

GCSE (9–1) Mathematics J560/04 Paper 4 (Higher Tier) Sample Question Paper

Date – Morning/Afternoon

Time allowed: 1 hour 30 minutes



You may use:

- A scientific or graphical calculator
- Geometrical instruments
- Tracing paper



First name					
Last name					
Centre number					
Candidate number					

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Read each question carefully before you start to write your answer.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION

- The total mark for this paper is **100**.
- The marks for each question are shown in brackets [].
- Use the π button on your calculator or take π to be 3.142 unless the question says otherwise.
- This document consists of **20** pages.

Answer **all** the questions

- 1 18 rice cakes weigh a total of 130 g.
There are 329 calories in 100 g of rice cakes.

How many calories are there in one rice cake?

..... calories [3]

- 2 A circular table top has radius 70 cm.

(a) Calculate the area of the table top in cm^2 , giving your answer as a multiple of π .

(a) cm^2 [2]

(b) The volume of the table top is $17\,150\pi \text{ cm}^3$.

Calculate the thickness of the table top.

(b) cm [2]

3 The value of a car £ V is given by

$$V = 20\,000 \times 0.9^t$$

where t is the age of the car in complete years.

(a) Write down the value of V when $t = 0$.

(a) £ [1]

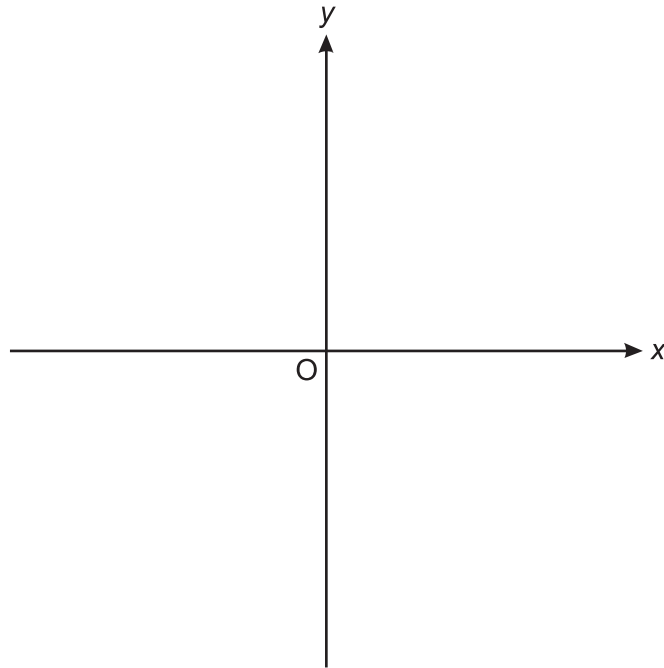
(b) What is the value of V when $t = 3$?

(b) £ [2]

(c) After how many complete years will the car's value drop below £10 000?

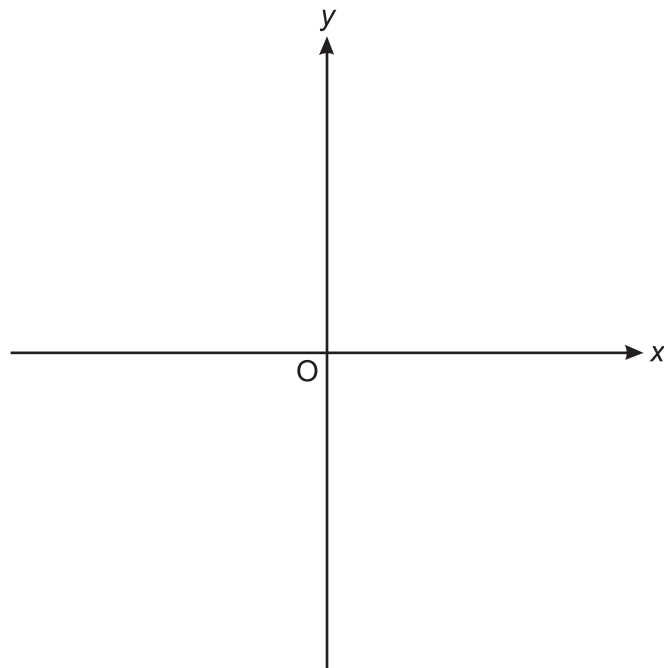
(c) [2]

- 4 (a) (i) Sketch a graph on the axes below that shows that y is directly proportional to x .



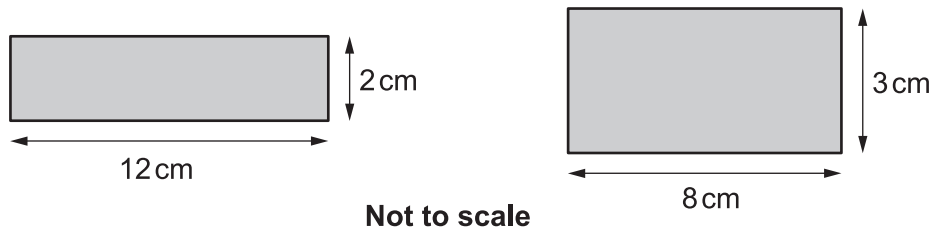
[2]

- (ii) Sketch a graph on the axes below that shows $y = x^3$.

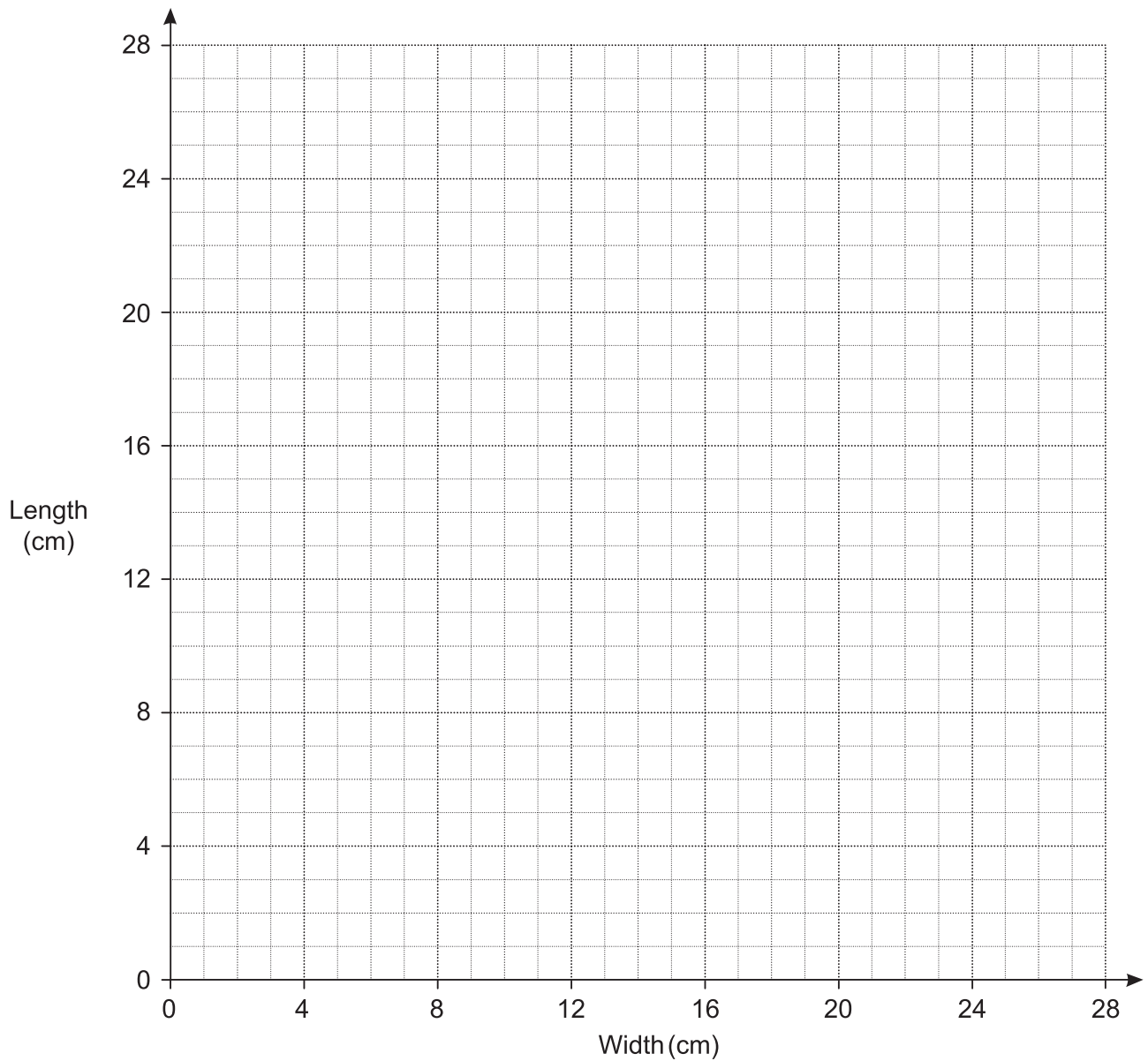


[2]

- (b) It is possible to draw many rectangles that have area 24 cm^2 .
Here are two of them.



- (i) Plot the dimensions of these two rectangles on the grid below. [1]
- (ii) Complete the graph to show the relationship between length and width for rectangles with area 24 cm^2 . [3]



5 Kieran, Jermaine and Chris play football.

- Kieran has scored 8 more goals than Chris.
- Jermaine has scored 5 more goals than Kieran.
- Altogether they have scored 72 goals.

How many goals did they each score?

Kieran

Jermaine

Chris

[5]

- 6 Peter makes a large amount of pink paint by mixing red and white paint in the ratio 2 : 3.

Red paint costs £80 per 10 litres.

White paint costs £5 per 10 litres.

Peter sells his pink paint in 10-litre tins for £60 per tin.

Calculate how much **profit** he makes for each tin he sells.

£ [5]

- 7 Dan believes he knows what his brother Ethan is thinking. He carries out an experiment to test this.

Dan and Ethan sit back-to-back.

Ethan rolls an ordinary fair dice.

Ethan then thinks about the number on the dice while Dan tries to predict this number.

- (a) In 300 attempts, how many correct predictions would you expect Dan to make if he was just guessing?

(a) [2]

- (b) The results of the first 15 attempts are shown in the table.

Ethan's number	2	6	5	3	2	1	5	1	3	4	4	6	1	6	5
Dan's prediction	2	4	3	1	2	6	1	6	4	3	2	6	5	2	3
Matching pair	✓				✓							✓			

Estimate the probability of getting a matching pair using the results of

- (i) the first five attempts,

(b)(i) [1]

- (ii) all 15 attempts.

(ii) [1]

- (c) Use answers from (a) and (b) to comment on Dan's belief that he knows what Ethan is thinking.

.....

 [2]

8 (a) A function is represented by the following function machine.



- (i) A number is input into the machine.
 The output is used as a new input.
 The second output is 11.

Work out the number that was the **first input**.

(a)(i) [2]

- (ii) A number is input into the machine.
 The output given is the same number.

Work out the number.

(ii) [3]

(b) Another function machine is shown below.

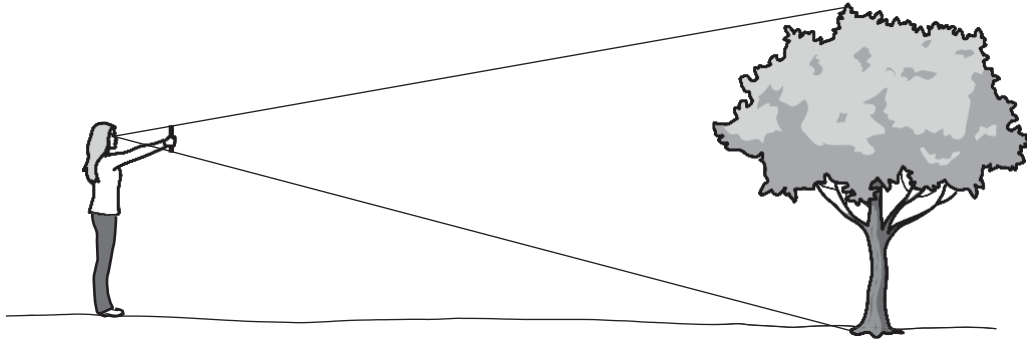


If the Input is 3, the Output is 5.
 If the Input is 7, the Output is 25.

Use this information to fill in the two boxes.

[3]

- 9 (a) Anna estimates the height of a tree.



Anna holds a ruler vertically so the height of the tree is exactly covered by the ruler.
 She is 20 metres from the tree.
 The ruler is 30 cm long.
 The horizontal distance from her eyes to the ruler is 60 cm.

Calculate an estimate of the height of the tree.

