any topic within the section – for example, if you feel comfortable with *Sequences*, start with Topic 17 on page 73.

2 Next, choose a grade that you are confident working at.

3 Complete each question at this grade and write your answers in the answer column on the right-hand side of the page.

4 Mark your answers using the page of answers at the end of the topic.

5 If you answered all the questions correctly, go to the topic's smiley face on pages 4/5 and colour it in to show your progress.

Well done! Now you are ready to move onto a higher grade, or your next topic.

6 If you answered any questions incorrectly, visit one of the websites listed left and revise the topic(s) you are stuck on. When you feel confident, answer these questions again.

When you answer all the questions correctly, go to the topic's smiley face on pages 4/5 and colour it in to show your progress.

Well done! Now you are ready to move onto a higher grade, or your next topic.

Algebra
12. Basic Algebra

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• Form an algebraic expression with a single operation • Simplify algebraic expressions by collecting like terms	
E	• Multiply a value over a bracket • Form an algebraic expression with two operations	
D	• Factorise linear algebraic expressions • Multiply a negative number over a bracket • Substitute negative values into expressions	
C	• Multiply an algebraic term over a bracket • Expand and simplify a pair of brackets • Use the laws of indices for integer values	
B	• Factorise quadratic equations • Form quadratic equations from word problems	
A	• Work with fractional indices • Factorise cubic expressions • Rearrange formulae involving roots	
A*	• Form expressions to give algebraic roots • Work with indices linked to surds	

Grade F

- **Form an algebraic expression with a single operation**

1. A garden centre sells plants in trays of 12.
   If I have x trays of plants, how many plants do I have altogether? *(1 mark)*

- **Simplify an algebraic expression by collecting like terms**

2. Simplify the following expression: $3x + 2y - 7z + 4x - 3y$ *(3 marks)*

Grade E

- **Multiply a value over a bracket**

1. Expand the bracket in the equation: $3(5a - 2b)$ *(2 marks)*

- **Form an algebraic expression with two operations**

2. A concert hall has x seats in the upstairs gallery and y seats in the stalls downstairs.
   (a) Write down an expression in terms of x and y for the number of seats altogether.
   (b) Tickets for the concert cost £5 each. Write down an expression in terms of x and y for the amount of money collected if all the tickets are sold. *(3 marks)*

Grade D

- **Factorise linear algebraic expressions**

1. Factorise the following expression: $5a - 15$ *(2 marks)*

- **Multiply a negative number over a bracket**

2. Expand the brackets in the following expression: $-6(3y - 2)$ *(2 marks)*

- **Substitute negative values into expressions**

3. If $a = -3$ and $b = 7$ what is the value of $3a + 4b$ *(2 marks)*

Grade C

- **Multiply an algebraic term over a bracket**

1. Expand the brackets in the following expression: $2x(x + 10)$ *(2 marks)*

- **Expand and simplify a pair of brackets**

2. Multiply out the brackets and simplify: $(a + 3)(a + 2)$ *(3 marks)*

- **Use the laws of indices for integer values**

3. (a) Simplify: $12y^5 \div 3y^2$ *(2 marks)*
   (b) Write the following as a power of 4: $4^5 \times 4^3$ *(1 mark)*

answers

Grade F

1.

2.

Grade E

1.

2.

(a)

(b)

Grade D

1.

2.

3.

Grade C

1.

2.

3. (a)

(b)

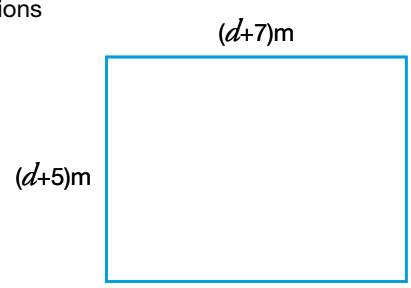
Grade B

- **Factorise quadratic equations**

1. Solve the equation by factorisation: $p^2 - 5p + 4 = 0$ *(3 marks)*

- **Form quadratic expressions from word problems**

2. A rectangular field has the dimensions as shown in the diagram



Write down an expression, in terms of d, for the area in m^2 for the area of the field. *(3 marks)*

Grade A

- **Work with fractional indices**

1. Solve: $25^{½}$ *(1 mark)*

- **Factorise cubic expressions**

2. Factorise the following expression completely: $9x^2y - 6xy^3$ *(3 marks)*

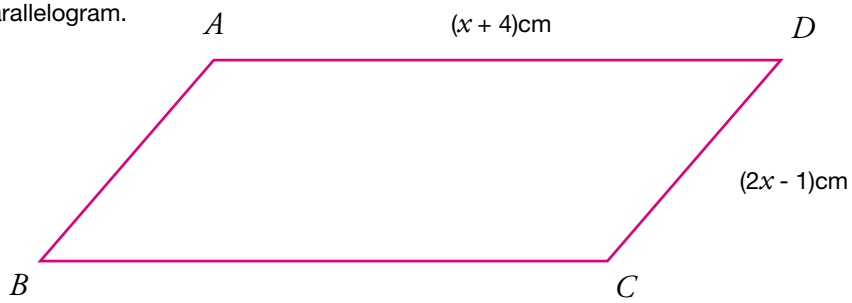
- **Rearrange formulae involving roots**

3. Make b the subject in the following formula: $\sqrt{(a/b - c)} = d$ *(3 marks)*

Grade A*

- **Form expressions to give algebraic roots**

1. $ABCD$ is a parallelogram.
$AD = (x + 4)$ cm
$CD = (2x - 1)$ cm



The perimeter of the parallelogram is 24 cm. Diagram NOT accurately drawn

(i) Use this information to write down an equation, in terms of x.

(ii) Solve your equation. *(3 marks)*

- **Work with indices linked to surds**

2. Evaluate $9^{3/2}$, without a calculator. *(2 marks)*

Grade B

1.

2.

Grade A

1.

2.

3.

Grade A*

1.

(i)

(ii)

2.

answers

Grade F

1. $12x$

2. $3x + 2y - 7z + 4x - 3y$
   $= 7x - y - 7z$

Grade E

1. $3(5a - 2b)$
   $= 15a - 6b$

2. (a) $x + y$
   (b) $5(x + y)$ or $5x + 5y$

Grade D

1. $5a - 15$
   $= 5(a - 3)$

2. $-6(3y - 2)$
   $= -18y + 12$

3. $3a + 4b$
   $= 3x(-3) + 4 \times 7 = -9 + 28 = 19$

Grade C

1. $2x(x + 10)$
   $= 2x^2 + 20x$

2. $(a + 3)(a + 2)$
   $= a^2 + 2a + 3a + 6$
   $= a^2 + 5a + 6$

3.(a) $12y^5 \div 3y^2$
   $= 4y^{(5-2)}$
   $= 4y^3$
   (b) $4^5 \times 4^3$
   $= 4^{(5+3)}$
   $= 4^8$

Grade B

1. $p^2 - 5p + 4 = 0$
   $\Rightarrow (p - 1)(p - 4) = 0$
   $\Rightarrow p = +1$ or $+4$

2. Area of rectangle = h × w
   h = $d + 5$, w = $d + 7$
   $\Rightarrow (d + 5)(d + 7)$
   $= d^2 + 7d + 5d + 35$
   $= d^2 + 12d + 35$

Grade A

1. $25^{½} = \sqrt{25} = \pm 5$

2. $x(9xy - 6y^3)$, $xy(9x - 6y^2)$
   or equivalent answer = $3xy(3x - 2y^2)$

3. $b = \dfrac{a}{d^2 + c}$

Grade A*

1. (i) $2(x + 4) + 2(2x - 1) = 24$
   (ii) $x = 3$
   $2x + 8 + 4x - 2 = 24$
   $6x + 6 = 24$
   $6x = 18$

2. $9^{3/2} = (\sqrt{9})^3 = 3^3 = 27$

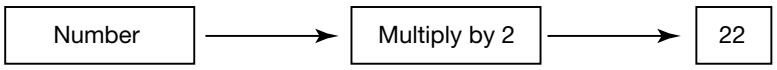
Algebra
13. Solving Equations

Grade	Learning Objective	Grade achieved
G	• Solve 'thinking of a number' problems • Solve equations involving only addition or subtraction from the unknown	
F	• Solve equations where there is a multiple of the unknown • Solve 'thinking of a number' problems where there are two operations	
E	• Solve equations involving two operations	
D	• Solve equations involving brackets and divisor lines • Solve equations with unknowns on both sides, where the solution is a positive integer	
C	• Solve equations with unknowns on both sides, where the solution is a fraction or negative integer	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Solve equations involving algebraic fractions	

Grade G

- **Solve 'thinking of a number' problems**

1. Dan thinks of a number.
   He multiplies his number by 2.
   His answer is 22.
   The diagram shows this.



(a) Work out the number that Dan thought of. *(1 mark)*

- **Solve equations involving only addition or subtraction from the unknown**

2. Solve the following equations:
   (i) $a + 10 = 16$ *(1 mark)*
   (ii) $b - 7 = 10$ *(1 mark)*

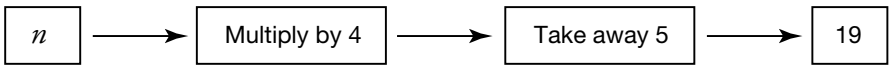
Grade F

- **Solve equations where there is a multiple of the unknown**

1. Solve $3x = 15$ *(1 mark)*

- **Solve 'thinking of a number' problems where there are two operations**

2. Tim thinks of a number.
   He calls the number n.
   He multiplies his number by 4 and then takes away 5.
   His answer is 19.
   The diagram shows this.



(a) Write the number Tim was thinking of. *(2 marks)*

Grade E

- **Solve equations involving two operations**

1. Solve $3x + 8 = 17$ *(2 marks)*

Grade G

1.

(a)

2.

(i)

(ii)

Grade F

1.

2.

(a)

Grade E

1.

answers

Grade D

- **Solve equations involving brackets and divisor lines**

1. (a) Solve $2(x + 1) = 12$ *(2 marks)*

   (b) Solve $\frac{x}{4} = 20$ *(2 marks)*

- **Solve equations with unknowns on both sides, where the solution is a positive integer**

2. Find the value of a in the equation

   $20a - 16 = 18a - 10$ *(3 marks)*

Grade C

- **Solve equations with unknowns on both sides, where the solution is a fraction or negative integer**

1. (a) Solve $5p + 7 = 3(4 - p)$ (3 marks)

   (b) Solve $4z + 4 = 3(-1 + z)$ (3 marks)

Grade A*

- **Solve equations involving algebraic fractions**

1. Solve the equation

$$\frac{2}{x+1} + \frac{3}{x-1} = \frac{5}{x^2-1}$$ *(4 marks)*

Grade D

1. (a)

   (b)

2.

Grade C

1. (a)

   (b)

Grade A*

1.

answers

Grade G

1. $n \times 2 = 22$
   $22 \div 2 = 11$
   $n = 11$
2 (i) $a + 10 = 16$
   $a = 16 - 10$
   $a = 6$
   (ii) $b - 7 = 10$
   $b = 10 + 7$
   $b = 17$

Grade F

1. $15 \div 3 = 5$
2. $19 + 5 = 24$
   $24 \div 4 = 6$

Grade E

1. $17 - 8 = 9$
   $9 \div 3 = 3$

Grade D

1. (a) $2x + 2 = 12$
   $2x = 10$
   $x = 5$
   (b) $x = 20 \times 4 = 80$
2. $20a - 18a = 16 - 10$
   $2a = 6$, so $a = 3$

Grade C

1. (a) $5p + 7 = 12 - 3p$
   $8p = 5$
   $p = \frac{5}{8}$
   (b) $4z + 4 = -3 + 3z$
   $4z - 3z = -3 - 4$
   $z = -7$

Grade A*

1. $2(x - 1) + 3(x + 1) = 5$
   $2x - 2 + 3x + 3 = 5$
   $5x + 1 = 5$
   $5x = 4$
   $x = 0.8$

Algebra
14. Forming and solving equations from written information

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• Form and solve equations from written information involving two operations	
C	• Form and solve equations from written information involving more complex operations	
B	• Form and solve equations from written information involving two operations, including negative numbers	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade D

- **Form and solve equations from written information involving two operations**

1. Chris is 6 years older than Alan.
   The sum of their ages is 30.
   Write an equation to work out how old they are. *(4 marks)*

Grade C

- **Form and solve equations from written information involving more complex operations**

1. David buys 7 CDs and 7 DVDs.
   A CD costs £x. A DVD costs £$(x + 2)$
   (a) Write down an expression, in terms of x, for the total cost, in pounds, of 7 CDs and 7 DVDs. *(2 marks)*
   (b) The total cost of 7CDs and 7 DVDs is £63
   (i) Express this information as an equation in terms of x. *(1 mark)*
   (ii) Solve your equation to find the cost of a CD and the cost of a DVD. *(4 marks)*

Grade B

- **Form and solve equations from written information involving more complex operations, including negative numbers**

1. A triangle has sides with the following lengths, in centimetres:
   $2x - 1$, $3(x - 2)$ and $4x + 5$
   (a) Write down an expression, in terms of x, for the perimeter of the triangle *(1 mark)*
   The perimeter of the triangle is 61cm
   (b) Work out the value of x *(2 marks)*

answers

Grade D

1.

Grade C

1.

(a)

(b)

(i)

(ii)

Grade B

1.

(a)

(b)

Grade D

1. Alan's age = x

   Chris's age = $x + 6$

   $x + x + 6 = 30$

   $2x + 6 = 30$

   $2x = 24$

   $x = 12$

   Alan is 12 years old and Chris is 18 years old

Grade C

1. (a) $7x + 7(x+2)$ or $14x+14$

   (b) (i) $7x + 7(x+2) = 63$

   (ii) $7x + 7x + 14 = 63$

   $14x = 63 - 14$

   $14x = 49$

   $x = 3.5$

   CDs cost £3.50 each and DVDs cost £5.50 each

Grade B

1. (a) $(2x - 1) + (3x - 6) + (4x + 5)$

   $2x - 1 + 3x - 6 + 4x + 5$

   $9x - 2$cm

   (b) $9x - 2 = 61$

   $9x = 63$

   $x = 63 \div 9$

   $x = 7$

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• No objectives at this grade	
C	• Use trial and improvement to solve quadratic equations	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade C

- **Use trial and improvement to solve quadratic equations.**

1. The equation $x^3 - x = 18$ has a solution between 2 and 3.
   Using trial and improvement, find the value of x.
   Give your answer correct to 1 decimal place.
   Show all your working out. *(4 marks)*

2. The equation $x^3 - 5x = 18$ has a solution that lies between 3 and 4.
   Using trial and improvement, find the value of x.
   Give your answer to 1 decimal place.
   Show all your working out. *(4 marks)*

Grade C

answers

1.

2.

Grade C

1. 2.7

   2.5? 13.125 (too small)

   2.7? 16.983 (too small)

   2.9? 21.489 (too large)

   2.8? 19.152 (too large)

   2.75? 18.046 (too large)

   Answer is between 2.7 and 2.8

   2.7 = 1.017 away from 18 (18-16.983)

   2.8 = 1.152 away from 18 (19.152-18)

   ∴ 2.7 = closer to 18.

   ∴ x = 2.7 to 1 decimal place.

2. 3.2

   3.5? 25.375 (too large)

   3.3? 19.437 (too large)

   3.2? 16.768 (too small)

   3.25? 18.078 (too large)

   Answer is between 3.2 and 3.3

   ∴ x = 3.2 to 1 decimal place.

Algebra
16. Formulae

Grade	Learning Objective	Grade achieved
G	• Substitute positive whole number values into formulae with a single operation	
F	• Substitution into formulae with two operations • Use inverse operations to find inputs to a formulae given an output	
E	• Make sure you are able to meet **ALL** the objectives at lower grades	
D	• Convert values between units before substituting into formulae	
C	• Rearrange a formula (linear or quadratic) to change its subject	
B	• Substitute fractional values into formulae • Substitute values into a quadratic formula • Discriminate between formulae for length, area and volume	
A	• Substitute negative decimal values into formulae • Rearrange more complex formulae involving algebraic fractions, including repeated subject • Use direct and inverse proportion to find formulae (linear and squared relationships)	
A*	• Use direct and inverse proportion with cubic variables	

Grade G

- **Substitute positive whole number values into formulae with a single operation**

1. Powder can be mixed with water to make a milk drink.
   The following rule is used

   Number of spoonfuls = Amount of water (ml) divided by 20

   A glass contains 160ml of water.
   (a) How many spoonfuls are needed? *(1 mark)*

   There are 20 spoonfuls of powder in a jug.
   (b) How much water is needed? *(1 mark)*

Grade F

- **Substitution into formulae with two operations**
- **Use inverse operations to find input to a formula given output**

1. Avril was checking her bill for hiring a car for a day.
   She used the following formula

   Mileage cost = Mileage rate × Number of miles travelled

   The mileage rate was 9 pence per mile and Avril's mileage cost was £24.30.
   (a) Work out the number of miles Avril had travelled. *(2 marks)*

   She then worked out the total hire cost using the following formula:

   Total hire cost = Basic hire cost + Mileage cost

   The basic hire cost was £25
   (b) Work out the total hire cost *(1 mark)*

Grade D

- **Convert values between units before substituting into formulae**

1. $C = 240R + 3\,000$
   The formula gives the capacity, C litres, of a tank needed to supply water to R hotel rooms
   (a) $R = 6$
   Work out the value of C. *(2 marks)*

   (b) $C = 4\,920$
   Work out the value of R *(2 marks)*

   (c) A water tank has a capacity of 4 700 litres.
   Work out the greatest number of hotel rooms it could supply. *(3 marks)*

Grade C

- **Rearrange a formula (linear or quadratic) to change its subject**

1. Make t the subject of the formula $v = u + 5t$ *(2 marks)*

answers

Grade G

1.

(a)

(b)

Grade F

1.

(a)

(b)

Grade D

1.

(a)

(b)

(c)

Grade C

1.

Grade B

- **Substitute fractional values into formulae**

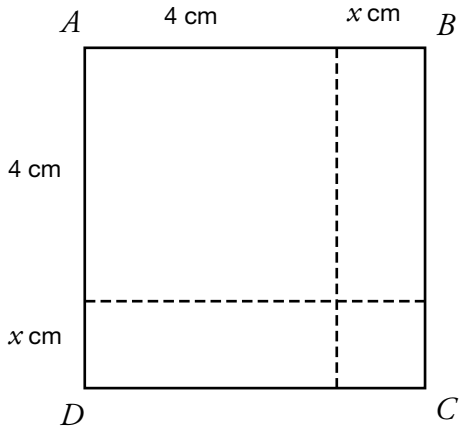
1. $y = ab + c$

   Calculate the value of y when

   $a = \frac{1}{2}$ $b = \frac{3}{4}$ $c = \frac{4}{5}$ *(4 marks)*

- **Substitute values into a quadratic formula**

2. In the diagram, each side of the square $ABCD$ is $(4 + x)$ cm.



   (a) Write down an expression in terms of x for the area, in cm^2, of the square $ABCD$.

   (b) The actual area of the square $ABCD$ is 20cm^2.

   Show that $x^2 + 8x = 4$ *(4 marks)*

- **Discriminate between formulae for length, area, volume**

3. Here are some expressions

$r^2/\pi x$	$\pi r^3/x$	$p^2r/2$	$\pi r^2 + rx$	πpq	$p^2\pi/r$

Tick the boxes below the three expressions which could represent areas *(3 marks)*

Grade A

- **Substitute negative decimal values into formulae**
- **Rearrange formulae involving algebraic fractions**

1. $r = \dfrac{9(s+t)}{st}$

   $s = -2.65$ $t = 4.93$

   (a) Calculate the value of r.

   Give your answer to a suitable degree of accuracy. *(2 marks)*

   (b) Make t the subject of the formula below

   $r = \dfrac{9(s+t)}{st}$ *(4 marks)*

answers

Grade B

1.

2.

(a)

(b)

3.

Grade A

1.

(a)

(b)

Grade A

2. (a) Make N the subject of the formula below.

$$\frac{P}{N} + E = \frac{T}{N}$$

(2 marks)

(b) Make l the subject of the formula below

$t = 2\pi\sqrt{l/g}$ *(4 marks)*

- **Use direct and inverse proportion to find formulae (linear and squared relationships)**

3. y is directly proportional to x^2.

When $x = 2$, $y = 16$.

(a) Express y in terms of x. *(3 marks)*

(b) z is inversely proportional to x.

When $x = 5$, $z = 20$.

Show that $z = c\ y^n$, where c and n are numbers and $c > 0$.

(You must find the values of c and n). *(4 marks)*

Grade A*

- **Use direct and inverse proportion with cubic variables**

1. The volume of a bottle (v) is directly proportional to the cube of its height (h).

When the height is 5cm the volume is 25cm³.

(a) Find a formula for v in terms of h.

(b) Calculate the volume of a similar bottle with a height of 8m.

answers

Grade A

2. (a)

(b)

3.

(a)

(b)

Grade A*

1.

(a)

(b)

Grade G

1. (a) 160 ÷ 20 = 8

   (b) 20 × 20 = 400

Grade F

1. (a) 2 430p ÷ 9p = 270

   or £24.30 ÷ £0.09 = 270

   (b) 25 + 24.30 = £49.30

Grade D

1. (a) (240 × 6) + 3 000 = 4 440 $\therefore C = 4\,440$

   (b) 4 920 - 3 000 = 1 920 $\therefore$

   $^{1920}/_{240} = 8 \therefore R = 8$

   (c) R = (4 700 - 3 000) ÷ 240 (= 7.08) = 7 rooms

Grade C

1. $v = u + 5t$

   $v - u = 5t$

   $t = \frac{v - u}{5}$

Grade B

1. y $= \frac{1}{2} \times \frac{3}{4} + \frac{4}{5}$

   $= \frac{3}{8} + \frac{4}{5} = {}^{15+32}/_{40} = {}^{47}/_{40}$

   $= 1\frac{7}{40}$

2. (a) $(4 + x)(4 + x)$ or $(4 + x)^2 = (x + 4)^2$

   (b) $(4 + x)(4 + x) = 20$

   $16 + 4x + 4x + x^2 = 20$

   $x^2 + 8x + 16 = 20$ and

   $x^2 + 8x = 4$

3. 3rd, 4th and 5th expressions

Grade A

1. (a) -1.57 or -1.571

   $\frac{9(-2.65 + 4.93)}{-2.65 \times 4.93}$

   $\frac{9 \times 2.28}{-13.0645}$

   $\frac{20.52}{-13.0645}$

   = -1.570668606 = -1.57 or -1.571

   (b) $t = \frac{9s}{rs - 9}$

   $r = \frac{9(s+t)}{st}$

   $rst = 9(s + t)$ then $rst = 9s + 9t$

   $rst - 9t = 9s$ then $t(rs - 9) = 9s$

   $\therefore t = \frac{9s}{rs - 9}$

Grade A

2. (a) $N = \frac{T - P}{E}$

   $\frac{P}{N} + E = \frac{T}{N}$

   $\frac{NP}{N} + NE = \frac{NT}{N}$

   $P + NE = T$

   $NE = T - P$

   $N = \frac{T - P}{E}$

   (b) $l = {}^{t^2 g}/_{4\pi^2}$

   $t = 2\pi\sqrt{({}^{l}/_{g})}$

   $t^2 = 4\pi^2({}^{l}/_{g})$

   $t^2 = {}^{4\pi^2 l}/_{g}$

   $t^2 g = 4\pi^2 l$

   $t^2 g / 4\pi^2 = l$

3. (a) $y = k \times x^2$

   $16 = k \times 2^2$

   $4 = k$

   $\therefore y = 4x^2$

   (b) $x = \frac{100}{z}$

   $x = \frac{\sqrt{y}}{2}$

   $\frac{\sqrt{y}}{2} = \frac{100}{z}$

   $z = \frac{200}{\sqrt{y}}$

   $z = 200 \times y^{-\frac{1}{2}}$

   $\therefore c = 200$ and $n = -\frac{1}{2}$

Grade A*

1. (a) $V = 0.2h^3$

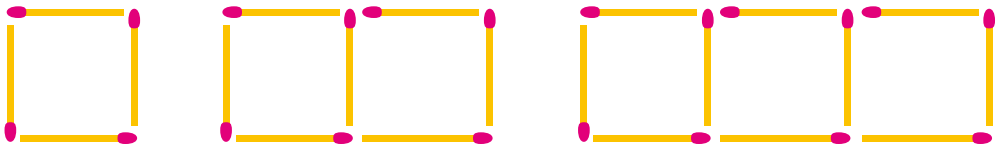
   (b) The volume is 102.4cm³

Grade	Learning Objective	Grade achieved
G	• Continue sequences of diagrams • Find missing values and/or word rule in a sequence with a single operation rule	
F	• Find the nth term of a sequence which has a single operation rule	
E	• Find the word rule for a sequence which has a rule with two operations	
D	• Find a word rule for a non-linear sequence	
C	• Find the nth term of a sequence which has a two-operation rule	
B	• Find the nth term of a descending sequence	
A	• Find the nth term of a quadratic sequence	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Continue sequences of diagrams.**

1. A pattern can be made from matchsticks, this is shown below



(a) Draw pattern number 4 *(1 mark)*

(b) Complete this table for the pattern sequence.

Pattern number	1	2	3	4	5
Number of matchsticks used	4	7	10		

(1 mark)

- **Find missing values and/or word rule in a sequence which has a single operation rule.**

2. Here is a sequence of numbers with two missing numbers.

7, 14, 21, …, …, 42.

(a) Fill in the two missing numbers.

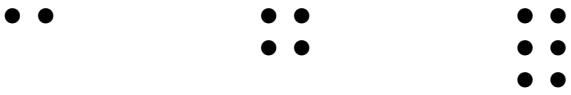
(b) Write in words, a rule that can be used to find the two missing numbers.

Grade F

- **Find the nth term of a sequence which has a single operation rule.**

1. A pattern is made using dots.

Pattern Number 1 Pattern Number 2 Pattern Number 3



Complete the table for pattern number 6 and n.

Pattern number	Number of dots
1	2
2	4
3	6
4	8
5	
6	
N	

answers

Grade G

1.

(a)

(b)

2.

(a)

(b)

Grade F

1.

Grade E

- **Find the word rule for a sequence which has a rule with two operations.**

1. Here are the first five terms in a number sequence:

   2, 5, 11, 23, 47…

   Write, in words, a rule to work out the next number.

Grade D

- **Find a word rule for a non-linear sequence.**

1. Here are the first five terms in a number sequence:

   1, 4, 9, 16, 25…

   Write, in words, a rule to work out the next number.

Grade C

- **Find the nth term of a sequence which has a two-operation rule.**

1. Here are the first five terms in a number sequence:

   6, 11, 16, 21, 26…

   Find an expression, in terms of n, for the nth term of the sequence. *(2 marks)*

Grade B

- **Find the nth term of a descending sequence.**

1. Here are the first four terms in a number sequence:

   20, 17, 14, 11…

   (a) Write down the next two terms of the sequence. *(2 marks)*

   (b) Find, in terms of n, an expression for the nth term of this sequence. *(2 marks)*

   (c) Find the 50th term of the sequence. *(1 mark)*

Grade A

- **Find the nth term of a quadratic sequence.**

1. Here are the first five terms in a number sequence:

   6, 9, 14, 21, 30…

   Find, in terms of n, an expression for the nth term of this sequence. *(4 marks)*

answers

Grade E

1.

Grade D

1.

Grade C

1.

Grade B

1.

(a)

(b)

(c)

Grade A

1.

Grade G

1. (a) One extra square = 13 matches

   (b)

Pattern number	1	2	3	4	5
Number of matchsticks used	4	7	10	13	16

2. (a) 28 and 35

   (b) Numbers go up in 7's or 7 times table.

Grade F

1.

Pattern number	Number of dots
1	2
2	4
3	6
4	8
5	10
6	12
N	2n

Grade E

1. Multiply the number by two and add one.

Grade D

1. The next number is 6^2 i.e $6 \times 6 = 36$

   (or multiply the number by its position, eg 7th $= 7 \times 7 = 49$)

Grade C

1. $5n + 1$

   eg. Sequence increases by 5 each time,

   so nth term must include $5n$.

   Substitute 1 for n

   $5 \times 1 = 5$

   So, to get first term (6) we must add 1

   $5 \times 2 = 10$

   To get second term (11) we must add 1,

   etc.

Grade B

1. (a) 8, 5

   (b) $23 - 3n$

   Sequence is descending by 3 each time

   So nth term must include $-3n$

   First term is 20

   Substitute 1 for n

   Inverse of -3 is +3

   $20 + 3 = 23 \quad \therefore 23-3n$

   (c) 50th term is -127

   $23 - 3n$

   $23 - (3 \times 50)$

   $23 - 150 = -127$

Grade A

1. $n^2 + 5$

   Differences between terms are not constant,

   so find second differences,

   2nd differences = 2 (constant)

   $\therefore n$th term must include n^2

   First term is 6

   Substitute 1 for n

   $6 - 1^2 = 5$

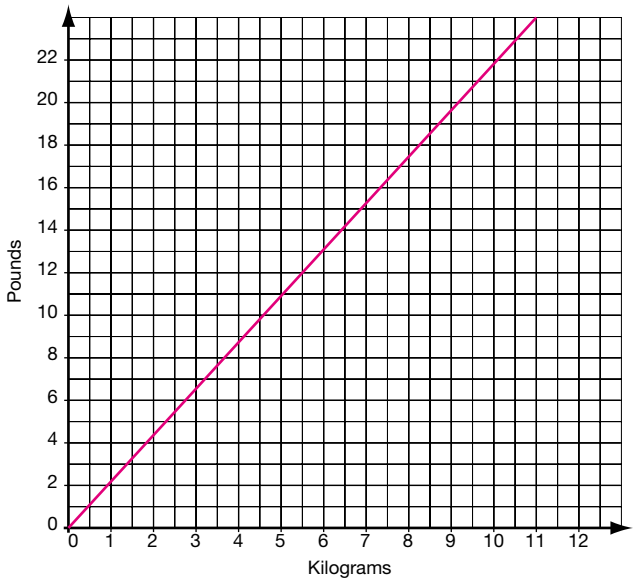
   $\therefore n$th term $= n^2 + 5$

Grade	Learning Objective	Grade achieved
G	• No objectives at his grade	
F	• Read from a linear (straight line) conversion graph	
E	• Draw a graph from a table of postive, whole number values • Interpret and plot distance-time graphs. Calculate speeds from these	
D	• Plot distance-time graphs from information about speed • Draw graphs from tables, with points in all four quadrants	
C	• Plot graphs of real-life functions	
B	• Interpret curved sections of distance-time graphs using language of acceleration and deceleration	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade F

- **Read from a linear (straight line) conversion graph**

1. The conversion graph below can be used for changing between kilograms and pounds.



(a) Use the graph to change 10 kilograms to pounds. *(1 mark)*

(b) Use the graph to change 11 pounds to kilograms. *(1 mark)*

Grade E

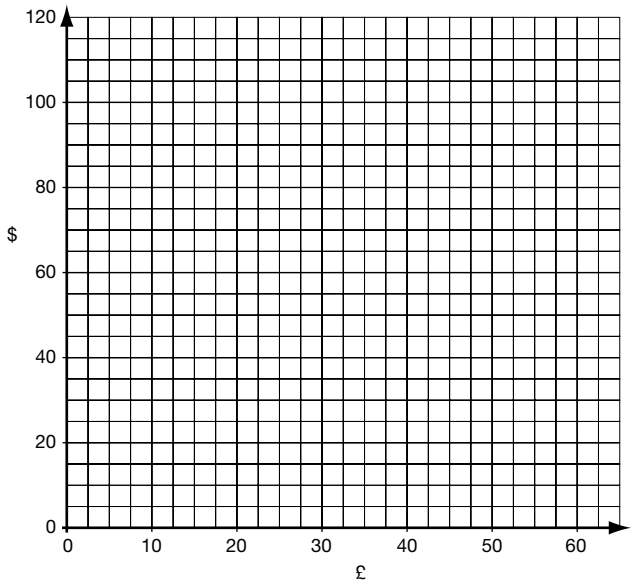
- **Draw a graph from a table of positive, whole number values**

1. The table below shows how many Australian Dollars can be exchanged for Pounds, for various amounts.

£	20	30	40	50
$	42	63	84	105

(a) Use the table to draw a conversion graph to convert Pounds to Australian dollars. *(2 marks)*

(b) Use your graph to convert £25 to Australian Dollars *(1 mark)*



answers

Grade F

1.

(a)

(b)

Grade E

1.

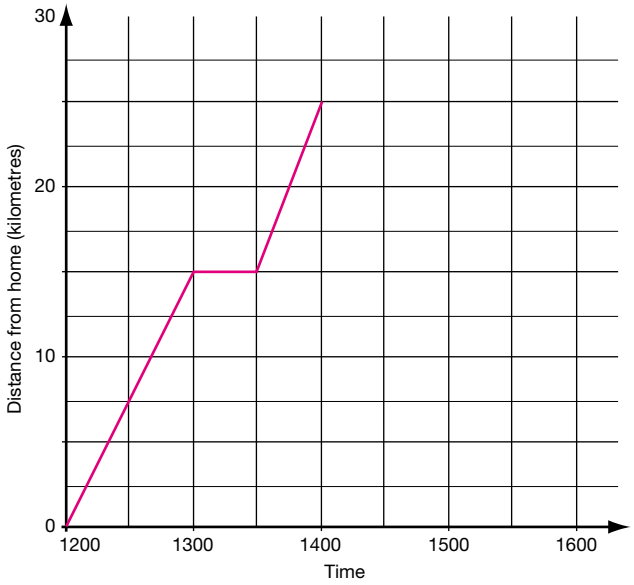
(a) Indicate your answer on the graph

(b)

Grade E

- **Interpret and plot distance-time graphs. Calculate speeds from these**

2. Jim went for a bike ride. The distance-time graph shows his journey.



He set off from home at 1200. During his ride, he stopped for a rest.

(a) (i) How long did he stop for a rest?

(ii) At what speed did he travel after his rest? *(3 marks)*

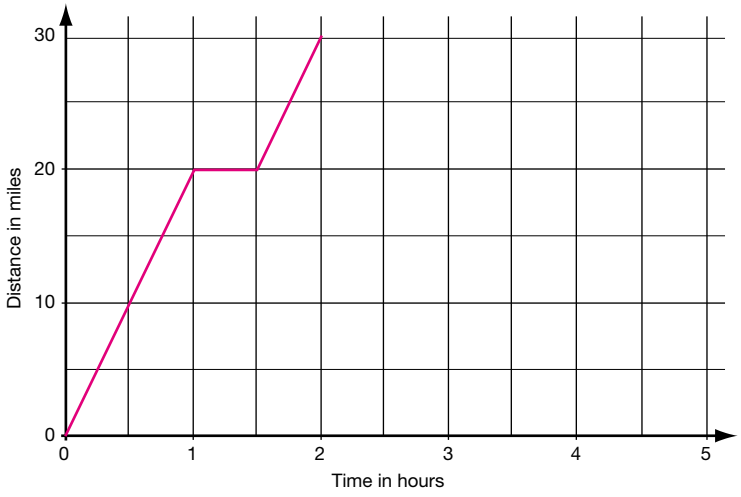
Jim then rested for the same amount of time as his first rest, and then travelled home at a speed of 25 km/h.

(b) Complete the graph to show this information. *(2 marks)*

Grade D

- **Plot distance-time graphs from information about speed**

1. Alice drives 30 miles to her friend's house. The travel graph shows Alice's journey.



(a) How long does the journey take? *(1 mark)*

Alice stays with her friend for one hour, She then travels home at 60 miles per hour.

(b) Complete the graph to show this information. *(3 marks)*

Grade E

2.

(a) (i)

(ii)

(b)

Grade D

1.

(a)

(b) Indicate your answer on the graph

answers

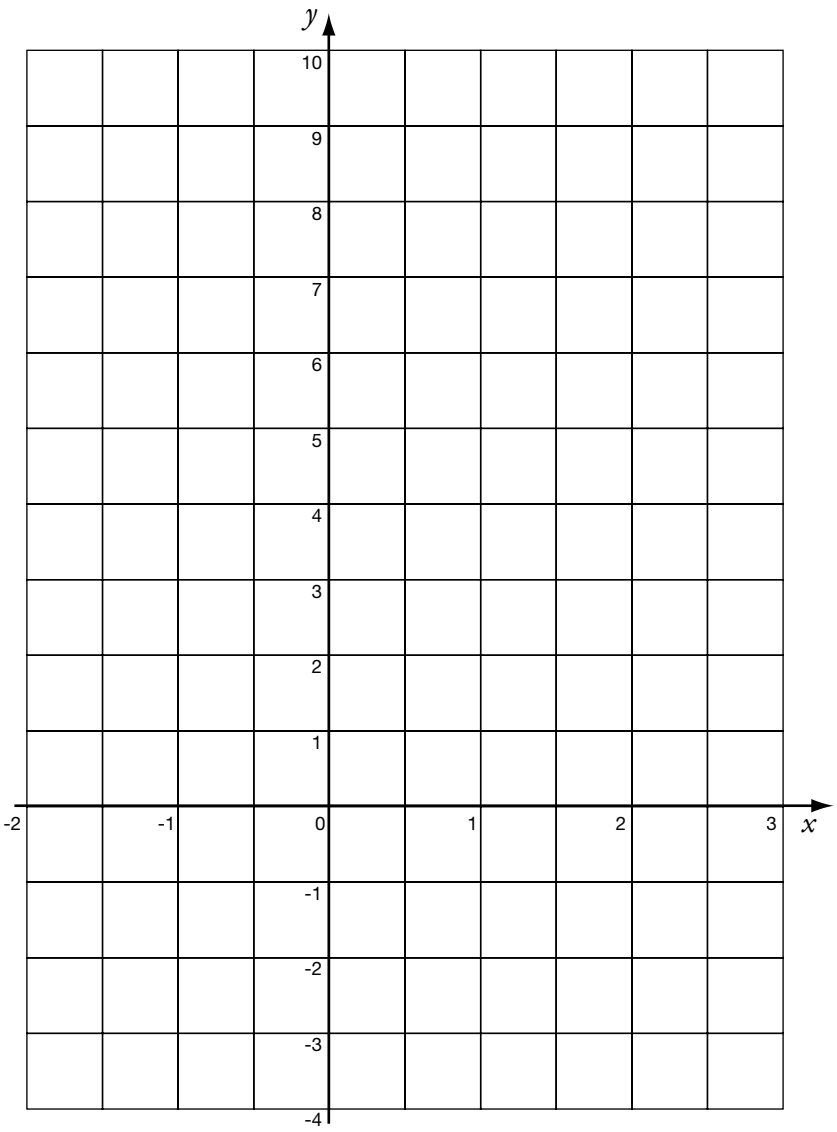
Grade D

- **Draw graphs from tables with points in all four quadrants**

2 (a) Complete the table of values for $y = 2x + 2$ *(2 marks)*

x	-2	-1	0	1	2
y	-2			4	

(b) On the grid, draw the graph of y = 2x + 2 *(2 marks)*



Grade D

2

(a) See Table

(b) Indicate your answer on the grid

answers

Grade C

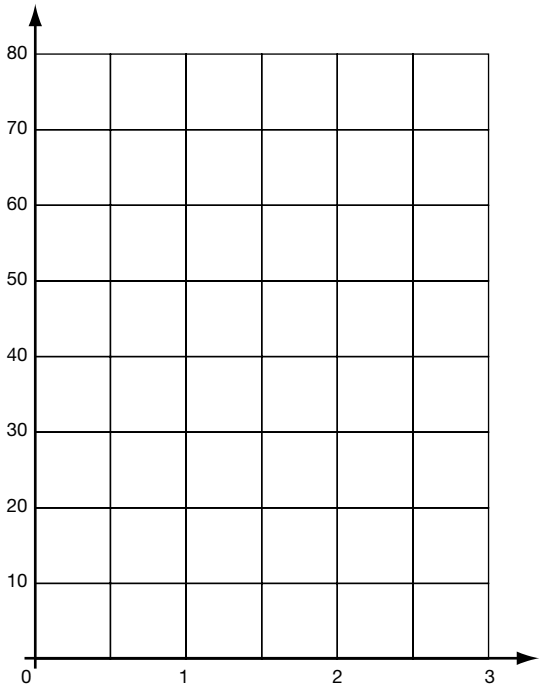
- **Plot graphs of real-life functions**

1. Hywel sets up his own business as an electrician.

(a) Complete the table below
where C stands for his total charge
and h stands for the number of hours he works.

h	0	1	2	3
C		33		

(b) Plot these values on the grid below.
Use your graph to find out how long Hywel worked if the charge was £55.50. *(Total 4 marks)*



Grade C

1.