(a) m [3]

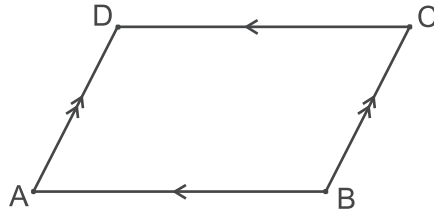
- (b) Give two reasons why this method may not be suitable to estimate the height of a very tall building.

1

2

[2]

10 ABCD is a parallelogram.



Prove that triangle ABD is congruent to triangle CDB.

[3]

- 11 (a) Give **one** reason why 0 is an even number.

.....
 [1]

- (b) The lengths of the sides of a **right-angled** triangle are all integers.

Prove that if the lengths of the two shortest sides are even, then the length of the third side must also be even.

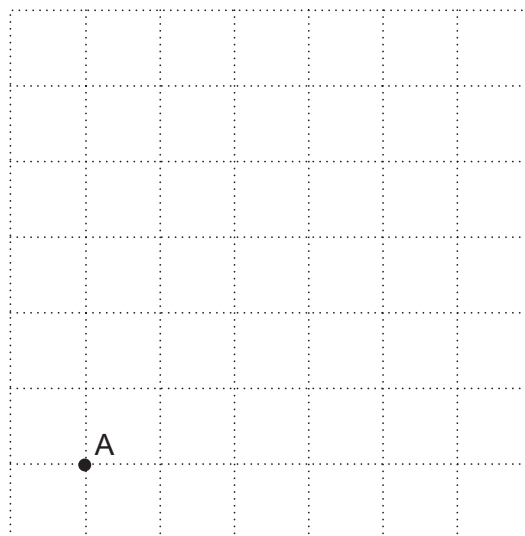
.....

 [3]

- 12 (a) Without using a calculator, show that $\sqrt{20} = 2\sqrt{5}$. [2]

- (b) The point A is shown on the unit grid below.
 The point B is $2\sqrt{5}$ units from A and lies on the intersection of two grid lines.

Mark **one** possible position for B.



[3]

- 13 The volume of Earth is $1.08 \times 10^{12} \text{ km}^3$.
The volume of Jupiter is $1.43 \times 10^{15} \text{ km}^3$.

How many times larger is the radius of Jupiter than the radius of Earth?
Assume that Jupiter and Earth are both spheres.

[The volume v of a sphere with radius r is $v = \frac{4}{3}\pi r^3$.]

..... [4]

14 The table shows the marks gained by 150 students taking an examination.

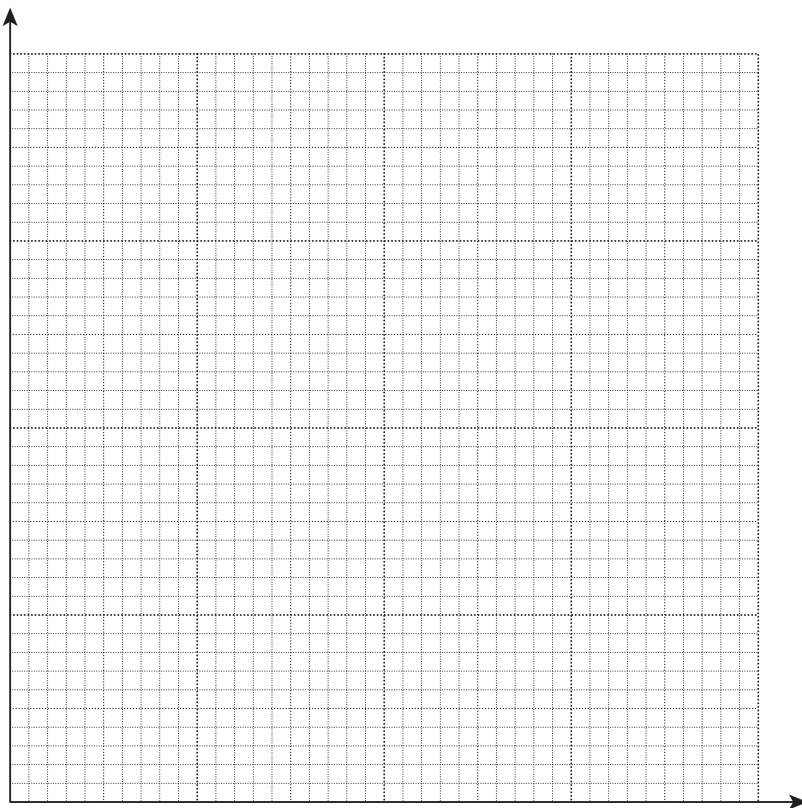
Mark (m)	$0 < m \leq 10$	$10 < m \leq 20$	$20 < m \leq 30$	$30 < m \leq 40$	$40 < m \leq 50$	$50 < m \leq 60$	$60 < m \leq 70$	$70 < m \leq 80$
Frequency	9	14	26	27	25	22	17	10

(a) (i) Construct a cumulative frequency table.

Mark (m)	$m \leq 10$	$m \leq 20$	$m \leq 30$	$m \leq 40$	$m \leq 50$	$m \leq 60$	$m \leq 70$	$m \leq 80$
Cumulative Frequency	9							150

[2]

(ii) Draw the cumulative frequency graph on the grid below.



[4]

- (b) Students are to be awarded Gold, Silver, Bronze or Fail.
The students' teacher wishes to award the top 10% of students Gold, the next 60% Silver and the next 20% Bronze.

Use your graph to estimate the lowest mark that Silver will be awarded for.

(b) [3]

- (c) Explain why the teacher's method will not necessarily award Gold to exactly 10% of the students.

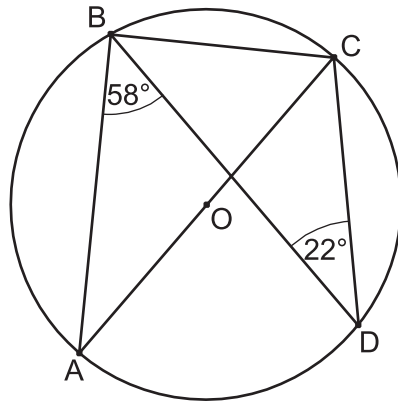
.....
..... [1]

- 15 At a constant temperature, the volume of a gas V is inversely proportional to its pressure p .

By what percentage will the pressure of a gas change if its volume increases by 25%?

..... % [4]

- 16 A, B, C and D are points on the circumference of a circle, centre O.
 AC is a diameter of the circle.
 Angle ABD = 58° .
 Angle CDB = 22° .



Not to scale

Work out the sizes of angle ACD and ACB, giving reasons for your answers.

- (a) Angle ACD = $^\circ$

.....
 [2]

- (b) Angle ACB = $^\circ$

.....

 [3]

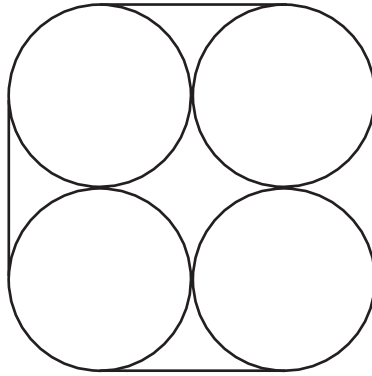
17 A restaurant menu has 8 starters, 12 mains and 6 desserts.
A customer can choose from the following meals

- a starter and a main,
- a main and a dessert,
- a starter, a main and a dessert.

Show that there are 744 different ways of choosing a meal at this restaurant.

[3]

- 18 Four pencils are held together with a band.
The figure below shows the bottom end of the pencils and the band.



Each of the pencils has diameter 9 mm.

Find the length of the band in this position.

..... mm **[4]**

19 A sequence is defined by the term-to-term rule $u_{n+1} = u_n^2 - 8u_n + 17$.

(a) Given that $u_1 = 4$, find u_2 and u_3 .

(a) [2]

(b) Given instead that $u_1 = 2$, find u_2 , u_3 and u_{100} .

(b) [3]

20 (a) Express as a single fraction.

$$\frac{m+1}{n+1} - \frac{m}{n}$$

Simplify your answer.

(a) [2]

(b) Using your answer to part (a), prove that if m and n are positive integers and $m < n$, then

$$\frac{m+1}{n+1} - \frac{m}{n} > 0. \quad [2]$$

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Date – Morning/Afternoon

GCSE (9–1) Mathematics

J560/04 Paper 4 (Higher Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 100

DRAFT

This document consists of 15 pages

Subject-Specific Marking Instructions

1. **M** marks are for using a correct method and are not lost for purely numerical errors.
A marks are for an accurate answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
B marks are independent of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.
SC marks are for special cases that are worthy of some credit.
2. Unless the answer and marks columns of the mark scheme specify **M** and **A** marks etc, or the mark scheme is 'banded', then if the correct answer is clearly given and is not from wrong working **full marks** should be awarded.

Do not award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen and the correct answer clearly follows from it.

3. Where follow through (**FT**) is indicated in the mark scheme, marks can be awarded where the candidate's work follows correctly from a previous answer whether or not it was correct.

Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, e.g. FT $180 \times (\textit{their} '37' + 16)$, or FT $300 - \sqrt{(\textit{their} '5^2 + 7^2')}$. Answers to part questions which are being followed through are indicated by e.g. FT $3 \times \textit{their} (a)$.

For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

4. Where dependent (**dep**) marks are indicated in the mark scheme, you must check that the candidate has met all the criteria specified for the mark to be awarded.
5. The following abbreviations are commonly found in GCSE Mathematics mark schemes.
 - **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point e.g. 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
 - **isw** means **ignore subsequent working** after correct answer obtained and applies as a default.
 - **nfww** means **not from wrong working**.
 - **oe** means **or equivalent**.
 - **rot** means **rounded or truncated**.
 - **seen** means that you should award the mark if that number/expression is seen anywhere in the answer space, including the answer line, even if it is not in the method leading to the final answer.

- **soi** means **seen or implied**.

6. In questions with no final answer line, make no deductions for wrong work after an acceptable answer (ie **isw**) unless the mark scheme says otherwise, indicated by the instruction 'mark final answer'.

7. In questions with a final answer line following working space:

- (i) If the correct answer is seen in the body of working and the answer given on the answer line is a clear transcription error allow full marks unless the mark scheme says 'mark final answer'. Place the annotation ✓ next to the correct answer.
- (ii) If the correct answer is seen in the body of working but the answer line is blank, allow full marks. Place the annotation ✓ next to the correct answer.
- (iii) If the correct answer is seen in the body of working but a completely different answer is seen on the answer line, then accuracy marks for the answer are lost. Method marks could still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation ✗ next to the wrong answer.

8. In questions with a final answer line:

- (i) If one answer is provided on the answer line, mark the method that leads to that answer.
- (ii) If more than one answer is provided on the answer line and there is a single method provided, award method marks only.
- (iii) If more than one answer is provided on the answer line and there is more than one method provided, award zero marks for the question unless the candidate has clearly indicated which method is to be marked.

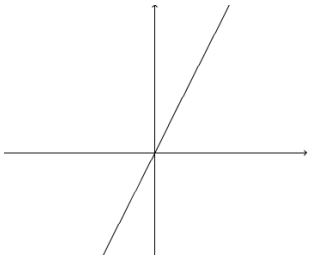
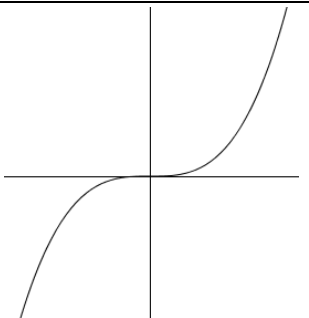
9. In questions with no final answer line:

- (i) If a single response is provided, mark as usual.
- (ii) If more than one response is provided, award zero marks for the question unless the candidate has clearly indicated which response is to be marked.

10. When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the MR annotation. **M** marks are not deducted for misreads.

11. Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures even if this is rounded or truncated on the answer line. For example, an answer in the mark scheme is 15.75, which is seen in the working. The candidate then rounds or truncates this to 15.8, 15 or 16 on the answer line. Allow full marks for the 15.75.
12. Ranges of answers given in the mark scheme are always inclusive.
13. For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.
14. Anything in the mark scheme which is in square brackets [...] is not required for the mark to be earned, but if present it must be correct.

Question		Answer	Marks	Part marks and guidance	
1		23.6 – 23.8 Accept 24 provided full method shown	3 1 AO1.3b 2 AO3.1c	M2 for $\frac{329 \times 130}{18 \times 100}$ Or M1 for any two of $\frac{329}{100}$ or $\frac{130}{100}$ or $\frac{329}{18}$ or 329×130	May be done in stages
2	(a)	4900π	2 1 AO1.2 1 AO1.3a	M1 for $\pi \times 70^2$ may be implied by 15393.8...	
	(b)	3.5	2 2 AO1.3a	M1 for $\frac{17150\pi}{\text{their '4900}\pi\text{'}}$	FT from (a), provided (a) is a multiple of π
3	(a)	£20 000	1 1 AO1.3a		
	(b)	£14 580 or £14 600	2 2 AO1.3a	M1 for $20\,000 \times 0.9^3$	
	(c)	7 years	2 1 AO1.3a 1 AO3.1c	M1 for 2 trials shown	

Question			Answer	Marks	Part marks and guidance
4	(a)	(i)	Any straight line through the origin e.g. 	2 1 AO1.1 1 AO2.3b	B1 for a straight line
		(ii)		2 1 AO1.1 1 AO2.3b	B1 for a cubic with two turning points
	(b)	(i)	At least one point plotted correctly	1 1 AO2.3b	

Question		Answer	Marks	Part marks and guidance	
	(ii)		<p>3</p> <p>1 AO2.3b 1 AO3.1b 1 AO3.2</p>	<p>B2 for at least 5 points correctly plotted</p> <p>OR</p> <p>B1 for at least 3 points correctly plotted</p> <p>AND</p> <p>B1 for <u>curve</u> drawn through <i>their</i> points</p>	
5		25, 30, 17	<p>5</p> <p>2 AO1.3a 2 AO3.1d 1 AO3.3</p>	<p>M1 for any two consistent expressions, e.g. $x - 8$, x</p> <p>M1 for $x - 8 + x + x + 5 = 72$ oe</p> <p>A1 for $x = 25$</p> <p>B1 for Kieran 25 or Jermaine 30 or Chris 17</p>	Accept equivalent correct equations

Question			Answer	Marks	Part marks and guidance
6			£25	5 2 AO1.3b 3 AO3.1d	M1 for $10 \times \frac{2}{5} = 4$ litres red or $10 \times \frac{3}{5} = 6$ litres white M1 for red costs £8 per litre or white costs £0.50 per litre M1 for cost of one 10-litre can is <i>their '4' × their '8' + their '6' × their '0.5'</i> M1 for $60 - \text{their '35'}$ Alternative method: M1 for $2 : 3 = 20$ litres red : 30 litres white M1 for $2 \times £80 + 3 \times £5 = £175$ M1 for $\frac{\text{their '175'}}{5} = 35$ M1 for $60 - \text{their '35'}$
7	(a)		50	2 2 AO1.3a	B1 for $\frac{1}{6}$
	(b)	(i)	$\frac{2}{5}$ oe	1 1 AO2.1b	
		(ii)	$\frac{1}{5}$ oe	1 1 AO2.1b	
	(c)		No evidence that Dan knows what Ethan is thinking as over the 15 trials the relative frequency of $\frac{1}{5}$ is very close to the theoretical probability of $\frac{1}{6}$	2 1 AO2.5a 1 AO3.3	M1 for reason not including reference to $\frac{1}{5}$ relative frequency or $\frac{1}{6}$ theoretical probability FT <i>their (a) and (b)</i>
8	(a)	(i)	-1	2 1 AO1.3a 1 AO3.1a	M1 for use of -5 and $\div 2$ soi Or M1 for answer 3

Question		Answer	Marks	Part marks and guidance	
	(ii)	-5	3 1 AO1.3a 2 AO3.1a	M1 for $2x + 5$ M1 for $x = \text{their '2x + 5'}$ and solve	
	(b)	5, 10	3 1 AO1.3a 2 AO3.1a	M1 for $3a + b = 5$ and $7a + b = 25$ M1 for attempt to solve Or M1 input increases by 4; output increases by 20 M1 so one box must have $\times 5$ for the arithmetic sequence	Condone $\frac{x^2 + 1}{2}$ across the two boxes for 3 marks
9	(a)	10 metres	3 1 AO1.3a 2 AO3.1c	M1 for correct ratio $\frac{\text{height}}{20} = \frac{30}{60}$ oe M1 rearrange Or M1 for scale factor 0.5 M1 for 20×0.5	
	(b)	2 valid reasons, e.g. She would have to be very far from the building. The estimate is likely to be inaccurate due to the scale factors at the distances involved.	2 2 AO3.4a		

Question		Answer	Marks	Part marks and guidance	
10		e.g. BD is common ABD = BDC (alternate angles) AB = CD (parallelogram) So triangles ABD and CBD are congruent by SAS	3 1 AO1.1 2 AO2.4b	B2 for two facts with conclusion or B2 for three facts with conclusion missing or unclear or B1 for one correct fact	Each fact must be backed up with a reason
11	(a)	Any correct reason	1 1 AO2.4a		Exemplar responses: -1 and 1 both odd and either side of 0 Or can be divided by 2 exactly Or numbers that end in 0 are even Or zero remainder when divided by 2 Or next number in pattern of even numbers 8 6 4 2 Or added to an even number it gives even answer and added to odd number gives odd answer
	(b)	e.g. $a^2 + b^2 = c^2$ $a = 2x$ and $b = 2y$ implies $c^2 = 4x^2 + 4y^2$ So c is even	3 1 AO2.1a 1 AO2.4b 1 AO3.2	B1 for use of Pythagoras' theorem M1 for even x even = even soi	

Question		Answer	Marks	Part marks and guidance	
12	(a)	$\sqrt{20} = \sqrt{4 \times 5}$ $= \sqrt{4} \times \sqrt{5}$ $= 2\sqrt{5}$	<p>2 2 AO1.3a</p>	<p>M1 for $\sqrt{4} \times \sqrt{5}$</p>	
	(b)	Either point which is 4 across and 2 up from A or 2 across and 4 up	<p>3 1 AO2.3b 1 AO3.1a 1 AO3.2</p>	<p>B1 for $a^2 + b^2 = 20$ B1 for 4 and 16 (or 2 and 4) seen</p> <p>If zero scored SC1 for correctly marking the position of <i>their a</i> and <i>b</i></p>	
13		11 or better	<p>4 2 AO1.3b 1 AO3.1b 1 AO3.2</p>	<p>M1 for $r = \sqrt[3]{\frac{3V}{4\pi}}$ soi</p> <p>A1 for r (Earth) = 6365 km or r (Jupiter) = 69890 km</p> <p>M1 for <math>\frac{\textit{their}'69890'}<!--{\textit{their}'6365'}</math--></math></p>	
				<p>Alternate method: M1 for $\frac{1.43 \times 10^{15}}{1.08 \times 10^{12}}$ A1 for 1324[.074...] M1 for $\sqrt[3]{1324}$</p>	

Question			Answer	Marks	Part marks and guidance
14	(a)	(i)	Table: 9 23 49 76 101 123 140 150	2 2 AO1.3a	M1 for attempt to accumulate the values
		(ii)		4 1 AO1.3b 3 AO2.3b	B1 for labelling axes B1 for correct curve through points B1 for at least six points correctly plotted
	(b)		28 – 32	3 2 AO2.1b 1 AO2.3a	M1 for 45 or 105 seen A1 for corresponding answer FT <i>their</i> graph
	(c)		The boundaries are set from approximations based on grouped data, not the actual scores obtained by the students	1 1 AO2.5b	
15			20 [decrease](%)	4 1 AO1.1 1 AO1.3b 2 AO3.1d	M1 for $pV = \text{constant}$ oe M1 for $p_{\text{initial}} V_{\text{initial}} = p_{\text{after}} V_{\text{after}}$ oe M1 for $1 \times 1 = p_{\text{after}} \times 1.25$ oe

Question		Answer	Marks	Part marks and guidance	
16	(a)	58° Subtended on same arc oe	2 1 AO2.1a 1 AO2.4b	B1 for angle	
	(b)	68° e.g. angle DBC is 32° because the angle in a semicircle is a right angle oe so angle ACB is 68° because angles in a triangle sum to 180° oe	3 2 AO2.1a 1 AO2.4b	B1 for using the angle in a semicircle is a right angle B1 for using angles in a triangle sum to 180°	
17		Starter and main 8 × 12 Main and dessert 12 × 6 Three courses 8 × 12 × 6 96 + 72 + 576 = 744	3 1 AO1.3b 1 AO2.1a 1 AO2.2	M1 for one correct product M1 for summing <i>their</i> three products	
18		64.3 or $9\pi + 36$ oe	4 2 AO1.3b 2 AO3.1d	M1 for $\frac{9\pi}{4}$ soi A1 for 9π or 28.2[7...] M1 for <i>their</i> ' 9π ' + 36	
19	(a)	1 nfww 10 nfww	2 1 AO1.2 1 AO1.3a	B1 for each	FT <i>their</i> ' u_2 ' for u_3
	(b)	5 nfww 2 nfww 5 nfww	3 1 AO1.2 1 AO1.3a 1 AO2.1a	B1 for each	FT <i>their</i> ' u_2 ' for u_3

Question		Answer	Marks	Part marks and guidance	
20	(a)	$\frac{n-m}{n(n+1)}$	2 2 AO1.3b	M1 for $\frac{n(m+1)-m(n+1)}{n(n+1)}$	
	(b)	$m < n \Rightarrow n - m > 0$ $\Rightarrow \frac{n-m}{n(n+1)} > 0$ $\Rightarrow \frac{m+1}{n+1} - \frac{m}{n} > 0$	2 2 AO2.4b	M1 for their ' $\frac{n-m}{n(n+1)}$ ' > 0	

Assessment Objectives (AO) Grid

Question	AO1	AO2	AO3	Total
1	1		2	3
2(a)	2			2
2(b)	2			2
3(a)	1			1
3(b)	2			2
3(c)	1		1	2
4(a)(i)	1	1		2
4(a)(ii)	1	1		2
4(b)(i)		1		1
4(b)(ii)		1	2	3
5	2		3	5
6	2		3	5
7(a)	2			2
7(b)(i)		1		1
7(b)(ii)		1		1
7(c)		1	1	2
8(a)(i)	1		1	2
8(a)(ii)	1		2	3
8(b)	1		2	3
9(a)	1		2	3
9(b)			2	2
10	1	2		3
11(a)		1		1
11(b)		2	1	3
12(a)	2			2
12(b)		1	2	3
13	2		2	4
14(a)(i)	2			2
14(a)(ii)	1	3		4
14(b)		3		3
14(c)		1		1
15	2		2	4
16(a)		2		2
16(b)		3		3
17	1	2		3
18	2		2	4
19(a)	2			2
19(b)	2	1		3
20(a)	2			2
20(b)		2		2
Totals	40	30	30	100

GCSE (9–1) Mathematics J560/05 Paper 5 (Higher Tier) Sample Question Paper

Date – Morning/Afternoon

Time allowed: 1 hour 30 minutes



You may use:

- Geometrical instruments
- Tracing paper

Do not use:

- A calculator



First name					
Last name					
Centre number					
Candidate number					

INSTRUCTIONS

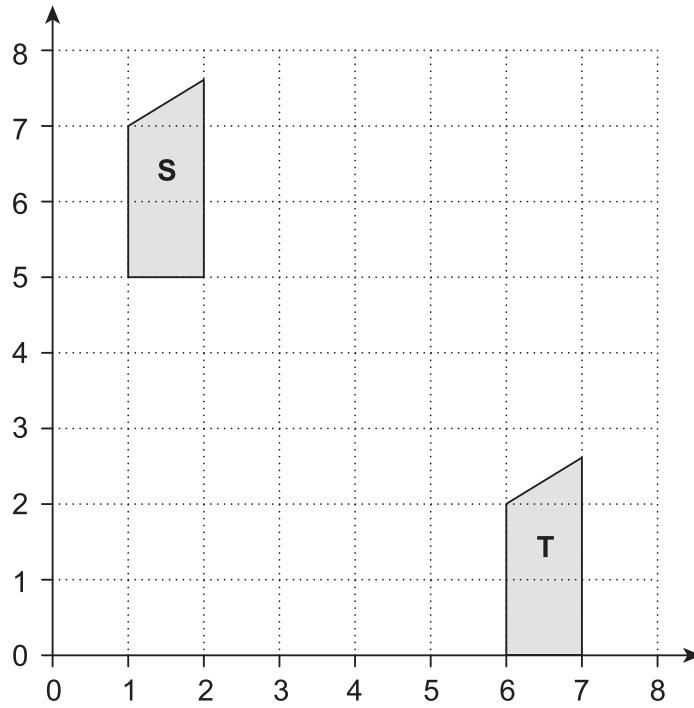
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Read each question carefully before you start to write your answer.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION

- The total mark for this paper is **100**.
- The marks for each question are shown in brackets [].
- This document consists of **20** pages.

Answer **all** the questions

1 (a) Here is a coordinate grid.