(a) See table

(b) See Grid

answers

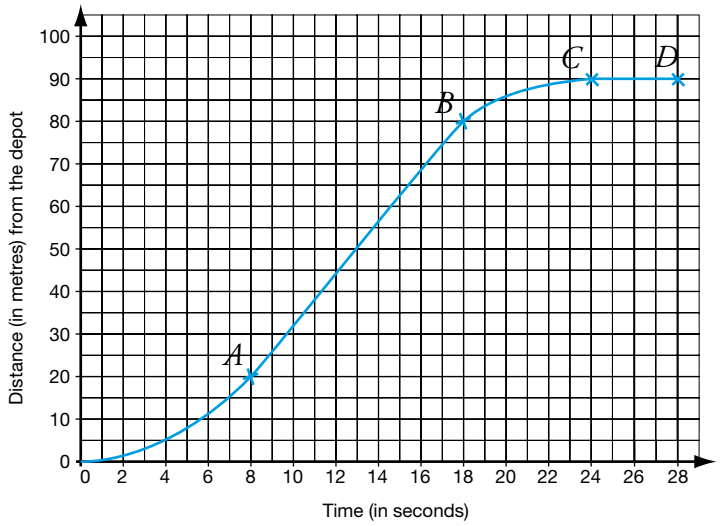
Grade B

- **Interpret curved sections of distance-time graphs using language of acceleration and deceleration**

1. This graph shows part of a distance/time graph for a delivery van after it had left the depot.

   (a) Use the graph to find the distance the van travelled in the first 10 seconds after it had left the depot.

   (b) Describe fully the journey of the bus represented by the parts AB,BC and CD of the graph. *(Total 4 marks)*



Grade B

1.

(a)

(b)

answers

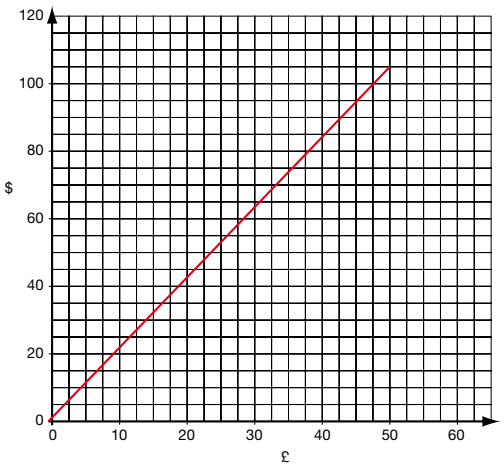
Grade F

1. (a) 22 pounds

   (b) 5 kg

Grade E

1. (a)

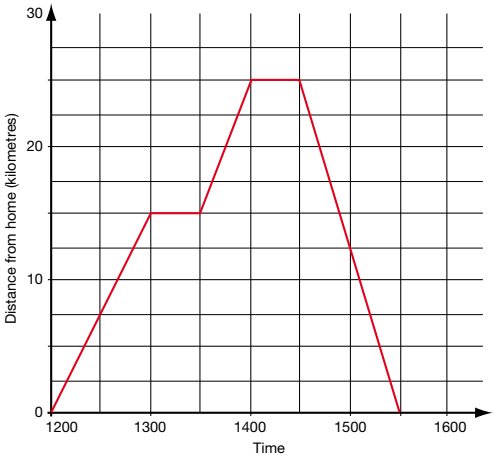


   (b) $54 - $56

2. (a) (i) 30 minutes or ½ hour.

   (ii) 20 kilometres per hour

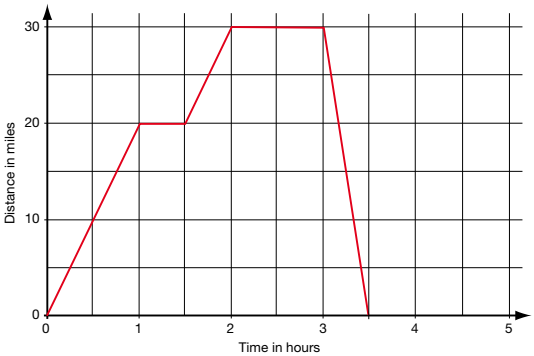
   (b)



Grade D

1. (a) 2 hours

   (b)

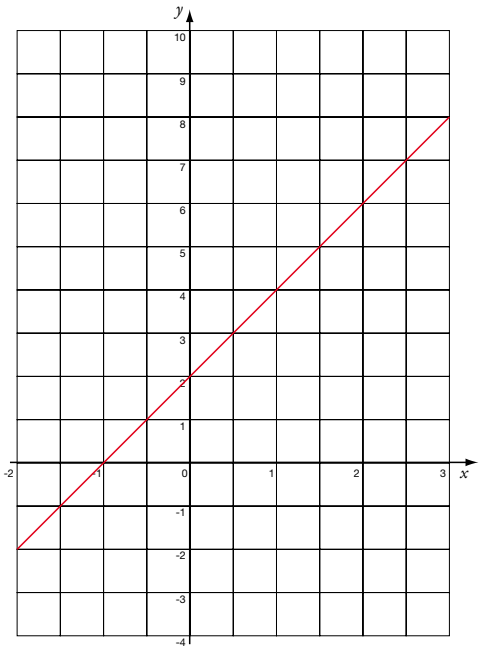


Grade D

2. (a)

x	-2	-1	0	1	2
y	-2	0	2	4	6

   (b)



Grade C

1. (a)

h	0	1	2	3
C	18	33	48	63

   (b) Accurate graph with above values.

   Hywel worked 2.5 hours.

Grade B

1. (a) 32 m

   (b) AB: van travelling at constant speed

   BC: van gradually slowing down

   CD: van stationary.

Algebra
19. Simultaneous Equations

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• No objectives at this grade	
C	• Solve simultaneous equations by substitution and graphical methods	
B	• Solve simultaneous equations by elimination	
A	• Solve simultaneous equations involving quadratics	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade C

- **Solve simultaneous equations by the substitution method.**

1. Solve these simultaneous equations using the substitution method:

   (a) $y = 2x - 1$

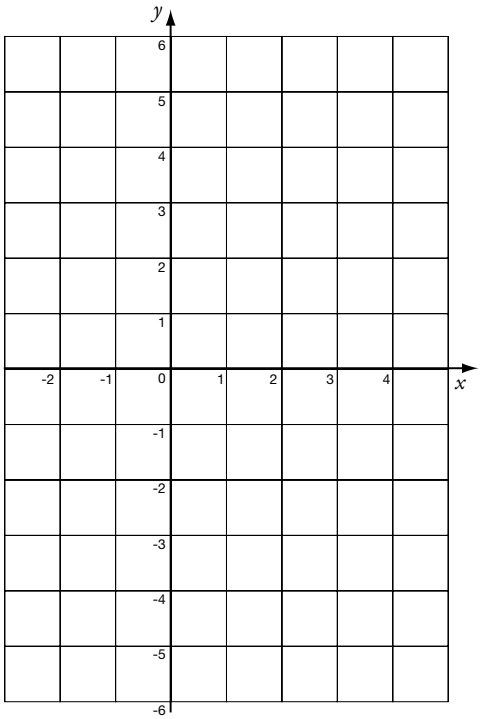
   (b) $x + 2y = 8$ *(4 marks)*

- **Solve simultaneous equations by the graphical method.**

2 (a) On the grid below, draw the graphs of

   (i) $x + y = 4$

   (ii) $y = x + 3$ *(2 marks)*



   (b) Use the graphs to solve the simultaneous equations

   (i) $x + y = 4$

   (ii) $y = x + 3$

Grade B

- **Solve simultaneous equations using the elimination method**

1. Solve this pair of simultaneous equations using the elimination method:

   $x - 3y = 1$

   $2x + y = 9$ *(4 marks)*

Grade A

- **Solve simultaneous equations involving quadratics**

1. Solve this pair of simultaneous equations:

   $x^2 + y^2 = 36$

   $y - x = 6$ *(7 marks)*

answers

Grade C

1.

(a)

(b)

2 See Grid

(a) (i)

(ii)

(b)

(i)

(ii)

Grade B

1.

Grade A

1.

Grade C

1. $x + 2(2x - 1) = 8$ (substitute $2x - 1$ for y in equation 2)
   $x + 4x - 2 = 8$ (expand brackets)
   $5x - 2 = 8$ (simplify)
   $5x = 8 + 2$ (add 2 to both sides)
   $5x = 10$ (divide by 5)
   $x = 2$
   (substitute 2 for x in equ. 1)
   $y = 4 - 1$
   $y = 3$

2. (a) (i) graph of $x + y = 4$ or $y = -x + 4$
   (ii) graph of $y = x + 3$
   (b) $x = ½$; $y = 3½$

Grade B

1. $2x - 6y = 2$
   Equation 1 multiplied by 2
   $2x + y = 9$
   $-7y = -7$ (equ. 1 subtract equ. 2)
   $y = 1$ (divide by -7)
   $2x + 1 = 9$ (substitute 1 for y)
   $2x = 9-1$ (take 1 from both sides)
   $2x = 8$ (divide by 2)
   $x = 4$

Grade A

1. $x = -6$ and $y = 0$
   OR $x = 0$ and $y = -6$
   $x^2 + y^2 = 36$
   $y = x + 6$ (rearranged)
   $x^2 + (x - 6)^2 = 36$
   $x^2 + x^2 - 12x + 36 = 36$
   $2x^2 - 12x + 36 = 36$
   $2x^2 - 12x - 0 = 0$
   $2(x - 6)(x + 0) = 0$

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• No objectives at this grade	
C	• No objectives at this grade	
B	• Solve quadratic equations by factorisation • Use graphs to solve quadratic and cubic equations	
A	• Solve quadratic equations by use of the formula • Solve quadratic equations by completing the square	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade B

- **Solve quadratic equations by factorisation.**

1. (a) Expand and simplify $(2x - 5)(x + 3)$ *(2 marks)*

   (b) (i) Factorise $x^2 + 6x - 7$

   (ii) Solve the equation $x^2 + 6x - 7 = 0$ *(3 marks)*

Grade A

- **Solve quadratic equations by use of the formula.**
- **Solve quadratic equations by completing the square.**

1. $(x + 1)(x - 5) = 1$

   (a) Show that $x^2 - 4x - 6 = 0$ *(2 marks)*

   (b) Solve the equation $x^2 - 4x - 6 = 0$

   Give your answer to 3 significant figures *(3 marks)*

   Use the formula $x = \dfrac{-b \pm \sqrt{b - 4ac}}{2a}$

2. Solve the following equation by completing the square.

   $x^2 + 12x - 9 = 0$

   Give your answer to 3 significant figures. *(3 marks)*

answers

Grade B

1.

(a)

(b) (i)

(ii)

Grade A

1.

(a)

(b)

Grade B

1. (a) $2x^2 + 6x - 5x - 15$

$= 2x^2 + x - 15$

(b) (i) $(x + 7)(x - 1) = 0$

(ii) $x = -7$

$x = 1$

Grade A

1. (a) $(x + 1)(x - 5) = 1$

$x^2 - 5x + x - 5 = 1$

$x^2 - 4x - 5 = 1$

$x^2 - 4x - 5 - 1 = 0$

$x^2 - 4x - 6 = 0$

(b) $x = \frac{4 \pm \sqrt{4 - 4\times1\times(-6)}}{2\times1}$

$x = \frac{4 \pm \sqrt{16+24}}{2}$

$x = \frac{4 + \sqrt{40}}{2} = 8.325$ *or*

$x = \frac{4 - \sqrt{40}}{2} = -4.325$

2. $x^2 - 12x - 9 = 0$

$(x - 6)^2 - 9 - 36 = 0$

$(x - 6)^2 = 45$

$x - 6 = \sqrt{45}$

$\pm \sqrt{45}$

$x = \sqrt{45} + 6 = 12.7$

$x = -\sqrt{45} + 6 = -0.708$

TIP: Quadratic equation is generally $x^2 + bx + c = 0$

To complete the square:

$$\left(x + \frac{b}{2}\right)^2 + c - \left(\frac{b}{2}\right)^2 = 0$$

Algebra
21. Inequalities

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• List values that satisfy an inequality	
C	• Solve inequalities involving one operation • Plot points on a graph governed by inequalities	
B	• Shade regions on a graph based on inequalities	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade D

- **List values that satisfy an inequality.**

1. y is an integer and $-3 < y \leq 3$

   (a) Write down all the possible values of y *(2 marks)*

   (b) (i) Solve the inequality $3n > -10$.

   (ii) Write down the smallest integer which satisfies the inequality $3n > -10$. *(2 marks)*

Grade C

- **Solve inequalities involving one operation.**
- **Plot points on a graph governed by inequalities.**

1. (a) $-3 < x \leq 1$

   x is an integer

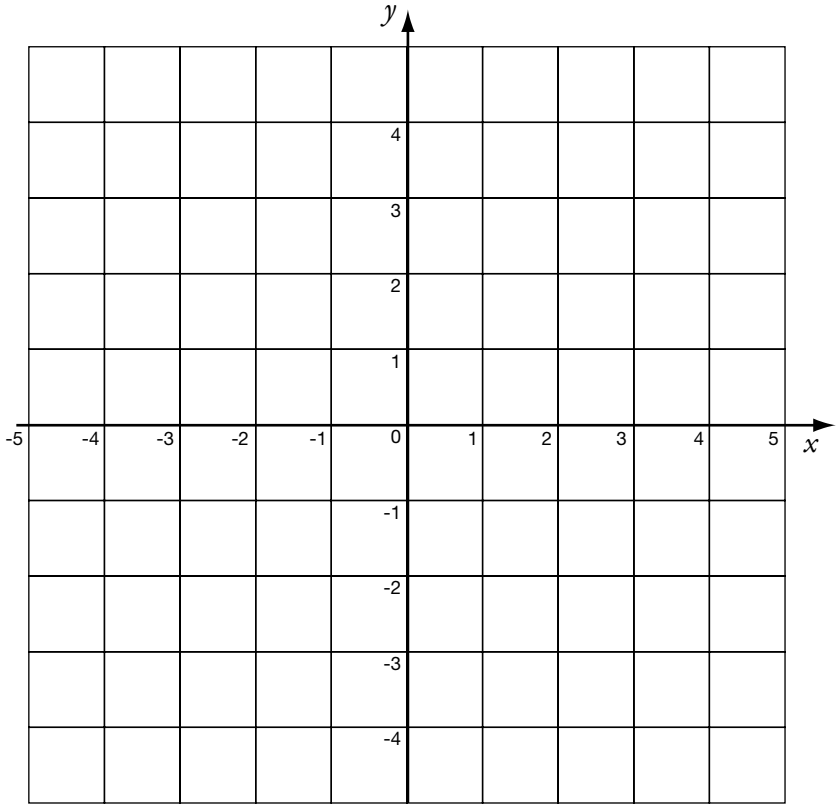
   Write down all the possible values of x *(2 marks)*

   (b) Shade the grid for each of these inequalities:

   $-3 < x \leq 1$ $\quad y > -1$ $\quad y < x + 1$

   x and y are integers *(3 marks)*

   (c) Using your answer to part (b), write down the co-ordinates of the points that satisfy all 3 inequalities. *(3 marks)*



answers

Grade D

1.

(a)

(b) (i)

(ii)

Grade C

1. (a)

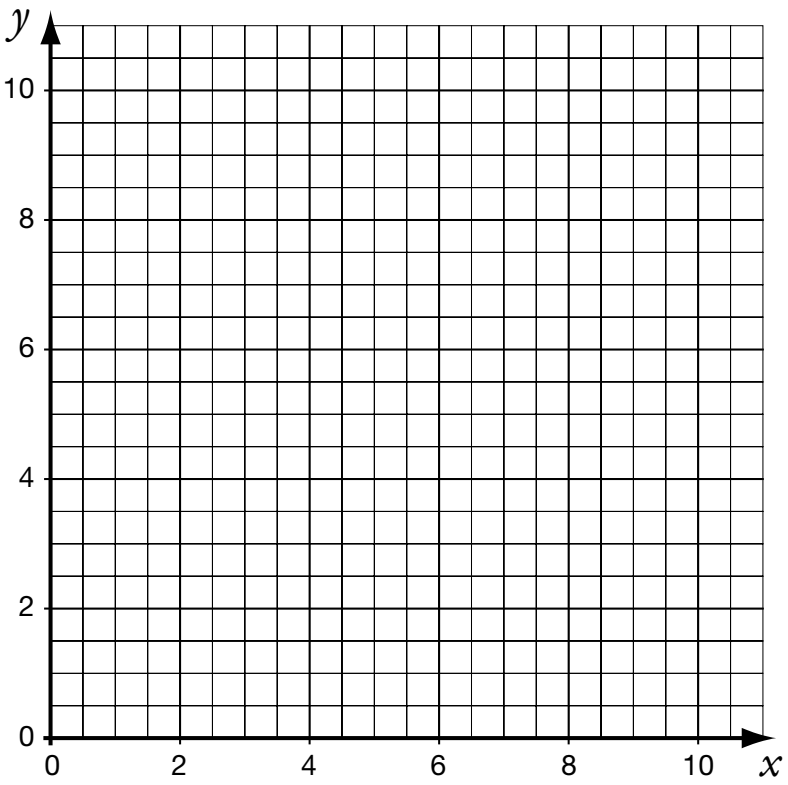
(b) See Grid

(c)

Grade B

- **Shade regions on a graph based on inequalities.**

1. (a) Make y the subject of the equation $x + 2y = 8$ *(2 marks)*
   (b) On the grid, draw the line with equation $x + 2y = 8$ *(1 mark)*
   (c) On the grid, shade the region for which $x + 2y \leqslant 8$, $0 \leqslant x \leqslant 4$ and $y \geqslant 0$ *(4 marks)*



answers

Grade B

1.

(a)

(b) See Grid

(c) See Grid

Grade D

1. (a) -2, -1, 0, 1, 2, 3

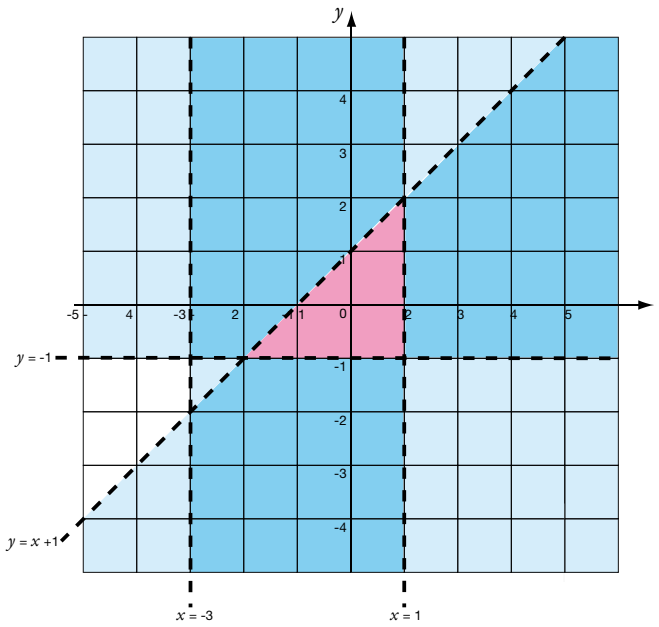
   (b) (i) $n > {}^{-10}/_{3}$

   (ii) -3

Grade C

1. (a) -1; 0; 1; -2

   (b)



   (c) (0,0); (1,0); (1,1)

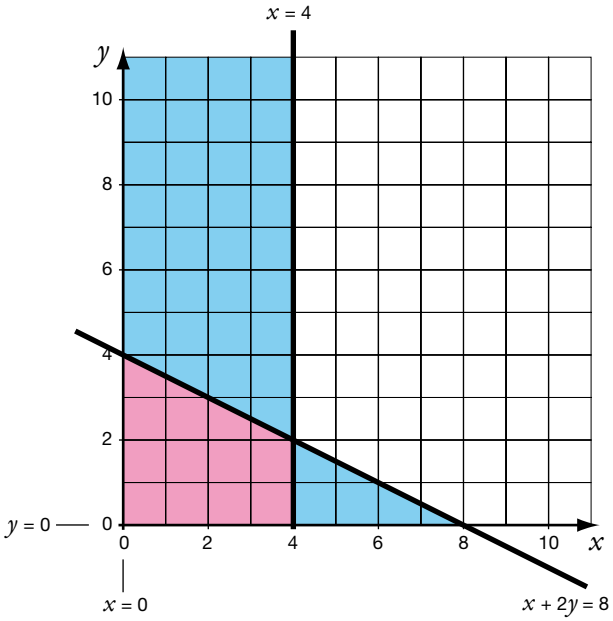
Grade B

1. (a) $2y = 8 - x$ (or ${}^{x}/_{2} + y = 4$)

   $y = {}^{8-x}/_{2}$ (or $y = 4 - {}^{x}/_{2}$)

   (b) eg (0,4), (2,3), (4,2)

   (c)



Algebra
22. Equations & Graphs

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• No objectives at this grade	
C	• Understand the relationship between a line's equation and its intercept and gradient • Find points on a line given its equation • Find the equation of a line given points that lie upon it • Find the equation of lines that are parallel • Plot graphs of quadratic functions	
B	• Plot graphs of reciprocal functions • Plot graphs of cubic functions	
A	• Find intersections between parabolas and cubic curves and straight lines	
A*	• Interpret and sketch transformations of graphs • Find equations resulting from transformations • Find intercepts of sketched graphs and the x and y axes	

Grade C

- **Understand the relationship between a line's equation and its intercept and gradient**

1. A straight line has equation $y = 4x - 6$
   (a) Find the value of x when $y = 1$. *(2 marks)*
   (b) A straight line is parallel to $y = 4x - 6$ and passes through the point (0, 2).
   What is its equation? *(2 marks)*

- **Find points on a line given its equation**

2. A straight line has equation $y = 4x + ½$
   The point A lies on the straight line. A has a y co-ordinate of 5.
   Find the x co-ordinate of A. *(2 marks)*

- **Find the equation of a line given points that lie upon it**

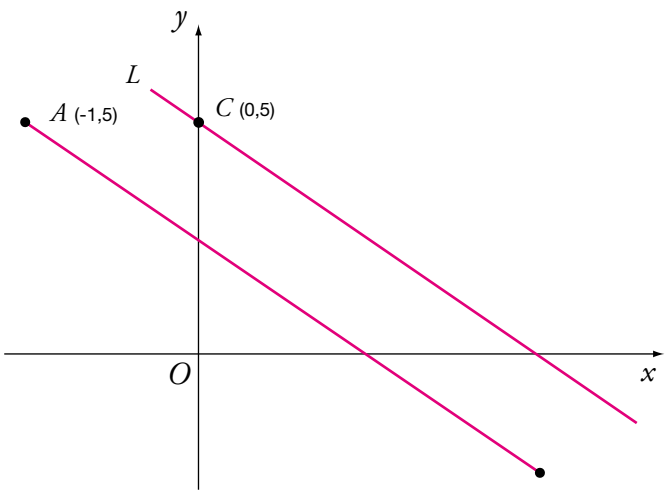
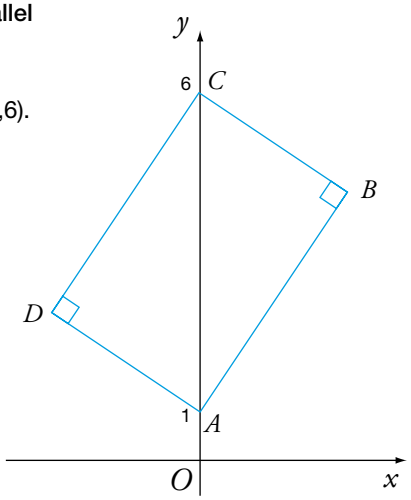
3. 

Diagram not accurately drawn.

The diagram above (not accurately drawn) shows three points A (-1,5), B (2,-1) and C (0,5)
A line L is parallel to AB and passes through C. Find the equation of the line L.

- **Find the equation of lines that are parallel**

4. $ABCD$ is a rectangle.
   A is the point (0,1) and C is the point (0,6).



The equation of the straight line through A and B is $y = 3x + 1$
Find the equation of the straight line through D and C. *(2 marks)*

Grade C

answers

1.
(a)
(b)

2.

3.

4.

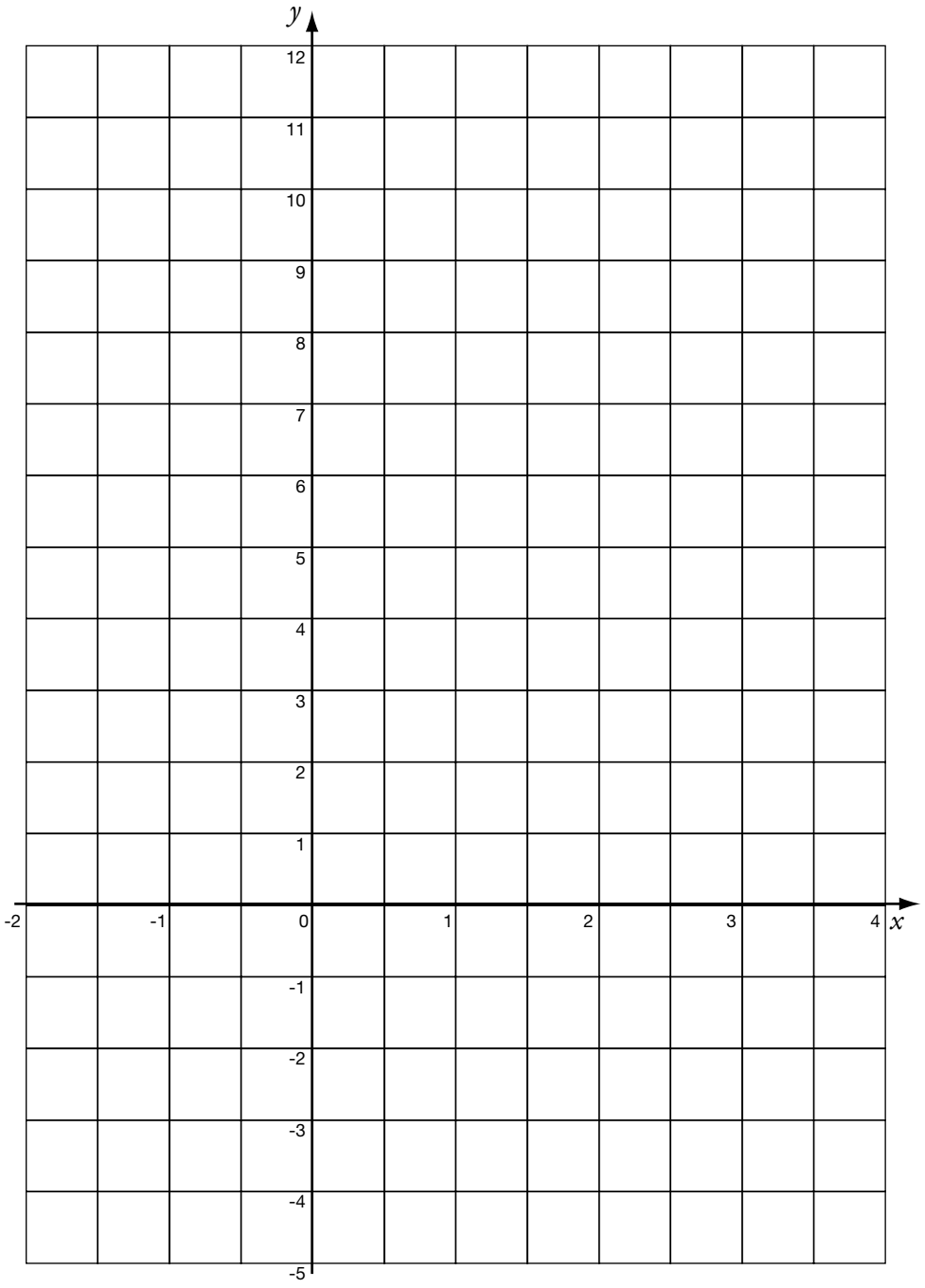
Grade C

- **Plot graphs of quadratic functions**

5. (a) Complete the table for $y = x^2 - 2x + 2$ *(2 marks)*

x	-2	-1	0	1	2	3	4
y	10		2	1			10

(b) On the grid below, draw the graph of $y = x^2 - 2x + 2$ *(2 marks)*



Grade C

5.

(a) See Table

(b) See Grid

answers

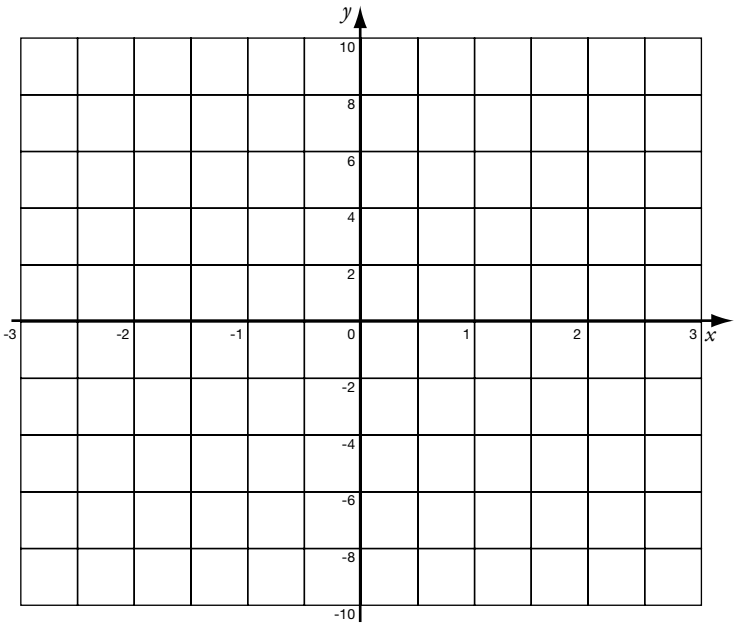
Grade B

- **Plot graphs of reciprocal functions**

1. (a) Complete this table of values for $y = 4 - \frac{2}{x}$

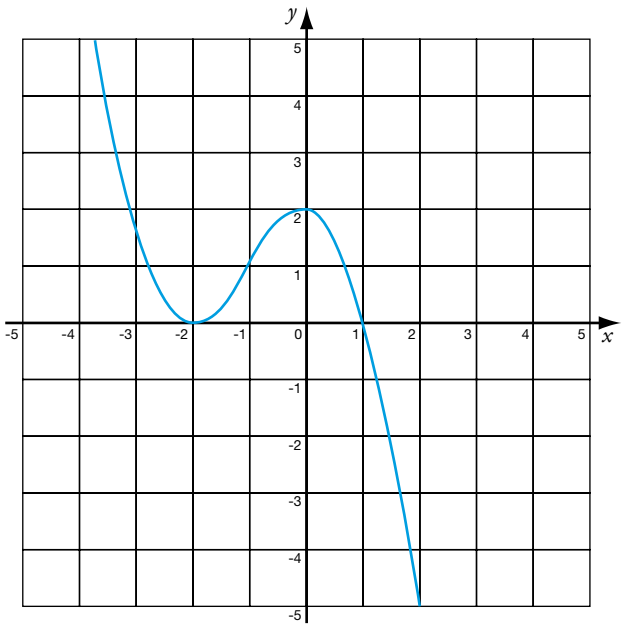
x	-3	-2	-1	-0.5	0.5	1	2	3
y	4.7					2		

(b) Draw a graph of $y = 4 - \frac{2}{x}$ on the grid below. *(Total 4 marks)*



- **Plot graphs of cubic functions**

2. The graph of $y = f(x)$ is shown on axes below.



(a) On the grid, sketch the graph of $y = f(x) + 2$ *(Total 4 marks)*

Grade B

1.

(a) See Table

(b) See Grid

2.

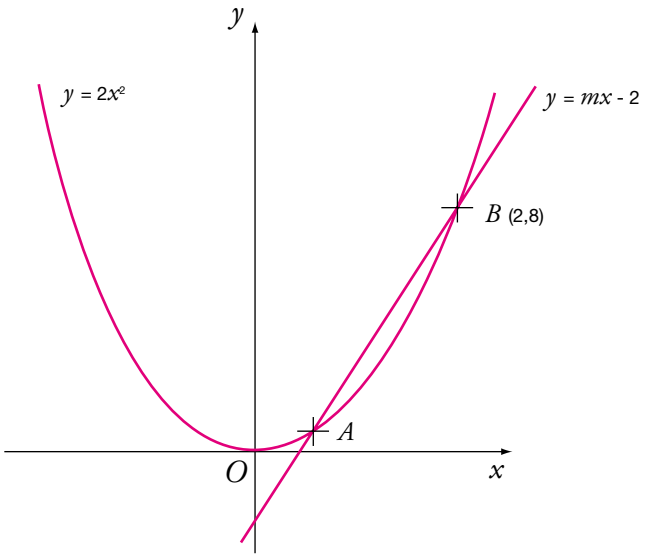
(a) See Grid

answers

Grade A

- **Find intersections between parabolas and cubic curves and straight lines**

1. The graphs of $y = 2x^2$ and $y = mx - 2$ intersect at the points A and B.
   The point B has co-ordinates (2, 8).



(a) Find the co-ordinates of the point A.

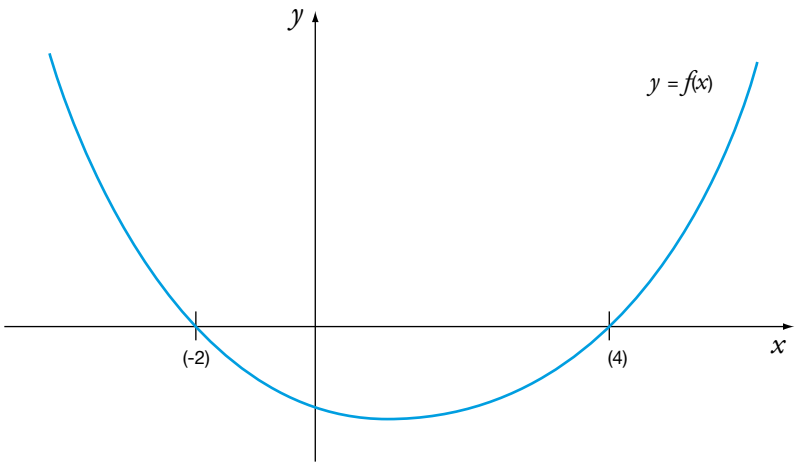
Grade A

1.

(a)

Grade A*

- **Interpret and sketch transformations of graphs**
- **Find equations resulting from transformations**
- **Find intercepts of sketched graphs and the x and y axes**



1. The diagram shows the curve with equation $y = f(x)$, where $f(x) = x^2 - 2x - 8$

   (a) On the same diagram sketch the curve with equation $y = f(x - 1)$.
   Label the points where this curve cuts the x axis. *(2 marks)*

   (b) The curve with equation $y = f(x)$ meets the curve with equation $y = f(x - a)$ at the point T.
   Calculate the x co–ordinate of the point T. Give your answer in terms of a. *(4 marks)*

   (c) The curve with equation $y = x^2 - 2x - 8$ is reflected in the y axis.
   Find the equation of this new curve. *(2 marks)*

   (d) Find y intercept of new curve. *(2 marks)*

Grade A*

1.

(a)

(b)

(c)

(d)

answers

Grade C

1. (a) $y = 4x - 6$

$\Rightarrow 1 = 4x - 6$

$\Rightarrow 4x = 7$

$\Rightarrow x = 7/4 = 1.75$

(b) $y = 4x + 2$

2. $y = 4x + \frac{1}{2}$

$5 = 4x + \frac{1}{2}$

$4\frac{1}{2} = 4x$

$x = 4\frac{1}{2} \div 4 = 1.125$

3. Gradient $\frac{\text{change in } y}{\text{change in } x}$

$= \frac{y_2 - y_1}{x_2 - x_1}$

$= \frac{5 - (-1)}{(-1) - 2}$

$= \frac{6}{-3} = -2$

y intercept = 5

$y = -2x + 5$

4. $y = 3x + 6$

5. (a)

x	-2	-1	0	1	2	3	4
y	10	5	2	1	2	5	10

(b) Graph with minimum at (1,1)

Grade B

1. (a)

x	-3	-2	-1	-0.5	0.5	1	2	3
y	4.7	5.0	6.0	8.0	0	2	3	3.3

(b) Reciprocal graph with above co-ordinates

2. (a) Graph translated two units up the grid.

(b) Graph stretched parallel to y axis by 3 units.