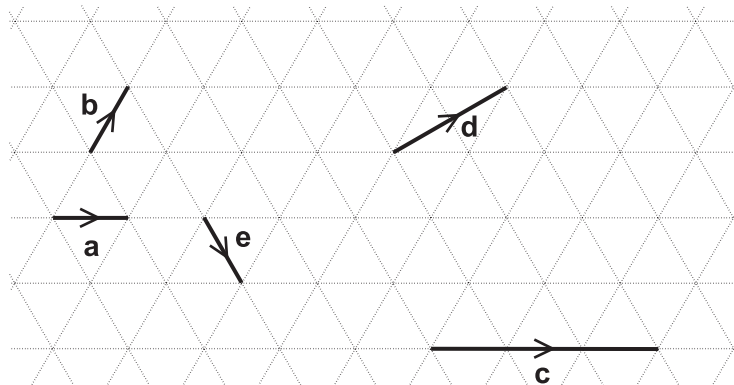


Shape S is translated to Shape T using vector $\begin{pmatrix} p \\ q \end{pmatrix}$.

Write down the values of p and q .

(a) $p = \dots\dots\dots$
 $q = \dots\dots\dots$ [2]

(b) Vectors **a**, **b**, **c**, **d** and **e** are drawn on an isometric grid.



Write each of the vectors **c**, **d** and **e** in terms of **a** and/or **b**.

c = $\dots\dots\dots$
d = $\dots\dots\dots$
e = $\dots\dots\dots$

[3]

2 Sam and two friends put letters in envelopes on Monday.
The three of them take two hours to put 600 letters in envelopes.

(a) On Tuesday Sam has three friends helping.

Working at the same rate, how many letters should the **four** of them be able to put in envelopes in two hours?

(a) [2]

(b) Working at the same rate, how much longer would it take **four** people to put 1000 letters in envelopes than it would take **five** people?

(b) [4]

(c) Sam says

It took two hours for three people to put 600 letters in envelopes.
If I assume they work all day, then in one day three people will put 7200 letters in envelopes because $600 \times 12 = 7200$.

Why is Sam's assumption not reasonable?
What effect has Sam's assumption had on her answer?

.....
..... [2]

- 3 Abi, Ben and Carl each drop a number of identical drawing pins, and count how many land with the pin upwards. The table shows some of their results.

	Number of pins dropped	Number landing 'pin up'
Abi	10	4
Ben	30	9
Carl	100	35

- (a) Abi says

As a drawing pin can only land with its pin up or with its pin down, the probability of a drawing pin landing 'pin up' is $\frac{1}{2}$.

Criticise her statement.

.....
 [1]

- (b) Carl's results give the best estimate of the probability of a drawing pin landing 'pin up'. Explain why.

.....
 [1]

- (c) Two pins are dropped.

Estimate the probability that both pins land 'pin up'.

(c) [2]

4 John is going to make chocolate squares to sell.

There are just three ingredients, chocolate, peanut butter and crisped rice, mixed in the ratio 4 : 2 : 3 respectively.

(a) How much of each ingredient will he need to make 900g of mixture?

(a) chocolate g
 peanut butter g
 crisped rice g
 [2]

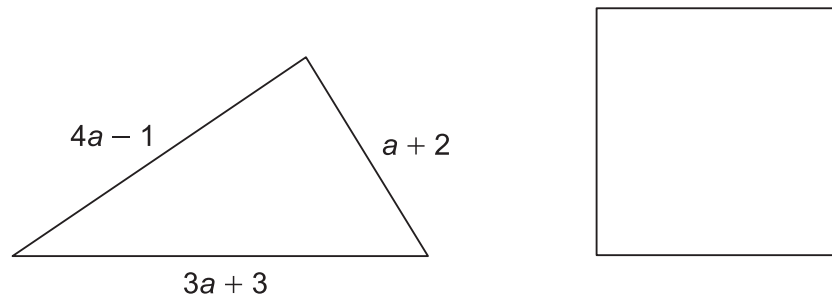
(b) A bar of chocolate weighs 200g and costs £2.50.
 A jar of peanut butter contains 250g and costs £1.70.
 A packet of crisped rice contains 300g and costs £2.00.

John makes 4.5kg of mixture, from which he can cut 100 chocolate squares.
 He charges 60p for each square and sells all 100 squares.

How much **profit** does he make?

(b) £ [5]

- 5 The perimeter of the triangle is the same length as the perimeter of the square.



Find an expression for the length of one side of the square in terms of a .
Give your answer in its simplest form.

..... [4]

- 6 A bag contains only red and blue marbles.

Yasmine takes one marble at random from the bag.

The probability that she takes a red marble is $\frac{1}{5}$.

Yasmine returns the marble to the bag and adds five more red marbles to the bag.

The probability that she takes one red marble at random is now $\frac{1}{3}$.

How many marbles of each colour were originally in the bag?

..... red marbles

..... blue marbles

[3]

- 7 The lengths of the sides of two squares are integers, when measured in cm.
The difference between the areas of the two squares is 36 cm^2 .

Find the lengths of the sides of the two squares.

..... cm

..... cm

[3]

- 8 Safety rules on a campsite require Sarah to set up her barbecue at least 4 m from her tent.
She decides to measure this distance using her stride length.
Sarah knows that her stride length is 0.8 m, rounded to the nearest 0.1 m.

Find the minimum number of strides Sarah will need to take to **guarantee** that her barbecue is a safe distance from her tent.

..... **[3]**

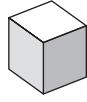
- 9 A sculptor needs to lift a piece of marble.
It is a cuboid with dimensions 1 m by 0.5 m by 0.2 m.
Marble has a density of 2.7 g/cm^3 .
The sculptor's lifting gear can lift a maximum load of 300 kg.

Can the lifting gear be used to lift the marble?
Justify your decision.

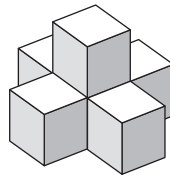
.....

..... [4]

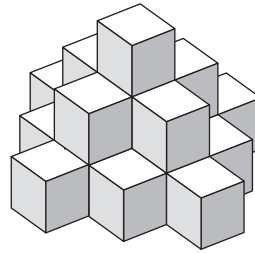
- 10 Here is a picture of three towers.
Not all the cubes can be seen in the towers.



Tower 1



Tower 2



Tower 3

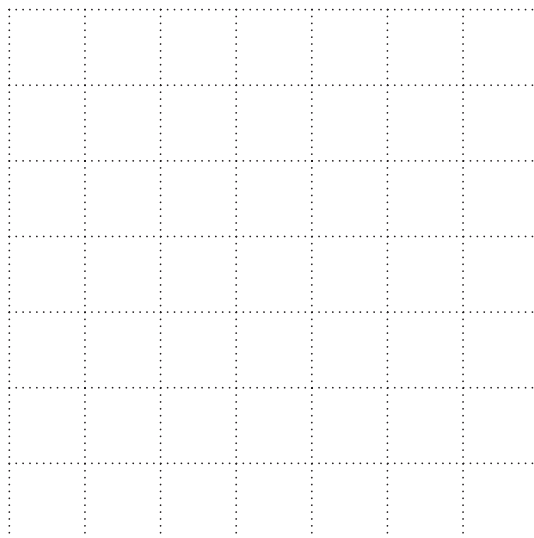
Edith uses 1 cube to build tower 1.

Edith uses 6 cubes to build tower 2. There are 5 cubes on the bottom layer.

- (a) Write down the total number of cubes in tower 3.

(a) [1]

- (b) Draw a plan view of the arrangement of cubes Edith will use for the bottom layer of tower 4.



[1]

(c) Continue this sequence to show the number of cubes used for the bottom layer of each tower.

Tower 1	Tower 2	Tower 3	Tower 4
1	5

[2]

(d) Find an expression for the number of cubes used in the bottom layer of tower n .

(d) [4]

11 A toy car is placed on the floor of a sports hall.

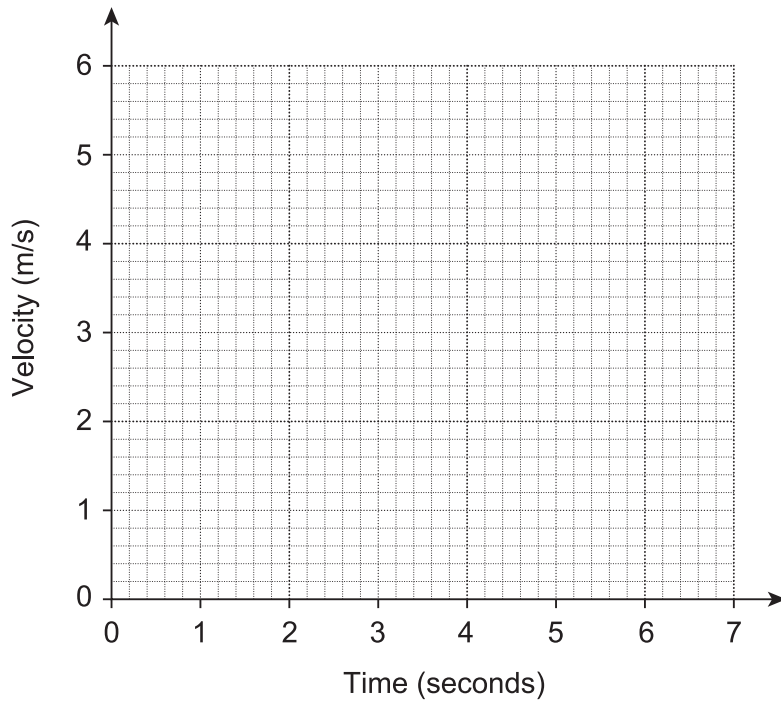
It moves in a straight line starting from rest.

It travels with constant acceleration for 4 seconds reaching a velocity of 5 m/s.

It then slows down with constant deceleration of 1 m/s^2 for 2 seconds.

It then hits a wall and stops.

(a) Draw a velocity-time graph for the toy car.

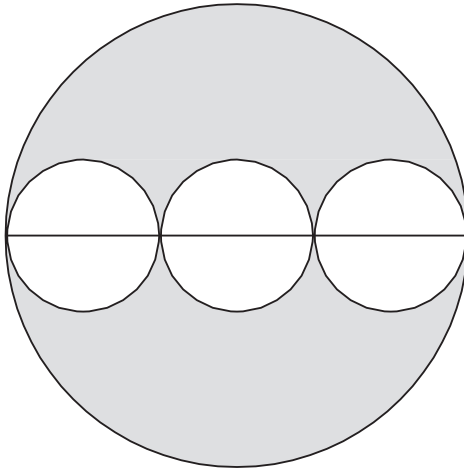


[3]

(b) Work out the total distance travelled by the toy car.

(b) m [3]

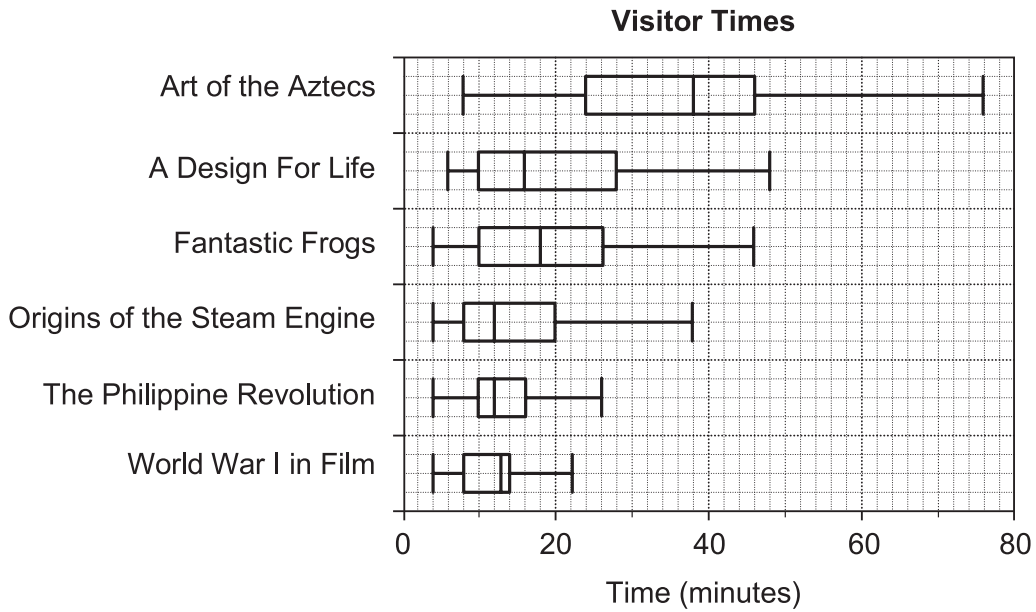
- 12 Three identical small circles are drawn inside one large circle, as shown in the diagram. The centres of the small circles lie on the diameter of the large circle.



Find the fraction of the large circle that is shaded.

..... [3]

- 13 One day a museum monitored the time spent by visitors at six exhibitions. The visitor times are summarised in the box plots below.



- (a) Work out the **range** in visitor times at the **Fantastic Frogs** exhibition.

(a) [2]

- (b) At which exhibition were visitor times the most consistent?
Give a reason for your answer.

.....

 [2]

- (c) Give one similarity and one difference between the **distributions** of the visitor times for **Origins of the Steam Engine** and **The Philippine Revolution**.

Similarity

.....

Difference

.....

[2]

- (d) Is it possible to work out from the box plots which exhibition had the most visitors?
Justify your answer.

.....

.....

.....

..... [2]

- 14 Show that line $3y = 4x - 14$ is perpendicular to line $4y = -3x + 48$.

[4]

15 (a) Write this list of numbers in order, smallest first.

$$\sqrt{35}, \quad \frac{20}{3}, \quad 2.5^2, \quad 6.83$$

(a) [2]
smallest

(b) Write $(1 + \sqrt{3})^2$ in the form $a + b\sqrt{3}$.

(b) [3]

16 Bethany says that $(2x)^2$ is always greater than or equal to $2x$.

Decide whether she is correct or not.

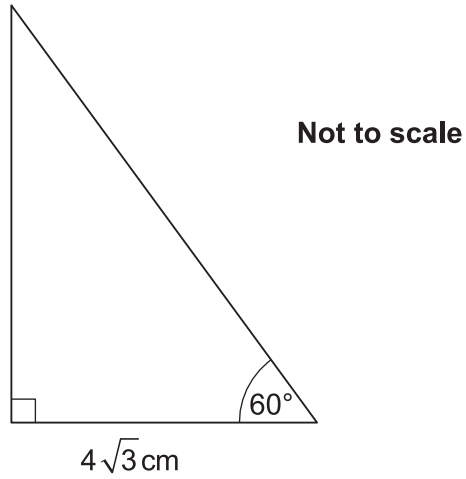
Show your working to justify your decision.

[3]

17 (a) Write down the exact value of $\tan 60^\circ$.

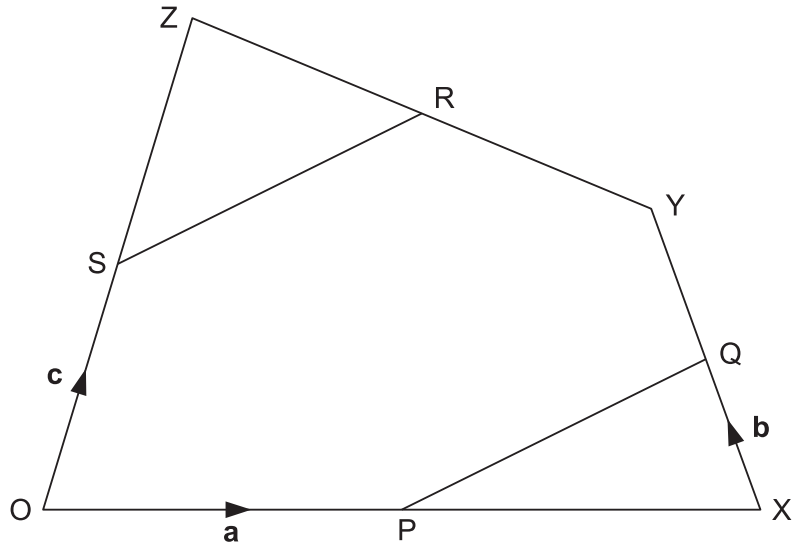
(a) [1]

(b) Find the exact area of this triangle.



(b) cm^2 [4]

18 P, Q, R and S are the midpoints of OX, XY, YZ and OZ respectively.



$\vec{OP} = \mathbf{a}$, $\vec{XQ} = \mathbf{b}$ and $\vec{OS} = \mathbf{c}$.

Show that PQ is parallel to SR.

[5]

19 The prices of two phones are in the ratio $x : y$.

When the prices are both increased by £20, the ratio becomes $5 : 2$.

When the prices are both reduced by £5, the ratio becomes $5 : 1$.

Express the ratio $x : y$ in its lowest terms.

..... : [6]

20 (a) Find the interval for which $x^2 - 7x + 10 \leq 0$.

(a) $\leq x \leq$ [3]

(b) The point $(-3, -4)$ is the turning point of the graph of $y = x^2 + ax + b$, where a and b are integers.

Find the values of a and b .

(b) $a =$ $b =$ [3]

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Date – Morning/Afternoon

GCSE (9–1) Mathematics

J560/05 Paper 5 (Higher Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 100

DRAFT

This document consists of 13 pages

Subject-Specific Marking Instructions

1. **M** marks are for using a correct method and are not lost for purely numerical errors.
A marks are for an accurate answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
B marks are independent of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.
SC marks are for special cases that are worthy of some credit.

2. Unless the answer and marks columns of the mark scheme specify **M** and **A** marks etc, or the mark scheme is 'banded', then if the correct answer is clearly given and is not from wrong working **full marks** should be awarded.

Do not award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen and the correct answer clearly follows from it.

3. Where follow through (**FT**) is indicated in the mark scheme, marks can be awarded where the candidate's work follows correctly from a previous answer whether or not it was correct.

Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, e.g. FT $180 \times (\textit{their} '37' + 16)$, or FT $300 - \sqrt{(\textit{their} '5^2 + 7^2')}$. Answers to part questions which are being followed through are indicated by e.g. FT $3 \times \textit{their} (a)$.

For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

4. Where dependent (**dep**) marks are indicated in the mark scheme, you must check that the candidate has met all the criteria specified for the mark to be awarded.

5. The following abbreviations are commonly found in GCSE Mathematics mark schemes.

- **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point e.g. 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
- **isw** means **ignore subsequent working** after correct answer obtained and applies as a default.
- **nfww** means **not from wrong working**.
- **oe** means **or equivalent**.
- **rot** means **rounded or truncated**.
- **seen** means that you should award the mark if that number/expression is seen anywhere in the answer space, including the answer line, even if it is not in the method leading to the final answer.

- **soi** means **seen or implied**.

6. In questions with no final answer line, make no deductions for wrong work after an acceptable answer (ie **isw**) unless the mark scheme says otherwise, indicated by the instruction 'mark final answer'.

7. In questions with a final answer line following working space:

- (i) If the correct answer is seen in the body of working and the answer given on the answer line is a clear transcription error allow full marks unless the mark scheme says 'mark final answer'. Place the annotation ✓ next to the correct answer.
- (ii) If the correct answer is seen in the body of working but the answer line is blank, allow full marks. Place the annotation ✓ next to the correct answer.
- (iii) If the correct answer is seen in the body of working but a completely different answer is seen on the answer line, then accuracy marks for the answer are lost. Method marks could still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation ✗ next to the wrong answer.

8. In questions with a final answer line:

- (i) If one answer is provided on the answer line, mark the method that leads to that answer.
- (ii) If more than one answer is provided on the answer line and there is a single method provided, award method marks only.
- (iii) If more than one answer is provided on the answer line and there is more than one method provided, award zero marks for the question unless the candidate has clearly indicated which method is to be marked.

9. In questions with no final answer line:

- (i) If a single response is provided, mark as usual.
- (ii) If more than one response is provided, award zero marks for the question unless the candidate has clearly indicated which response is to be marked.

10. When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the MR annotation. **M** marks are not deducted for misreads.

11. Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures even if this is rounded or truncated on the answer line. For example, an answer in the mark scheme is 15.75, which is seen in the working. The candidate then rounds or truncates this to 15.8, 15 or 16 on the answer line. Allow full marks for the 15.75.
12. Ranges of answers given in the mark scheme are always inclusive.
13. For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.
14. Anything in the mark scheme which is in square brackets [...] is not required for the mark to be earned, but if present it must be correct.

Question		Answer	Marks	Part marks and guidance
1	(a)	$[p =] 5$ $[q =] -5$	2 1 AO1.2 1 AO1.3a	B1 for each
	(b)	$c = 3a$ $d = a + b$ $e = a - b$	3 3 AO1.3a	B1 for each
2	(a)	800	2 1 AO1.3b 1 AO3.1c	M1 for unitary work, e.g. 1 person does 200 letters in 2 hours
	(b)	30 minutes oe	4 2 AO2.1a 2 AO3.1d	M1 for 1 person does 100 letters in 1 hour M1 for 5 people do 1000 letters in 2 hours M1 for 4 people do 1000 letters in 2.5 hours FT from <i>their</i> rate in (a) throughout
	(c)	Correct comment on the reasonableness of her assumption e.g. 'She has assumed that 'all day' means 'for 24 hours', but it is not reasonable for them to work without a break.' Correct comment on the effect it will have on the answer e.g. 'They can't work at that rate for that long, so her answer is an over-estimate.'	2 1 AO3.4a 1 AO3.5	B1 for each
3	(a)	Outcomes not equally likely oe	1 1 AO3.4b	

Question		Answer	Marks	Part marks and guidance
	(b)	Larger number of trials	1 1 AO3.4a	
	(c)	0.09 - 0.16	2 1 AO1.3a 1 AO2.1b	M1 for $\left(\frac{48}{150}\right)^2$ or 0.35^2 or any reasonable estimate (FT their (b))
4	(a)	400 g 200 g 300 g	2 1 AO1.3a 1 AO3.1c	M1 for 9 soi
	(b)	Profit = £18.20	5 2 AO1.3b 2 AO3.1d 1 AO3.3	M1 Multiply <i>their</i> weights by 5 M1 Find number of each required M1* calculate total cost *M1 dep subtract from £60
5		$2a + 1$	4 1 AO1.3b 2 AO3.1b 1 AO3.2	M1 for $a + 2 + 3a + 3 + 4a - 1$ M1 for collecting terms M1 for dividing <i>their</i> '8a + 4' by 4
6		5 red 20 blue	3 1 AO1.3b 1 AO3.1b 1 AO3.2	M1 for listing at least two pairs of red and blue marbles giving a probability $\frac{1}{5}$ M1 for at adding 5 red marbles to at least two pairs SC2 for 10 and 20 pairing seen

Question		Answer	Marks	Part marks and guidance
7		8 cm 10 cm	3 1 AO1.3a 1 AO3.1b 1 AO3.2	M1 for listing square numbers and finding differences M1 for square rooting <i>their</i> pair of square numbers
8		6	3 1 AO1.3b 1 AO3.1d 1 AO3.3	B1 for 0.75 m M1 for $\frac{4}{\text{their '0.75'}}$ Or $5 \times 0.75 = 3.75$
9		Volume of cuboid = $100\,000 \text{ cm}^3$ Mass of cuboid = 270 kg Yes, because $270 < 300 \text{ kg}$	4 1 AO1.3b 2 AO3.1d 1 AO3.3	B3 for 270 kg or M1 for $100\,000 \text{ cm}^3$ OR 0.1 m^3 OR $100 \text{ cm} \times 50 \text{ cm} \times 20 \text{ cm}$ OR $1 \text{ m} \times 0.5 \text{ m} \times 0.2 \text{ m}$ M1 for $2.7 \times \text{their '100\,000'}$ OR $2\,700\,000 \times \text{their '0.1'}$
10	(a)	19	1 1 AO2.3a	

Question		Answer	Marks	Part marks and guidance	
	(b)		<p>1 1 AO2.3b</p>		
	(c)	13 25	<p>2 2 AO2.1a</p>	M1 for 13 or 25	FT <i>their</i> bottom layer in (b) and <i>their</i> number of cubes in (a)
	(d)	$2n^2 - 2n + 1$ oe	<p>4 2 AO1.3b 2 AO2.1a</p>	<p>M3 for expression with $2n^2 - 2n$ oe or M2 for expression with $2n^2$ or M1 for expression with n^2 or first differences</p>	

Question	Answer	Marks	Part marks and guidance
11 (a)	Both sections of graph correct 	3 1 AO1.3b 2 AO2.3b	B1 for plotting a line segment from the origin to (4, 5) B1 for plotting a line segment from their '(4, 5)' to their '(4' + 2, '5' - 2)
(b)	18	3 2 AO1.3a 1 AO2.3a	M2 for $\frac{1}{2}(5 \times 4) + \frac{1}{2}(5 + 3) \times 2$ or M1 for attempt to find area under graph Accept alt ways to split area FT their graph
12	$\frac{2}{3}$	3 1 AO1.3a 1 AO3.1b 1 AO3.2	B1 for radius of large circle = 3 × radius of small circle M1 for $\frac{9\pi r^2 - 3(\pi r^2)}{9\pi r^2}$ oe
13 (a)	42	2 1 AO1.3a 1 AO2.3a	M1 for 46 or 4 seen
(b)	World War I in film Smallest range / IQR	2 2 AO2.1b	M1 M1