Grade A

1. $y = mx - 2$ (at B, $x = 2$, $y = 8$)

$8 = 2m - 2$

$10 = 2m$

$5 = m$

$\therefore y = 5x - 2$ (straight line)

$y = 2x^2$ (the curve)

At A, y values are equal

$\therefore 2x^2 = 5x - 2$

$2x^2 - 5x + 2 = 0$

$(2x - 1)(x - 2) = 0$

$x = \frac{1}{2}$ or 2

$y = 2x^2$

$y = 2 \times (\frac{1}{2})^2 = \frac{1}{2}$

Co-ordinates of point $A = (\frac{1}{2}, \frac{1}{2})$

Grade A*

1. (a) Moved one space to the right

Cuts x axis at (-1, 0) and (5,0)

(b) $x = \frac{a + 2}{2}$

$f(x) = x^2 - 2x - 8$

$f(x - a) = (x - a)^2 - 2(x - a) - 8$

at T

$x^2 - 2x - 8 = (x - a)^2 - 2(x - a) - 8$

$x^2 - 2x = x^2 - 2ax + a^2 - 2x + 2a$

$0 = -2ax + a^2 + 2a$

$2ax = a^2 + 2a$

$x = \frac{a^2 + 2a}{2a}$

$x = \frac{a + 2}{2}$

(c) $(x + 4)(x - 2) = y$

$x^2 + 2x - 8 = y$

(d) $y = -8$

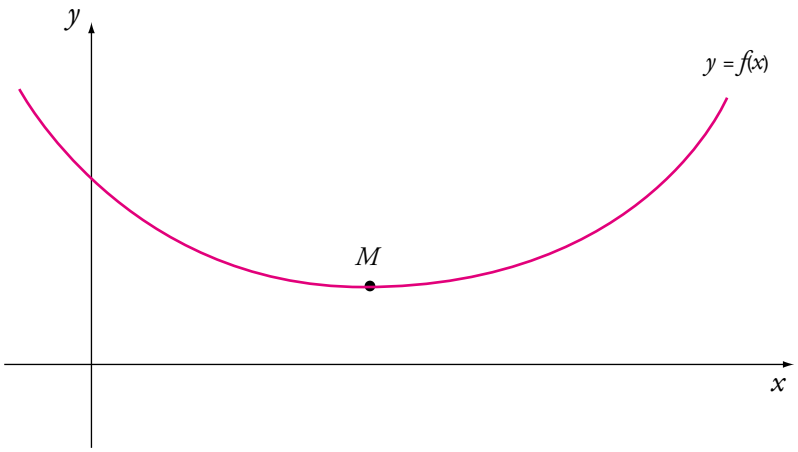
Algebra
23. Functions

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• No objectives at this grade	
C	• No objectives at this grade	
B	• No objectives at this grade	
A	• No objectives at this grade	
A*	• Find vertices of functions (maxima and minima) after translations • Interpret tranformations of functions including translations, enlargements and reflections in the x and y axes	

Grade A*

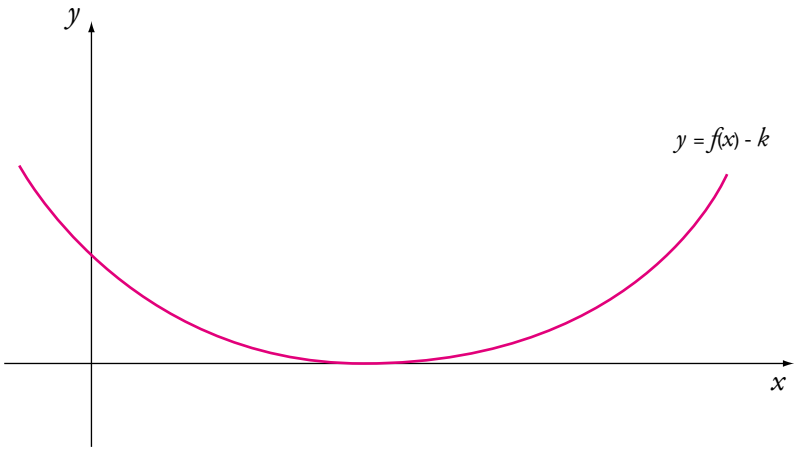
- **Find vertices of functions (maxima and minima) after translations**

1. The equation of a curve is $y = f(x)$, where $f(x) = x^2 - 6x + 14$.
   Below is a sketch of the graph of $y = f(x)$.



(a) Write down the co-ordinates of the minimum point, M, of the curve. *(1 mark)*

Here is a sketch of the graph of $y = f(x) - k$, where k is a positive constant.
The graph touches the x axis.



(b) Find the value of k. *(1 mark)*

(c) For the graph of $y = f(x - 1)$,

(i) Write down the co-ordinates of the minimum point

(ii) Calculate the co-ordinates of the point where the curve crosses the y axis. *(3 marks)*

Grade A*

1.

(a)

(b)

(c)

(i)

(ii)

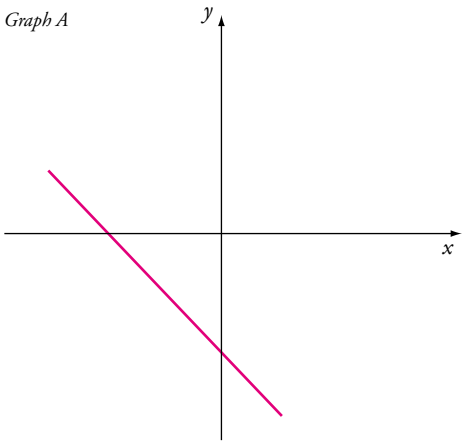
answers

Grade A*

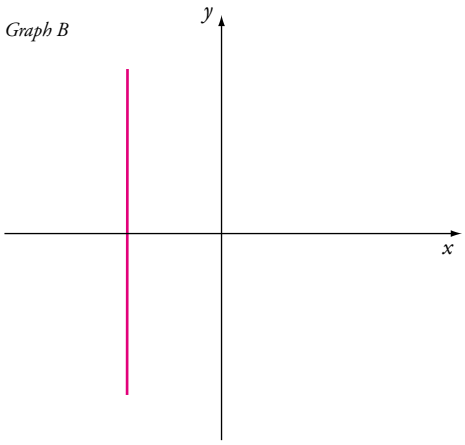
- **Interpret transformations of functions including translations, enlargements and reflections in the x and y axes**

2. Here are five graphs labelled A, B, C, D and E.

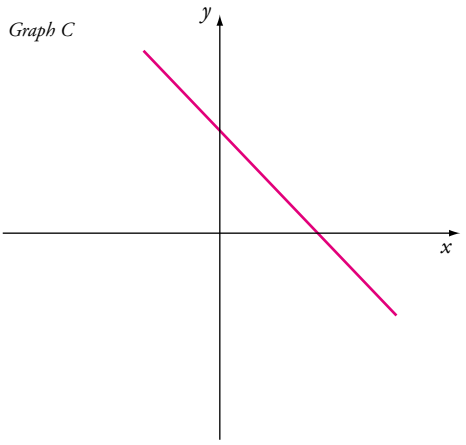
Graph A



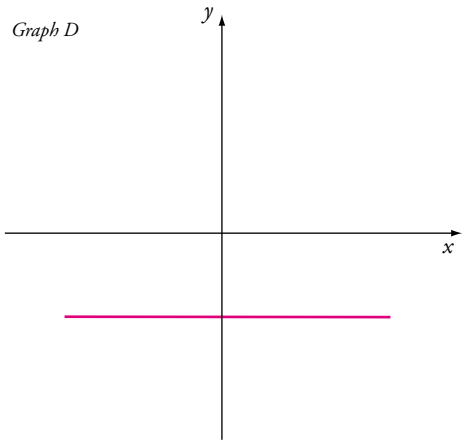
Graph B



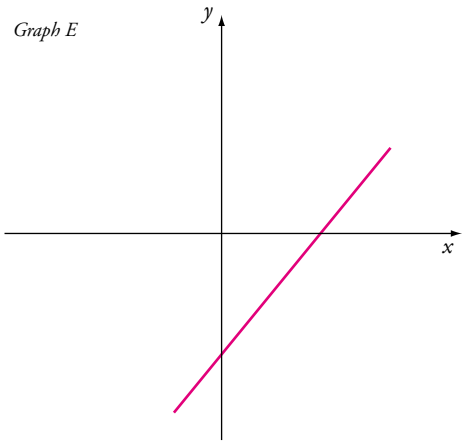
Graph C



Graph D



Graph E



Each of the equations in the table represents one of the graphs A to E.

Write the letter of each graph in the correct place in the table. *(3 marks)*

Grade A*

answers

2.

Equation	Graph
$x + y = 7$	
$y = x - 7$	
$y = -7 - x$	
$y = -7$	
$x = -7$	

Grade A*

1. (a) (3, 5)

   (b) 5

   (c) (i) (4, 5)

   (ii) (0, 21)

TIP: $f(x - 1) = (x - 1)^2 - 6(x - 1) + 14$

$x = 0$ where it crosses the y axis.

2.

Equation	Graph
$x + y = 7$	C
$y = x - 7$	E
$y = -7 - x$	A
$y = -7$	D
$x = -7$	B

TIP: In a quadratic function: $ax^2 + bx + c$

the minimum / maximum occurs at:

$$x = \frac{-b}{2a}$$

section 3

Shape, Space & Measures

Page		Topic Title
106-111	**24.**	Angles
112-121	**25.**	2D and 3D shapes
122-125	**26.**	Measures
126-131	**27.**	Length, area and volume
132-135	**28.**	Symmetry
136-145	**29.**	Transformations
146-150	**30.**	Loci
151-155	**31.**	Pythagoras' Theorem and Trigonometry
156-159	**32.**	Vectors
160-163	**33.**	Circle theorems

Revision Websites

http://www.bbc.co.uk/schools/gcsebitesize/maths/shape/

http://www.bbc.co.uk/schools/gcsebitesize/maths/shapeih/

http://www.s-cool.co.uk/topic_index.asp?subject_id=15&d=0

http://www.mathsrevision.net/gcse/index.php

http://www.gcseguide.co.uk/shape_and_space.htm

http://www.gcse.com/maths/

http://www.easymaths.com/shape_main.htm

Add your favourite websites and school software here.

This section of the Salford GCSE Maths Revision Package deals with *Shape, Space and Measures*. This is how to get the most out of it:

1 Start with any topic within the section – for example, if you feel comfortable with *Symmetry*, start with Topic 28 on page 132.

2 Next, choose a grade that you are confident working at.

3 Complete each question at this grade and write your answers in the answer column on the right-hand side of the page.

4 Mark your answers using the page of answers at the end of the topic.

5 If you answered all the questions correctly, go to the topic's smiley face on pages 4/5 and colour it in to show your progress.

Well done! Now you are ready to move onto a higher grade, or your next topic.

6 If you answered any questions incorrectly, visit one of the websites listed left and revise the topic(s) you are stuck on. When you feel confident, answer these questions again.

When you answer all the questions correctly, go to the topic's smiley face on pages 4/5 and colour it in to show your progress.

Well done! Now you are ready to move onto a higher grade, or your next topic.

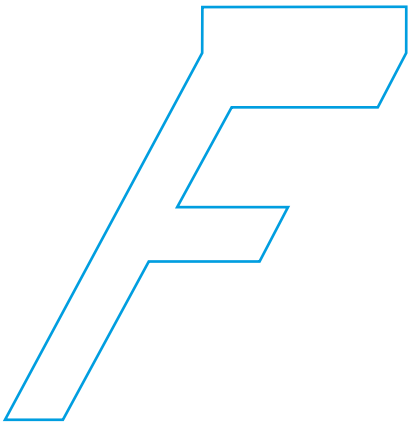
Shape, Space and Measures
24. Angles

Grade	Learning Objective	Grade achieved
G	• Recognise right angles • Know and use names of types of angle (acute, obtuse and reflex)	
F	• Know the sum of the angles in a triangle and use this fact to find missing angles • Use notation of 'angle ABC' • Know the sum of the angles on a straight line and the sum of the angles round a point	
E	• Know and use the fact that the base angles in an isosceles triangle are equal • Know and use the fact that angles in an equilateral triangle are equal • Know and use the fact that vertically opposite sides are equal	
D	• Know and use the fact that corresponding and alternate angles are equal • Find interior and exterior angles of regular shapes	
C	• Know that the sum of exterior angles for a convex shape is 360 degrees	
B	• Calculate three-figure bearings	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- Recognise right angles
- Know and use names of types of angle (acute, obtuse and reflex)

1.



On this diagram mark…

(a) a right angle with a letter R *(1 mark)*

(b) an acute angle with a letter A *(1 mark)*

(c) an obtuse angle with a letter O *(1 mark)*

(d) a reflex angle with a letter F *(1 mark)*

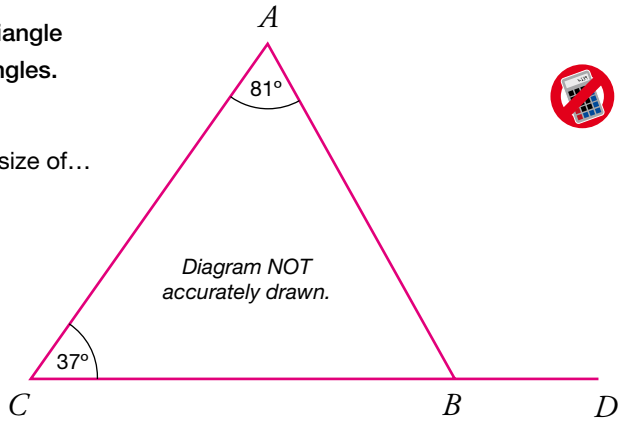
Grade F

- Know the sum of the angles in a triangle and use this fact to find missing angles.
- Use notation of 'angle ABC'

1. In the diagram below, work out the size of…

(a) angle ABC *(2 marks)*

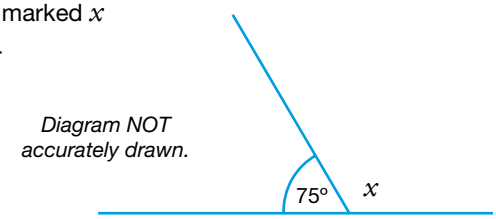
(b) angle ABD *(2 marks)*



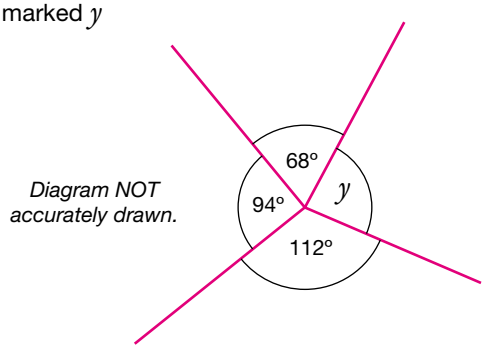
- Know the sum of the angles on a straight line and the sum of the angles round a point

2. (a) (i) Work out the size of the angle marked x *(1 mark)*

(ii) Give a reason for your answer *(1 mark)*



(b) Work out the size of the angle marked y *(1 mark)*



Grade G

1. See Diagram

(a)

(b)

(c)

(d)

Grade F

1.

(a)

(b)

2.

(a) (i)

(ii)

(b)

answers

Grade E

- **Know and use the fact that the base angles in an isosceles triangle are equal.**
- **Know and use the fact that angles in an equilateral triangle are equal.**
- **Know and use the fact that vertically opposite sides are equal.**

1. (a) What is the special name given to this type of triangle? *(1 mark)*

   (b) Work out the size of the angles marked…

   (i) a

   (ii) b *(3 marks)*

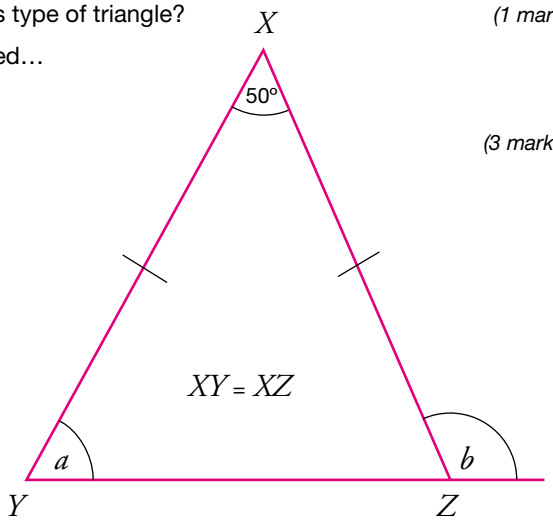
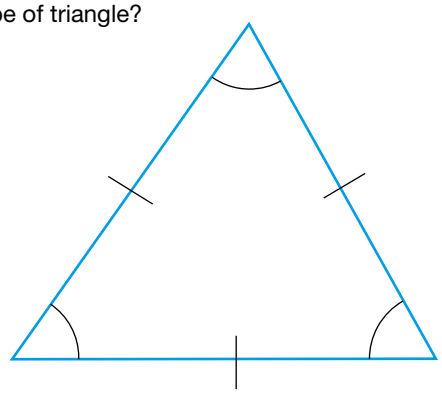


Diagram NOT accurately drawn.

2. (a) What is the special name given to this type of triangle? *(1 mark)*

   (b) What is the size of each angle? *(1 mark)*



- **Know and use the fact that vertically opposite angles are equal.**

3. In the diagram QR and ST are straight lines

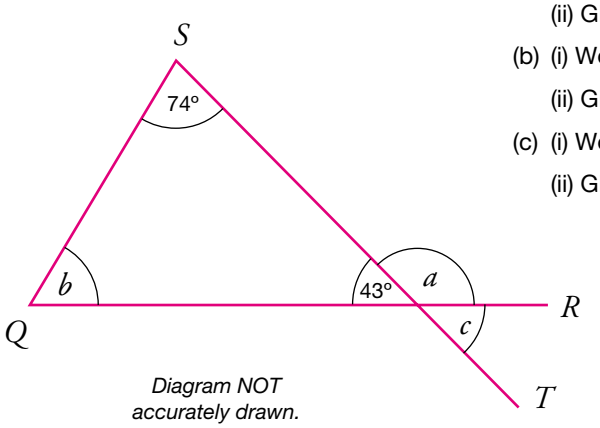


Diagram NOT accurately drawn.

(a) (i) Work out the value of a

(ii) Give a reason for your answer *(2 marks)*

(b) (i) Work out the value of b

(ii) Give a reason for your answer *(3 marks)*

(c) (i) Work out the value of c

(ii) Give a reason for your answer *(2 marks)*

answers

Grade E

1.

(a)

(b)

(i)

(ii)

2.

(a)

(b)

3.

(a) (i)

(ii)

(b) (i)

(ii)

(c) (i)

(ii)

Grade D

- **Find interior and exterior angles of regular shapes.**

1.

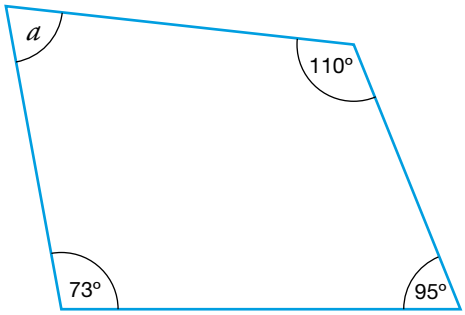


Diagram A

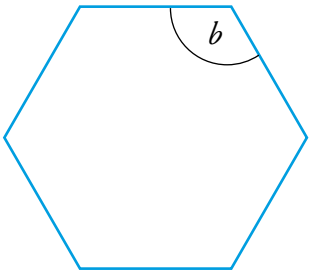


Diagram B

Diagrams NOT accurately drawn.

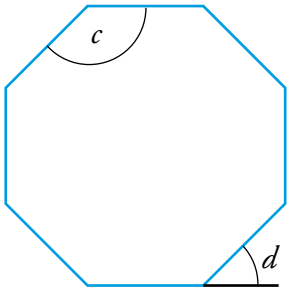


Diagram C

(a) Diagram A shows a quadrilateral
Work out the size of the angle marked a *(2 marks)*

(b) Diagram B shows a regular hexagon
Work out the size of the angle marked b *(2 marks)*

(c) Diagram C shows a regular octagon
(i) Work out the size of the angle marked c *(2 marks)*
(ii) angle d is an exterior angle. Work out its size. *(2 marks)*

- **Know and use the fact that corresponding and alternate angles are equal.**

2. The diagram shows a quadrilateral $ABCD$ and a straight line CE.
AB is parallel to CE.

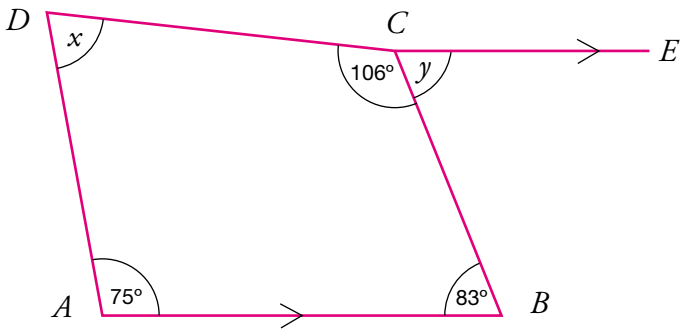


Diagram NOT accurately drawn.

(a) Work out the size of the angle marked x *(2 marks)*

(b) (i) Write down the size of the angle marked y *(1 mark)*
(ii) Give a reason for your answer *(1 mark)*

3.

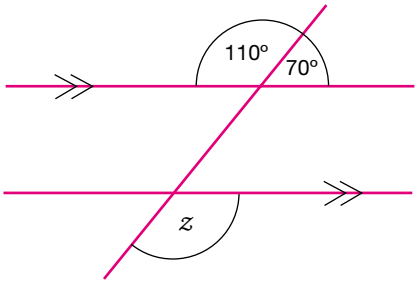


Diagram NOT accurately drawn.

(a) (i) Write down the size of the angle marked z *(1 mark)*
(ii) Give a reason for your answer *(1 mark)*

Grade D

1.

(a)

(b)

(c)
(i)
(ii)

2.

(a)

(b) (i)
(ii)

3.

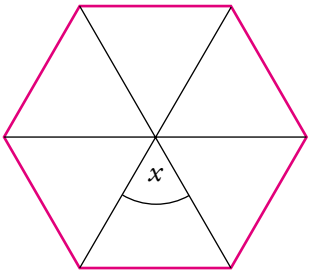
(a) (i)

(ii)

answers

Grade C

- **Know that the sum of the exterior angles for a convex shape is 360°.**

1. 

The diagram shows a regular hexagon.

(a) Calculate the size of the angle marked x *(2 marks)*

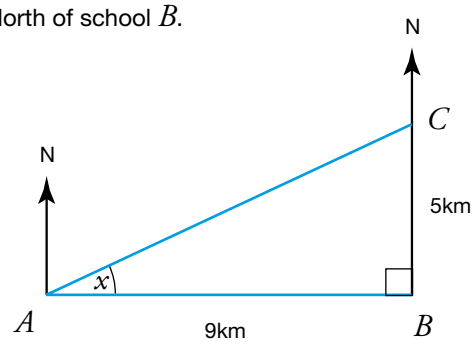
(b) Work out the size of an exterior angle *(2 marks)*

Grade B

- **Calculate 3 figure bearings.**

2. The diagram shows the positions of three schools A, B and C.
School A is 9 kilometres due West of school B.
School C is 5 kilometres due North of school B.

Diagram NOT accurately drawn.



(a) Calculate the size of the angle marked x
Give your answer correct to one decimal place. *(3 marks)*

Jeremy's house is 9 kilometres due East of school B.

(b) Calculate the bearing of Jeremy's house from school C *(2 marks)*

answers

Grade C

1.

(a)

(b)

Grade B

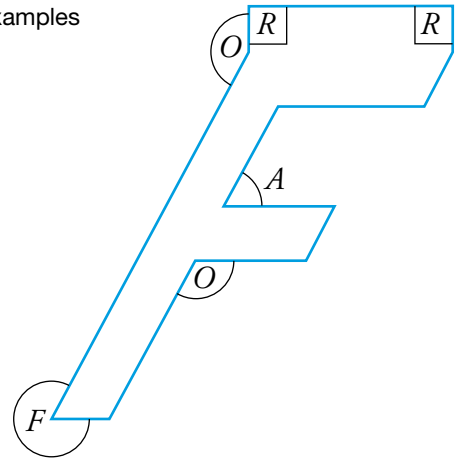
2.

(a)

(b)

Grade G

1. Examples



Grade F

1. (a) 180° - (81° + 37°) = 62°
   (b) 180° - 62° = 118°
2. (a) (i) 180° - 75° = 105°
   (ii) Sum of angles on a straight line = 180°
   (b) 360° - (68° + 112° + 94°) = 86°

Grade E

1. (a) Isosceles
   (b) (i) 180° - 50° = 130°
   130° ÷ 2 = 65°
   a = 65°
   (ii) 180° (straight line)
   180° - 65° = 115°
   b = 115°
2. (a) Equilateral
   (b) 180° ÷ 3 = 60°
3. (a) (i) 137°
   (ii) Angles on a straight line = 180°
   180° - 43° = 137°
   (b) (i) 63°
   (ii) Angles of a triangle = 180°
   180° - (74° + 43°) = 63°
   (c) (i) 43°
   (ii) Vertically opposite angles are equal.

Grade D

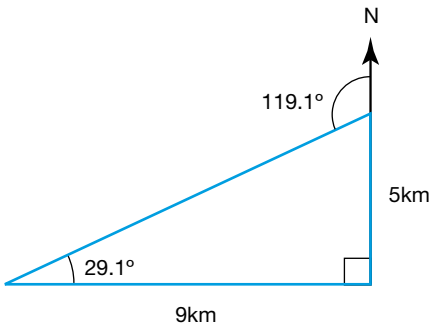
1. The sum of the interior angles of a quadrilateral
   = 360° (2 × 180°)
   (a) 360° - (110° + 95° + 73°) = 82°
   a = 82°
   The sum of the interior angles of a hexagon
   = 720° (4 × 180°)
   (b) 720° ÷ 6 sides = 120°
   b = 120°
   The sum of the interior angles of an octagon
   = 1 080° (6 × 180°)
   (c) (i) 1 080° ÷ 8 sides = 135°
   c = 135°
   (ii) Sum of exterior angles of a polygon = 360°
   360° ÷ 8 sides = 45°
   d = 45°
2. (a) 360° - (106° + 83° + 75°) = 96°
   x = 96°
   (b) (i) y = 83°
   (ii) Alternate angles are equal
3. (a) (i) z = 110°
   (ii) Corresponding angles are equal

Grade C

1. (a) 360° ÷ 6 = 60°
   (b) 360° ÷ 6 = 60°

Grade B

1. (a) Tan ⅝ = 29.1°



   (b) Exterior angle equals sum of opposite interior angles
   90° + 29.1° = 119.1°
   ∴ bearing = 119°

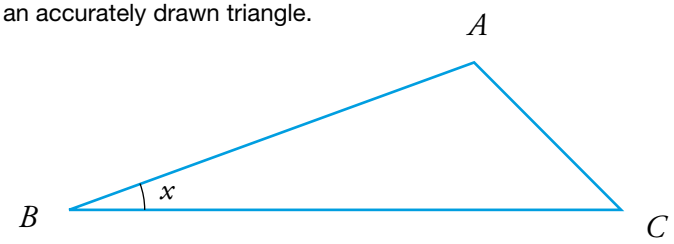
Shape, Space and Measures
25. 2D & 3D shapes

Grade	Learning Objective	Grade achieved
G	• Measure lengths and angles • Recognise notation (symbols) for parallel, equal length and right angle • Know names of triangles (including scalene, isosceles, equilateral) • Know the names of 2D shapes (including trapezium, parallelogram, square, rectangle, kite) • Know the names of 3D shapes (including cylinder, cuboid, cube, cone, prism) • Know and use terms horizontal and vertical • Recognise nets of solids	
F	• Draw triangles given Side, Angle and Side • Use notation (symbol) for parallel • Use terms face, edge, vertex and vertices	
E	• Know the names of 3D shapes (including sphere, square based pyramid and triangular based pyramid) • Sketch 3D shapes from their nets • Understand what is meant by *perpendicular* • Make isometric drawings • Draw triangles given Side, Side and Side	
D	• Visualise spatial relationships to find touching vertices or edges • Understand how a 3D shape can be represented using 2D drawings of a plan (top) view, side and front elevations	
C	• Make sure you are able to meet **ALL** the objectives at lower grades	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Measure lengths and angles**

1. Here is an accurately drawn triangle.



Giving your answers in centimetres and millimetres

(a) Measure side AB *(1 mark)*

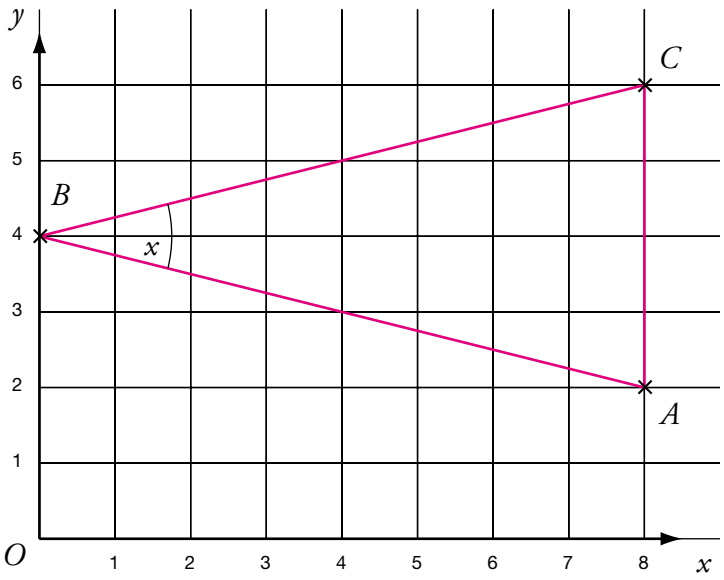
(b) Measure side BC *(1 mark)*

(c) Measure side AC *(1 mark)*

(d) Using an angle measurer, measure the size of angle x *(1 mark)*

- **Measure lengths and angles**
- **Know names of triangles and angles**
- **Know and use the terms horizontal and vertical**

2. The diagram shows a triangle ABC on a centimetre grid



(a) Write down the co-ordinates of the point

(i) A

(ii) B *(2 marks)*

(b) Write down the special name for triangle ABC *(1 mark)*

(c) Measure the length of the line AB

Give your answer in millimetres *(1 mark)*

(d) (i) Measure the size of the angle x *(1 mark)*

(ii) Write down the special name given to this type of angle *(1 mark)*

(e) (i) Draw a horizontal line on the grid and label it H *(1 mark)*

(ii) Label the vertical line on the grid V *(1 mark)*

Grade G

1.

(a)

(b)

(c)

(d)

2.

(a)

(i)

(ii)

(b)

(c)

(d) (i)

(ii)

(e) (i) See Diagram

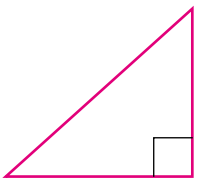
(ii) See Diagram

answers

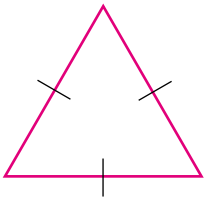
Grade G

- Know the names of 2D shapes
- Recognise notation (symbols) for parallel, equal length and right angle

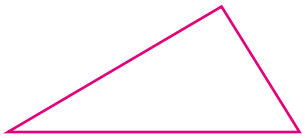
3. (a) Write down the mathematical name for each of the following 2D shapes. *(Total 6 marks)*



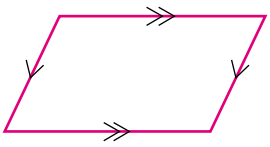
(i)



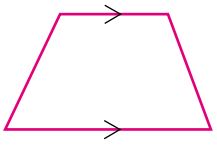
(ii)



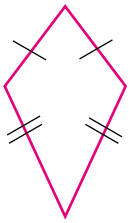
(iii)



(iv)



(v)



(vi)

(b) Look at the shapes above and label…

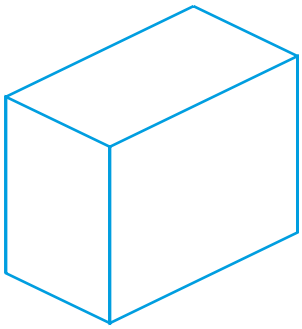
(i) A right angle with an R *(1 mark)*

(ii) Parallel lines with a P *(3 marks)*

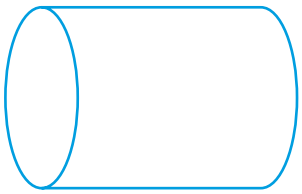
(iii) 'Equal length' marks with an E *(2 marks)*

- Know the names of 3D shapes

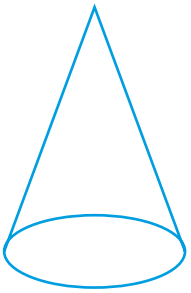
4. (a) Write down the mathematical name for each of the following 3D shapes. *(Total 5 marks)*



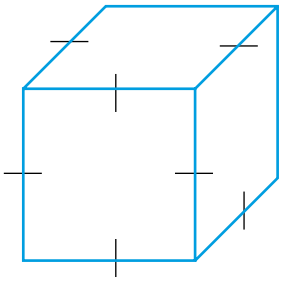
(i)



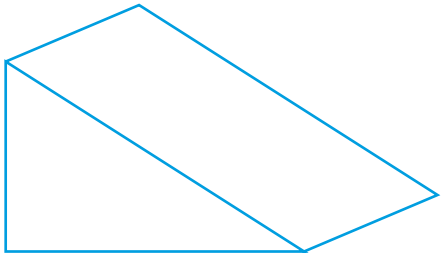
(ii)



(iii)



(iv)



(v)

Grade G

3.

(a)

(i)

(ii)

(iii)

(iv)

(v)

(vi)

(b) See Diagram

(i)

(ii)

(iii)

4.

(a)

(i)

(ii)

(iii)

(iv)

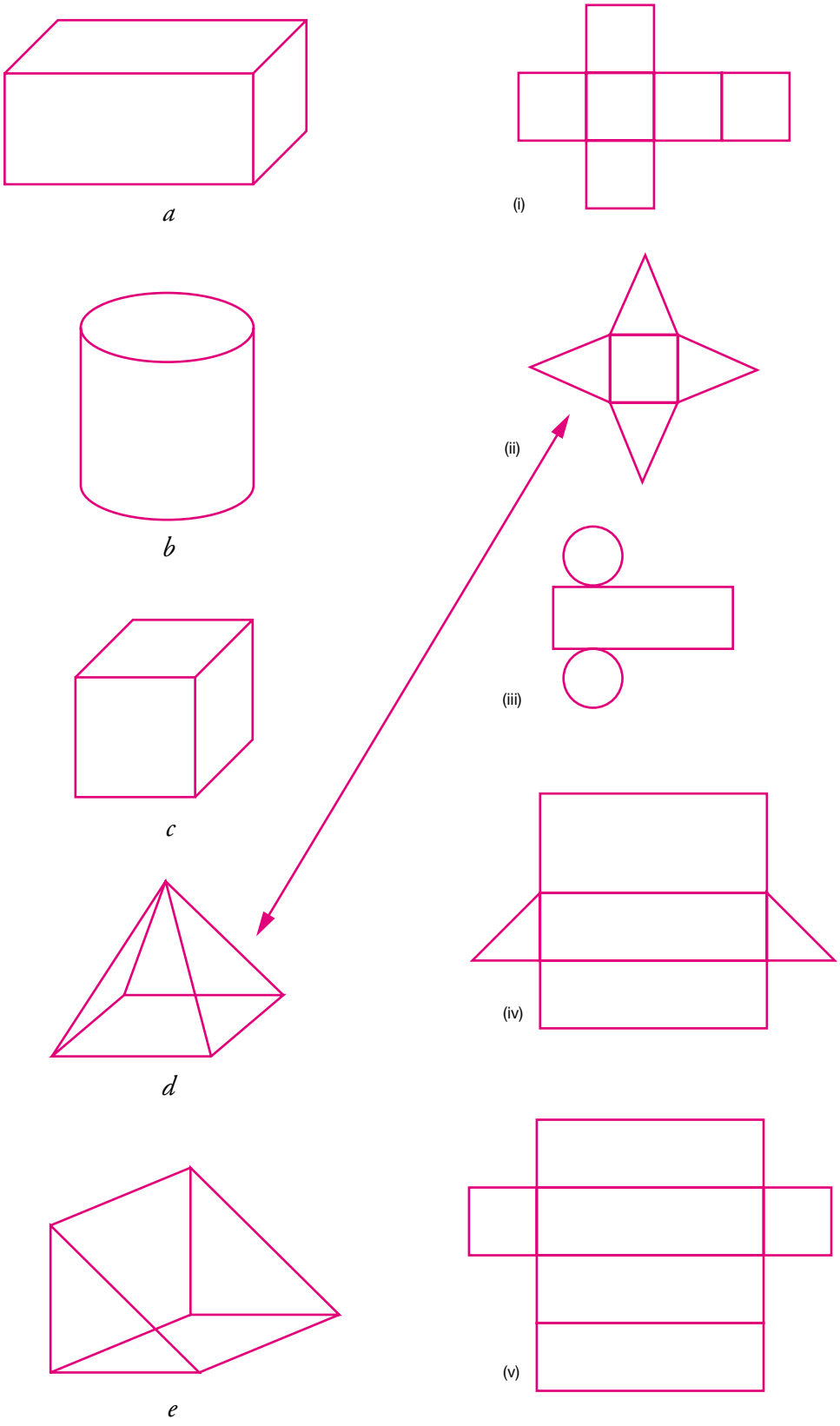
(v)

answers

Grade G

- Recognise nets of solids

5. The diagrams below show some solid, 3D shapes and their nets.
   An arrow has been drawn from one 3D shape to its net.
   (a) Draw an arrow from each of the other solid shapes to its net. *(Total 5 marks)*



Grade G

5.

(a) See Diagram

Grade F

- **Draw triangles given Side, Angle, Side**

1. This diagram shows a sketch (not accurately drawn) of a triangle.

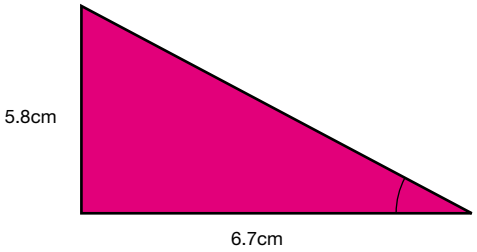


Diagram not accurately drawn.

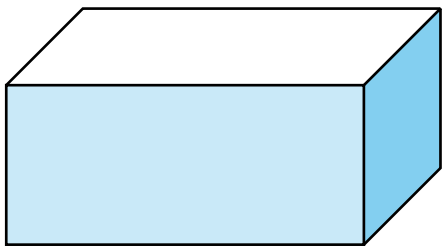
(a) Make an accurate drawing of the triangle *(2 marks)*

(b) (i) On your drawing, measure the size of the angle marked x

(ii) Write down the special mathematical name of the angle marked x *(2 marks)*

- **Use notation (symbol) for parallel**
- **Use terms face, edge, vertex and vertices**

2. This diagram shows a sketch of a solid, 3D shape.



(a) Write down the name of the solid *(1 mark)*

(b) Label two pairs of the parallel lines using the correct markings *(2 marks)*

(c) For this solid, write down

(i) The number of faces

(ii) the number of edges

(iii) the number of vertices *(3 marks)*

answers

Grade F

1.

(a) See Drawing

(b) (i) See Drawing

(ii)

2.

(a)

(b) See Diagram

(c)

(i)

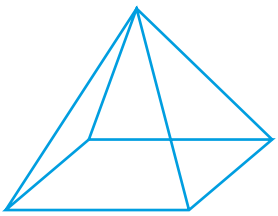
(ii)

(iii)

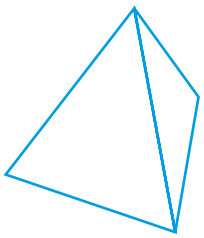
Grade E

- **Know the names of 3D shapes**

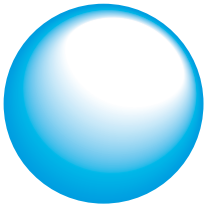
1. Write down the mathematical name for each of these 3D shapes. *(3 marks)*



a



b

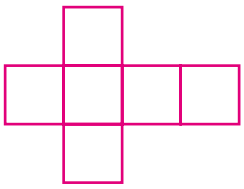


c

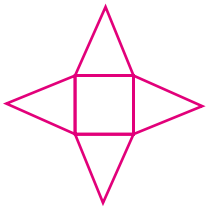
- **Sketch 3D shapes from their nets**

2. Sketch the 3D shapes belonging to the nets below. *(Total 10 marks)*

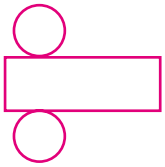
(a)



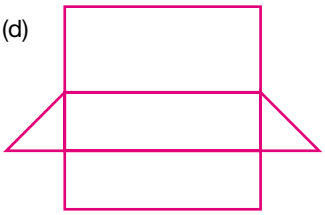
(b)



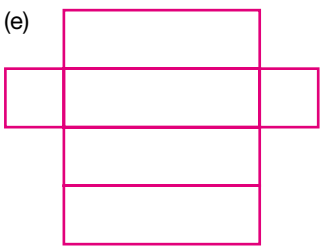
(c)



(d)



(e)



answers

Grade E

1.

(a)

(b)

(c)

2.