Question		Answer	Marks	Part marks and guidance	
	(c)	Correct similarity Correct difference	2 1 AO2.3a 1 AO2.3b	B1 for similarity B1 for difference	Exemplar response: Similarity: They have the same median value Difference: There was less variation in the visitor times for The Philippine Revolution than for Origins of the Steam Engine To be awarded both marks at least one statement must be in context
	(d)	No, as there is no indication of total numbers who visited each	2 1 AO2.4a 1 AO2.5b	M1 for 'No' with insufficient reason	
14		Fully correct explanation, finding gradients of both lines and showing that the gradients' product equals -1	4 1 AO1.3a 2 AO2.2 1 AO2.4b	B1 for gradient of first line is $\frac{4}{3}$ B1 for gradient of second line is $-\frac{3}{4}$ M1 for finding the product of <i>their</i> gradients oe	
15	(a)	$\sqrt{35}$, 2.5^2 , $\frac{20}{3}$, 6.83	2 2 AO1.3b	B1 if one is in the wrong place, but others are in the correct order or reverse order	
	(b)	$4+2\sqrt{3}$	3 3 AO1.3a	M1 for expanding $(1 + \sqrt{3})^2 = 1 + \sqrt{3} + \sqrt{3} + \sqrt{3} \times \sqrt{3}$ B1 for $\sqrt{3} \times \sqrt{3} = 3$ soi	

Question		Answer	Marks	Part marks and guidance
16		e.g. When $x = 0.1$ $(2x)^2 = 0.04$ $2x = 0.2$ So $(2x)^2 < 2x$ which contradicts Bethany's statement So it is not always true	3 2 AO2.4a 1 AO2.5a	M1 for attempting to demonstrate that for some value of x in range $0 < x < \frac{1}{2}$ it is not true A1 for complete working A1 for explanation or M1 for attempt including squaring bracket A1 for complete solution for either $x < 0$ or $x \geq \frac{1}{2}$ A1 for explanation or B1 for a counter example given without working
17	(a)	$\sqrt{3}$	1 1 AO1.1	
	(b)	$24\sqrt{3}$	4 4 AO1.3b	M1* for $\frac{\text{height}}{4\sqrt{3}} = \text{their } \tan 60^\circ$ A1 for 12 or $4\sqrt{3} \times \sqrt{3}$ *M1 Dep for $\frac{1}{2} \times 4\sqrt{3} \times \text{their '12'}$

Question		Answer	Marks	Part marks and guidance	
18		$\vec{ZY} = -2\mathbf{c} + 2\mathbf{a} + 2\mathbf{b}$ $\vec{SR} = \mathbf{c} + (-\mathbf{c} + \mathbf{a} + \mathbf{b})$ so $\vec{SR} = \mathbf{a} + \mathbf{b}$ $\vec{PQ} = \mathbf{a} + \mathbf{b}$ $\vec{SR} = \vec{PQ}$ so they are parallel	5 1 AO1.3a 2 AO2.2 2 AO2.4b	M1 for $\vec{ZY} = -2\mathbf{c} + 2\mathbf{a} + 2\mathbf{b}$ M1 for $\vec{SR} = \mathbf{c} + (-\mathbf{c} + \mathbf{a} + \mathbf{b})$ M1 for $\vec{SR} = \mathbf{a} + \mathbf{b}$ M1 for $\vec{PQ} = \mathbf{a} + \mathbf{b}$	
19		4 : 1	6 2 AO1.3b 4 AO3.1d	M1 for $(x + 20) : (y + 20) = 5 : 2$ or $(x - 5) : (y - 5) = 5 : 1$ A1 for $\frac{x+20}{y+20} = \frac{5}{2}$ oe A1 for $\frac{x-5}{y-5} = \frac{5}{1}$ oe M1 for solving <i>their</i> simultaneous equations A1 for $x = 80$ or $y = 20$	Do not accept wrong notation for ratio in the final mark, e.g. for 4/1, 4, etc
20	(a)	$2 \leq x \leq 5$	3 3 AO1.3b	M1 for factorising $(x - 5)(x - 2)$ soi A1 for 2 and 5	Answer may be on a number line in which case the ends must be clearly seen
	(b)	[a =] 6 [b =] 5	3 1 AO1.3b 1 AO2.1a 1 AO3.1b	M1 for $y = (x + 3)^2 - 4$ M1 for multiplying out and simplifying <i>their</i> $y = (x + 3)^2 - 4$	

Assessment Objectives (AO) Grid

Question	AO1	AO2	AO3	Total
1(a)	2			2
1(b)	3			3
2(a)	1		1	2
2(b)		2	2	4
2(c)			2	2
3(a)			1	1
3(b)			1	1
3(c)	1	1		2
4(a)	1		1	2
4(b)	2		3	5
5	1		3	4
6	1		2	3
7	1		2	3
8	1		2	3
9	1		3	4
10(a)		1		1
10(b)		1		1
10(c)		2		2
10(d)	2	2		4
11(a)	1	2		3
11(b)	2	1		3
12	1		2	3
13(a)	1	1		2
13(b)		2		2
13(c)		2		2
13(d)		2		2
14	1	3		4
15(a)	2			2
15(b)	3			3
16		3		3
17(a)	1			1
17(b)	4			4
18	1	4		5
19	2		4	6
20(a)	3			3
20(b)	1	1	1	3
Totals	40	30	30	100

GCSE (9–1) Mathematics J560/06 Paper 6 (Higher Tier) Sample Question Paper

Date – Morning/Afternoon

Time allowed: 1 hour 30 minutes



You may use:

- A scientific or graphical calculator
- Geometrical instruments
- Tracing paper



First name					
Last name					
Centre number					
Candidate number					

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Read each question carefully before you start to write your answer.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION

- The total mark for this paper is **100**.
- The marks for each question are shown in brackets [].
- Use the π button on your calculator or take π to be 3.142 unless the question says otherwise.
- This document consists of **20** pages.

Answer **all** the questions

1 180 g of copper is mixed with 105 g of zinc to make an alloy.

The density of copper is 9 g/cm^3 .

The density of zinc is 7 g/cm^3 .

(a) Work out the volume of copper used in the alloy.

(a) cm^3 [2]

(b) What is the density of the alloy?

(b) g/cm^3 [4]

2 (a) (i) Solve.

$$5x + 1 > x + 13$$

(a)(i) [3]

(ii) Write down the largest integer that satisfies $5x - 1 < 10$.

(ii) [1]

(b) Solve.

$$3x^2 = 75$$

(b) $x =$ [2]

(c) Solve.

$$\begin{aligned} 4x + 3y &= 5 \\ 2x + 3y &= 1 \end{aligned}$$

(c) $x =$

$y =$

[3]

- 3 (a) This expression can be used to generate a sequence of numbers.

$$n^2 - n + 11$$

- (i) Work out the first three terms of this sequence.

(a)(i) , , [2]

- (ii) Show that this expression does not only generate prime numbers.

.....
 [2]

- (b) Marta says

odd square numbers have exactly three factors.

Give one example where this is correct and another where this is not correct.
 In each case, write down the number and its factors.

Correct

Not correct

[2]

(c) Here are some properties of a number.

- It is a common factor of 288 and 360.
- It is a common multiple of 4 and 6.
- It is larger than 25.

Find the **two** possible numbers with these properties.

(c) and [4]

4 Here are the interest rates for two accounts.

Account A
Interest: 3% per year compound interest.
No withdrawals until the end of three years.

Account B
Interest: 4% for the first year, 3% for the second year and 2% for the third year.
Withdrawals allowed at any time.

Derrick has £10 000 he wants to invest.

- (a) Calculate which account would give him most money if he invests his money for 3 years. Give the difference in the interest to the nearest penny.

(a) Account by p [5]

- (b) Explain why he might **not** want to use Account A.

.....
 [1]

5 Lei is in a class of 28 students, 3 of whom are left-handed.
There are 1250 students in the school.

(a) Use this information to estimate how many students in the school are left-handed.

(a) [3]

(b) Is your solution to (a) likely to be an overestimate or an underestimate?
Explain your reasoning.

.....
..... [1]

(c) Vid is at a different school.
He is in a class of 26 students, 6 of whom are left-handed.

Vid says to Lei

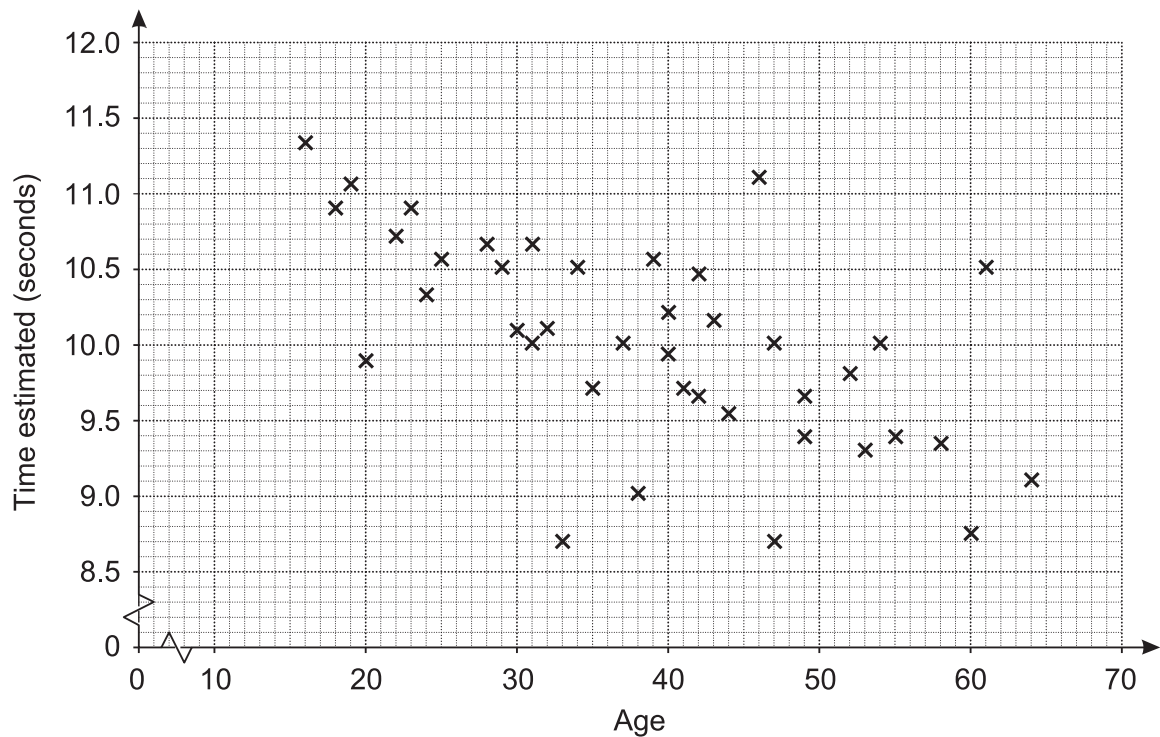
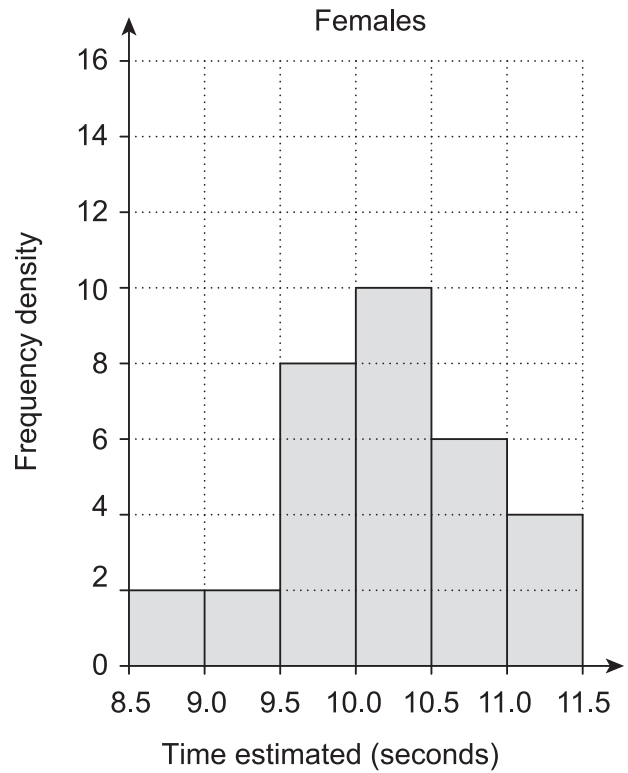
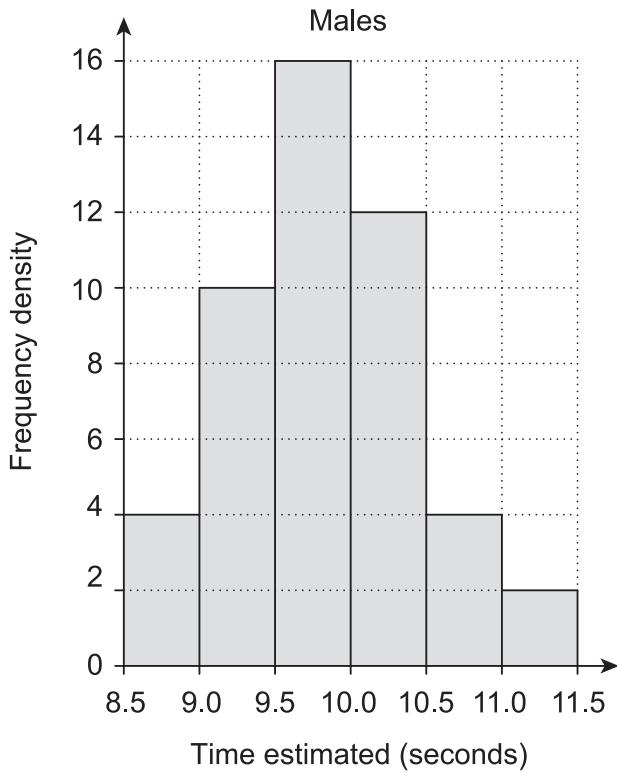
In our two classes there are 54 students, 9 of whom are left-handed.
We can use this bigger sample to improve the estimate for your school.