(a) See Drawing

(b) See Drawing

(c) See Drawing

(d) See Drawing

(e) See Drawing

Grade E

- Make isometric drawings
- Understand what is meant by perpendicular

3. Here is a net of a prism.

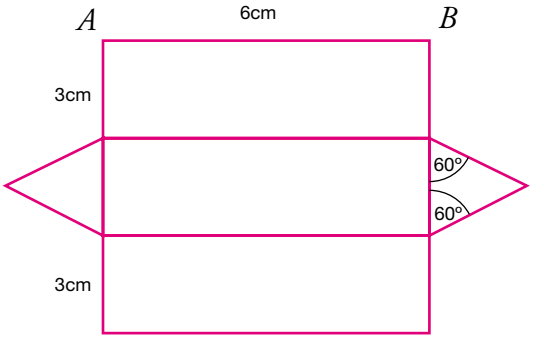


Diagram NOT accurately drawn.

(a) Mark with a P, a line that is parallel to the line AB *(1 mark)*

(b) Mark with an X, a line that is perpendicular to the line AB *(1 mark)*

(c) Make an accurate drawing of the net. *(2 marks)*

(d) Sketch the prism *(2 marks)*

Grade E

3.

(a) See Diagram

(b) See Diagram

(c) See Drawing

(d) See Drawing

answers

Grade E

- **Draw triangles given Side, Side, Side**

4. Here is a sketch of a triangle.

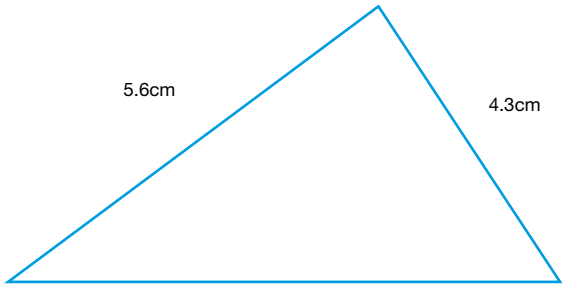


Diagram NOT accurately drawn.

Use a ruler and compasses to construct this triangle accurately in the space below.

You must show all your construction lines. *(3 marks)*

Grade D

- **Visualise spatial relationships to find touching vertices or edges**

1. Here is a net of a cube.

The net is folded to make a cube.

Two other vertices meet at A.

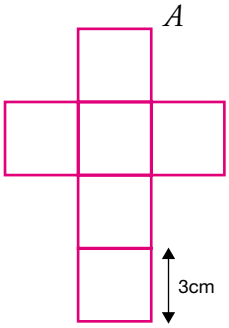


Diagram NOT accurately drawn.

(a) Mark each of them with the letter A. *(2 marks)*

(b) The length of each edge is 3cm.

Work out the volume of the cube. *(2 marks)*

answers

Grade E

4. See Drawing

Grade D

1.

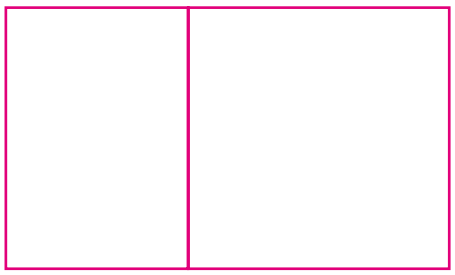
(a) See Diagram

(b)

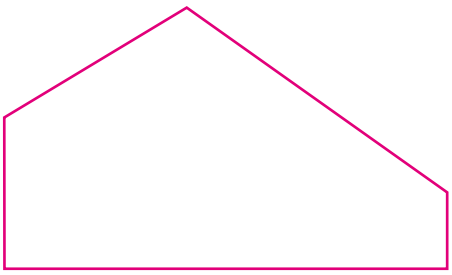
Grade D

- **Understand how a 3D shape can be represented using 2D drawings of plan (top) view, side and front elevations**

2. Below are a plan view and a front elevation of a prism.
   The front elevation shows a cross section of the prism.



Plan View



Front Elevation

(a) On the grid below, draw a side elevation of the prism *(3 marks)*

(b) Draw a 3D sketch of the prism *(2 marks)*

Grade D

2.

(a) See Grid

(b) See Drawing

answers

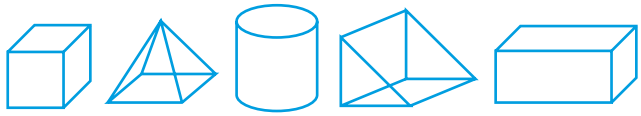
Grade G

1. (a) (i) AB = 5cm 4mm
   (ii) BC = 6cm 9mm
   (iii) AC = 2cm 6mm
   (b) 20°
2. (a) (i) (8,2)
   (ii) (0,4)
   (b) Isosceles
   (c) 78mm
   (d) (i) 27°
   (ii) Acute
   (e) (i) Any horizontal line
   (ii) AC should be labelled V
3. (a) (i) Right-angled triangle
   (ii) Equilateral triangle
   (iii) Scalene triangle
   (iv) Parallelogram
   (v) Trapezium
   (vi) Kite
   (b) (i) Bottom right corner on right angled triangle
   (ii) < and << on parallelogram and trapezium
   (iii) \ and \\ on equilateral triangle and kite
4. (a) (i) Cuboid
   (ii) Cylinder
   (iii) Cone
   (iv) Cube
   (v) Triangular prism
5. (a) = (v)
   (b) = (iii)
   (c) = (i)
   (d) = (ii)
   (e) = (iv)

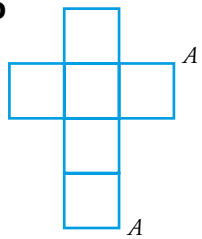
Grade F

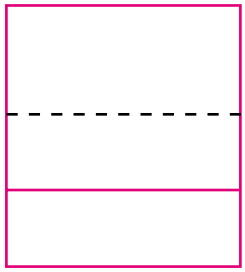
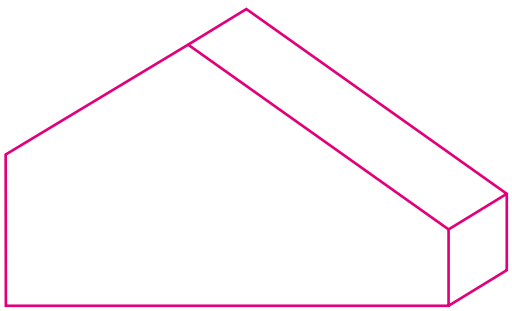
1. (a) Accurately drawn triangle
   (b) (i) 40°
   (ii) Acute
2. (a) Cuboid
   (b) < and << on parallel edges
   (c) (i) 6
   (ii) 12
   (iii) 8

Grade E

1. (a) Square-based pyramid
   (b) Triangular-based pyramid
   (c) Sphere
2. 
   (a) (b) (c) (d) (e)
3. (a) Any horizontal line
   (b) Any vertical line
   (c) Accurate drawing
   (d)
4. Correctly constructed triangle and arcs *(3 marks)*
   Correct triangle and incorrect arcs *(2 marks)*
   Correct arcs and two correct sides *(2 marks)*
   Two correct sides *(1 mark)*

Grade D

1. (a) 

   (b) 3 × 3 × 3 = 27cm^3
2. (a) 
   

Shape, Space and Measures
26. Measures

Grade	Learning Objective	Grade achieved
G	• Choose appropriate units with which to measure weights, lengths, areas and volumes • Change between units for weight, length, volume and time	
F	• Make estimates of weights, lengths and volumes in real-life situations • Convert metric units to imperial units of weight, length and volume	
E	• Make sure you are able to meet **ALL** the objectives at lower grades	
D	• Change between units for area, eg. m^2 to cm^2	
C	• Make sure you are able to meet **ALL** the objectives at lower grades	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Choose appropriate units with which to measure weights, lengths, areas and volumes.**

1. Below is a table of measurements.
   Complete the table by writing a sensible metric unit on each dotted line. *(3 marks)*
   The first one has been done for you.

The weight of a small bag of crisps	25 grams
The distance from Manchester to London	328 .....
The height of a man	183 .....
The volume of petrol in a car's petrol tank	45 .....

- **Change between units for weight, length, volume and time.**

2. (a) Change 250 millimetres to centimetres *(1 mark)*
   (b) Change 3.7 litres to millilitres *(1 mark)*
   (c) Change 400 seconds to minutes and seconds *(1 mark)*

answers

Grade G

-

1. See Table.

2. (a)
   (b)
   (c)

Grade F

- **Make estimates of weights, lengths and volumes in real-life situations.**

1. Here is a picture of a man standing near a giraffe.

Both the man and the giraffe are drawn to the same scale.

(a) Estimate the height of the man, in metres. *(1 mark)*

(b) Estimate the height of the giraffe, in metres. *(3 marks)*

- **Convert metric units to imperial units of weight, length and volume.**

2. (a) Change 10 kilograms into pounds. *(2 marks)*

(b) Change 5 litres into pints. *(2 marks)*

(c) Change 5 miles into kilometres. *(2 marks)*

Grade D

- **Change between units for area, eg. m^2 into cm^2.**

1. Change $2.8m^2$ to cm^2. *(2 marks)*

Grade F

1.

(a)

(b)

2. (a)

(b)

(c)

Grade D

1.

answers

Grade G

1. (a) Kilometres
   (b) Centimetres
   (c) Litres

2. (a) 25
   10mm = 1cm
   250 divided by 10 = 25
   (b) 3 700
   1 litre = 1 000 ml
   3.7 × 1 000 = 3 700
   (c) 6 minutes, 40 seconds
   60 seconds = 1 minute
   400 divided by 60 = 6 remainder 40

Grade F

1. (a) 1.5 - 2 metres
   (b) man's height × 2.5

2. (a) 22 pounds
   1 kilogram = 2.2 pounds
   10 × 2.2 = 22
   (b) 8.75
   1 litre = Approximately 1.75 pints
   5 × 1.75 = 8.75
   (c) 8 kilometres
   1 mile = Approximately 1.6 kilometres
   5 × 1.6 = 8

Grade D

1. 28 000 cm^2
   2.8 × 10 000 (or 2.8 × 100 × 100)

Shape, Space and Measures
27. Length, Area and Volume

Grade	Learning Objective	Grade achieved
G	• Count squares to find areas • Measure perimeters • Find volume by counting cubes	
F	• Calculate the area of a triangle • Calculate the area of a square • Calculate the perimeter of a compound shape • Understand and use the words *length* and *width*	
E	• Estimate areas for shapes without straight lines • Calculate volumes • Calculate area of a rectangle • Calculate areas and perimeters of compound shapes • Convert between metric units for length, area and volume	
D	• Calculate the circumference and area of a circle • Calculate the diameter and radius given the circumference of a circle • Calculate missing dimensions of a cuboid given its volume	
C	• Calculate the area of a trapezium • Calculate missing dimensions of a prism given its volume • Calculate the volume of a prism	
B	• Recognise algebraic expressions for Length, Area and Volume • Calculate the length of an arc • Calculate the area of a sector	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- Count squares to find areas
- Measure perimeters

1.

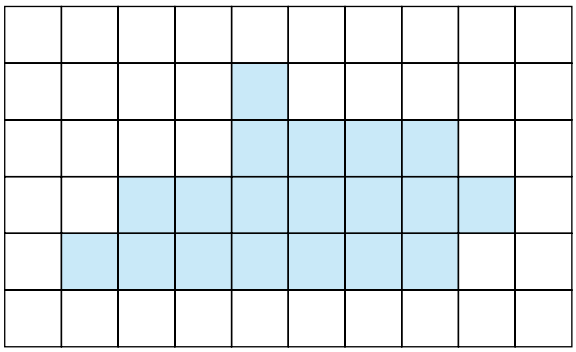


Diagram NOT accurately drawn.

If each square on the grid is 1cm^2

(a) Find the area, in cm^2, of the shaded shape. *(1 mark)*

(b) Find the perimeter, in cm, of the shaded shape. *(2 marks)*

- Find volume by counting cubes.

2.

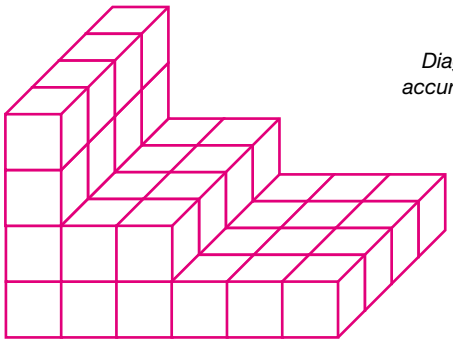


Diagram NOT accurately drawn.

This solid shape is made up from cubes of side 1cm

Find the volume, in cm^3, of the shape. *(2 marks)*

Grade F

- Calculate the perimeter of a compound shape
- Calculate the area of a square
- Calculate the area of a triangle
- Use the words *length* and *width*

1. (a) Work out the perimeter of the whole shape $ABCD$. *(2 marks)*

In part (b) you must write down the units with your answer.

(b) Work out the area of…

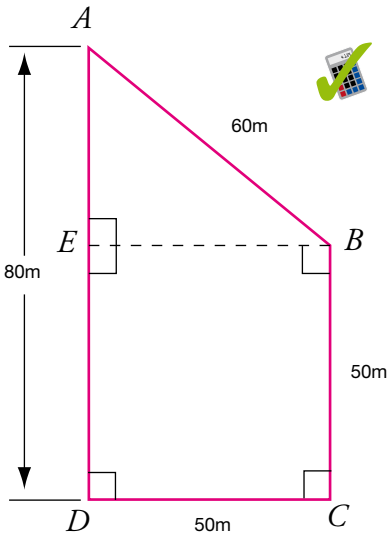
(i) the square $EBCD$. *(1 mark)*

(ii) the triangle ABE. *(2 marks)*

(c) Label the length with the letter L *(1 mark)*

(d) Label the width with the letter W *(1 mark)*

Diagram NOT accurately drawn.



answers

Grade G

1.

(a)

(b)

2.

Grade F

1.

(a)

(b)

(i)

(ii)

(c) See Diagram

(d) See Diagram

Grade E

- **Calculate areas for shapes without straight lines**

1. The shaded area on the grid represents the surface of a lake in winter.

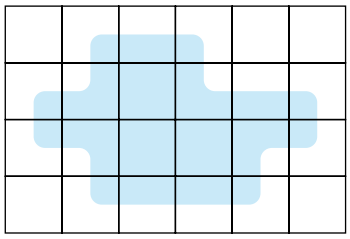


Diagram NOT accurately drawn.

(a) Estimate the area, in cm^2, of the diagram that is shaded. *(1 mark)*

If each square on the grid represents an area with sides of length 120m:

(b) Work out the area, in m^2, represented by one square on the grid *(1 mark)*

(c) Estimate the area, in m^2, of the lake *(2 marks)*

In summer the area of the lake decreases by 15%

(d) Work out the area, in m^2, of the lake in summer *(2 marks)*

- **Calculate volumes**
- **Convert between metric units for Length, Area and Volume**

2. In this question you must write down the units of your answer.

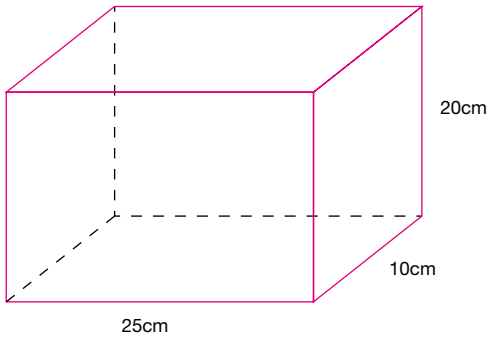


Diagram NOT accurately drawn.

(a) Work out the area of the base of the solid shape. *(1 mark)*

(b) (i) Work out the volume of the solid shape *(2 marks)*

(ii) Write this volume in litres *(2 marks)*

- **Calculate the area of a rectangle**
- **Calculate the area and perimeter of a compound shape**

3. This diagram shows the plan of a floor.

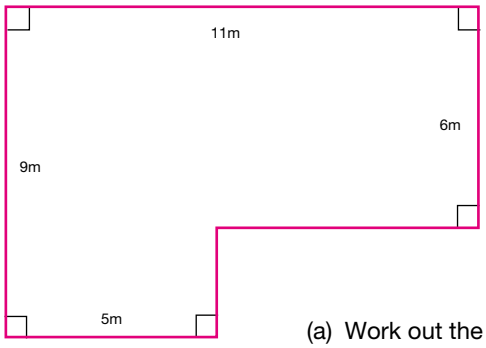


Diagram NOT accurately drawn.

(a) Work out the perimeter of the floor. *(2 marks)*

(b) Work out the area of the floor. *(3 marks)*

Grade E

answers

1.

(a)

(b)

(c)

(d)

2.

(a)

(b) (i)

(ii)

3.

(a)

(b)

Grade D

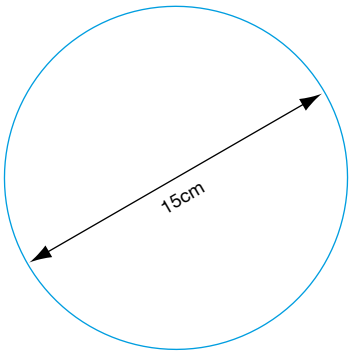
- **Calculate the circumference and area of a circle.**

1. Some oil is spilt. The spilt oil is in the shape of a circle.
   The circle has a diameter of 15 centimetres.

   (a) Work out the circumference, in cm, of the spilt oil.
   Give your answer correct to one decimal place.
   (2 marks)

   (b) Work out the area, in cm^2, of the spilt oil.
   Give your answer correct to 2 decimal places.
   (3 marks)

Diagram NOT accurately drawn.



- **Calculate the diameter and radius given the circumference of a circle.**

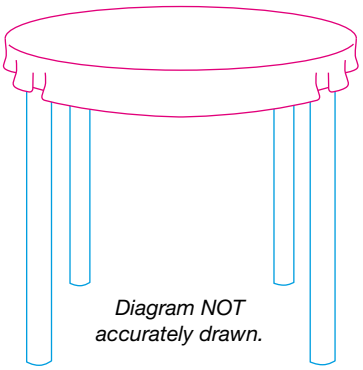
2. 

Diagram NOT accurately drawn.

Audrey has a circular dining table.
The perimeter of the circular tablecloth is 6.5m

(a) Work out the diameter of the tablecloth.
Give your answer correct to 3 significant figures.
(2 marks)

(b) Work out the radius of the tablecloth.
Give your answer correct to 3 significant figures.
(1 mark)

- **Calculate missing dimensions of a cuboid given its volume.**

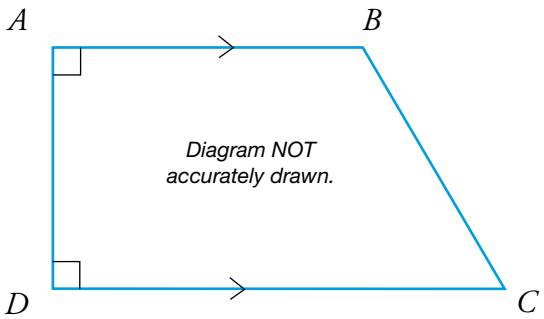
3. A cuboid has…
   a volume of $72cm^3$
   a length of 4cm
   a width of 3cm
   Work out the height of the cuboid
   (2 marks)

Grade C

- **Calculate the area of a trapezium.**

1. The diagram (not accurately drawn) shows a trapezium $ABCD$.

   AB is parallel to DC.
   AB = 4.2m DC = 5.8m AD = 2.6m
   Angle BAD = 90° Angle ADC = 90°
   Calculate the area of trapezium $ABCD$.
   (2 marks)



Grade D

1.

(a)

(b)

2.

(a)

(b)

3. 1.

Grade C

1.

answers

Grade C

- **Calculate missing dimensions of a prism given its volume**

2. The diagram shows a triangular prism.

BC = 3cm, CF = 9cm and angle ABC = 90°

The volume of the triangular prism is 54cm³.

Work out the height AB of the prism.

(4 marks)

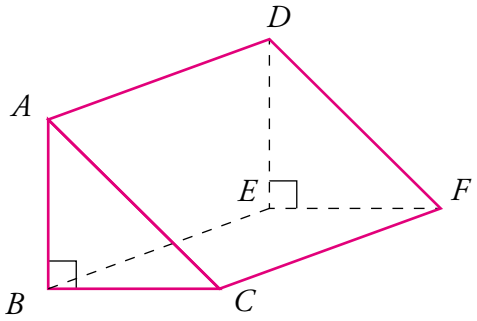


Diagram NOT accurately drawn.

- **Calculate the volume of a prism**

3.

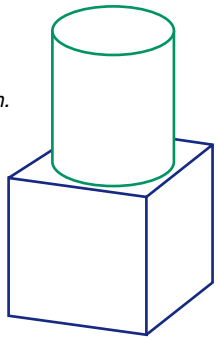


Diagram NOT accurately drawn.

The cylinder has a height of 25cm.

It has a base radius of 8cm.

The cube has side of edges 15cm.

(a) Calculate the total volume, in cm³, of the cylinder.
Give your answer to the nearest cm³.

(3 marks)

(b) Calculate the total volume, in cm³, of the container.
Give your answer to the nearest cm³.

(3 marks)

Grade B

- **Recognise algebraic expressions for Length, Area and Volume**

1. Here are some expressions.

$(a+b)ch$	$2\pi a^3$	$2ab$	ab/h	$2\pi b^2$	$2(a^2+b^2)$	$\pi a^2 b$

The letters a, b, c and h represent lengths.

π and 2 are numbers that have no dimensions.

Tick the boxes underneath the three expressions which could represent areas. *(3 marks)*

- **Calculate the length of an arc**
  Calulate the area of a sector

2. This is the sector of a circle, radius = 10cm.

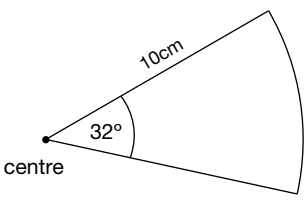


Diagram NOT accurately drawn.

(a) Calculate the length of the arc.
Give your answer correct to 3 significant figures. *(4 marks)*

(b) Calculate the area of the sector.
Give your answer to 3 significant figures. *(4 marks)*

answers

Grade C

2.

3.

(a)

(b)

Grade B

1. See Table

2.

(a)

(b)

Grade G

1. (a) Area = 19cm^2
   (b) Perimeter = 24cm
2. 44cm^3

Grade F

1. (a) 60 + 50 + 50 + 80 = 240cm
   (b) (i) 50 × 50 = 2 500m^2
   (ii) (50 × 30) ÷ 2 = 750m^2
   (c) Length = side AD
   (d) Width = side DC

Grade E

1. (a) 10cm^2
   (b) 120 × 120 = 14 400m^2 (1 square)
   (c) 10 × 14 400 = 144 000m^2
   (d) 144 000 × $^{85}/_{100}$ = 122 400m^2 (100% - 15% = 85%)
2. (a) 25 × 10 = 250cm^2
   (b) (i) 25 × 10 × 20 = 5 000cm^3
   (ii) 5 000 ÷ 1 000 = 5 litres (1litre = 1 000cm^3)
3. (a) 11 + 9 + 5 + 6 + 6 + 3
   Perimeter = 40m
   (b) (9 × 5 = 45m^2) + (6 × 6 = 36m^2) = 81m^2
   ∴ area = 81m^2

Grade D

1. (a) Circumference = πd
   π × 15 = 47.123
   = 47.1cm
   (b) Area = πr^2
   π × (7.5)^2
   = π × 56.25 = 176.714
   = 176.71cm^2
2. (a) $^{6.5}/_{\pi}$ = 2.069
   = 2.07m
   (b) $^{2.069}/_{2}$ = 1.034
   = 1.03m
3. 4(L) × 3(W) = 12
   $^{72}/_{12}$ = 6
   ∴ height = 6cm

Grade C

1. Area of trapezium = average of parallel sides × height
   = (4.2 + 5.8) ÷ 2 × 2.6
   = 10 ÷ 2 × 2.6
   = 5 × 2.6
   = 13m^2
2. Volume of a prism = Area of base × Length
   Area of base × 9 = 54
   Area of base = 54 ÷ 9 = 6
   = ½ × 3 × height = 6
   ∴ height = 4cm
3. (a) $\pi r^2 \times h$
   π (8)^2 × 25 = 5 026.54…
   = 5027cm^3
   (b) 15 × 15 × 15 (15^3)
   = 3 375cm^3
   + 5 027cm^3
   = 8 402cm^3

Grade B

1. 3rd: $2ab$
   5th: $2\pi b^2$
   6th: $2(a^2 + b^2)$
2. (a) 5.59cm (to 3 significant figures)
   $C = \pi \times d$
   Arc = $^{O°}/_{360}$ × circle's circumference
   = $^{32}/_{360}$ × π × 20
   = 5.585… or 5.59 to 3 significant figures
   (b) 27.9cm^2 to 3 significant figures
   A = πr^2
   Sector = $^{O°}/_{360}$ × circle's area
   = $^{32}/_{360}$ × π × 100
   = 27.925… or 27.9 (to 3 significant figures)

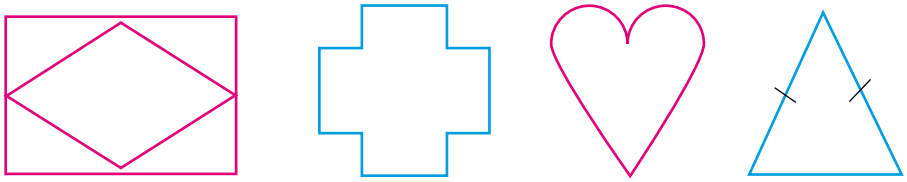
Shape, Space and Measures
28. Symmetry

Grade	Learning Objective	Grade achieved
G	• Draw lines of symmetry in shapes and recognise shapes having a line of symmetry • Recognise shapes having rotational symmetry	
F	• Recognise and draw planes of symmetry in 3D shapes • Find the order of rotational symmetry for a shape	
E	• Find the centre of rotation given an object and its image • Draw shapes with a given line of symmetry and / or order of rotational symmetry	
D	• Make sure you are able to meet **ALL** the objectives at lower grades	
C	• Make sure you are able to meet **ALL** the objectives at lower grades	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Recognise shapes having a line of symmetry and draw lines of symmetry in shapes**

1. Draw in all the lines of symmetry on each of the following shapes. *(4 marks)*



(a) (b) (c) (d)

- **Recognise shapes having rotational symmetry**

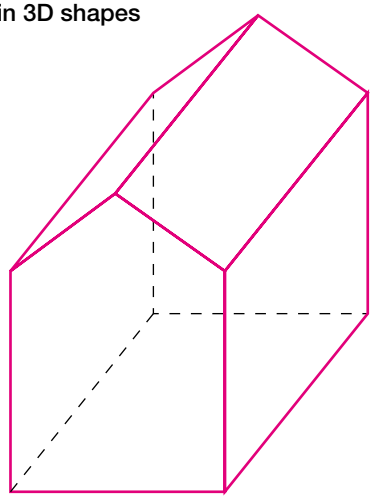
2. Draw a circle around each of the shapes below that have rotational symmetry.

(a) (b) (c) (d) (e)

Grade F

- **Recognise and draw planes of symmetry in 3D shapes**

1. The diagram represents a prism.
   Draw in one plane of symmetry.



- **Find the order of rotational symmetry**

2. Write down the order of rotational symmetry for each of the shapes below. *(3 marks)*

(a) (b) (c)

answers

Grade G

1. See Shapes

2. See Shapes

Grade F

1. See Diagram

2.

(a)

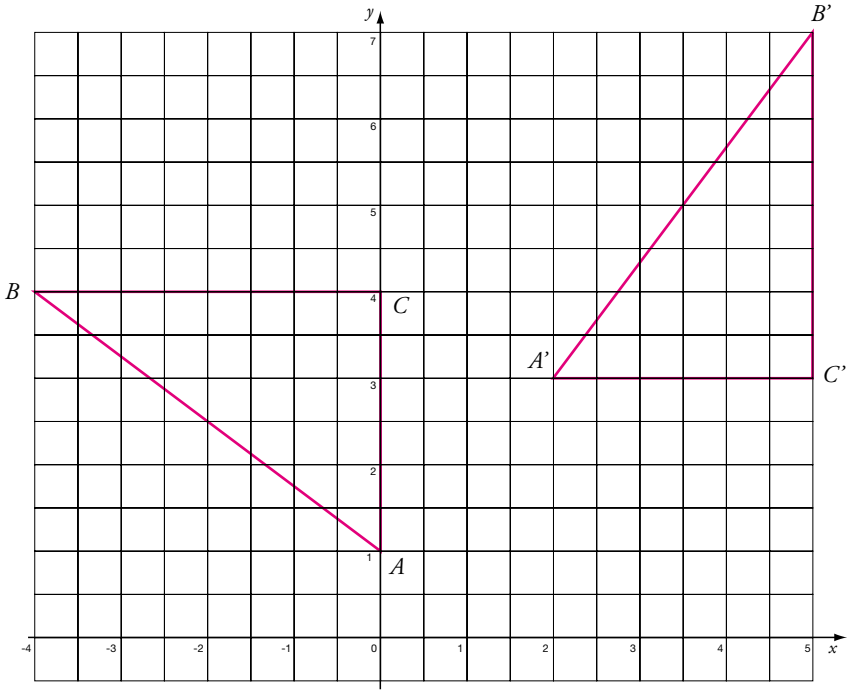
(b)

(c)

Grade E

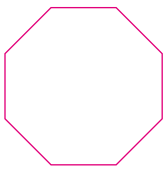
- **Find the centre of rotation given an object and its image**

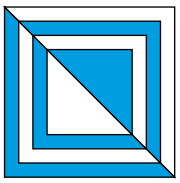
1. Here is a triangle ABC and its image A'B'C', after being rotated 90° clockwise
   Find the centre of rotation



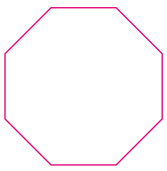
- **Draw shapes with a given line of symmetry and/or order of rotational symmetry**

2. (a) On these shapes draw in all lines of symmetry. *(2 marks)*

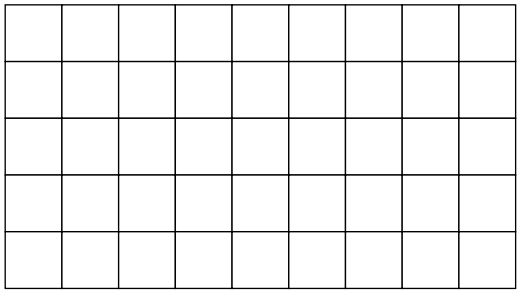




(b) Write down the order of rotational symmetry for these shapes. *(2 marks)*



(c) On the grid below draw a shape with 4 lines of symmetry and rotational symmetry of order 4. *(2 marks)*



Grade E

1. See Grid

2. (a) See Shapes

(b)

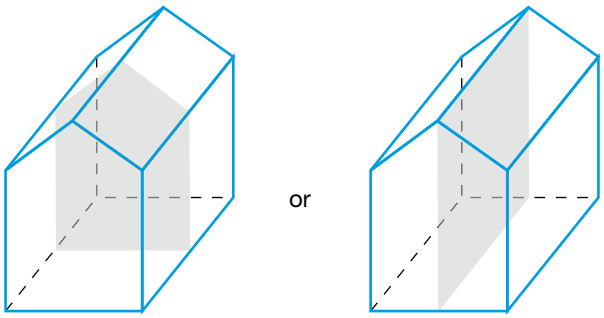
(c) See Grid

Grade G

1. (a) 2 lines
   (b) 4 lines
   (c) 1 line
   (d) 1 line

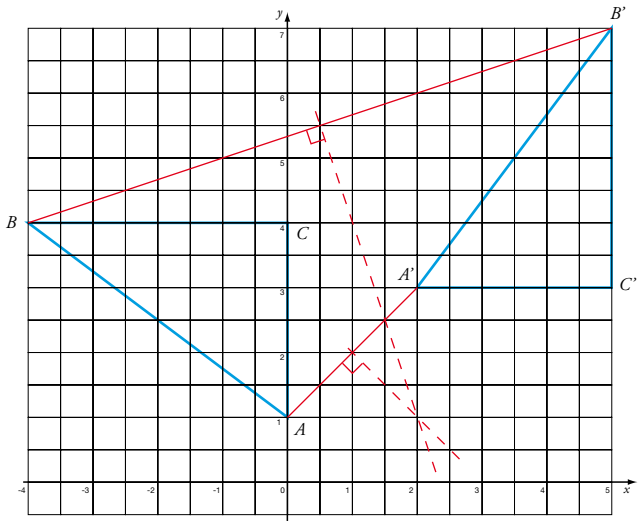
2. Draw a circle around (a), (c) and (e)

Grade F

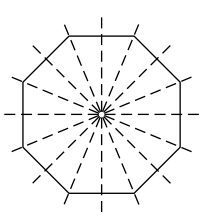
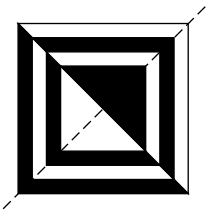
1. 

2. (a) 6
   (b) 8
   (c) 2

Grade E

1. 

Centre of rotation is where the perpendicular bisectors cross (2, 1)

2. (a)  

   (b) (i) 8
   (ii) 4

   (c) Pupils' own answers, eg square

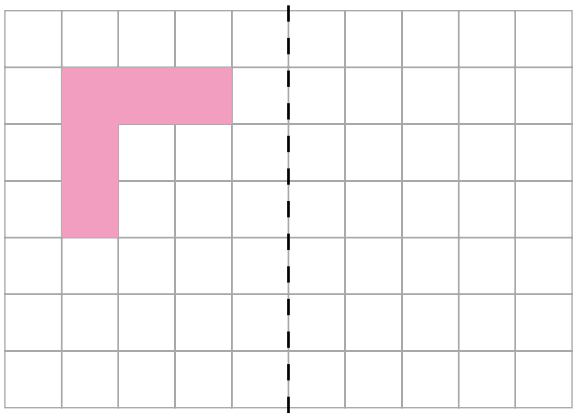
Shape, Space and Measures
29. Transformations

Grade	Learning Objective	Grade achieved
G	• Reflect a shape in a mirror line	
F	• Show how a shape can tesselate	
E	• Enlarge a shape by a positive integer scale factor • Recognise congruent shapes • Find a scale factor from a drawing • Find distances on a map for a given scale factor • Rotate shapes given a centre of rotation and angle of rotation	
D	• Plot points given a three-figure bearing • Understand the effect of enlargement on the area of a shape • Describe rotations and reflections, giving angles and equations of mirror lines	
C	• Produce enlargements by a fractional positive scale factor and a given centre of enlargement • Translate simple 2D shapes using vectors	
B	• Understand that enlargements produce mathematically similar shapes preserving angles within the shapes • Find side length for similar shapes	
A	• Enlarge shapes by negative scale factors	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Reflect a shape in a mirror line**

1. A shaded shape is shown in the grid of centimetre squares.



Mirror Line

(a) Work out the perimeter of the shaded shape *(1 mark)*

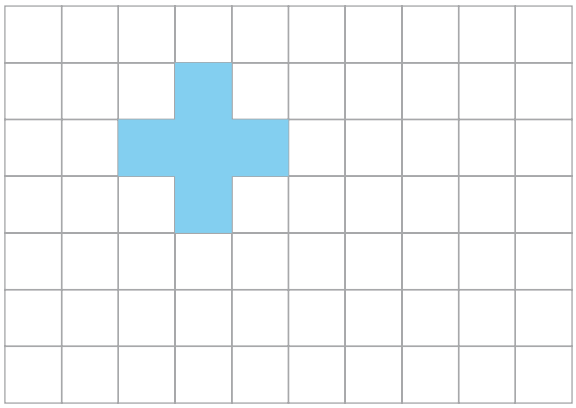
(b) Work out the area of the shaded shape *(1 mark)*

(c) Reflect the shaded shape in the mirror line *(1 mark*

Grade F

- **Show how a shape can tesselate**

1. Show how the shape in the grid will tesselate.
   You should draw at least 6 shapes. *(2 marks)*



answers

Grade G

1.

(a)

(b)

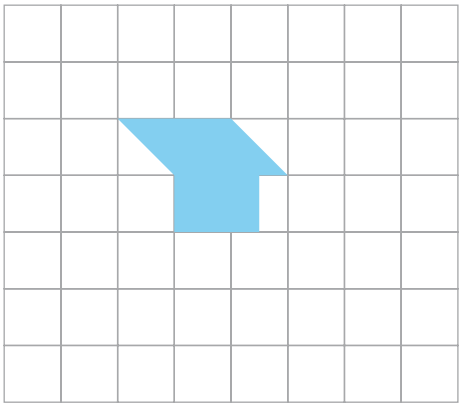
(c)

1. See Grid

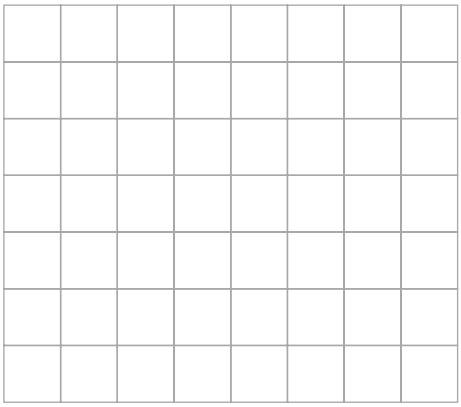
Grade E

- **Enlarge a shape by a positive integer scale factor**

1. A shaded shape is shown on grid A. On grid B draw an enlargement, scale factor 2, of the shaded shape. *(2 marks)*



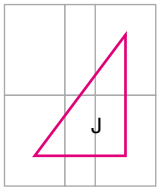
Grid A

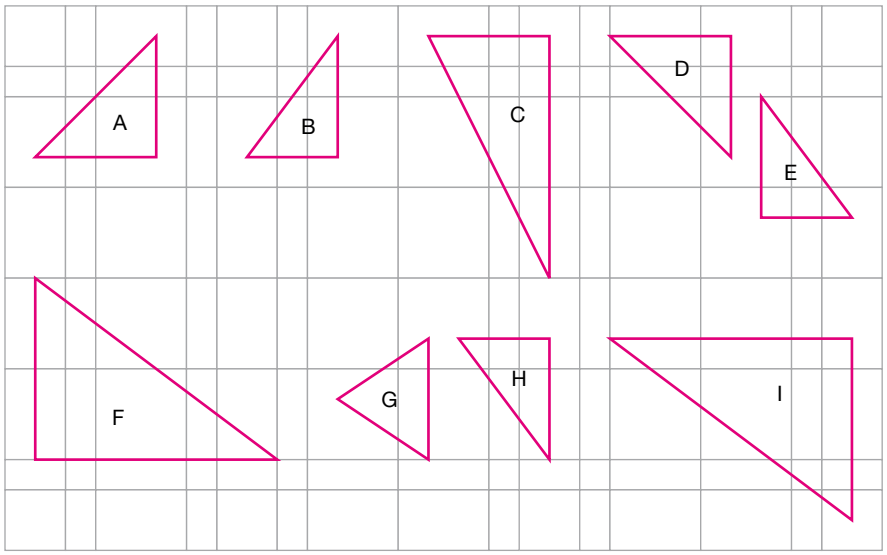


Grid B

- **Recognise congruent shapes**
- **Find a scale factor from a drawing**

2. Here is a triangle J.
Here are nine more triangles.





(a) Write down the letters of the triangles that are congruent to triangle J. *(2 marks)*

(b) (i) Write down the letter of a triangle that is an enlargement of triangle J. *(1 mark)*

(ii) Find the scale factor of the enlargement. *(1 mark)*

answers

Grade E

1. See Drawing

Grade E

2.

(a)

(b) (i)

(ii)

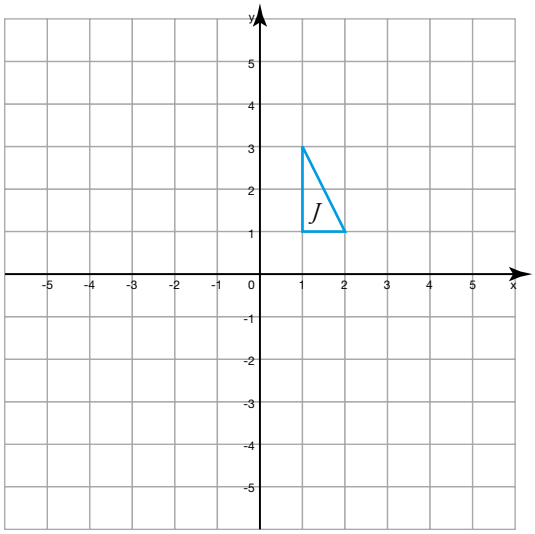
Grade E

- **Find distances on maps for a given scale factor**

3. Isobel uses a map with a scale of 1 to 50,000. She measures the distance between two towns on the map. The distance Isobel measures is 7.3cm
Give the actual distance between the two towns - in kilometres. *(2 marks)*

- **Rotate shapes given a centre and angle of rotation**

4. Rotate triangle J 90° clockwise about the the point (1,1) *(2 marks)*



Grade E

answers

3.

4. See Grid

Grade D

- **Plot points given a three-figure bearing**

1. The scale drawing below shows the positions of a lighthouse, L, and a ship, S. 1 cm on the diagram represents 20 km.

(a) (i) Measure, in centimetres, the distance LS. *(1 mark)*

(ii) Work out the distance, in kilometres, of the ship from the lighthouse. *(1 mark)*

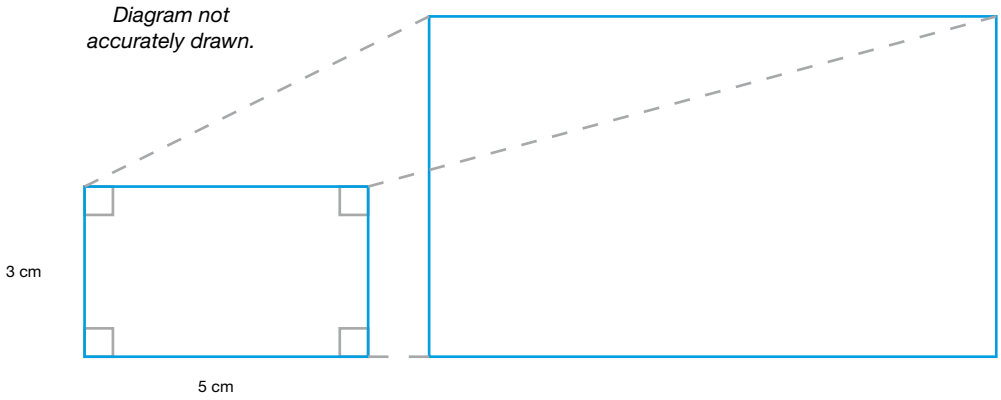
(b) (i) Measure and write down the bearing of the ship from the lighthouse. *(1 mark)*

(ii) Write down the bearing of the lighthouse from the ship. *(1 mark)*

(c) A tug boat is 70 km from the lighthouse on a bearing of 300 degrees.
Plot the position of the tug boat, using a scale of 1 cm to 20 km
on the scale diagram above. *(3 marks)*

- **Understand the effect of enlargement on the area of a shape**

2. The diagram represents two photographs.



(a) Work out the area of the small photograph. State the units of your answer. *(2 marks)*

The photograph is to be enlarged by scale factor 4.

(b) Write down the measurements of the enlarged photograph. *(2 marks)*

(c) How many times bigger is the area of the enlarged photograph
than the area of the small photograph? *(2 marks)*

Grade D

answers

1.

(a) (i)

(ii)

(b) (i)

(ii)

(c) See Diagram

2.

(a)

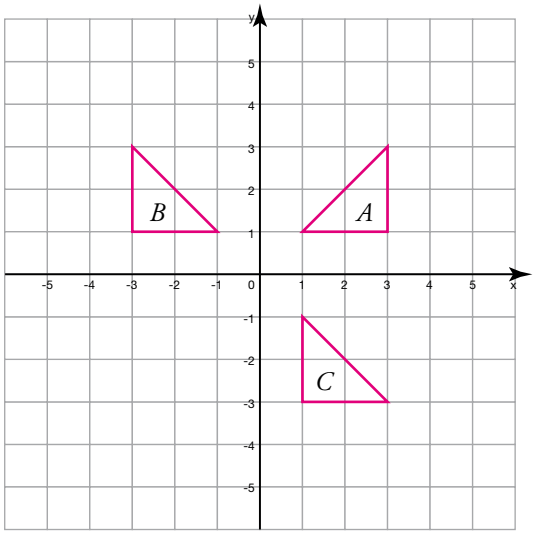
(b)

(c)

Grade D

- Describe rotations and reflections giving angles and equations of mirror lines

3.



(a) Describe fully the single transformation which takes shape A onto shape B. *(2 marks)*

(b) Describe fully the single transformation which takes shape A onto shape C. *(3 marks)*

Grade D

answers

3.

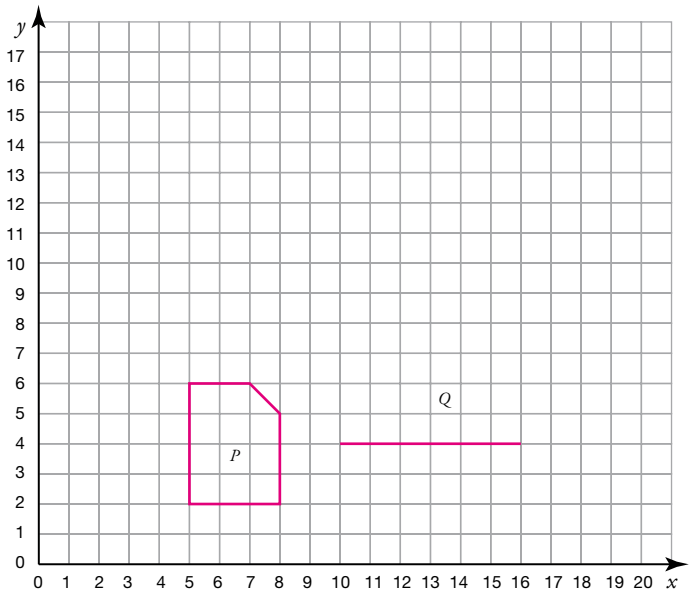
(a)

(b)

Grade C

- **Produce enlargements by a fractional positive scale factor and a given centre of enlargement**

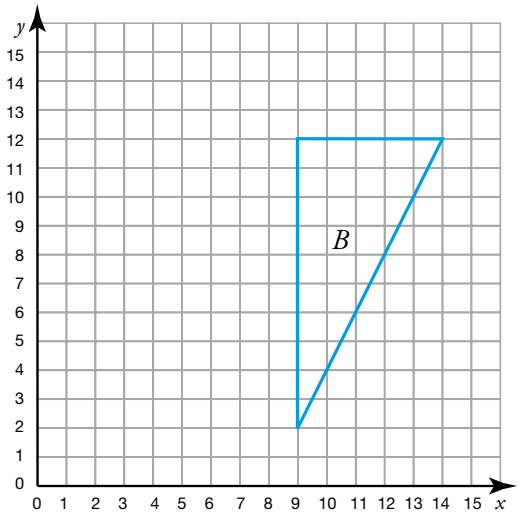
1. Shape P is shown on the grid. Shape P is enlarged, centre (0,0), to obtain shape Q.
   One side of shape Q has been drawn for you.
   (a) Write down the scale factor of the enlargement. *(1 mark)*
   (b) On the grid, complete shape Q. *(2 marks)*
   (c) The shape Q is enlarged by scale factor ½, centre (5,12) to give shape R.
   On the grid, draw shape R. *(3 marks)*



d) Shapes P, Q and R are mathematically similar. What does this mean? *(2 marks)*

- **Translate simple 2D shapes using vectors**

2. On the grid, translate triangle B by the vector $\begin{pmatrix}-7\\3\end{pmatrix}$
   Label the new triangle C *(2 marks)*



Grade C

1.

(a)

(b) See Grid

(c) See Grid

(d)

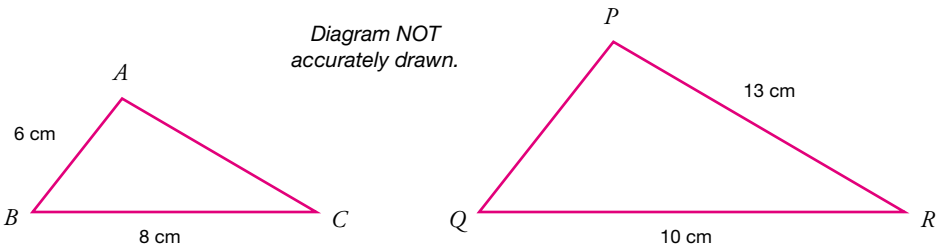
2. See Grid

answers

Grade B

- Understand that enlargements produce mathematically similar shapes preserving angles within the shapes
- Find the side length for similar shapes

1. Triangle ABC is similar to triangle PQR.
   Angle ABC = angle PQR
   Angle ACB = angle PRQ.



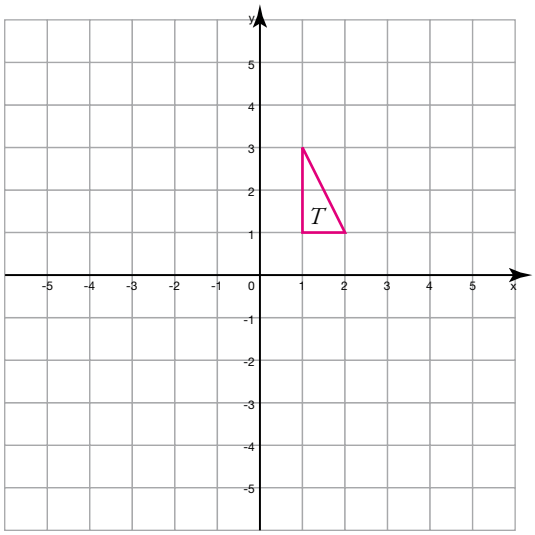
(a) Calculate the length of PQ. *(2 marks)*

(b) Calculate the length of AC. *(2 marks)*

Grade A

- Enlarge shapes by negative scale factors

1. Enlarge triangle T by scale factor -1½ , centre O. *(3 marks)*



Grade B

1.

(a)

(b)

Grade A

1. See Grid

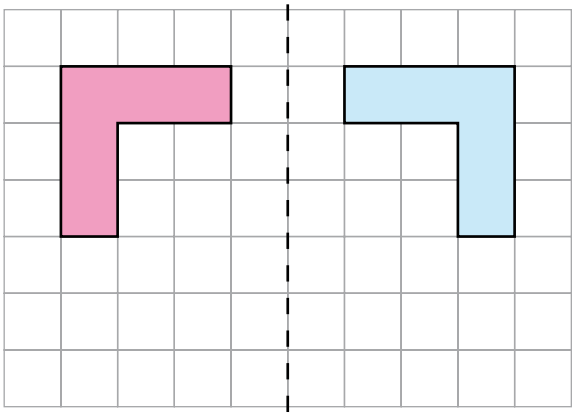
answers

Grade G

1. (a) Perimeter = 12cm

   (b) Area = 5cm^2

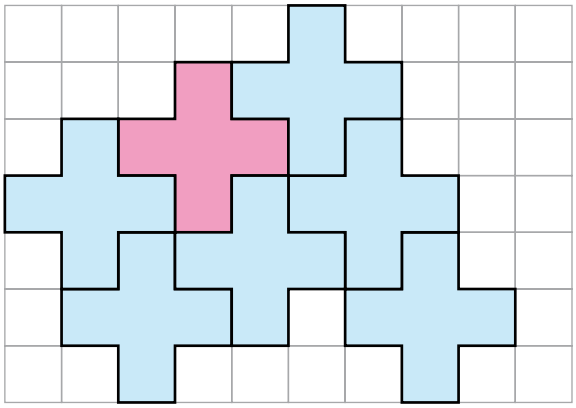
   (c)



Mirror Line

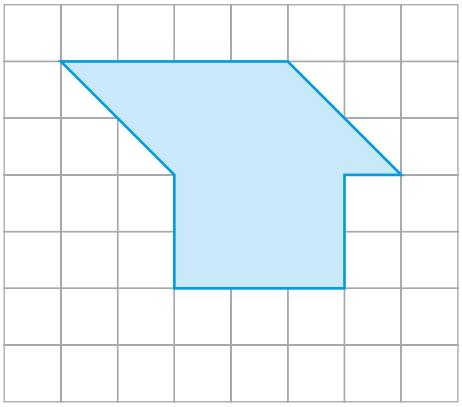
Grade F

1.



Grade E

1.



Anywhere on the grid.

Grade E

2. (a) B, E, H

   (b) (i) F or I

   (ii) 2

3. 7.3 × 50 000 = 365 000cm

   365 000 ÷ 100 000 = 3.65km

4. Co-ordinates (1,1), (1,0), (3,1)

Grade D

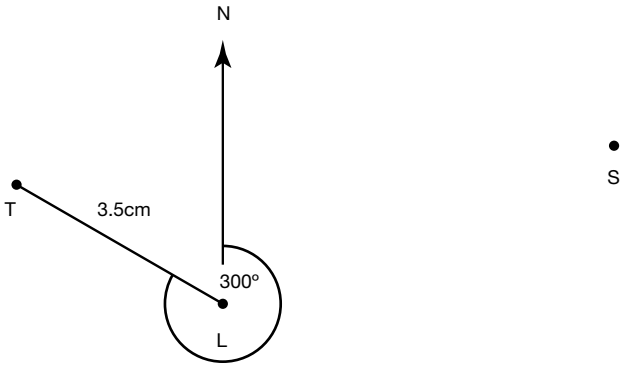
1. (a) (i) 5.7cm

   (ii) 5.7 × 20 = 114 km

   (b) (i) 068°

   (ii) 248° (360° - 068° = 248°)

   (c)



2. (a) 3 × 5 = 15cm^2

   (b) Height 4 × 3 = 12cm

   Length 4 × 5 = 20cm

   (c) 16

   Area of small photo = 15cm^2

   Area of large photo = 12 × 20 = 240cm^2

   240 ÷ 15 = 16

3. (a) Reflection in the y axis

   (b) Rotation 90° clockwise about the origin (0,0)

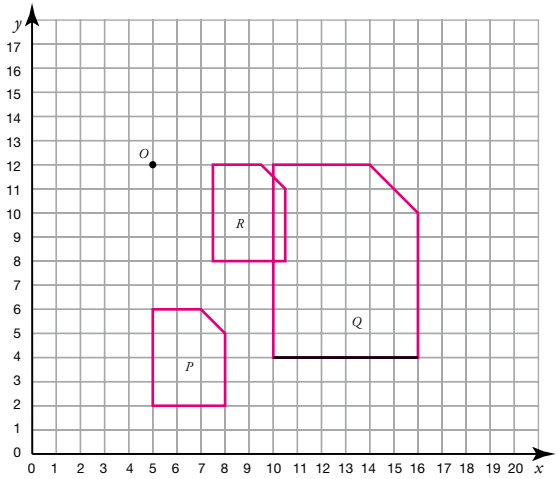
Grade C

1. (a) 2

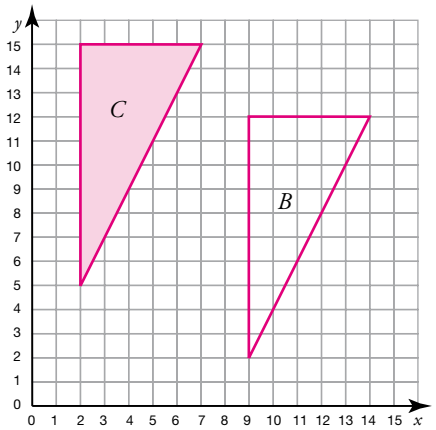
   (b) See diagram

   (c) See diagram

   (d) They are the same shape with the same angles, but a different size.



2.



Grade B

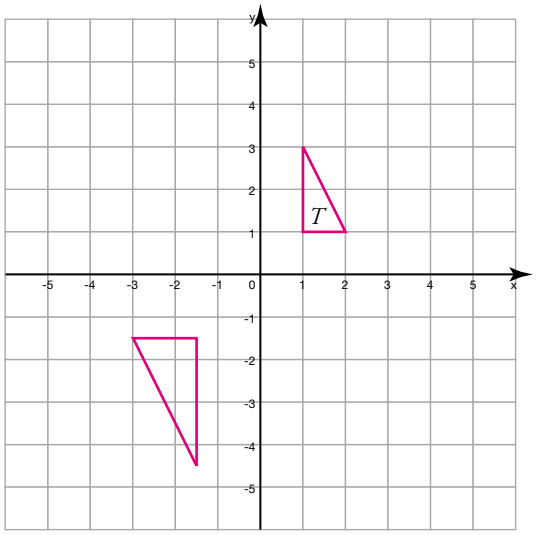
1. (a) $6 \times (10/8) = 7.5$cm

   (b) $13 \div 10/8 = 10.4$cm

   or $13 \times 8/10 = 10.4$cm

Grade A

1. Vectors at (-1.5,-1.5), (-3,-1.5), (-1.5,-4.5)



Shape, Space and Measures
30. Loci

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• Construct shapes from given information using only compasses and a ruler	
D	• Locate the position of an object given information about its bearing and distance	
C	• Construct perpendicular bisectors and angle bisectors using only compasses and a ruler • Construct loci in terms of distance from a point, equidistance from two points and distance from a line • Shade regions using loci to solve problems, eg vicinity to lighthouse/port	
B	• Construct loci in terms of equidistance from two lines	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade E

- **Construct shapes from given information using only compasses and a ruler**

1. Here is a sketch of a triangle, not drawn to scale.
   In the space below, use ruler and compasses to construct this triangle accurately.
   You must show all construction lines.
   (Total 3 marks)

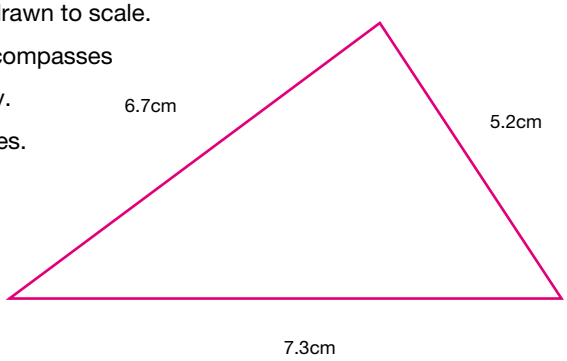


Diagram NOT accurately drawn.

Grade D

- **Locate the position of an object given information about its bearing and distance**

1 The scale drawing below shows the positions of two ships, P and Q.
1 cm on the diagram represents 20 km.

Diagram NOT accurately drawn.

A ship R is 100 km away from ship P, on a bearing of 058°.
Ship R is also on a bearing of 279° from ship Q.
In the space above, draw an accurate diagram to show the position of ship R.
Mark the position of ship R with a cross. Label it R. *(Total 4 marks)*

answers

Grade E

1. See Drawing

Grade D

1. See Diagram

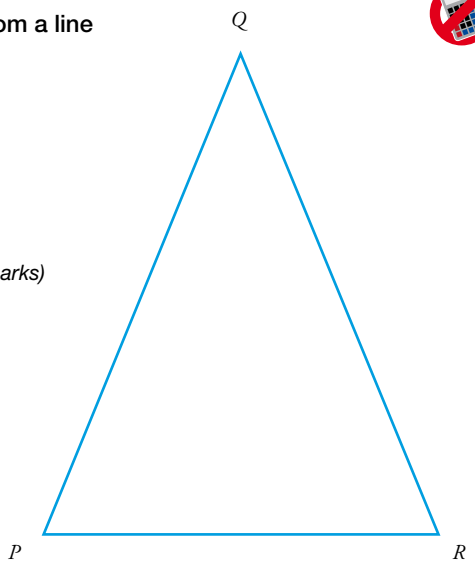
Grade C

- **Construct perpendicular bisectors and angle bisectors using only compasses and a ruler**

1. Use ruler and compasses to construct the perpendicular bisector of the line segment YZ.
   You must show all construction lines. *(Total 2 marks)*

- **Construct loci in terms of distance from a point, equidistance from two points and distance from a line**

2. Triangle PQR is shown on the right.



   (a) On the diagram, draw accurately the locus of the points which are 4cm from Q. *(2 marks)*

   (b) On the diagram, draw accurately the locus of the points which are the same distance from QP as they are from QR. *(2 marks)*

   J is a point inside triangle PQR
   J is 4cm from Q
   J is the same distance from QP as it is from QR

   (c) On the diagram, mark the point J clearly with a cross.
   Label it with the letter J. *(2 marks)*

answers

Grade C

1. See Drawing

2.

(a) See Diagram

(b) See Diagram

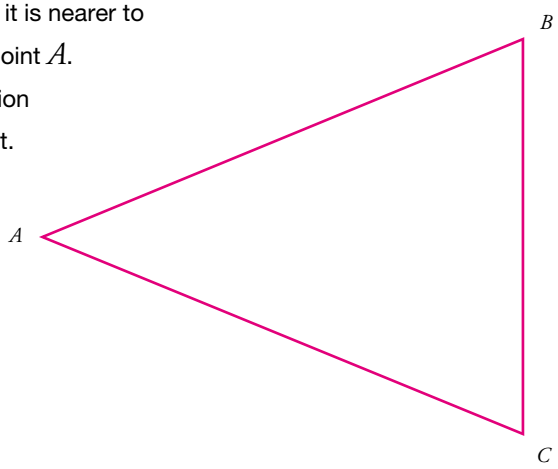
(c) See Diagram

Grade C

- **Shade regions using loci to solve problems**

3. The diagram represents a triangular pool ABC.
The scale of the diagram is 1cm represents 2m.
A fountain is to be built so that it is nearer to AB than to AC, within 7m of point A.
On the diagram, shade the region where the fountain may be built.
(Total 3 marks)

Diagram NOT accurately drawn.



Grade B

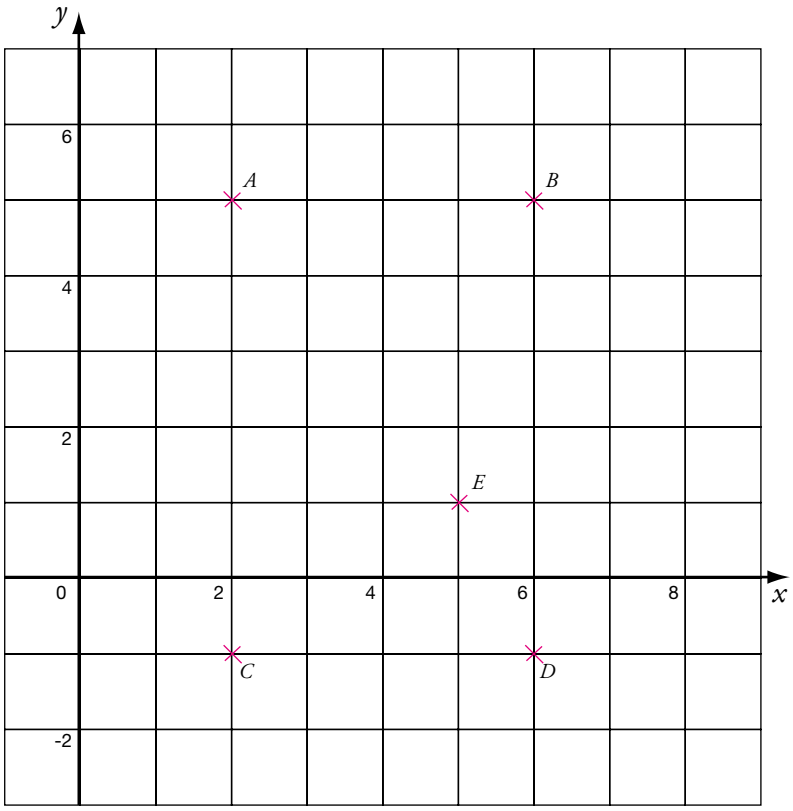
- **Construct loci in terms of equidistance from 2 lines**

1. The diagram shows three points A, B and C on a centimetre grid.

(a) On the grid, draw the locus of points which are equidistant from AB and CD. *(1 mark)*

(b) On the grid, draw the locus of points which are 3.5 cm from E. *(1 mark)*

(c) On the grid, shade the region in which points are nearer to AB than CD and also less than 3.5cm from E. *(1 mark)*



answers

Grade C

3. See Diagram

Grade B

1.

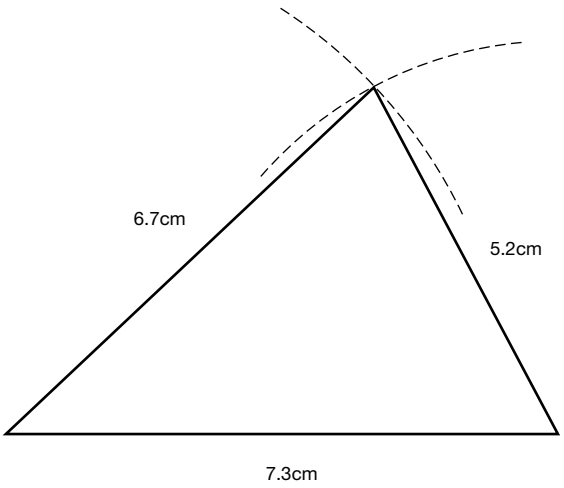
(a) See Diagram

(b) See Diagram

(c) See Diagram

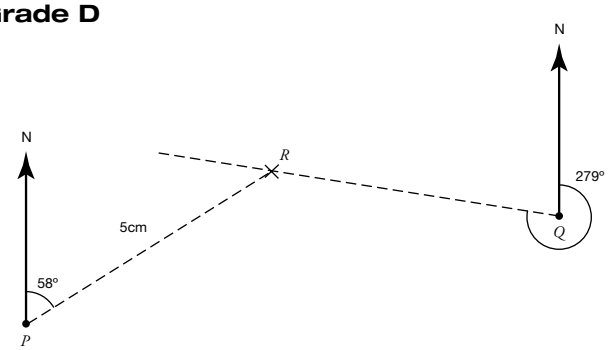
Grade E

1.



Grade D

1.



58° angle *(1mark)*

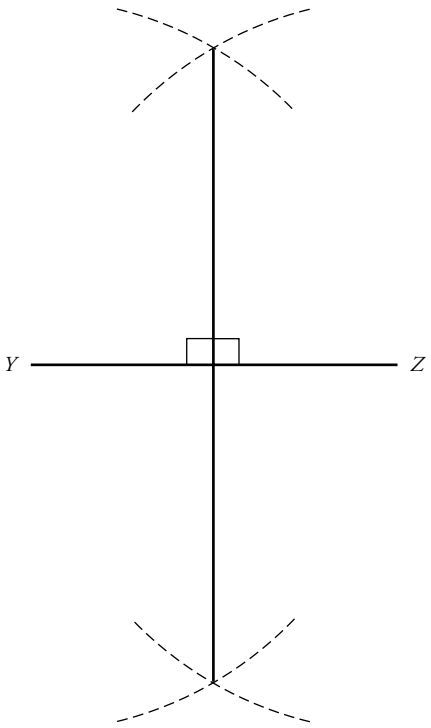
279° angle *(1mark)*

5cm line *(1mark)*

Letter R *(1mark)*

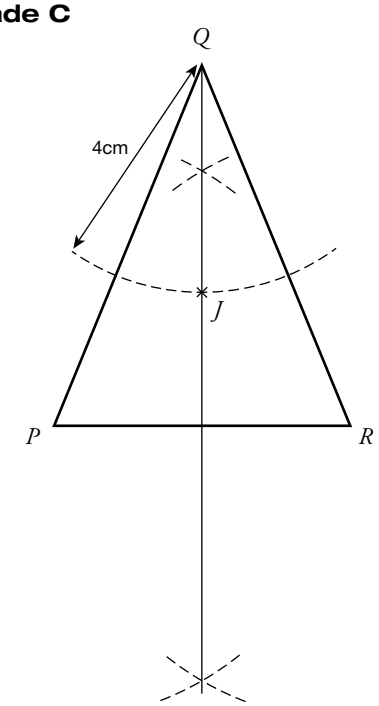
Grade C

1.

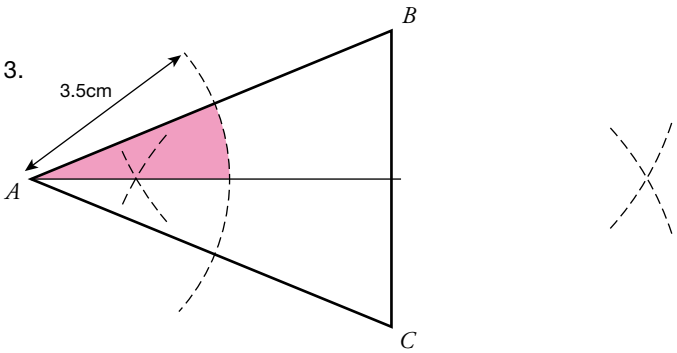


Grade C

2.

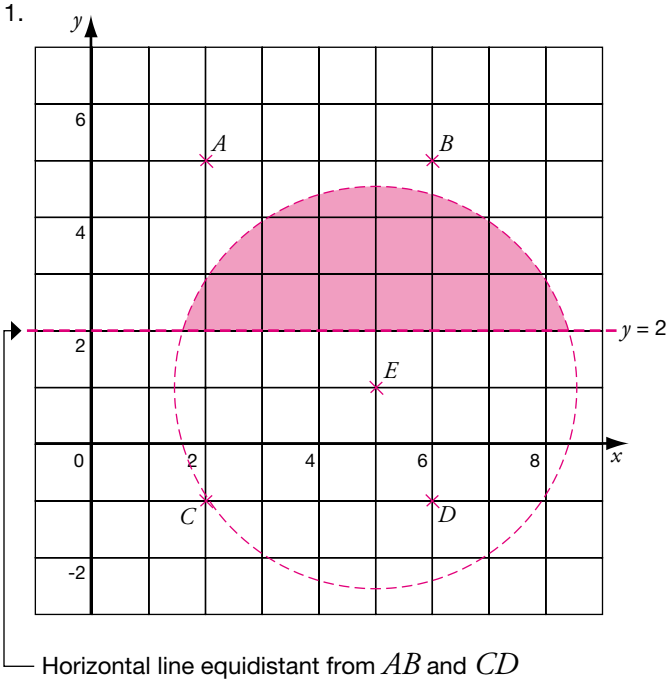


3.



Grade B

1.



Horizontal line equidistant from AB and CD

Circle radius 3.5cm from E

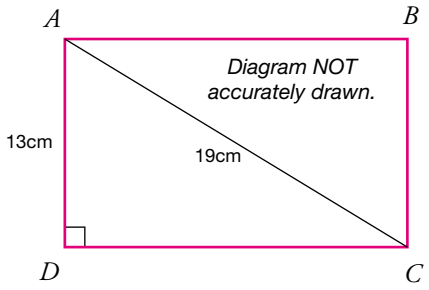
Shape, Space and Measures
31. Pythagoras' Theorem & Trigonometry

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• No objectives at this grade	
C	• Recall Pythagoras' Theorem and use it to find the length of any side of a right-angled triangle • Use Pythagoras' theorem to solve problems such as bearings, areas of triangles, diagonals of rectangles, etc	
B	• Use sine, cosine and tangent ratios to calculate angles and sides in right-angled triangles • Apply sine, cosine and tangent ratios to solve problems involving right-angled triangles, including bearings and angles of depression and elevation	
A	• Use Pythagoras' Theorem and trigonometry in 3-dimensional problems • Use the sine rule to find the size of an angle or side in a non-right-angled triangle • Use the cosine rule to find the size of an angle or side in a non-right-angled triangle	
A*	• Solve more complex sine and cosine rule problems, when the quadratic formula is required • Understand the ambiguous case for the sine rule	

Grade C

- **Recall Pythagoras' Theorem and use it to find the length of any side of a right-angled triangle**

1.



$ABCD$ is a rectangle.
AC = 19 cm and AD = 13 cm
Calculate the length of the side CD.
Give your answer correct to one decimal place.

(3 marks)

- **Use Pythagoras' Theorem to solve problems such as bearings, areas of triangles and diagonals of rectangles**

2. A paint can is a cylinder of radius 11cm and height 21cm.
Vincent, the painter, drops his stirring stick into the tin and it disappears.
Work out the maximum length of the stick.
Give your answer correct to two decimal places.

(3 marks)

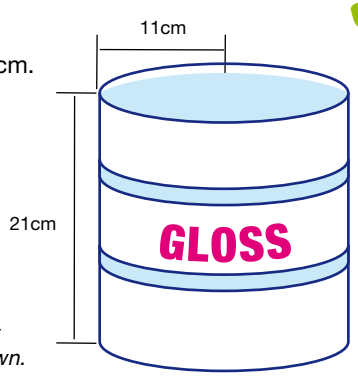
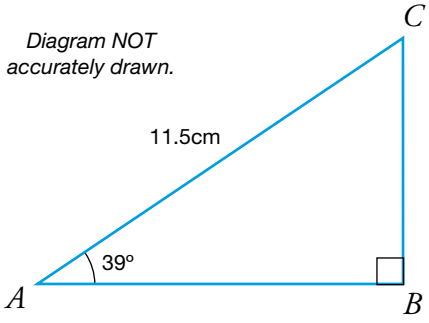


Diagram not accurately drawn.

Grade B

- **Use sine, cosine and tangent ratios to calculate angles and sides in right-angled triangles**

1.



The diagram shows a right-angled triangle ABC.
AC = 11.5cm
Angle CAB = 39°
Angle ABC = 90°
Find the length of the side AB.
Give your answer correct to 3 significant figures.

(3 marks)

- **Apply sine, cosine and tangent ratios to solve problems involving right-angled triangles including bearings and angles of depression and elevation.**

2. CD represents a vertical cliff 16m high.
A boat, B, is 25 m due east of D.

(a) Calculate the size of the angle of elevation of C from B.
Give your answer correct to 3 significant figures. *(3 marks)*

(b) What is the angle of depression of B from C?
Give a mathematical reason for this. *(2 marks)*

answers

Grade C

1.

2.

Grade B

1.

2.

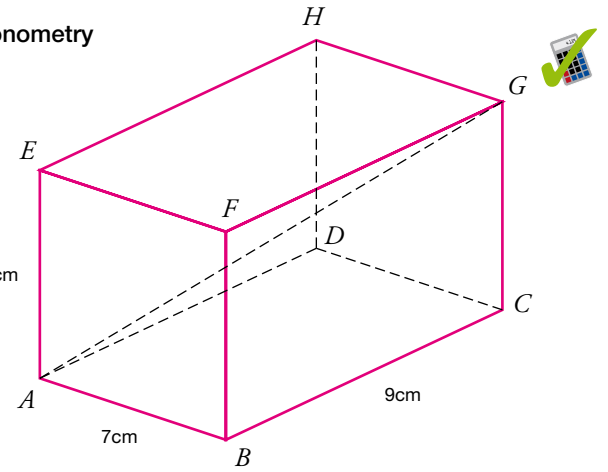
(a)

(b)

Grade A

- **Use Pythagoras' Theorem and trigonometry in 3-dimensional problems**

1. The diagram (not accurately drawn) represents a cuboid $ABCDEFGH$.



AB = 7 cm,
BC = 9 cm
AE = 5 cm.

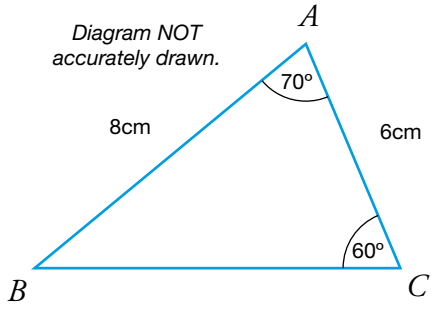
Diagram NOT accurately drawn.

(a) Calculate the length of AG.
Give your answer correct to 3 significant figures. *(2 marks)*

(b) Calculate the size of the angle between AG and the face $ABCD$.
Give your answer correct to 1 decimal place. *(2 marks)*

- **Use the sine rule to find the size of a side in a non-right-angled triangle**

2. *Diagram NOT accurately drawn.*



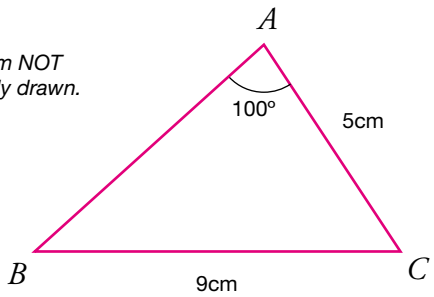
In triangle ABC (not accurately drawn),
AB = 8 cm,
AC = 6 cm
Angle ACB = 60° and Angle BAC = 70°
Calculate the length of BC.
Give your answer correct to 3 significant figures.
(3 marks)

- **Use the sine rule to find the size of an angle in a non-right-angled triangle**

3. In triangle ABC

AC = 5 cm
BC = 9 cm

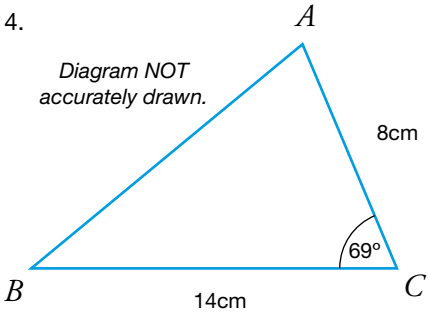
Diagram NOT accurately drawn.



Angle BAC = 100°
Calculate the size of angle ABC.
Give your answer correct to 1 decimal place. *(2 marks)*

- **Use the cosine rule to find the size of a side or angle in a non-right-angled triangle**

4. *Diagram NOT accurately drawn.*



In triangle ABC (not accurately drawn)
AC = 8 cm, BC = 14 cm and Angle ACB = 69°.

(a) Calculate the length of AB. *(3 marks)*
Give your answer correct to 3 significant figures.

(b) Calculate the size of angle BAC. *(2 marks)*
Give your answer correct to 1 decimal place.

Grade A

1.

(a)

(b)

2.

3.

4.

(a)

(b)

answers

Grade A*

- **Solve more complex sine and cosine rule problems, when the quadratic formula is required**

1.

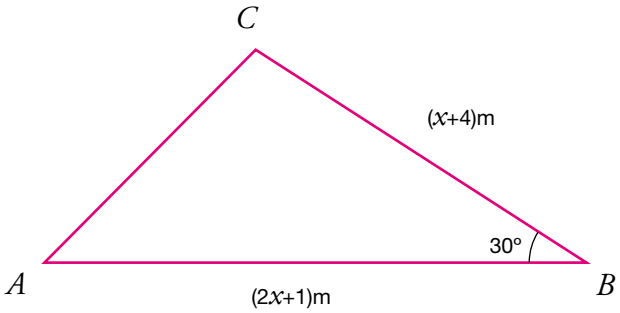


Diagram NOT accurately drawn.

In triangle ABC (not accurately drawn)

$AB = (2x + 1)$ metres.

$BC = (x + 4)$ metres.

Angle $ABC = 30°$.

The area of the triangle ABC is $4m^2$.

Calculate the value of x.