What assumption has Vid made?
Explain whether you think that his argument is correct.

.....
..... [2]

- 6 John wants to investigate whether men in the UK are better at estimating a time interval of 10 seconds than women in the UK. He decides to sample the population by asking his work colleagues to take the test.

The diagrams below summarise John's results.



(a) What information from the diagrams can be used to support each of these statements?

(i) The older John's colleagues are, the lower their estimate is.

.....
..... [1]

(ii) Males in the sample tend to underestimate the interval and females in the sample tend to overestimate the interval.

.....
..... [2]

(b) Comment on whether any conclusions can be drawn for the UK population from the results of this sample.

.....
..... [2]

7 Without using a calculator, show clearly that $64^{\frac{2}{3}}$ is equal to 16. [2]

8 (a) Prove that the sum of four consecutive whole numbers is always even. [3]

(b) Give an example to show that the sum of four consecutive integers is **not** always divisible by 4.

..... [2]

9 Alexander, Reiner and Wim each watch a different film.

- Alexander's film is thirty minutes longer than Wim's film.
- Reiner's film is twice as long as Wim's film.
- Altogether the films last 390 minutes.

How long is each of their films?

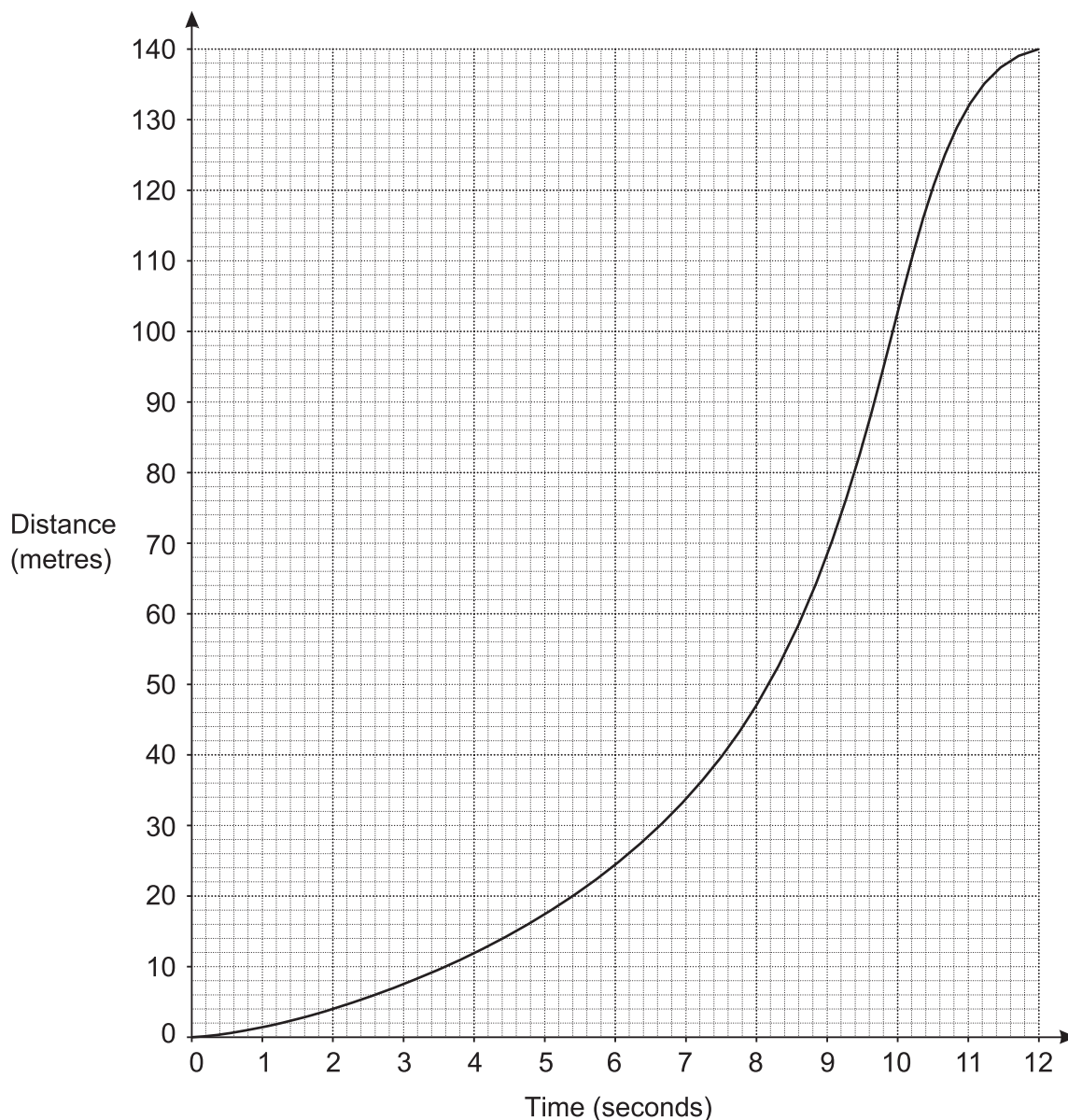
Alexander's film minutes

Reiner's film minutes

Wim's film minutes

[4]

10 The graph shows the distance travelled by an animal over 12 seconds.



(a) Work out the average speed between 2 and 8 seconds.

(a) m/s [2]

(b) Estimate the speed of the animal at 6 seconds.

(b) m/s [4]

(c) Nuri says

I think this animal must be able to move at over 20 m/s!

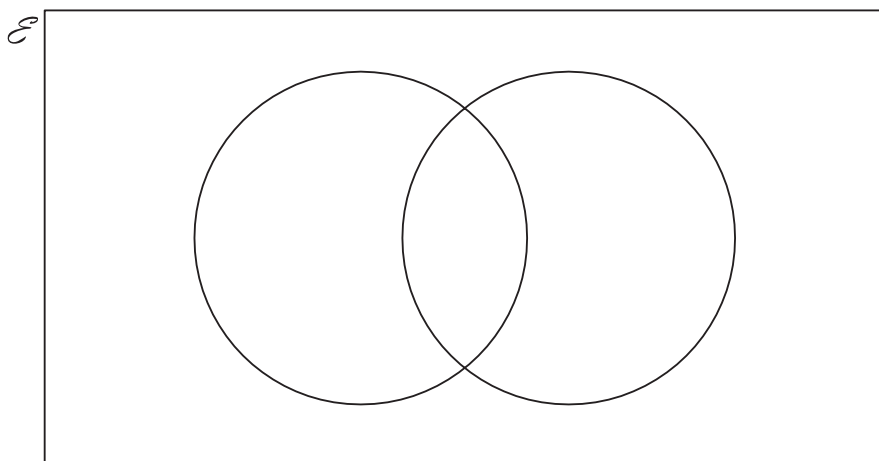
Do you agree with Nuri?
Explain your decision.

.....

..... [2]

11 A skills test has two sections, literacy (L) and numeracy (N).
One day everyone who took the skills test passed at least one section.
88% passed the literacy section and 76% passed the numeracy section.

(a) Represent this information on a Venn diagram.
Show clearly the **percentage** in each section of the diagram.



[3]

(b) One person is chosen at random from all the people who took the skills test that day.

What is the probability that this person

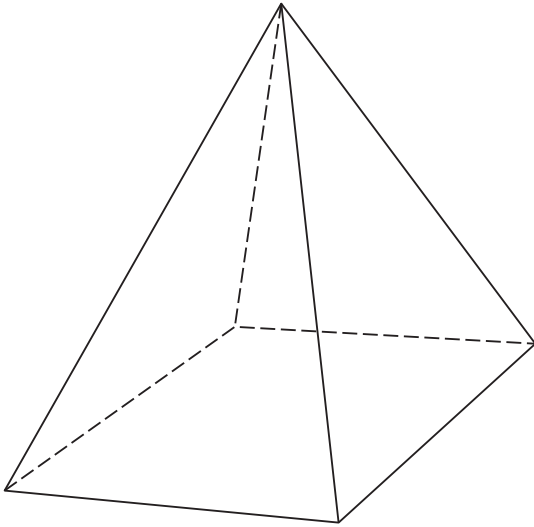
(i) passed the numeracy section, given that they passed the literacy section,

(b)(i) [2]

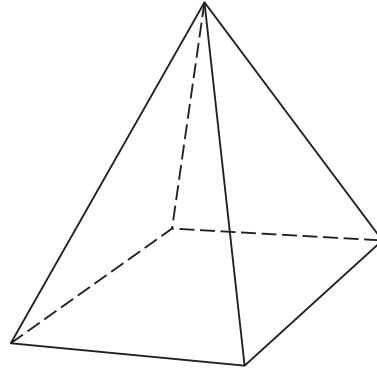
(ii) passed the literacy section, given that they passed only one section?

(ii) [2]

- 12 Two similar pyramids A and B have surface areas 180 cm^2 and 80 cm^2 respectively.



Pyramid A



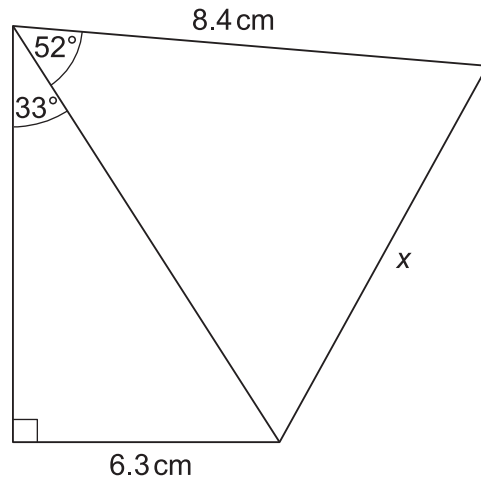
Pyramid B

The volume of pyramid A is 810 cm^3 .

Show that the volume of pyramid B is 240 cm^3 .

[5]

13 Calculate x .



Not to scale

..... cm [5]

14 A straight line goes through the points (p, q) and (r, s) , where

- $p + 2 = r$
- $q + 4 = s$.

Find the gradient of the line.

..... [3]

- 15 A unit fraction has a numerator equal to 1, for example $\frac{1}{3}$, $\frac{1}{7}$ and $\frac{1}{25}$.

Unit fractions can be written as the sum of two different unit fractions, for example

$$\frac{1}{2} = \frac{1}{3} + \frac{1}{6}$$

Write each of the following unit fractions as the sum of two **different** unit fractions.

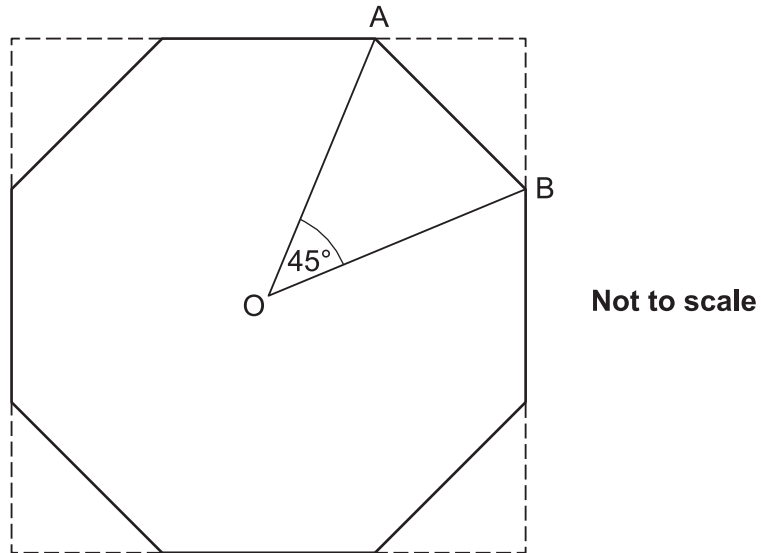
$$\frac{1}{4} = \frac{1}{\square} + \frac{1}{\square}$$

$$\frac{1}{5} = \frac{1}{\square} + \frac{1}{\square}$$

$$\frac{1}{6} = \frac{1}{\square} + \frac{1}{\square}$$

[3]

- 16** Simon cuts the corners off a square piece of card to leave the regular octagon shown below.
 O is the centre of the octagon.
 A and B are vertices of the octagon.
 $OA = OB = 5$ cm.
 Angle $AOB = 45^\circ$.