Give your answer correct to 3 significant figures. *(Total 5 marks)*

- **Understand the ambiguous case for the sine rule**

2. Triangle ABC (not accurately drawn) is obtuse.

Calculate the size of angle A giving your answer to 3 significant figures. *(3 marks)*

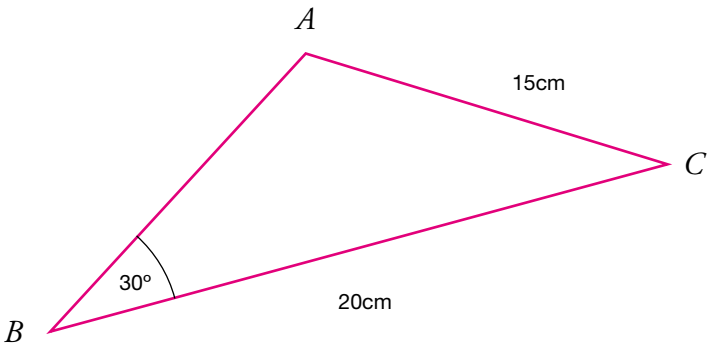


Diagram NOT accurately drawn.

Grade A*

1.

2.

answers

Grade C

1. $19^2 - 13^2 = 192$
   $\sqrt{192} = 13.85\ldots$
   Length $CD = 13.9$ cm

2. $21^2 + 22^2 = 925$
   $\sqrt{925} = 30.4138\ldots$
   $= 30.41$cm

Grade B

1. $AB = \text{Cos}39 \times 11.5$
   $= 8.937\ldots$
   $\therefore AB = 8.94$m

2. (a) $16/25\ \tan^{-1} = 32.619\ldots$
   Angle of elevation = 32.6°
   (b) 32.6° Angle of depression is equal to the angle of elevation because they are alternate angles.

Grade A

1. (a) $AG^2 = CG^2 + AC^2$
   $AC^2 = 9^2 + 7^2 = 130$
   $AC^2 = 130$
   $\therefore\ AG^2 = 5^2 + 130$
   $= 25 + 130 = 155$
   $= \sqrt{155} = 12.449\ldots$
   $AG = 12.4$ cm (3 sf)

   (b) Find angle GAC
   $\text{Sin}^{-1}(5/12.4)$
   $= 23.8°$ (1 dp)

2. $a/\text{Sin}70 = 8/\text{Sin}60$

   $$a = \frac{\text{Sin}70 \times 8}{\text{Sin}\ 60}$$

   $a = 8.68$ cm (3 sf)

3. $$\frac{\text{Sin}BAC}{9} = \frac{\text{Sin}ABC}{5}$$

   $$\text{Sin}ABC = \frac{\text{Sin}BAC \times 5}{9}$$

   $$= \frac{\text{Sin}100 \times 5}{9}$$

   $= 0.5471\ldots$
   $ABC = 33.2°$ (1 dp)

Grade A

4. (a) $a^2 = b^2 + c^2 - 2bc\text{Cos}A$
   $14^2 + 8^2 - (2 \times 14 \times 8 \times \text{Cos}69)$
   $260 - 80.27 = 179.73$
   $\sqrt{179.73} = 13.406\ldots$
   $= 13.4$ cm (3 sf)

4. (b) $$\text{Cos}A = \frac{b^2 + c^2 - a^2}{2bc}$$

   $$\text{Cos}BAC = \frac{13.4^2 + 8^2 - 14^2}{2 \times 13.4 \times 8}$$

   $= 77.18°$
   $= 77.2°$ (1 dp)

Grade A*

1. $4 = \frac{1}{2}(x + 4)(2x + 1)\ \text{Sin}\ 30°$
   $4 = \frac{1}{4}(x + 4)(2x + 1)$
   $16 = 2x^2 + 9x + 4$
   $2x^2 + 9x - 12 = 0$
   $a = 2,\ b = 9,\ c = -12$

   $$x = \frac{-9 \pm \sqrt{9^2 - (4 \times 2 \times -12)}}{4}$$

   $$x = \frac{-9 \pm \sqrt{177}}{4}$$

   $x = 1.076$
   (Reject negative value from $(-9 + \sqrt{177}) \div 4$ as length can't be negative).

2. $\text{Sin}\ BAC/20\text{cm} = \text{Sin}\ 30/15\text{cm}$
   $\text{Sin}BAC = 20 \times \text{Sin}\ 30/15\text{cm}$
   $\text{Sin}BAC = 20 \times 0.5/15$
   $\text{Sin}BAC = 0.6$ recurring
   Angle BAC = inverse Sin (0.6 recurring)

   Angle $BAC = 41.81°$.
   However, remember that the sine curve has symmetry.
   An angle of 180° - 41.81° will also give the same sine.
   So BAC could be either 41.81° or 138.91°.

   To decide which is right we must remember that the largest angle is always opposite the largest side. If BAC were 41.81° then ACB would be 180° - 30° - 41.81° which gives 108.19°

   Therefore BAC must be 138.19°. This is an acute angle so satisfies the constraint in the question.
   $BAC = 138°$ to 3 significant figures.

Shape, Space and Measures
32. Vectors

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• No objectives at this grade	
C	• No objectives at this grade	
B	• Understand and use vector notation	
A	• Calculate the sum, difference, scalar multiple and resultant of 2 vectors	
A*	• Solve geometrical problems in 2D using vector methods	

Grade B

- **Understand and use vector notation**

1. A is the point (3,2) and B is the point (-1,0)

   (a) Find $\overrightarrow{AB}$ as a column vector. *(1 mark)*

   (b) C is a point such that $\overrightarrow{AC} = \begin{pmatrix}4\\9\end{pmatrix}$ *(1 mark)*

   Write down the co-ordinates of the point C.

   (c) X is the midpoint of AB. O is the origin.

   Find $\overrightarrow{OX}$ as a column vector. *(2 marks)*

Grade A

- **Calculate the sum, difference, scalar multiple and resultant of 2 vectors**

1. Given that $a = \begin{pmatrix}4\\1\end{pmatrix}$ $b = \begin{pmatrix}1\\4\end{pmatrix}$ $c = \begin{pmatrix}-3\\1\end{pmatrix}$

   Work out the following:·

   (a) $2a$

   (b) $a + 2b$

   (c) $a - b + c$

   (d) $2a + b - c$

   (e) ½ a

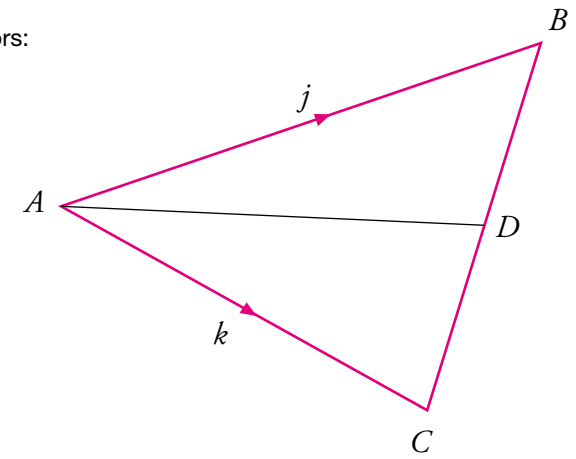
2. In the triangle ABC, $\overrightarrow{AB} = j$ and $\overrightarrow{AC} = k$ and D is the midpoint of BC.

   Work out the vectors:

   (a) $\overrightarrow{BC}$

   (b) $\overrightarrow{BD}$

   (c) $\overrightarrow{AD}$



answers

Grade B

1.

(a)

(b)

(c)

Grade A

1. (a)

(b)

(c)

(d)

(e)

2.

(a)

(b)

(c)

Grade A*

- **Solve geometrical problems in 2D using vector methods**

1. The diagram shows two triangles OAB and OCD.
   OAC and OBD are straight lines.
   AB is parallel to CD.

   $\overrightarrow{OA} = a$ and $\overrightarrow{OB} = b$
   The point A cuts the line OC in the ratio $OA:OC = 2:3$

   Express $\overrightarrow{CD}$ in terms of a and b

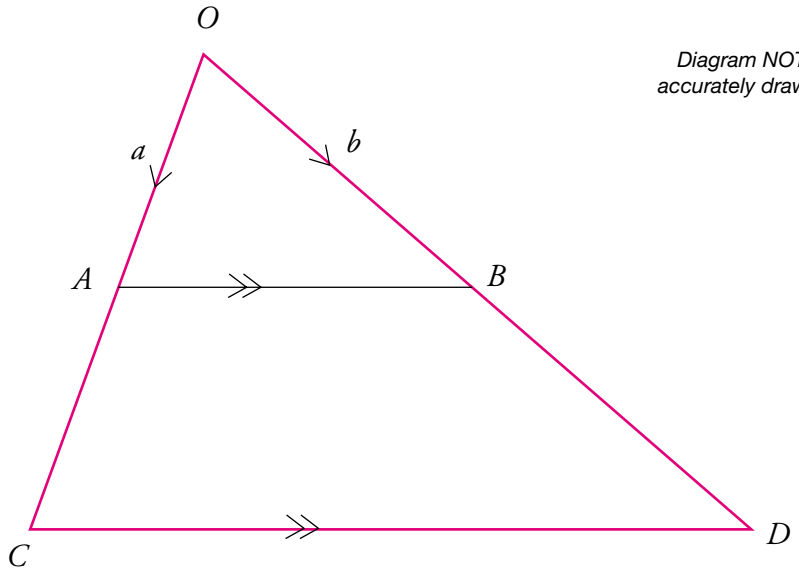


Diagram NOT accurately drawn.

Grade A*

1.

answers

Grade B

1. (a) $\begin{pmatrix}-4\\-2\end{pmatrix}$

   (b) (7, 11)

   (c) $A = (3, 2)$ $B = (-1, 0)$

   $\therefore$ $X = (2, 1)$

   $\therefore$ $OX = \begin{pmatrix}2\\1\end{pmatrix}$

Grade A

1. (a) $2a = 2 \times \begin{pmatrix}4\\1\end{pmatrix} = \begin{pmatrix}8\\2\end{pmatrix}$

   (b) $a + 2b = \begin{pmatrix}4\\1\end{pmatrix} + 2 \times \begin{pmatrix}1\\4\end{pmatrix} = \begin{pmatrix}6\\9\end{pmatrix}$

   (c) $a - b + c = \begin{pmatrix}4\\1\end{pmatrix} - \begin{pmatrix}1\\4\end{pmatrix} - \begin{pmatrix}-3\\1\end{pmatrix} = \begin{pmatrix}0\\-2\end{pmatrix}$

   (d) $2a + b - c = 2 \times \begin{pmatrix}4\\1\end{pmatrix} + \begin{pmatrix}1\\4\end{pmatrix} - \begin{pmatrix}-3\\1\end{pmatrix} = \begin{pmatrix}12\\5\end{pmatrix}$

   (e) $\frac{1}{2}a = \frac{1}{2} \times \begin{pmatrix}4\\1\end{pmatrix} = \begin{pmatrix}2\\0.5\end{pmatrix}$

2. (a) $\overrightarrow{BC} = \overrightarrow{BA} + \overrightarrow{AC} = -j + k = k-j$

   (b) $\overrightarrow{BD} = \frac{1}{2}\overrightarrow{BC} = \frac{1}{2}(k-j)$

   (c) $\overrightarrow{AD} = \overrightarrow{AB} + \overrightarrow{BD} = j + \frac{1}{2}(k-j) = j + \frac{1}{2}k - \frac{1}{2}j$
   $= \frac{1}{2}j + \frac{1}{2}k = \frac{1}{2}(j-k)$

Grade A*

1. $\frac{3}{2}(b - a)$

   $AB = (-a + b) = (b - a)$

   $CD = \frac{3}{2} \times AB$

   $= \frac{3}{2}(b - a)$

Shape, Space and Measures
33. Circle Theorems

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• No objectives at this grade	
C	• No objectives at this grade	
B	• Solve problems by understanding and applying circle theorems	
A	• Solve more complex problems by understanding and applying circle theorems	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

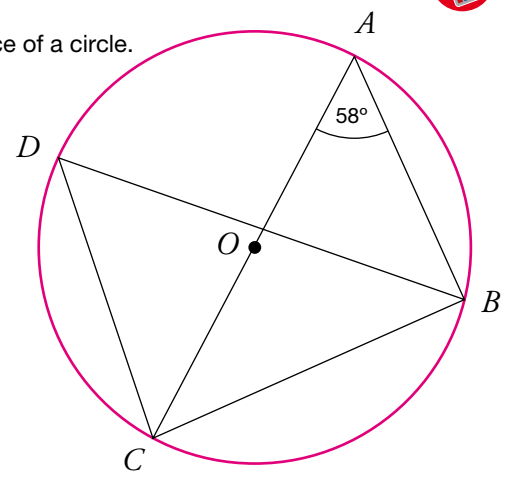
Grade B

- **Solve problems by understanding and applying circle theorems**

- **Angle at the centre of a circle is twice as big as the angle at the circumference**
- **Angle in a semi-circle is a right angle**
- **Angles in the same segment are equal**

1. A, B, C and D are points on the circumference of a circle.
O is the centre of the circle.
Angle BAC = 58°

Diagram NOT accurately drawn.



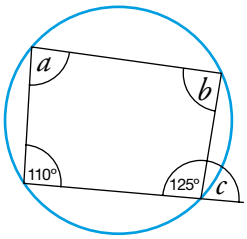
(a) Work out the size of angle BOC.
Give a reason for your answer. *(2 marks)*

(b) Work out the size of angle ABC.
Give a reason for your answer. *(2 marks)*

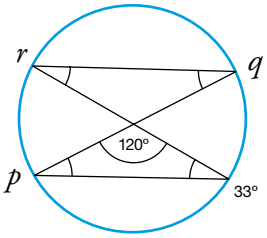
(c) Work out the size of angle BDC.
Give a reason for your answer. *(2 marks)*

- **Know the sum of the opposite angles in a cyclic quadrilateral**
- **Know the sum of the angles on a straight line**
- **Know the sum of the angles in a triangle**
- **Know the angles in the same segment are equal**

2.



Diagrams NOT accurately drawn.



(a) Work out the size of these angles.
Give a reason for each answer.

(i) Angle a
(ii) Angle b
(iii) Angle c *(6 marks)*

(b) Work out the size of these angles.
Give a reason for each answer.

(i) Angle p
(ii) Angle q
(iii) Angle r *(6 marks)*

- **Two tangents drawn to a circle from outside it are of equal length**

3. X, Y and Z are points on the circumference of a circle.
O is the centre of the circle.
Angle XZY = 65°

(a) Find the size of angle XOY.
Give a reason for your answer. *(2 marks)*

(b) Find the size of angle XTY.
Give a reason for your answer. *(3 marks)*

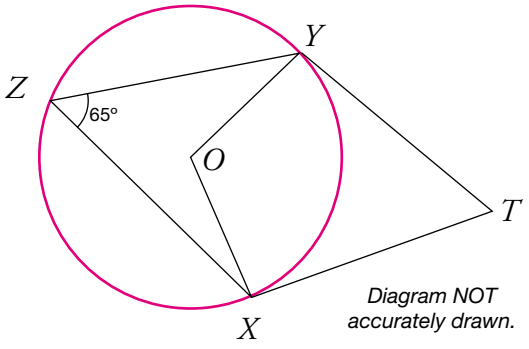


Diagram NOT accurately drawn.

Grade B

1.

(a)

(b)

(c)

2.

(a) (i)

(ii)

(iii)

(b) (i)

(ii)

(iii)

3.

(a)

(b)

answers

Grade A

- **Solve problems by understanding and applying circle theorems**
- **Prove and use the alternative segment theory**

1. TA and TB are are tangents to a circle. O is the centre of the circle. Angle ATB = 40°
   Diagram not accuartely drawn.

   (a) Work out the size of angle ABT. Give a reason for your answer. *(2 marks)*

   (b) Work out the size of angle OBA. Give a reason for your answer. *(2 marks)*

   (c) Work out the size of angle ACB. Give a reason for your answer. *(2 marks)*

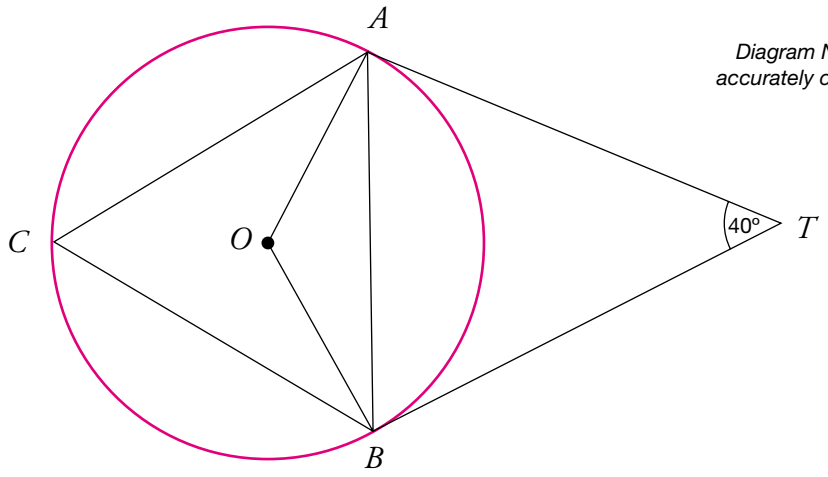
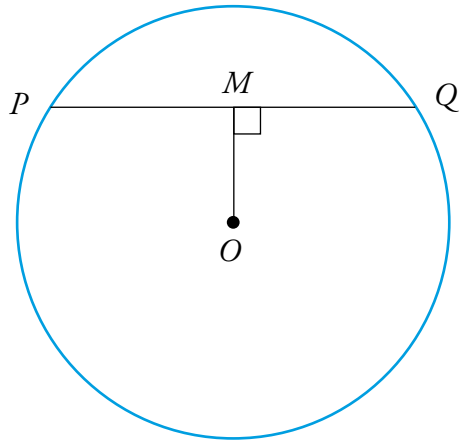


Diagram NOT accurately drawn.

- **Perpendicular line from the centre of a chord bisects the chord**

2. P and Q are points on the circumference of a circle.
   O is the centre of the circle.
   M is the point where the perpendicular line from O meets the chord PQ
   Prove that M is the midpoint of the chord PQ *(3 marks)*



Grade A

1.

(a)

(b)

(c)

2.

answers

Grade B

1. (a) 116°
   Angle BOC - at centre of circle - is twice as big as the angle at the circumference (BAC = 58°)

   (b) 90°
   Angle in a semi-circle is a right angle
   (AC is a diameter)

   (c) 58°
   Angles in the same segment are equal
   and angle BAC = 58°

2. (a) (i) a = 55°
   180° - 125° = 55° (opposite angles in a cyclic quadrilateral add up to 180°)

   (ii) b = 70°
   180° - 110° = 70° (opposite angles in a cyclic quadrilateral add up to 180°)

   (iii) c = 55°
   180° - 125° = 55°
   (angles on a straight line add up to 180°)

   (b) (i) p = 27°
   180° - 153° = 27°
   (angles in a triangle add up to 180°)

   (ii) q = 33°
   (angles in the same segment are equal)

   (iii) r = 27°
   (angles in the same segment are equal)

3. (a) 130° - (angle at the centre is twice the angle at the circumference)

   (b) 50°
   2 tangents drawn to a circle from an outside point are equal in length and have formed 2 congruent right-angled triangles.
   OXT and OYT are right angles
   360° - 90° - 90° - 130°
   360° - 310° = 50°

Grade A

1. (a) Triangle TBA = isosceles (TA = TB)
   Angle ABT = (180° - 40°) ÷ 2 = 70°

   (b) Angle OBT = 90°
   (angle between tangent and radius is equal to 90°)
   Angle OBA = 90° - 70° = 20°

   (c) Angle ACB = Angle ABT
   Alternate segment theory
   $\therefore ACB$ = 70°

2. OP = OQ (both are radii)
   OM = OM (OM is common)
   Angle OMP = Angle OMQ = 90°
   $\therefore$ Triangle OMP = Triangle OMQ
   $\therefore PM$ = QM
   $\therefore M$ is the midpoint of PQ

Section 4

Handling Data

Page		Topic Title
166-169	**34.**	Tallying, collecting and grouping data
170-179	**35.**	Averages and measures of spread
180-182	**36.**	Line graphs and pictograms
183-186	**37.**	Pie charts and frequency diagrams
187-195	**38.**	Scatter diagrams and cumulative frequency diagrams
196-201	**39.**	Bar charts and histograms
202-205	**40.**	Questionnaires
206-208	**41.**	Sampling
209-217	**42.**	Probability

Revision Websites

http://www.bbc.co.uk/schools/gcsebitesize/maths/datahandlingih/

http://www.bbc.co.uk/schools/gcsebitesize/maths/datahandlingh/

http://www.s-cool.co.uk/topic_index.asp?subject_id=15&d=0

http://www.mathsrevision.net/gcse/index.php

http://www.gcse.com/maths/

http://www.easymaths.com/stats_main.htm

Add your favourite websites and school software here.

This section of the Salford GCSE Maths Revision Package deals with *Handling Data*. This is how to get the most out of it:

1 Start with any topic within the section – for example, if you feel comfortable with *Line graphs and pictograms*, start with Topic 36 on page 180.

2 Next, choose a grade that you are confident working at.

3 Complete each question at this grade and write your answers in the answer column on the right-hand side of the page.

4 Mark your answers using the page of answers at the end of the topic.

5 If you answered all the questions correctly, go to the topic's smiley face on pages 4/5 and colour it in to show your progress.

Well done! Now you are ready to move onto a higher grade, or your next topic.

6 If you answered any questions incorrectly, visit one of the websites listed left and revise the topic(s) you are stuck on. When you feel confident, answer these questions again.

When you answer all the questions correctly, go to the topic's smiley face on pages 4/5 and colour it in to show your progress.

Well done! Now you are ready to move onto a higher grade, or your next topic.

Handling Data
34. Tallying, Collecting & Grouping Data

Grade	Learning Objective	Grade achieved
G	• Read information from a database, table or list • Complete a simple tally chart	
F	• Collect data by tallying in a grouped frequency table	
E	• Use inequality signs accurately to construct a grouped frequency table • Design, complete and use two-way tables	
D	• Make sure you are able to meet **ALL** the objectives at lower grades	
C	• Make sure you are able to meet **ALL** the objectives at lower grades	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Read information from a database, table or list**

1. Here is part of a railway timetable.

Whitefield	12 30	12 55	–	–	13 30	13 55
Prestwich	12 34	12 59	13 04	13 29	13 34	13 59
Unsworth	12 39	13 04	13 09	13 34	13 39	14 04
Hollins	12 53	–	13 23	–	13 53	–
Fishpool	12 59	–	13 29	–	13 59	–
Bury	13 17	13 30	13 48	14 05	14 17	14 31

(a) A train leaves Whitefield at 12 30
At what time should this train arrive in Bury? *(1 mark)*

(b) Another train leaves Whitefield at 13 30
Work out how many minutes it should take this train to get to Bury. *(1 mark)*

- **Complete a simple tally chart**

2. Eliot carried out a survey of his friends' favourite drinks.
Here are his results.

Cola	Lemonade	Blackcurrant	Blackcurrant	Cola
Blackcurrant	Cola	Lemonade	Cola	Orange Juice
Cola	Lemonade	Orange Juice	Blackcurrant	Orange Juice
Orange Juice	Cola	Cola	Blackcurrant	Cola

(a) Complete the table to show Eliot's results. *(3 marks)*

Flavour of drink	Tally	Frequency
Cola		
Lemonade		
Orange		
Blackcurrant		

(b) Write down the number of Eliot's friends whose favourite drink was Orange. *(1 mark)*

(c) Which was the favourite drink of most of Eliot's friends? *(1 mark)*

answers

Grade G

1.

(a)

(b)

2.

(a) See Table

(b)

(c)

Grade F

- **Collect data by tallying in a grouped frequency table**

1. Simon carried out a survey of 45 pupils in Year 10.
   He asked how many CDs they had bought in the last month.
   These are Simon's results.

   4, 6, 3, 9, 10, 5, 4, 7, 6, 3, 8, 3, 1, 9, 0,
   12, 5, 6, 3, 3, 0, 7, 9, 4, 3, 8, 2, 1, 6, 1,
   3, 4, 6, 0, 7, 10, 4, 8, 1, 6, 7, 1, 2, 3, 1.

   Complete the frequency table. *(3marks)*

Number Of CDs	Tally	Frequency
0 to 2		
3 to 5		
6 to 8		
More than 8		

Grade E

- **Use inequality signs accurately to construct a grouped frequency table**

1. A set of 25 times in seconds is recorded.

21.0	12.6	24.4	17.8	15.7	11.4	20.5	16.4	22.2	8.3
17.4	8.0	20.5	13.6	6.0	13.6	18.0	11.3	14.6	9.6
9.5	6.4	14.8	6.2	11.5					

   (a) Complete the frequency table below, using intervals of 5 seconds. *(3 marks)*

Time (t) seconds	Tally	Frequency
$5 < t \leq 10$		

- **Design, complete and use two-way tables**

2. Bob carried out a survey of 100 people who buy milk.
   He asked them about the milk they buy most.
   The two-way table gives some information about his results.

	Skimmed	Semi-skimmed	Full Fat	Total
1 pint	2	0	5	
2 pints	35	20		60
3 pints	15			
Total		25		100

   (a) Complete the two-way table.
   (b) How many more people bought skimmed milk than full fat? *(3 marks)*

Grade F

1. See Table

Grade E

1.

(a) See Table

2.

(a) See Table
(b)

answers

Grade G

1. (a) 13 17

   (b) 47 minutes

2 (a)

Cola	8
Lemonade	3
Orange	4
Blackcurrant	5

(b) 4

(c) Cola

Grade F

1.

Number Of CDs	Frequency
0 to 2	11
3 to 5	15
6 to 8	13
More than 8	6

Grade E

1.

Time (t) seconds	Frequency
$5 < t \leq 10$	7
$10 < t \leq 15$	8
$15 < t \leq 20$	5
$t > 20$	5

2. (a)

	Skimmed	Semi-skimmed	Full Fat	Total
1 pint	2	0	5	7
2 pints	35	20	5	60
3 pints	15	5	13	33
Total	52	25	23	100

(b) 52 - 23 = 29

Handling Data
35. Averages & Measures of Spread

Grade	Learning Objective	Grade achieved
G	• Find the mode from a list, frequency table or bar chart • Find the mean or range from a list or table of data	
F	• Find the median from a list of data	
E	• Identify the mode or modal class from a frequency table	
D	• Calculate the median and range from a frequency table • Construct a stem and leaf diagram and calculate averages and range from it • Compare distributions using average and range • Justify the choice of a particular average	
C	• Calculate an estimate of the mean from a grouped frequency table • Identify the class interval which contains the median • Calculate moving averages and use them to make predictions • Solve problems involving averages • Construct box plots to present measures of spread	
B	• Calculate averages and interquartile range from graphs, lists, stem and leaf diagrams or box plots and use them to compare two distributions • Identify trends in time series	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

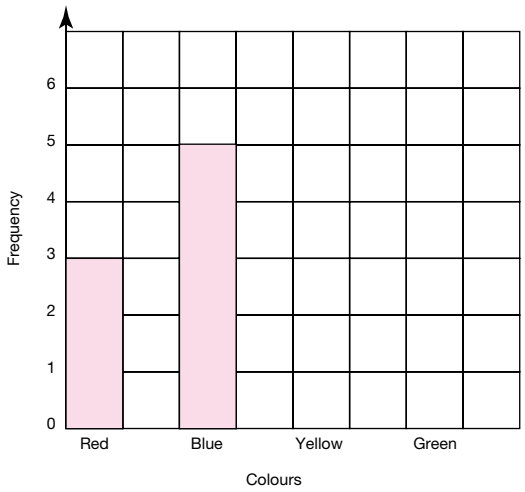
Grade G

- **Find the mode from a list, frequency table or bar chart**

1. Suzanne drew a bar chart of her teachers' favourite colours.
   Part of her bar chart is shown below.

   4 teachers said that Yellow was their favourite colour

   2 teachers said that Green was their favourite colour



   (a) Complete Suzanne's bar chart. *(2 marks)*

   (b) Which colour was the mode for the teachers that Suzanne asked? *(1 mark)*

   (c) Work out the number of teachers Suzanne asked. *(1 mark)*

- **Find the mean or range from a list or table of data**

2. John made a list of his homework marks.

   4 5 5 5 4 3 2 1 4 5

   (a) Write down the mode of his homework marks. *(1 mark)*

   (b) Work out his mean homework mark. *(2 marks)*

Grade F

- **Find the median from a list of data**

1. Find the median of these 15 numbers.

   2, 8, 8, 6, 4, 2, 8, 9, 4, 5, 1, 5, 7, 8, 9 *(2 marks)*

Grade E

- **Identify the mode or modal class from a frequency table**

1. Diane had 10 boxes of matches.
   She counted the number of matches in each box.
   The table gives information about her results.

Number of matches	Frequency
29	2
30	5
31	2
32	1

   Write down the modal number of matches in a box. *(1 mark)*

answers

Grade G

1.

(a) See Bar Chart

(b)

(c)

2.

(a)

(b)

Grade F

1.

Grade E

1.

Grade D

- **Calculate the median and range from a frequency table**

1. 20 students scored goals for the school football team last month.
   The table gives information about the number of goals they scored.

Goals scored	Number of students
1	5
2	7
3	5
4	3

(a) Find the median number of goals scored. *(1 mark)*

(b) Work out the range of the number of goals scored. *(1 mark)*

- **Construct a stem and leaf diagram and calculate averages and range from it**

2. The list shows the number of students late for school each day for 21 days.
   17, 14, 27, 18, 33, 18, 27, 26, 19, 22, 29, 36, 25, 26, 29, 15, 29, 30, 22, 31, 34

(a) Complete the stem and leaf diagram for the number of students late. *(2 marks)*

1	
2	
3	

Key
1|4 means
14 students late

(b) Find the median number of students late for school. *(1 mark)*

(c) Work out the range of the number of students late for school. *(1 mark)*

- **Compare distributions using averages and range**

3. There are 10 children in a playgroup.
   The table shows information about the ages, in years, of these children.

Age in years	Frequency
2	3
3	5
4	2

(a) Work out the mean age of the children. *(3 marks)*

A second playgroup has 30 pupils. The table below show information about this playgroup.

Age in years	Frequency
2	18
3	7
4	3
5	2

(b) Work out the mean age of the children in this playgroup *(3 marks)*

(c) On average, does the first or second playgroup have the oldest pupils? *(1 mark)*

answers

Grade D

1.

(a)

(b)

2.

(a) See Diagram

(b)

(c)

3.

(a)

(b)

(c)

Grade D

- **Compare distributions using averages and range**

4. Mrs Hami gives her class a maths test. Here are the results for the girls:
   8, 6, 9, 6, 2, 9, 8, 5, 8, 11, 4, 8, 5, 4, 7
   (a) Work out the mode. (1 mark)
   (b) Work out the median. (2 marks)
   The median mark for the boys was 9 and the range of the marks for the boys was 5.
   The range of the girls' marks was 9.
   (c) By comparing the results, explain whether the boys or girls did better.

- **Justify the choice of a particular average**

5. Jackie is the Chairman of a company that employs 10 people, including herself.
   Their salaries are as follows:

   Chairman: £70 000 per year
   7 people earning: £18 000 per year
   2 people earning: £9 000 per year

   (a) Work out the mean salary (2 marks)
   (b) Work out the modal salary (1 mark)
   (c) Work out the median salary. (2 marks)
   (d) Which average salary do you think gives the most accurate picture of the above salaries? Give a reason. (2 marks)

Grade C

- **Calculate an estimate of the mean from a grouped frequency table**

1. The table shows information about the number of hours that 120 children used a computer last week.

Number of hours (h)	Frequency
$0 < h \leq 2$	10
$2 < h \leq 4$	20
$4 < h \leq 6$	25
$6 < h \leq 8$	35
$8 < h \leq 10$	24
$10 < h \leq 12$	6

Work out an estimate for the mean number of hours that the children used a computer.
Give your answer correct to 1 decimal place. *(4 marks)*

answers

Grade D

4.
(a)
(b)

(c)

5.
(a)
(b)
(c)
(d)

Grade C

1.

Grade C

- **Identify the class interval that contains the median**

2. A computer store keeps records of the costs of repairs to its customers' computers.
The table gives information about the costs of all repairs that were less than £250 in one week.

Cost (£C)	Frequency
0 < C ≤ £50	5
50 < C ≤ £100	9
100 < C ≤ £150	8
150 < C ≤ £200	11
200 < C ≤ £250	12

(a) Find the class interval in which the median lies. *(4 marks)*

(b) There was only one further repair that week, not included in the table.
That repair cost £1 000. Craig says 'The class interval in which the median lies will change.'
Is Craig correct? Explain your answer. *(1 mark)*

- **Calculate moving averages and use them to make predictions**

3. A shop sells DVD players. The table shows the number of DVD players sold in every three-month period from January 2003 to June 2004.

Year	Months	Number of DVD players sold
2003	Jan – Mar	56
	Apr – Jun	66
	Jul – Sep	84
	Oct – Dec	106
2004	Jan – Mar	66
	Apr – Jun	70

(a) Calculate the set of four-point moving averages for this data. *(2 marks)*

(b) What do your moving averages in part (a) tell you about the trend in the sale of DVD players? *(1 mark)*

- **Solve problems involving averages**

4. A youth club has 60 members.
40 of the members are girls.
20 of the members are boys.
The mean number of videos watched last week by all 60 members was 2.8.
The mean number of videos watched last week by the 40 girls was 3.3.
Calculate the mean number of videos watched last week by the 20 boys. *(3 marks)*

Grade C

answers

2.

(a)

(b)

3.

(a)

(b)

4.

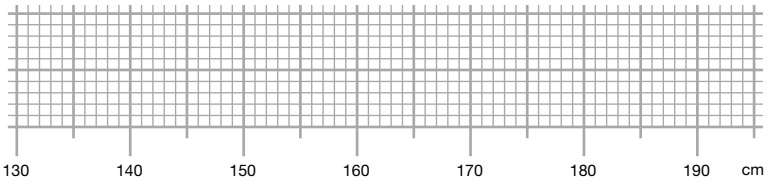
Grade C

- **Construct box plots to present measures of spread**

5. Betty recorded the heights, in centimetres, of the girls in her class.
   She put the heights in order.
   134, 146, 152, 154, 162, 164, 164, 169, 169, 172, 174, 179, 183, 184, 184

   (a) Find:
   (i) the lower quartile, *(1mark)*
   (ii) the upper quartile. *(1mark)*

   (b) Draw a box plot for this data on the grid below. *(3 marks)*



answers

Grade C

5.

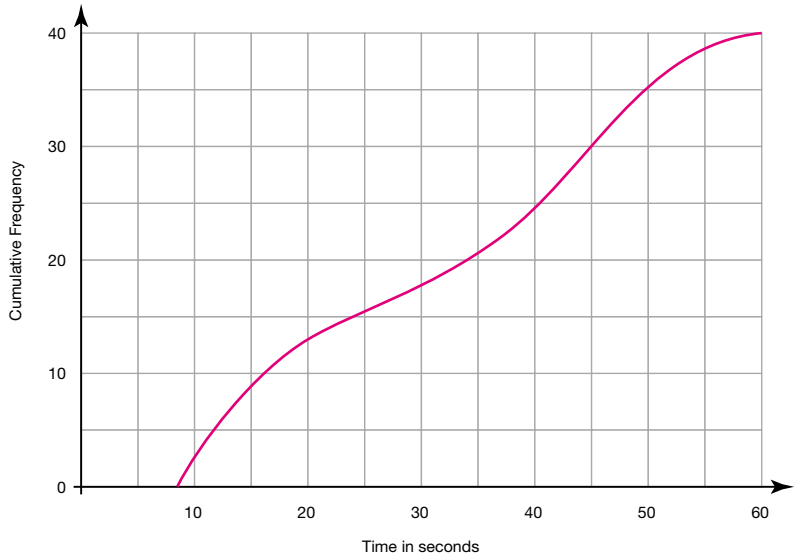
(a)
(i)
(ii)

(b) See Diagram

Grade B

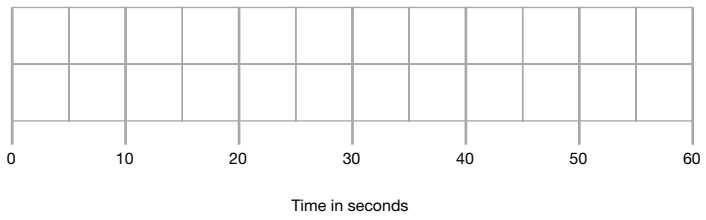
- **Calculate averages and interquartile range from graphs, lists, stem and leaf diagrams or box plots and use them to compare two distributions**

1. 40 girls each solved a simultaneous equation. The cumulative frequency graph below gives information about the times it took them to complete the question.

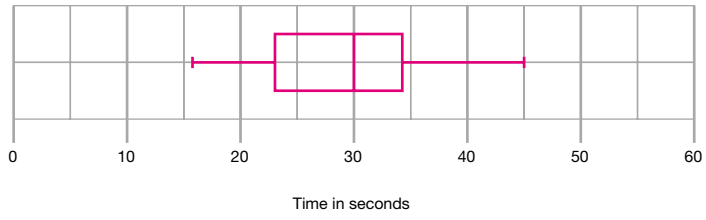


(a) Use the graph to find an estimate for the median time. *(1 mark)*

(b) For the girls the minimum time to complete the question was 8 seconds and the maximum time to complete the question was 57 seconds.
Use this information and the cumulative frequency graph to draw a box plot showing information about the girls' times. *(3 marks)*



(c) The box plot below shows information about the times taken by 40 boys to complete the same question.
Calculate the interquartile range. *(2 marks)*



(d) Make two comparisons between the boys' times and the girls' times. *(2 marks)*

Grade B

answers

1.

(a)

(b) See Diagram

(c)

(d)

Grade B

- **Identify trends in time series**

2. Matthew records the number of job vacancies in his company each quarter, for three years. Here is a table of the results.

Year	March	June	September	December
2001	672	775	732	413
2002	612	712	742	375
2003	540	629	651	366

(a) Work out the four-point moving average for the data.

(b) Plot the original data and the moving average on the same graph.

(c) Comment on how the number of job vacancies has changed over the three years.

(Total 5 marks)

Grade B

answers

2.

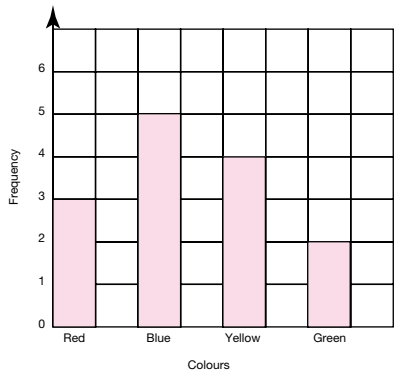
(a)

(b) See Grid

(c)

Grade G

1. (a)



(b) Mode: Blue

(c) 3 + 5 + 4 + 2 = 14 teachers

2. (a) Mode: 5

(b) Mean: (4 + 5 + 5 + 5 + 4 + 3 + 2 + 1 + 4 + 5) ÷ 10

$^{38}/_{10}$ = 3.8

Grade F

1. 6

1 2 2 4 4 5 5 6 7 8 8 8 8 9 9

Grade E

1. Mode: 30 matches

Grade D

1. (a) Median: (2 + 2) ÷ 2 = 2 (middle pair divided by 2)

1 1 1 1 1 2 2 2 2 2 2 3 3 3 3 3 3 4 4 4

(b) Range: 4 – 1 = 3

2. (a) Number of students late

1	4 5 7 8 8 9
2	2 2 5 6 6 7 7 9 9 9
3	0 1 3 4 6

(b) Median: 26 (11th result)

(c) Range: 22 (36 - 14 = 22)

3. (a) Mean = ((2×3) + (3×5) + (4×2)) ÷ 10 = $^{29}/_{10}$ = 2.9 years

(b) Mean = ((2×18) + (3×7) + (4×3) + (5×2)) ÷ 30 = $^{79}/_{30}$

= $2.6\dot{3}$ years

(c) First playgroup has older pupils

4. (a) Mode : 8

(b) Median: 7

(c) The boys did better in the test as their median mark was 9, which is higher than the girls' median mark of 7. Also the range of the boys' marks was smaller, which means their marks were more consistent overall.

5 (a) Mean = (70 000 + (7 x 18 000) + (2 x 9 000)) ÷ 10

= 214 000 ÷ 10

= £21 400

(b) Mode = £18 000

(d) Median salary = £18 000

(d) Mode or median are the best as most employees earn £18 000. Mean is not a sensible choice as no-one actually earns £21 400 – one person earns considerably more than this and two people earn less than half of it.

Grade C

1. ((1×10) + (3×20) + (5×25) + (7×35) + (9×24) + (11×6)) ÷ 120
   722 ÷ 120 = 6.016...
   = 6.0 hours

2. (a) 150 < C ≤ 200
   Use of cumulative frequency to find
   the cost of the 23rd computer.
   5, 14, 22, 33, 45. It is in the 150 < c ⩽ 200 interval.

   (b) No, because the value is in the same interval

3. (a) (56 + 66 + 84 + 106) ÷ 4 = 78
   (66 + 84 + 106 + 66) ÷ 4 = 80.5
   (84 + 106 + 66 + 70) ÷ 4 = 81.5
   (b) The number of DVD players being sold is increasing

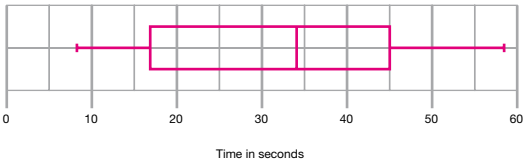
4. 60 × 2.8 = 168 (total watched)
   40 × 3.3 = 132 (watched by girls)
   (168 – 132) ÷ 20 = 1.8

5. (a) (i) 154
   (15 results, lower quartile = 4th, upper quartile = 12th)
   (ii) 179
   (b) Box with ends at 154 and 179
   Median marked at 169 (8th result)
   Whiskers with ends at 134 and 184
   (the lowest and highest values)

Grade B

1. (a) 34 seconds (33.5 – 34.5)

   (b)



   (c) 45 - 16 = 29 seconds
   On average girls take longer (higher median), girls' times more spread out (higher interquartile range).
   On average boys take less time (lower median), boys' times less spread out (lower interquartile range) so the boys' times are more consistent.

2 (a)

MA1	MA2	MA3	MA4	MA5	MA6	MA7	MA8	MA9
648	633	617	620	610	592	572	549	547

   (b) Graph with original data and above moving averages.
   (c) Gradual downward trend, ie the number of job vacancies fell between the beginning of 2001 and the end of 2003.

Handling Data
36. Line Graphs and Pictograms

Grade	Learning Objective	Grade achieved
G	• Draw and interpret pictograms	
F	• Draw and interpret line graphs for all types of data	
E	• Make sure you are able to meet **ALL** the objectives at lower grades	
D	• Make sure you are able to meet **ALL** the objectives at lower grades	
C	• Make sure you are able to meet **ALL** the objectives at lower grades	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade G

- **Draw and interpret pictograms**

1. Here is a pictogram showing time Christine spent on the telephone last week.

Monday	✆ ✆
Tuesday	✆ ✆ ✆
Wednesday	✆ ✆
Thursday	✆ ✆
Friday	✆ ✆ ✆ ✆
Saturday	
Sunday	

✆ Represents 10 minutes

(a) Write down the time spent on the telephone on

(i) Tuesday

(ii) Wednesday *(2 marks)*

(b) On Saturday Christine spent 40 minutes on the telephone.

Show this on the pictogram. *(1 mark)*

(c) On Sunday Christine spent 25 minutes on the telephone.

Show this on the pictogram. *(1 mark)*

Grade F

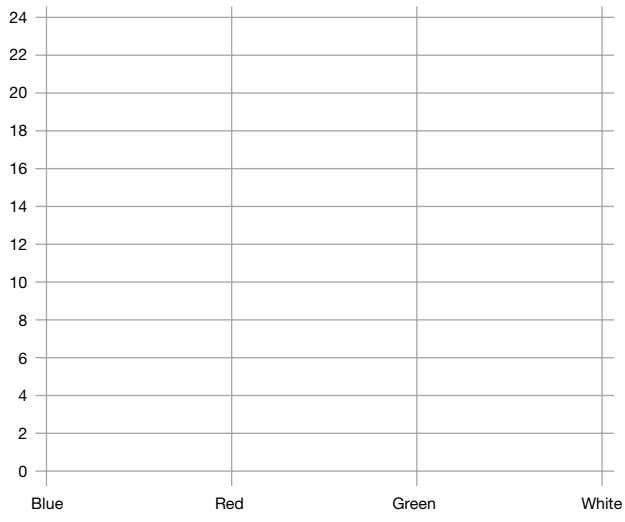
- **Draw and interpret line graphs for all types of data**

1. Sam recorded the colours of cars parked at her school yesterday.

The table shows her results.

Colour	Frequency
Blue	20
Red	22
Green	6
White	12

(a) On the grid below, draw an accurate line graph to show this information. *(2 marks)*



(b) Which is the modal colour of car? *(1 mark)*

answers

Grade G

1.

(a)

(i)

(ii)

(b)

(c)

Grade F

1.

(a) See Grid

(b)

Grade G

1. (a) (i) 30 minutes

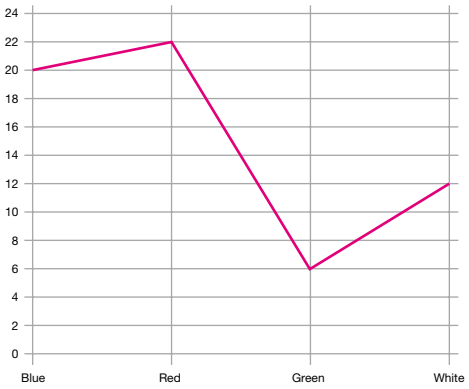
   (ii) 20 minutes

   (b) ✆ ✆ ✆ ✆

   (c) ✆ ✆ ✆

Grade F

1. (a)



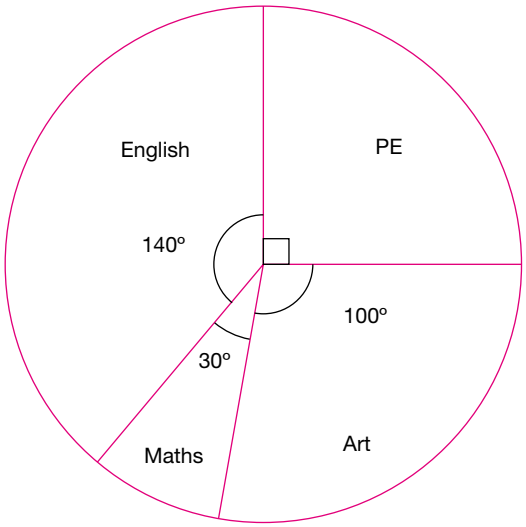
   (b) Red

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• Interpret pie charts	
E	• Make sure you are able to meet **ALL** the objectives at lower grades	
D	• Construct pie charts	
C	• Construct a frequency polygon for grouped data	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade F

- **Interpret pie charts**

1. In a survey, some students at a primary school were asked what their favourite subject was. Their answers were used to draw this pie chart.



(a) Write down the fraction of the students who answered "Art".
Write your answer in its simplest form. *(2 marks)*

18 students answered "PE".

(b) Work out the number of students who took part in the survey. *(2 marks)*

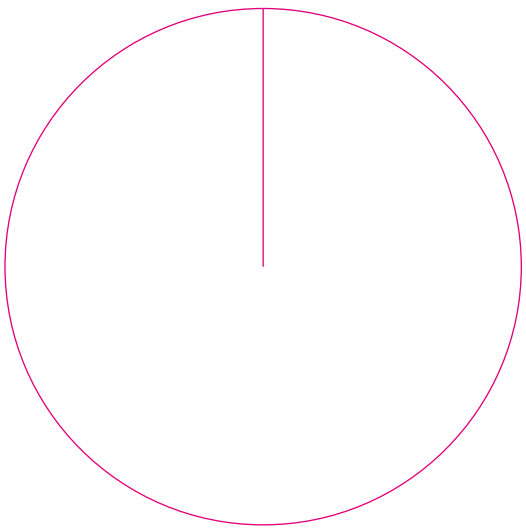
Grade D

- **Construct pie charts**

1. The table shows information about 40 people's colour of car.

Colour of car	Number of cars
Red	12
Blue	5
White	14
Black	9

Draw an accurate pie chart to show the information in the table. *(4 marks)*



answers

Grade F

1.

(a)

(b)

Grade D

1. See Diagram

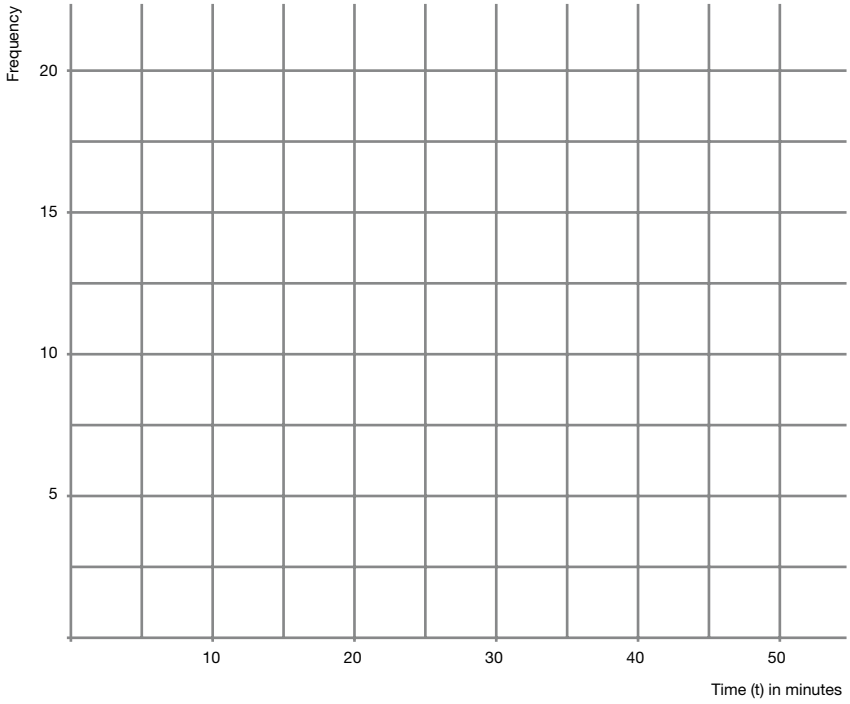
Grade C

- **Construct a frequency polygon for grouped data**

1. The number of minutes it took a group of year 4 pupils to get to school was recorded.
   This information was used to complete the frequency table.

Time (t) minutes	Frequency
$0 < t \leqslant 10$	8
$10 < t \leqslant 20$	16
$20 < t \leqslant 30$	15
$30 < t \leqslant 40$	12
$40 < t \leqslant 50$	6

On the grid below draw a frequency polygon to represent this data. *(3 marks)*



answers

Grade C

1.

See Grid

Grade F

Answers

1. (a) $\frac{100°}{360°} = \frac{10}{36} = \frac{5}{18}$

   (b) PE = 18 pupils, PE is ¼ of the circle

   ∴ Total = 18 × 4

   = 72 pupils

Grade D

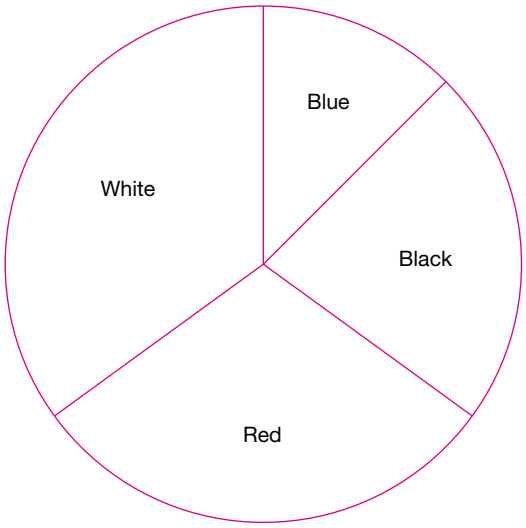
1. 360° ÷ 40 = 9° per car

   Blue = 5 × 9 = 45°

   Black = 9 × 9 = 81°

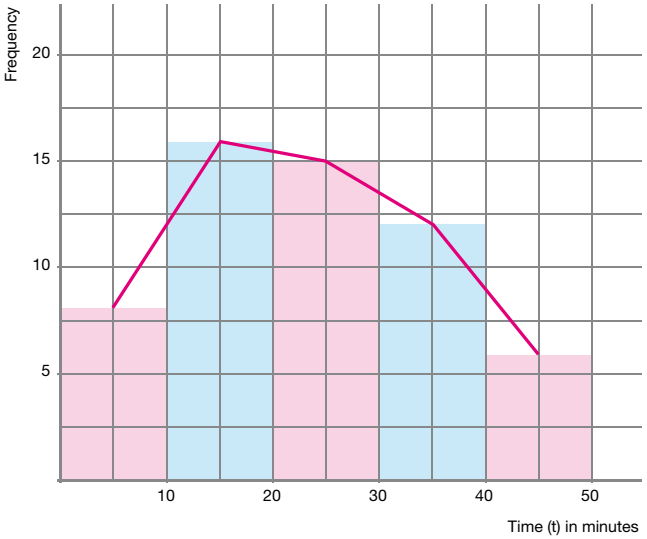
   Red = 12 × 9 = 108°

   White = 14 × 9 = 126°



Grade C

1.



38. Scatter Diagrams & Cumulative Frequency Diagrams

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• Plot and use a scatter diagram to describe the relationship between two variables, in terms of weak or strong and positive or negative • Draw a line of best fit where possible, 'by eye', and use this to make predictions	
C	• Complete a cumulative frequency table • Plot a cumulative frequency curve using upper class boundaries	
B	• Use a cumulative frequency curve to estimate median, lower quartile, upper quartile and interquartile range • Solve problems using a cumulative frequency curve • Compare two cumulative frequency curves and comment on the differences between the distributions	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

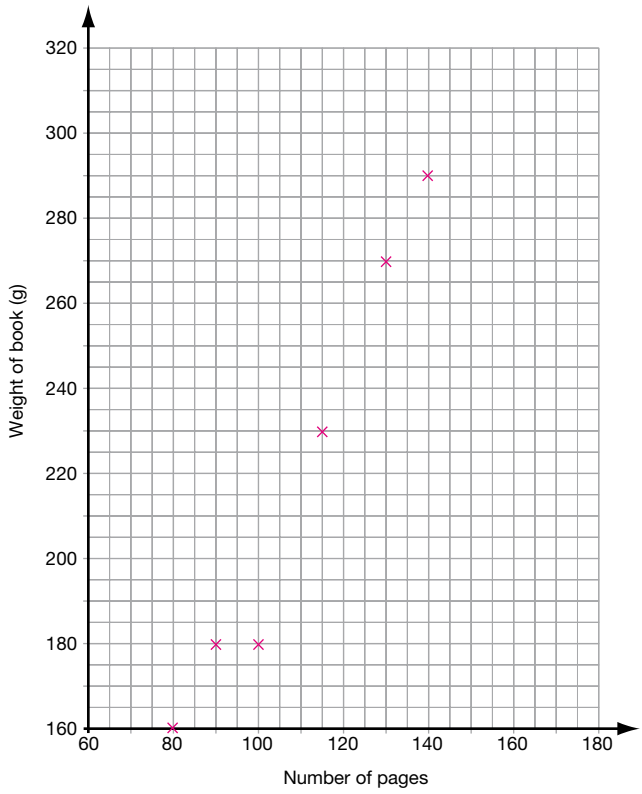
Grade D

- **Plot and use a scatter diagram to describe the relationship between two variables, in terms of weak or strong and positive or negative**

1. The table shows the number of pages and the weight, in grams, for each of 10 books.

Number of pages	80	130	100	140	115	90	160	140	115	140
Weight (g)	160	270	180	290	230	180	315	270	215	295

(a) Complete the scatter graph to show the information in the table.
The first 6 points in the table have been plotted for you. *(1 mark)*



(b) For these books, describe the relationship between the number of pages and the weight of a book. *(1 mark)*

Grade D

answers

1.

(a) See Graph

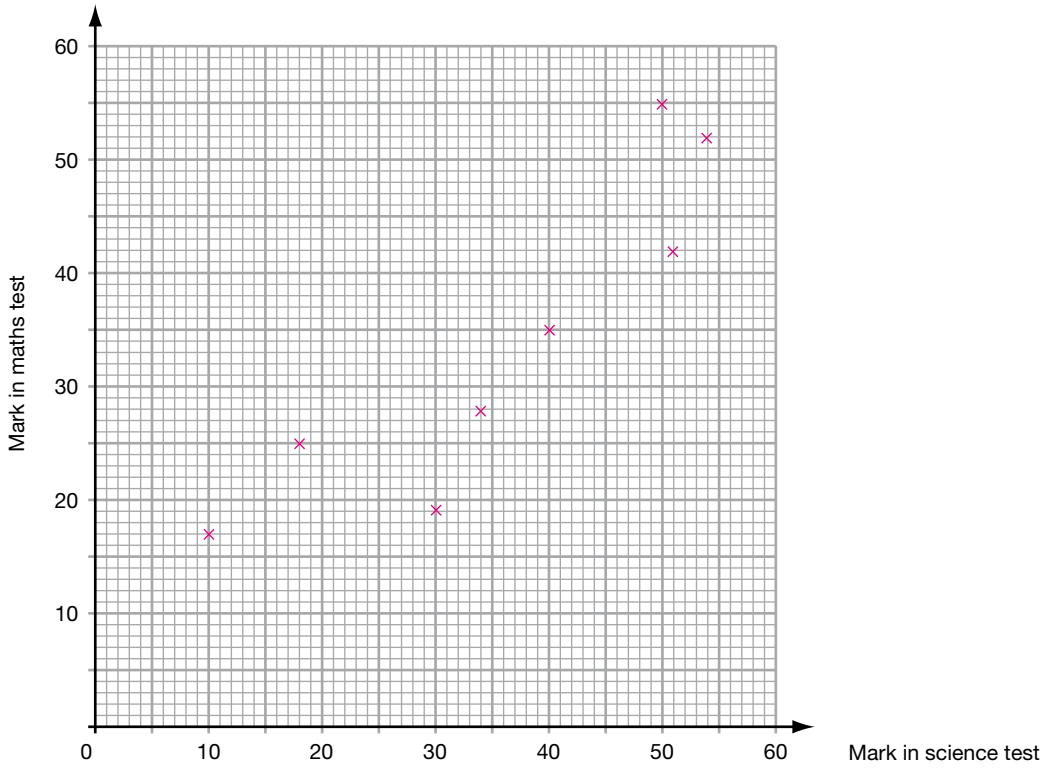
(b)

Grade D

- **Draw a line of best fit where possible, 'by eye' and use this to make predictions**

2. Some students took a science test and a mathematics test.

The scatter graph shows information about the test marks of eight students.



The table shows the test marks of four more students.

Mark in science test	24	25	40	53
Mark in maths test	17	23	48	55

(a) On the scatter graph, plot the information from the table. *(2 marks)*

(b) Draw a line of best fit on the scatter graph. *(1 mark)*

(c) Joe scored 45 marks on his science test

Use the line of best fit to estimate what he scored on his mathematics test *(1 mark)*

Grade C

- **Design and complete a cumulative frequency table, identifying class boundaries where necessary**

1. The table gives information about the ages of 150 employees of a department store.

Age (A) in years	Frequency	Cumulative Frequency
$15 < A \leq 25$	38	
$25 < A \leq 35$	54	
$35 < A \leq 45$	30	
$45 < A \leq 55$	21	
$55 < A \leq 75$	7	

Complete the cumulative frequency table. *(1 mark)*

answers

Grade D

2.

(a) See Graph

(b) See Graph

(c)

Grade C

1. See Table

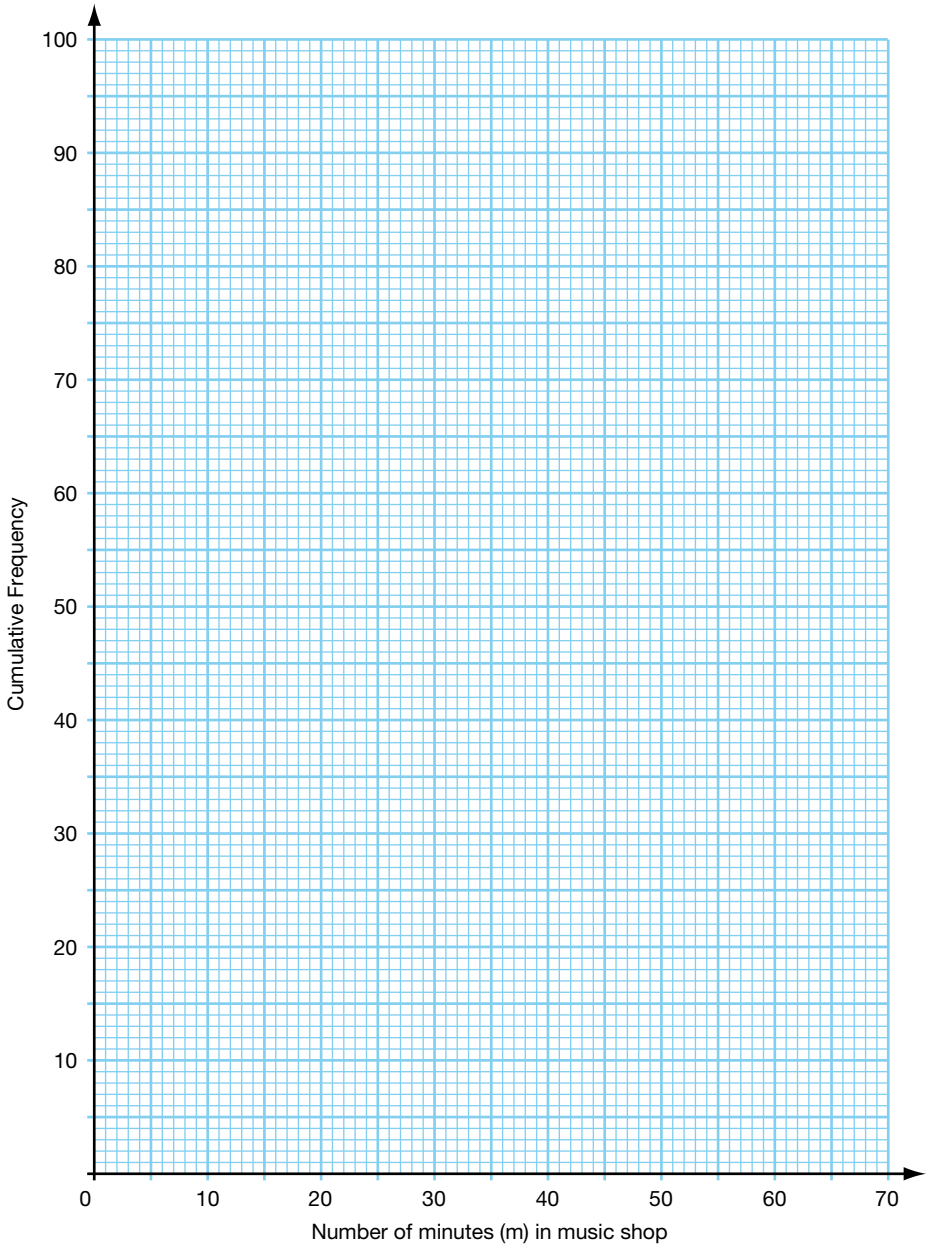
Grade C

- **Plot a cumulative frequency curve using upper class boundaries**

2. This cumulative frequency table gives information about the number of minutes 80 customers were in a music shop.

No. of minutes (m) in music shop	Frequency	Cumulative frequency
$0 < m \leq 10$	2	2
$0 < m \leq 20$	7	9
$0 < m \leq 30$	9	18
$0 < m \leq 40$	25	43
$0 < m \leq 50$	21	64
$0 < m \leq 60$	10	74
$0 < m \leq 70$	6	80

(a) On the grid, draw a cumulative frequency graph for the data in the table. *(2 marks)*



answers

Grade C

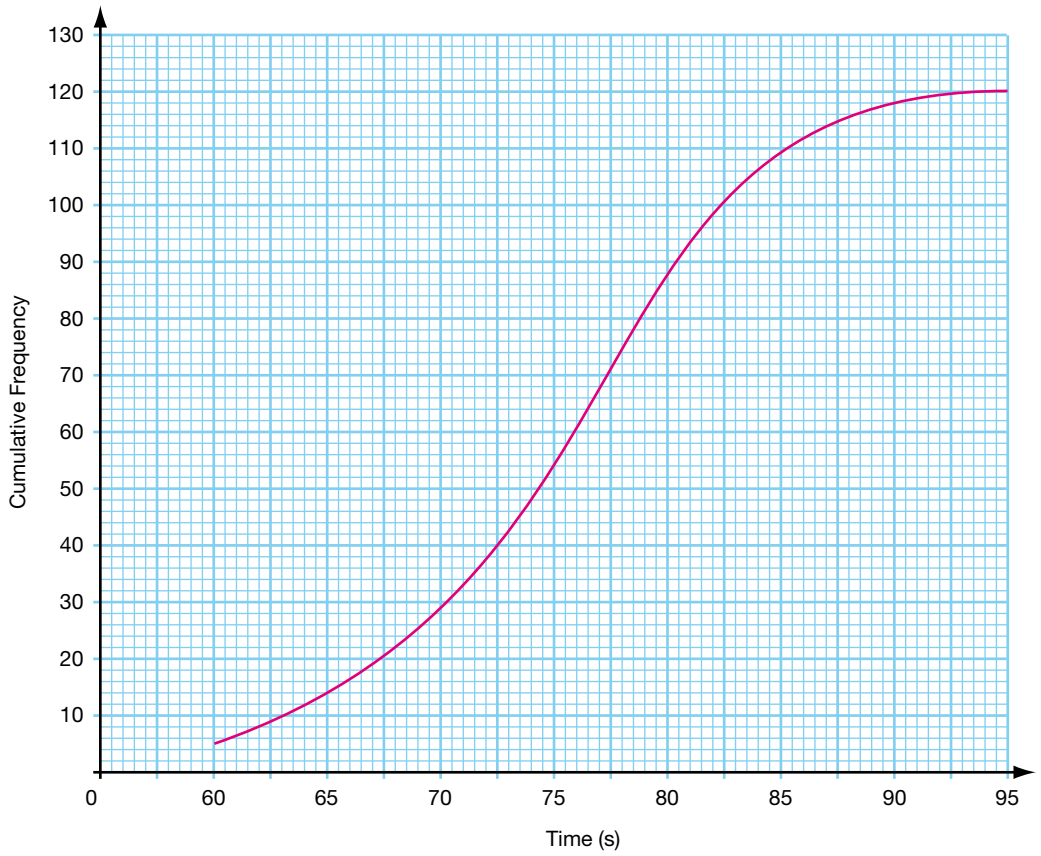
2.

(a) See Graph

Grade B

- **Use a cumulative frequency curve to estimate median, lower quartile, upper quartile and interquartile range**

1. The cumulative frequency diagram below gives information about how long it took 120 pupils to complete 3 lengths of a swimming pool.



(a) Find an estimate for the median time. *(1 mark)*

(b) Work out an estimate for the

(i) Upper quartile *(1 mark)*

(ii) Lower quartile *(1 mark)*

(iii) Interquartile range of the times of the 120 pupils. *(2 marks)*

answers

Grade B

1.

(a)

(b)

(i)

(ii)

(iii)

Grade B

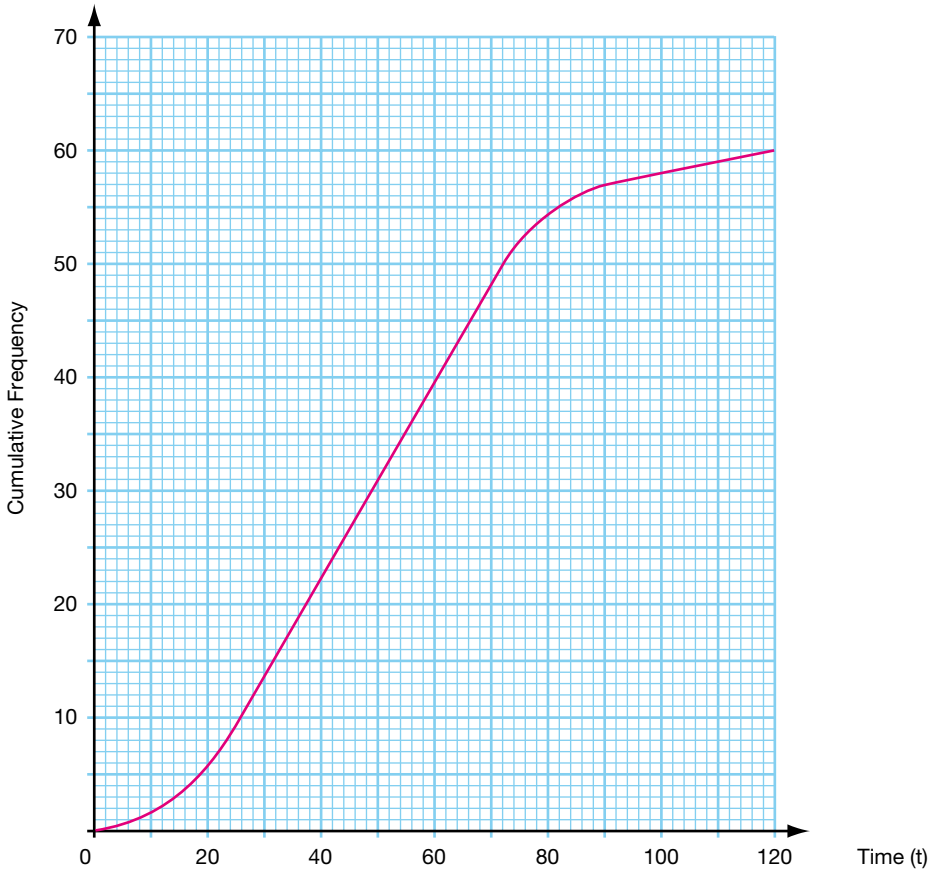
- **Solve problems using a cumulative frequency curve**

2. 60 office workers recorded how many minutes it took them to travel to work.

The grouped frequency table gives information about their journeys.

Time taken (t) in minutes	Frequency
$0 \le m < 20$	6
$20 \le m < 40$	18
$40 \le m < 60$	16
$60 \le m < 80$	15
$80 \le m < 100$	3
$100 \le m < 120$	2

The cumulative frequency graph for this information has been drawn on the grid.



(a) Use this graph to work out an estimate for the number of workers who take more than 70 minutes to travel to work. *(2 marks)*

Grade B

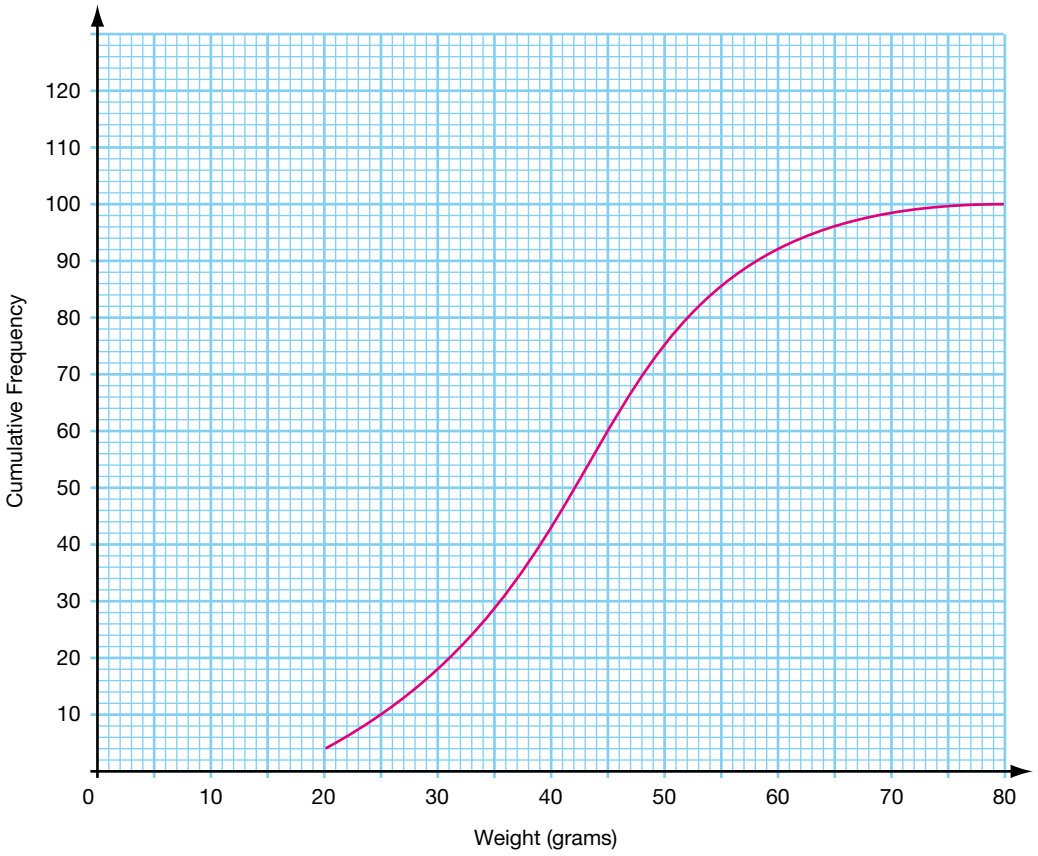
2.

(a)

Grade B

- **Compare two cumulative frequency curves and comment on the differences between the distributions**

3. David took a sample of 100 stones from Cleethorpes Beach.
   He weighed each stone and recorded its mass.
   With this information he drew the cumulative frequency graph shown below.



David also took a sample of 100 stones from Scarborough Beach.
This table shows the distribution of the mass of the stones in the sample from Scarborough Beach.

Mass (w grams)	Cumulative frequency
$0 < w \leq 20$	2
$0 < w \leq 30$	14
$0 < w \leq 40$	37
$0 < w \leq 50$	64
$0 < w \leq 60$	85
$0 < w \leq 70$	93
$0 < w \leq 80$	100

(a) On the same grid, draw the cumulative frequency graph for the information shown in the table above. *(2 marks)*

(b) (i) Find the median and interquartile range for each beach. *(3 marks)*

(ii) Comment on the differences between the two distributions. *(2 marks)*

Grade B

3.

(a) See Graph

(b) (i)

(ii)

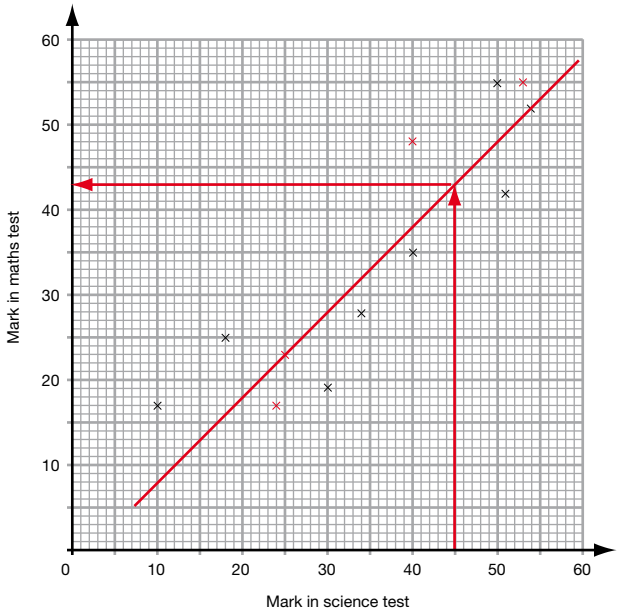
answers

Grade D

1. (a) Points correctly plotted

   (b) Strong positive correlation

2. (a) and (b)



   (c) Approximately 43 marks

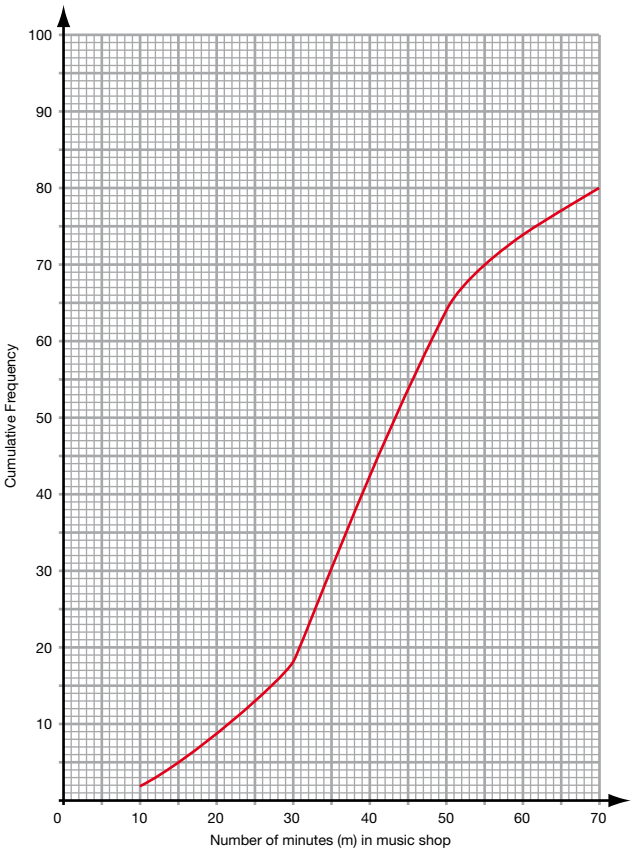
Grade C

1.

Age (A) in years	Frequency	Cumulative Frequency
$15 < A \leq 25$	38	38
$25 < A \leq 35$	54	92
$35 < A \leq 45$	30	122
$45 < A \leq 55$	21	143
$55 < A \leq 75$	7	150

Grade C

2. (a)



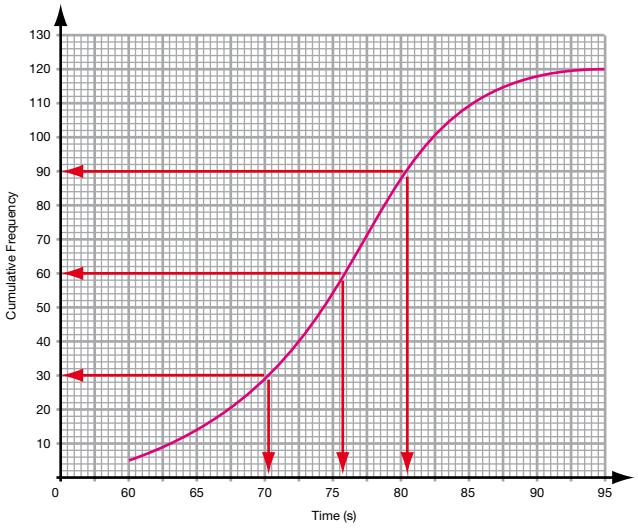
Grade B

1. (a) Median: 76.5 seconds

Lower Quartile (LQ): 70.5 secs;

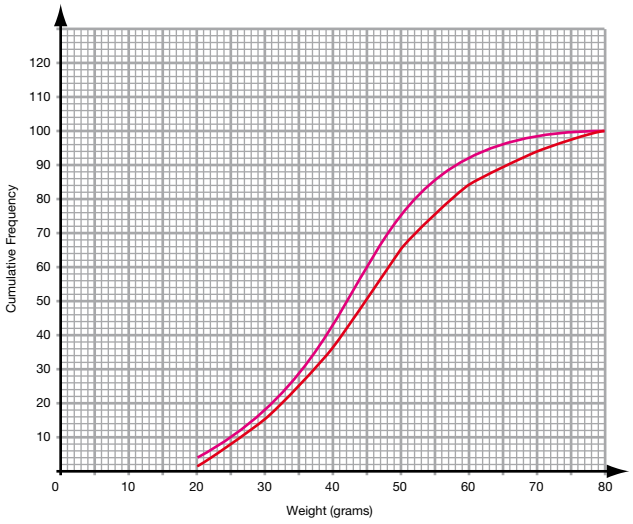
Upper Quartile (UQ): 81 secs

Interquartile range (IQR): 81 – 70.5 = 10.5 secs



2. 48 workers

3. (a)



(b) (i) Cleethorpes Beach: Median = 42 g; IQR = 17

Scarborough Beach: Median = 45 g; IQR = 19

(ii) Distributions very similar, but stones on Scarborough beach tend to be a little heavier than those on Cleethorpes Beach (higher median weight). Slightly lower IQR for Cleethorpes indicates weight of stones slightly more concentrated about the median than for Scarborough.

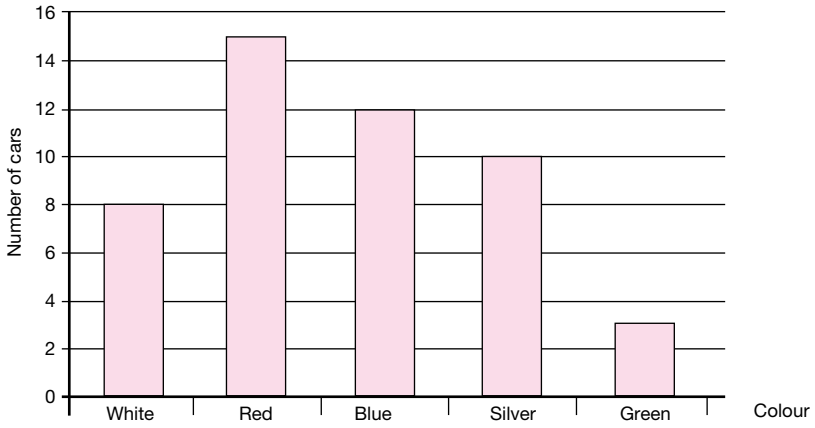
Handling Data
39. Bar Charts & Histograms

Grade	Learning Objective	Grade achieved
G	• Interpret simple bar charts	
F	• Draw and interpret bar charts from grouped data	
E	• Interpret dual bar charts	
D	• Make sure you are able to meet **ALL** the objectives at lower grades	
C	• Make sure you are able to meet **ALL** the objectives at lower grades	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Construct and interpret histograms for grouped continuous data with unequal class intervals	
A*	• Use frequency density to construct a histogram	

Grade G

- **Interpret simple bar charts**

1. Joan wrote down the colour of each car in the school car park.
   The bar chart shows this information.



(a) Write down the number of silver cars. *(1 mark)*

(b) What colour is the mode? *(1 mark)*

(c) Work out the total number of cars. *(1 mark)*

Grade F

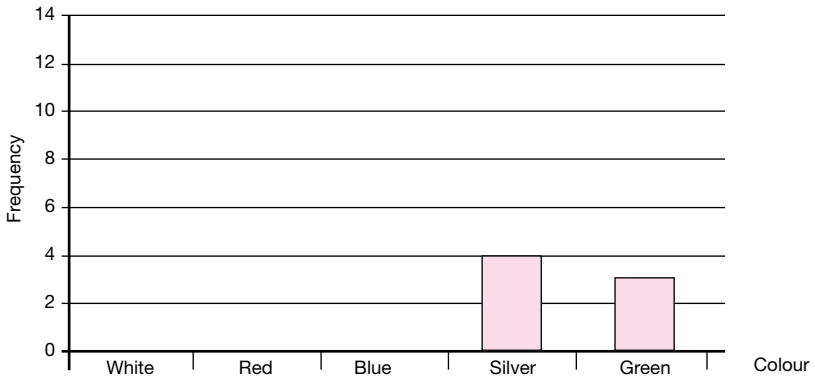
- **Draw and interpret bar charts from grouped data**

1. Stuart did an investigation into the colours of cars sold by a garage in one week.
   He recorded the colour of each car sold. There were only five different colours.
   Stuart then drew a frequency table and a bar chart. Part of the frequency table is shown here.

Colour	Tally	Frequency
Red	𝍸 𝍸 | | |	
Black	𝍸 | | |	
White	𝍸	

(a) Complete the frequency column for the three colours in Stuart's frequency table. *(2 marks)*

Part of Stuart's bar chart is shown below.



(b) Complete the bar chart for the colours Red, Black and White. *(2 marks)*

(c) Which colour was the mode for cars sold in Stuart's investigation? *(1 mark)*

(d) Work out the number of cars that were sold during Stuart's investigation. *(1 mark)*

answers

Grade G

1.

(a)

(b)

(c)

Grade F

1.

(a) See Table

(b) See Bar Chart

(c)

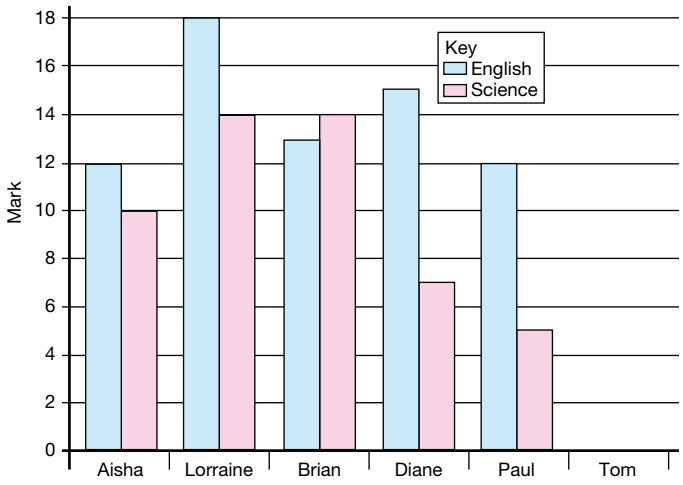
(d)

Grade E

- **Interpret dual bar charts**

1. Six students each sat an English test and a Science test.

   The marks of five of the students, in each of the tests, were used to draw the bar chart.



(a) How many marks did Aisha get in her English test? *(1 mark)*

(b) How many marks did Diane get in her Science test? *(1 mark)*

(c) One student got a lower mark in the English test than in the Science test.

Write down the name of this student. *(1 mark)*

Tom got 16 marks in the English test and 11 marks in the Science test.

(d) Use this information to complete the bar chart. *(2 marks)*

answers

Grade E

1.

(a)

(b)

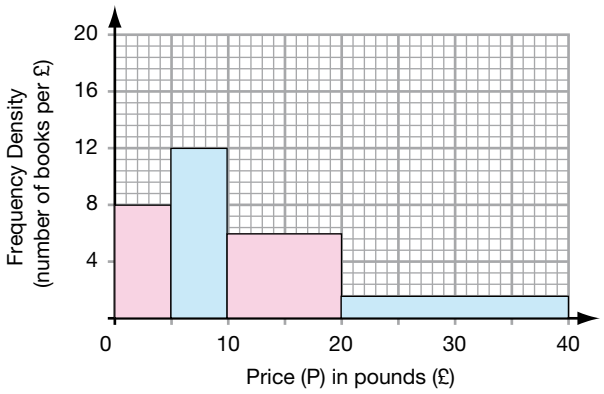
(c)

(d) See Bar Chart

Grade A

- **Construct and interpret histograms for grouped continuous data with unequal class intervals**

1. This histogram gives information about the books sold in a university bookshop one Tuesday.



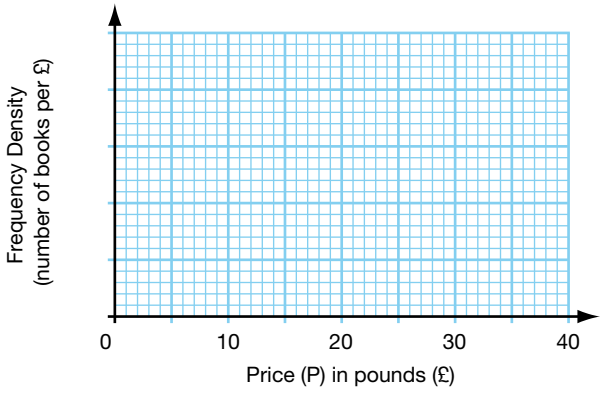
(a) Use the histogram to complete the table. *(2 marks)*

Price (P) in pounds (£)	Frequency
$0 < P \leq 5$	
$5 < P \leq 10$	
$10 < P \leq 20$	
$20 < P \leq 40$	

(b) The frequency table below gives information about the books sold in a different bookshop on the same Tuesday.

Price (P) in pounds (£)	Frequency
$0 < P \leq 5$	80
$5 < P \leq 10$	20
$10 < P \leq 20$	24
$20 < P \leq 40$	96

On the grid below, draw a histogram to represent the information about the books sold in the second bookshop. *(3 marks)*



Grade A

1.

(a) See Table

(b) See Grid

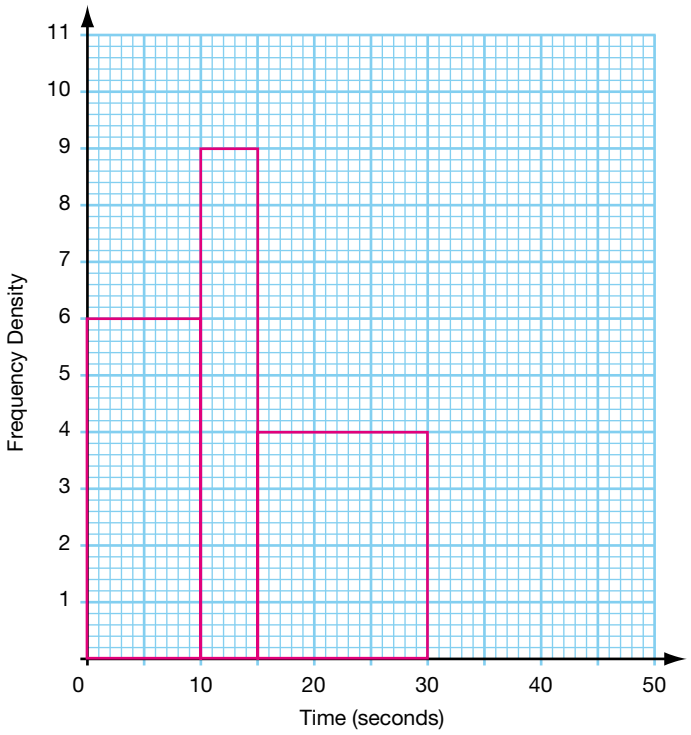
answers

Grade A*

- **Use frequency density to construct a histogram**

1. Sally carried out a survey about the journey time, in minutes, of pupils getting to her school. The results are shown in the incomplete table and the incomplete histogram below.

Time (minutes)	Frequency
0 to < 10	60
10 to < 15	
15 to < 30	60
30 to < 50	50



(a) Use the information in the histogram to complete the table. *(1 mark)*

(b) Use the information in the table to complete the histogram. *(1 mark)*

answers

Grade A*

1.

(a) See Table

(b) See Grid

Grade G

1. (a) 10

   (b) Red

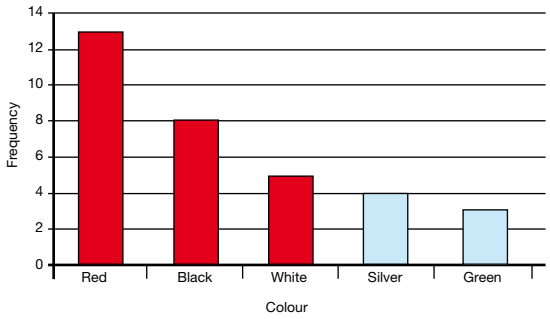
   (c) 8 + 15 + 12 + 10 + 3 = 48 cars

Grade F

1. (a)

Colour	Frequency
Red	13
Black	8
White	5

(b)



(c) Red

(d) 13 + 8 + 5 + 4 + 3 = 33 cars

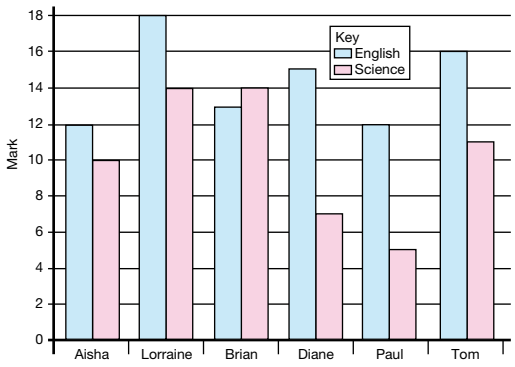
Grade E

1. (a) 12

   (b) 7

   (c) Brian

   (d)



Grade A

1. (a) (Frequency = Frequency density × interval)

Price (P) in pounds (£)	Frequency
$0 < P \leq 5$	40
$5 < P \leq 10$	60
$10 < P \leq 20$	60
$20 < P \leq 40$	20

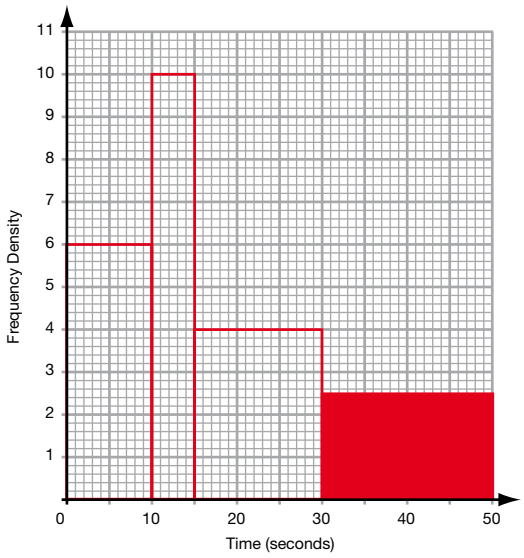
(b)

Price (P) in pounds (£)	Frequency	Frequency density (Height of bar)
$0 < P \leq 5$	80	16
$5 < P \leq 10$	20	4
$10 < P \leq 20$	24	2.4
$20 < P \leq 40$	96	4.8

Grade A*

1. (a)/(b)

Time (minutes)	Frequency
0 to less than 10	60
10 to less than 15	45
15 to less than 30	60
30 to less than 50	50



Handling Data
40. Questionnaires

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• Design a suitable data sheet to collect information	
C	• Design relevant questions to collect information • Appreciate deficiencies in a question, and be able to construct more appropriate questions to collect information	
B	• Make sure you are able to meet **ALL** the objectives at lower grades	
A	• Make sure you are able to meet **ALL** the objectives at lower grades	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade D

- **Design a suitable data sheet to collect information**

1. Anna is going to carry out a survey of the clothes shops each of her female friends shop at. In the space below, draw a suitable data collection sheet that Anna could use. *(3 marks)*

Grade D

answers

1. See Data Sheet

Grade C

- **Design relevant questions to collect information**

1. Mr Smith is going to sell drinks at a school concert.
   He wants to know what type of drinks people like.
   Design a suitable questionnaire he could use to find out what type of drink people like. *(2 marks)*

- **Appreciate deficiencies in a question and be able to construct more appropriate questions to collect information.**

2. Nigella Ramsey, manager of a local restaurant, has made some changes.
   She wants to find out what her customers think of these changes.
   She uses this question on a questionnaire.

> Q. What do you think of the changes in the restaurant?
>
> Excellent ☐ Very Good ☐ Good ☐

   (a) Write down 2 things that are wrong with this question. *(2 marks)*
   (b) Design a better question for the manager to use.
   You should include some response boxes. *(2 marks)*

answers

Grade C

1. See Questionnaire

2.

(a)

(b) See Question/Boxes

Grade D

1. List of shops, tally column, frequency column

Grade C

1. Unbiased question, eg 'What type of soft drink would you like to be on sale at the disco?'
   Boxes for people to tick a response.
2. (a) Insufficient number of responses.
   Biased responses.
   (b) Relevant questions about changes in the restaurant, eg
   'How do you rate the menu changes?'
   'How do you rate the decor changes?'
   Boxes allowing for an unbiased range of responses.

Handling Data
41. Sampling

Grade	Learning Objective	Grade achieved
G	• No objectives at this grade	
F	• No objectives at this grade	
E	• No objectives at this grade	
D	• No objectives at this grade	
C	• No objectives at this grade	
B	• No objectives at this grade	
A	• Understand sampling techniques and justify their choice • Appreciate that a larger sample size will give a more accurate estimate, and question the reliability of results	
A*	• Make sure you are able to meet **ALL** the objectives at lower grades	

Grade A

- **Understand sampling techniques, and justify their choice**

1. The table shows some information about the pupils at Castor School.

Year Group	Boys	Girls	Total
Year 7	104	71	175
Year 8	94	98	192
Year 9	80	120	200
Total	278	289	567

Sophie carries out a survey of the pupils at Castor School.
She takes a sample of 90 pupils, stratified by both Year group and gender.

(a) Work out the number of Year 9 girls in her sample. *(2 marks)*

(b) (i) Explain what is meant by a random sample.

(ii) Describe a method that Sophie could use to take a random sample of Year 9 boys. *(2 marks)*

(iii) Explain why the method you described above is appropriate. *(2 marks)*

- **Appreciate that a larger sample size will give a more accurate estimate, and question the reliability of results**

2. Ian conducted a telephone poll.
He asked 120 people if they travelled by train regularly, and 25% said they did.
Ian concluded that his research proved that 25% of the population use the train regularly.

(a) Was Ian's conclusion correct? *(1 mark)*

(b) List three deficiencies in Ian's sampling technique. *(3 marks)*

(c) Name two types of sampling that are essential if a sample is to represent groups of people or the population of a whole country. *(2 marks)*

Grade A

answers

1.

(a)

(b) (i)

(ii)

(iii)

2.

(a)

(b)

(c)

Grade A

1. (a) $^{120}/_{567} \times 90 = 19$ pupils

   (b) (i) Everyone has an equal chance of being selected

   (ii) Any valid method (e.g. names out of hat)

   (iii) Everyone has equal chance of being selected, simple way of selecting sample, not time-consuming, inexpensive, can be seen to be fair

2. (a) Probably not.

   (b) Sample is far too small, plus any two others,
   Some people have no telephone (eg tenants/students)
   What time of day was the poll conducted? - When might train-users be at home?
   Which part or parts of the country were involved?

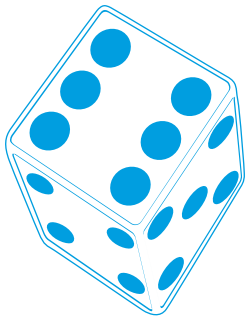
   (c) Stratified; quota.

Grade	Learning Objective	Grade achieved
G	• Mark the position of a probability on a probability scale • Describe the likelihood of an event • List the outcomes of one or two events • Understand the meaning of *certainty* and *impossibility* • Know the values that all probabilities lie between	
F	• Write down the probability of a single event happening • Use a probability scale to solve problems • Use a list of outcomes to write down the probability of an event occurring	
E	• Write down theoretical probabilities as numbers • Find the probability of an event happening given the probability of an event not happening • Solve probability problems using two-way tables	
D	• Predict how many times an event may happen given the probability • Construct a sample space and use it to find probabilities	
C	• Know when to use the 'OR' rule: P(A) + P(B) and the 'AND' rule: P(A) × P(B).	
B	• Use tree diagrams to represent outcomes for two successive events and calculate their related probabilities • Use the vocabulary of probability to interpret results	
A	• Understand and use tree diagrams without replacement	
A*	• Use the ideas of conditional probability to solve problems	

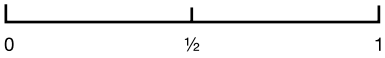
Grade G

- **Mark the position of a probability on a probability scale**
- **Understand the meaning of *certainty* and *impossibility*.**

1. Alexis rolls a normal dice with faces numbered from 1 to 6.



On the probability scale below mark with a letter

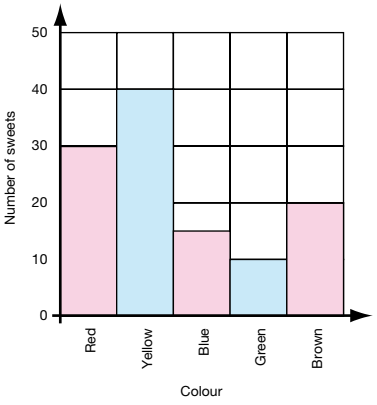


(i) A the probability of scoring an odd number.

(ii) B the probability of scoring a twelve. Use a word to describe this probability.

(iii) C the probability of scoring a number between 1 and 6.
Use a word to describe this probability. *(5 marks)*

- **Describe in words the likelihood of an event**



2. A box contains sweets of different colours.
The bar chart shows how many sweets of each colour are in the box.

(a) (i) Which colour sweet is most likely to be taken?

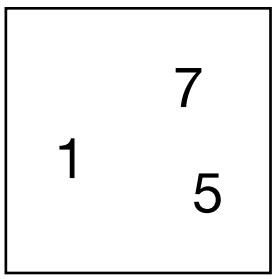
(ii) Explain your answer to part i).

(b) In words, what is the probability of picking a green sweet? *(3 marks)*

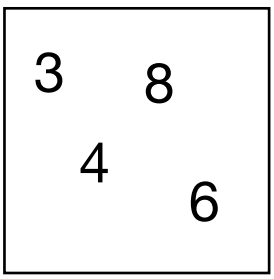
- **List the outcomes of one or two events**

3. Lizzy picks one number from Box A.
She then picks one number from Box B.
List all the pairs of numbers she could pick. One pair (1, 3) is shown. *(2 marks)*

Box A



Box B



- **Know the values that all probabilities lie between**

4. Luke says the probability that he will have his tea tonight is 1.6,
explain why he is wrong. *(1 mark)*

Grade G

answers

1.

(i) See Diagram

(ii) See Diagram

(iii) See Diagram

2.

(a) (i)

(ii)

(b)

3. (1,3)

4.

Grade F

- **Write down the probability of a single event happening**

1. Richard has a box of toy cars. Each car is red or blue or white.

   3 of the cars are red.

   4 of the cars are blue.

   2 of the cars are white.

   Richard chooses one car at random from the box.

   Write down the probability that Richard will choose a white car. *(1 mark)*

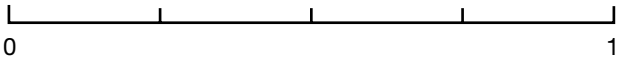
- **Use a probability scale to solve problems**

2. There are eight counters in a bag.

   Four counters are black and the others are white.

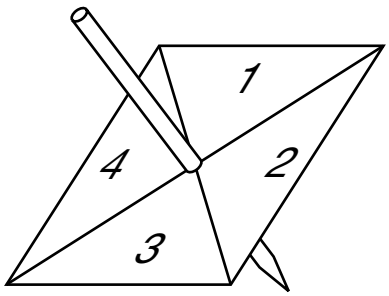
   Noor takes a counter from the bag without looking.

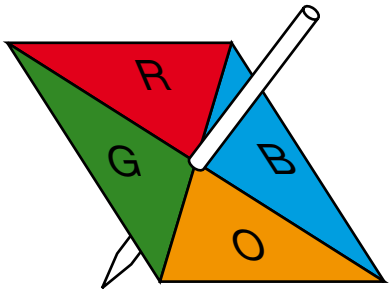
   (a) On the probability line below mark with an arrow the probability that she will take a black counter. *(1 mark)*



- **Use a list of outcomes to write down the probability of an event occurring**

3. Here are two fair 4-sided spinners.





   The first spinner has four sections numbered 1, 2, 3 and 4.

   The second has four sections that are red (R), blue (B), orange (O) and green (G)

   (a) List all the options the two spinners could land on when they are both spun, the first has been done for you (1, Red). *(2 marks)*

   (b) Use this list to find the probability of the first spinner landing on 1, and the second landing on blue. *(1 mark)*

Grade F

1.

2.

(a) See Diagram

3.

(a) (1, Red)

(b)

answers

Grade E

- **Write down theoretical probabilities as numbers**

1. Janet has a bag of £1 coins.
   6 of the coins are dated 1998.
   5 of the coins are dated 1999.
   The other 9 coins are dated 2000.

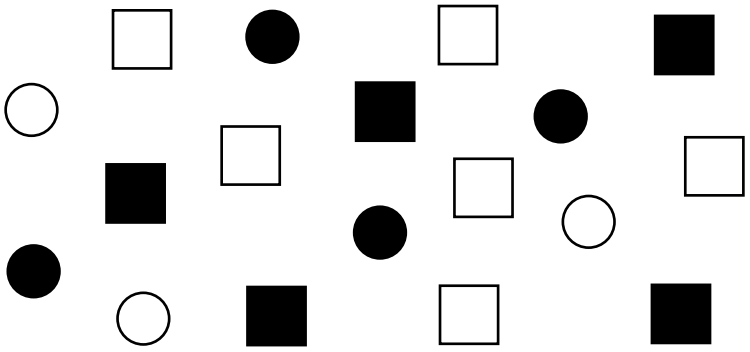
   Janet chooses one of the coins at random from the bag.
   What is the probability she will choose a coin dated 2000?
   Write your answer as a decimal. *(2 marks)*

- **Find the probability of an event happening given the probability of an event not happening**

2. Debbie is playing a game.
   The probability that she will lose the game is 0.11
   Write down the probability that Debbie will win the game. *(1 mark)*

- **Solve probability problems using 2-way tables**

3. Look at the shapes below.



(a) Complete the table to show the number of shapes in each category. *(2 marks)*

	Black	White	Total
Square			
Circle			
Total			

(b) One of the shapes in the diagram is chosen at random.
Write down the probability that the shape will be
(i) a white square,
(ii) a black square or a white circle. *(4 marks)*

Grade E

1.

2.

3.

(a) See Table

(b)
(i)
(ii)

Grade D

- **Predict how many times an event may happen given the probability**

1. The probability that a biased dice will land on a four is 0.4
   Pam is going to roll the dice 200 times.

   Work out an estimate for the number of times the dice will land on a four. *(2 marks)*

- **Construct a sample space and use it to find probabilities**

2. (a) A coin and an ordinary die are thrown. Complete the sample space below. *(2 marks)*

	1	2	3	4	5	6
Head (H)	H1					
Tail (T)				T4		

   (b) What is the probability of:
   (i) Getting a head and a 4
   (ii) Getting a tail and a prime number
   (iii) Getting a head and a factor of 12
   (iv) Getting a tail and a number bigger than or equal to 4? *(4 marks)*

Grade C

- **Know when to use the 'OR' rule: P(A)+P(B) and the 'AND' rule: P(A) x P(B)**

1. Julia and Gaby each try to score a goal.
   They each have one attempt.
   The probability that Julia will score a goal is 0.8.
   The probability that Gaby will score a goal is 0.65.

   (a) Work out the probability that both Julia and Gaby will score a goal. *(2 marks)*
   (b) Work out the probability that Julia will score a goal and Gaby will not score a goal. *(2 marks)*

answers

Grade D

1.

2. (a) See Table

(b)
(i)
(ii)
(iii)
(iv)

Grade C

1.

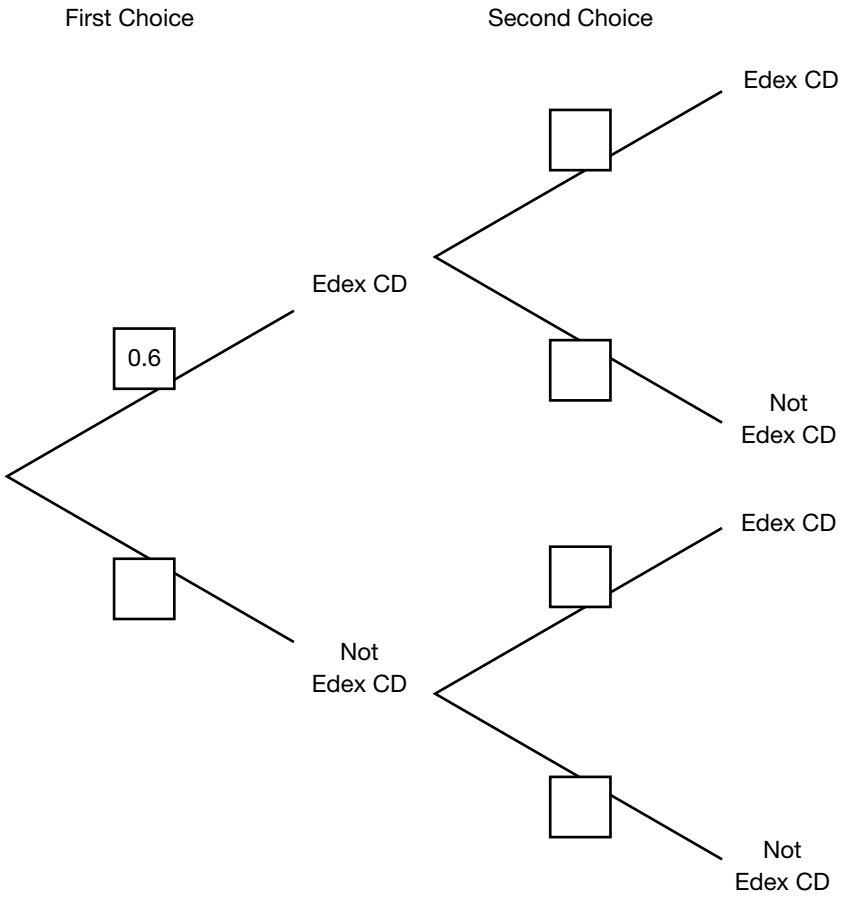
(a)
(b)

Grade B

- **Use tree diagrams to represent outcomes for two successive events and calculate their related probabilities**

1. Chrissie has 20 CDs in a CD holder. Chrissie's favourite group is Edex.
   She has 12 Edex CDs in the CD holder. Chrissie takes one of these CDs at random.
   She writes down whether or not it is an Edex CD. She puts the CD back in the holder.
   Chrissie again takes one of these CDs at random.

   (a) Complete the probability tree diagram. *(2 marks)*



   (b) Find the probability that Chrissie will pick an Edex CD,
   followed by a CD that is not an Edex CD. *(2 marks)*

- **Use the vocabulary of probability to interpret results**

2. Jane does a statistical experiment. She throws a dice 600 times.
   She scores six 200 times.
   (a) Is the dice fair?
   Explain your answer. *(2 marks)*

Grade B

1.

(a) See Diagram

(b)

2.

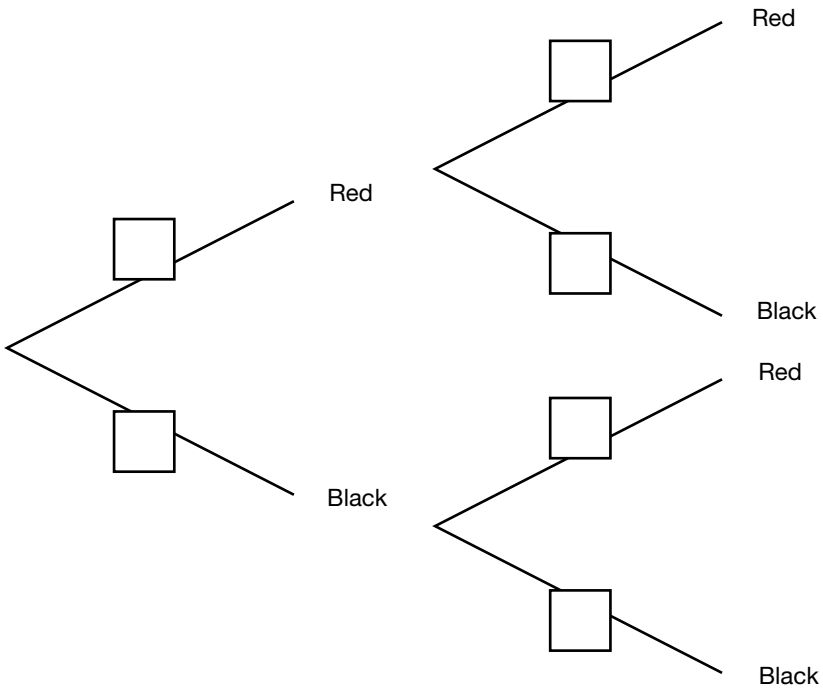
(a)

answers

Grade A

- **Understand and use tree diagrams without replacement**

1. A bag contains 10 coloured discs.
   6 of the discs are red and 4 of the discs are black.
   Brenda is going to take two discs at random from the bag, without replacement.
   (a) Complete the tree diagram. *(2 marks)*



   (b) Work out the probability that Brenda will take two red discs. *(2 marks)*
   (c) Work out the probability that Brenda takes two discs of the same colour. *(3 marks)*

Grade A*

- **Use the ideas of conditional probability to solve problems**

1. In a game of chess, you can win, draw or lose.
   Paul plays two games of chess against Amaani.
   The probability that Paul will win any game against Amaani is 0.65
   The probability that Paul will draw game against Amaani is 0.2
   (a) Work out the probability that Paul will win exactly
   one of the two games against Amaani. *(3 marks)*
   (b) In a game of chess, you score
   1 point for a win
   ½ point for a draw,
   0 points for a loss.
   Work out the probability that after two games,
   Paul's total score will be the same as Amaani's total score. *(3 marks)*

answers

Grade A

1.

(a) See Diagram

(b)

(c)

Grade A*

1.

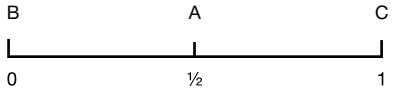
(a)

(b)

Grade G

1. (a)

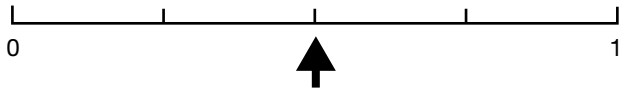
Impossible Certain



2. (a) (i) Yellow
   (ii) There are more yellow sweets than any other
   (b) (Very) unlikely
3. (1,3) (1,4) (1,6) (1,8) (5,3) (5,4)
   (5,6) (5,8) (7,3) (7,4) (7,6) (7,8)
4. All probabilities lie between 0 and 1

Grade F

1. 2/9
2.



3. (a) (1, Red) (1, Blue) (1, Orange) (1, Green)
   (2, Red) (2, Blue) (2, Orange) (2, Green)
   (3, Red) (3, Blue) (3, Orange) (3, Green)
   (4, Red) (4, Blue) (4, Orange) (4, Green)
   (b) 1/16

Grade E

1. 0.45
2. 1 - 0.11 = 0.89
3. (a)

	Black	White	Total
Square	5	6	11
Circle	4	3	7
Total	9	9	18

   (b) (i) 6/18 = 1/3
   (ii) 5/18 + 3/18 = 8/18 = 4/9

Grade D

1. 0.4 × 200 = 80 times
2. (a)

	1	2	3	4	5	6
Head (H)	H1	H2	H3	H4	H5	H6
Tail (T)	T1	T2	T3	T4	T5	T6

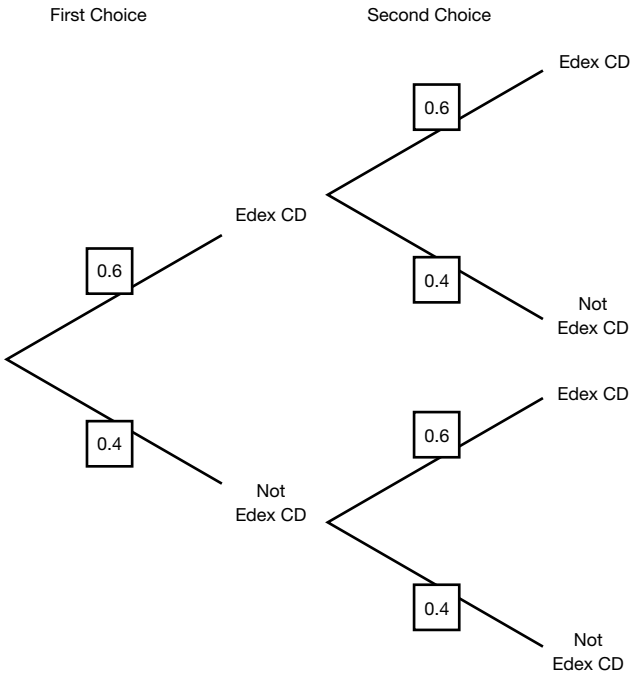
   (b) (i) 1/12
   (ii) 3/12 = 1/4
   (iii) 5/12
   (iv) 3/12 = 1/4

Grade C

1. (a) 0.52 ('AND' rule: 0.8 × 0.65)
   (b) 0.28 (0.8 × 0.35)
   (Probability Gaby will not score a goal is 1 - 0.65 = 0.35)

Grade B

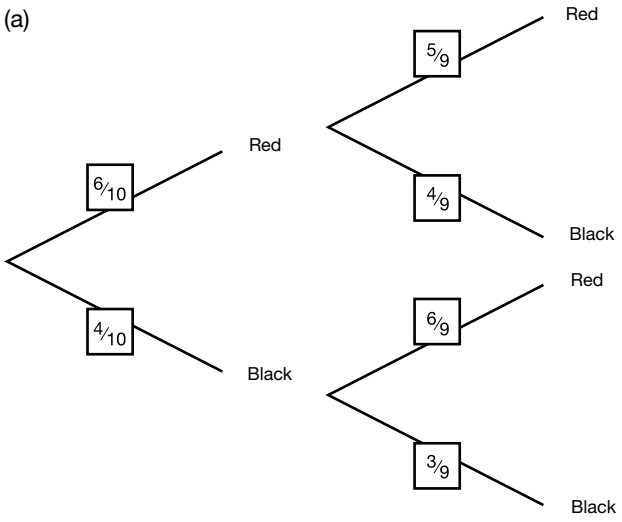
1. (a)



   (b) P(Edex) = 12/20 =0.6
   0.6 × 0.4 = 0.24
2. Theoretical probability of throwing a 6 = 1/6, therefore, in 600 throws expected to throw 6 100 times. Because results in this experiment were 2/6, ie twice the theoretical probability, it could be argued that the dice is biased toward 6, but experimental probability is frequently different to theoretical when the experiment is small scale.

Grade A

1. (a)



(b) P(rr) = $\frac{6}{10} \times \frac{5}{9} = \frac{30}{90} = \frac{1}{3}$

(c) P(rr) + P(bb)

P(bb) = $\frac{4}{10} \times \frac{3}{9} = \frac{12}{90} = \frac{2}{15}$

$\therefore$ P(rr) or P(bb) = $\frac{30}{90} + \frac{12}{90} = \frac{42}{90}$

= $\frac{7}{15}$

Grade A*

1. (a) P(Win) = 0.65

so P(Lose) = 0.35

P(Win) exactly 1 game

= 0.65 × 0.35 or 0.35 × 0.65

= 0.65 × 0.35 × 2

= 0.455

(b) P(Win, Lose) or P(Lose, Win) or P(Draw, Draw)

(0.65 × 0.15) + (0.15 × 0.65) + (0.2 × 0.2)

= 0.0975 + 0.0975 + 0.04

= 0.235

Credits

Written by

Vanessa McGowan

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