- (a) (i)** Work out the area of the octagon.

(a)(i) cm^2 **[3]**

(ii) Work out the area of the original square piece of card.

(ii) cm² [5]

(b) Simon now makes a table top using the card as a model.

The sides of the table top are 8 times as long as the sides of the card model.

Find the ratio of the **area** of Simon's table top to the **area** of the card model.

(b) : [2]

17 $y = 6x^4 + 7x^2$ and $x = \sqrt{w+1}$.

Find the value of w when $y = 10$.

Show your working.

$w = \dots\dots\dots$ [6]

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Date – Morning/Afternoon

GCSE (9–1) Mathematics

J560/06 Paper 6 (Higher Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 100

DRAFT

This document consists of 13 pages

Subject-Specific Marking Instructions

1. **M** marks are for using a correct method and are not lost for purely numerical errors.
A marks are for an accurate answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
B marks are independent of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.
SC marks are for special cases that are worthy of some credit.

2. Unless the answer and marks columns of the mark scheme specify **M** and **A** marks etc, or the mark scheme is 'banded', then if the correct answer is clearly given and is not from wrong working **full marks** should be awarded.

Do not award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen and the correct answer clearly follows from it.

3. Where follow through (**FT**) is indicated in the mark scheme, marks can be awarded where the candidate's work follows correctly from a previous answer whether or not it was correct.

Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, e.g. FT $180 \times (\textit{their} '37' + 16)$, or FT $300 - \sqrt{(\textit{their} '5^2 + 7^2')}$. Answers to part questions which are being followed through are indicated by e.g. FT $3 \times \textit{their} (a)$.

For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

4. Where dependent (**dep**) marks are indicated in the mark scheme, you must check that the candidate has met all the criteria specified for the mark to be awarded.

5. The following abbreviations are commonly found in GCSE Mathematics mark schemes.

- **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point e.g. 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
- **isw** means **ignore subsequent working** after correct answer obtained and applies as a default.
- **nfww** means **not from wrong working**.
- **oe** means **or equivalent**.
- **rot** means **rounded or truncated**.
- **seen** means that you should award the mark if that number/expression is seen anywhere in the answer space, including the answer line, even if it is not in the method leading to the final answer.

- **soi** means **seen or implied**.

6. In questions with no final answer line, make no deductions for wrong work after an acceptable answer (ie **isw**) unless the mark scheme says otherwise, indicated by the instruction 'mark final answer'.

7. In questions with a final answer line following working space:

- (i) If the correct answer is seen in the body of working and the answer given on the answer line is a clear transcription error allow full marks unless the mark scheme says 'mark final answer'. Place the annotation ✓ next to the correct answer.
- (ii) If the correct answer is seen in the body of working but the answer line is blank, allow full marks. Place the annotation ✓ next to the correct answer.
- (iii) If the correct answer is seen in the body of working but a completely different answer is seen on the answer line, then accuracy marks for the answer are lost. Method marks could still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation ✗ next to the wrong answer.

8. In questions with a final answer line:

- (i) If one answer is provided on the answer line, mark the method that leads to that answer.
- (ii) If more than one answer is provided on the answer line and there is a single method provided, award method marks only.
- (iii) If more than one answer is provided on the answer line and there is more than one method provided, award zero marks for the question unless the candidate has clearly indicated which method is to be marked.

9. In questions with no final answer line:

- (i) If a single response is provided, mark as usual.
- (ii) If more than one response is provided, award zero marks for the question unless the candidate has clearly indicated which response is to be marked.

10. When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the MR annotation. **M** marks are not deducted for misreads.

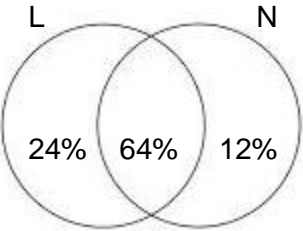
11. Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures even if this is rounded or truncated on the answer line. For example, an answer in the mark scheme is 15.75, which is seen in the working. The candidate then rounds or truncates this to 15.8, 15 or 16 on the answer line. Allow full marks for the 15.75.
12. Ranges of answers given in the mark scheme are always inclusive.
13. For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.
14. Anything in the mark scheme which is in square brackets [...] is not required for the mark to be earned, but if present it must be correct.

Question			Answer	Marks	Part marks and guidance
1	(a)		20	2 1 A01.1 1 A02.3a	M1 for $D = \frac{M}{V}$ soi Can be implied by an answer of 2
	(b)		$8\frac{1}{7}$ or 8.14[...]	4 2 A01.3b 2 A03.1d	M1 for 15 or $105 \div 7$ And M2 for $\frac{180+105}{their(20+15)}$ or $\frac{18+10.5}{their '(2+1.5)'}$ Or M1 for some attempt to find $\frac{total\ mass}{total\ volume}$
2	(a)	(i)	$x > 3$	3 3 A01.3a	M1 for $4x$ soi M1 for 12 soi
		(ii)	2	1 1 A01.3a	
	(b)		[+]5 -5	2 2 A01.3a	M1 for $x^2 = 25$ If zero scored SC1 for 5 seen as answer
	(c)		[x=] 2 [y=] -1	3 3 A01.3b	M1 for eliminating one variable M1 for correct substitution of <i>their</i> x or y
3	(a)	(i)	11 13 17	2 2 A01.3a	B1 for any two correct

Question		Answer	Marks	Part marks and guidance	
	(ii)	Any multiple of 11 and its result e.g. 11th term is $121 = 11^2$	2 1 AO1.3a 1 AO2.4a	Accept any correct argument B1 at least two more evaluated terms	
	(b)	[Correct] e.g. $9 = (1, 3, 9)$ or $25 = (1, 5, 25)$ or $49 = (1, 7, 49)$ [Not correct] e.g. $1 = (1)$ or $81 = (1, 3, 9, 27, 81)$	2 2 AO2.4a	B1 for each	Factors given must be correct for each number given for B1
	(c)	36 and 72	4 2 AO1.3a 2 AO3.1b	B1 for common factors of 288 and 360 found, e.g. 2, 3, 6, 8, 9, 12, 18, 24, 36, 72 and B1 for common multiples of 4 and 6 found, e.g. 12, 24, 36, 48, 60, 72, 84, 96 and B1 for 36 or 72	
4	(a)	(Account) A (by) 103[p]	5 3 AO1.3b 1 AO3.1d 1 AO3.3	B2 for 10 927.27 and B2 for 10 926.24 or B1 for 10 400 or 10 712 If zero scored M1 for 1.03^3 oe used M1 for 1.04, 1.03 and 1.02 used oe	
	(b)	He may not want to leave it there for 3 years	1 1 AO2.3a	Accept any valid reason	

Question		Answer	Marks	Part marks and guidance	
5	(a)	120 to 180	3 1 AO1.3a 1 AO2.1b 1 AO3.1c	M1 for proportion of left-handed between $\frac{1}{7}$ and $\frac{1}{10}$ M1 for <i>their</i> '1250' \times <i>their</i> proportion	
	(b)	Correct explanation for <i>their</i> answer, e.g. 'underestimate because I rounded to 3 out of 30' oe or 'overestimate because I rounded to 4 out of 28' oe or 'Not possible to tell because we only have a small sample' oe	1 1 AO3.4b	FT from <i>their</i> (a)	
	(c)	'He has assumed that the populations of the two schools have approximately the same proportion of left-handers.' oe Correct explanation for <i>their</i> decision, 'Yes. This is a bigger sample so it should give a more reliable estimate.' oe or 'No. The two samples are from different populations, so we can't use Vid's class to infer properties of Lei's school.' oe	2 1 AO2.5a 1 AO3.5	B1 for identification of assumption B1 for correct explanation for <i>their</i> decision	
6	(a)	(i)	[Using the scatter diagram] the points slope down/negative correlation	1 1 AO2.1a	
		(ii)	[Using diagrams 1 and 2] 15/24 males have less than 10 so more than half underestimate, 10/16 females have more than 10 so more than half over-estimate	2 2 AO2.1a	B1 for 15/24 males estimate less than 10 seconds B1 for 10/16 females estimate more than 10 seconds

Question		Answer	Marks	Part marks and guidance	
	(b)	No; it is a very small sample, so it doesn't represent the population very well	2 1 A02.1a 1 A03.4a	B1 for any relevant comment, e.g. small sample, more men than women, John's work may involve estimating time so the sample is biased, etc. B1 for "No"	
7		$(64^{\frac{1}{3}})^2$ $= 4^2 = 16$	2 2 A02.2	B1 for $(64^{\frac{1}{3}})^2$, 4^2 or $\sqrt[3]{4096}$ oe	Condone $(64^2)^{\frac{1}{3}}$ and $(4096)^{\frac{1}{3}}$ for B1
8	(a)	$x, x + 1, x + 2, x + 3$ $x + (x + 1) + (x + 2) + (x + 3)$ or $4x + 6$ $2(x + 3)$	1 1 1 3 A02.4b	accept correct alternatives	
	(b)	e.g. $1 + 2 + 3 + 4$ $4x + 6$ is not a multiple of 4	1 1 2 A02.4a	Allow e.g. $1 + 2 + 3 + 4 = 10$ is not a multiple of 4	
9		Alexander = 120 (minutes) Reiner = 180 (minutes) Wim = 90 (minutes)	4 2 A01.3b 1 A03.1d 1 A03.3	M1 for any two correct expressions, e.g. $r = 2w$, $a = w + 30$, $a + r + w = 390$ M1 for equating one variable, e.g. $w + 30 + 2w + w = 390$ oe A1 for solving for one variable, e.g. $w = 90$ oe	
10	(a)	7.1 to 7.2	2 2 A01.3b	M1 for $(47 - 4) \div (8 - 2)$, allow one error	

Question		Answer	Marks	Part marks and guidance	
	(b)	7.5 to 8.5	4 1 AO1.3a 2 AO2.1b 1 AO2.3a	M1 for an attempt to draw a tangent drawn at 6 and M2 for <i>their</i> distance \div <i>their</i> time e.g. $(40 - 2) \div (8 - 3)$ with a time gap of at least two seconds or M1 for an inaccurate attempt at distance \div time (FT <i>their</i> tangent)	Accuracy ± 1 mm
	(c)	Agreement, with correct reasoning	2 1 AO2.3a 1 AO3.4b	B1 for agreement, with partial reasoning	
11	(a)		3 1 AO2.3a 2 AO2.3b	B1 for 24% in L and B1 for 12% in N and M1 for $100 - (\textit{their '12' + their '24'})$ in overlap	Condone universal set missing
	(b) (i)	$\frac{64}{88}$ oe	2 2 AO1.3a	M1 for 64 or 88	FT <i>their</i> Venn diagram
	(ii)	$\frac{24}{36}$ oe	2 2 AO1.3a	M1 for 24 or 36	FT <i>their</i> Venn diagram

Question	Answer	Marks	Part marks and guidance
12	<p>The area scale factor is $\frac{80}{180} = \frac{4}{9}$</p> <p>[So the length scale factor is $\sqrt{\frac{4}{9}} = \frac{2}{3}$]</p> <p>and the volume scale factor is $\left(\frac{2}{3}\right)^3 = \frac{8}{27}$</p> <p>So the volume of B is $810 \times \frac{8}{27} = 240$</p>	<p>5</p> <p>1 AO1.3b 4 AO2.2</p>	<p>M1 for finding area scale factor and</p> <p>M1 for square root of area scale factor soi and</p> <p>M1 for cubing length scale factor and</p> <p>M1 for $810 \times$ <i>their</i> volume scale factor</p> <p>Allow any equivalent argument, for example by ratios</p>
13	9.2(0)	<p>5</p> <p>3 AO1.3b 2 AO3.1b</p>	<p>M1 for $\frac{6.3}{\sin 33}$</p> <p>A1 for 11.567(...) soi</p> <p>M1 dep *for evidence of cosine rule used</p> <p>M1 for <i>their</i> $'11.6'^2 + 8.4^2 - 2 \times$ <i>their</i> $'11.6' \times 8.4 \times \cos 52$</p> <p>rot to 3 or more sf *Dep on 1st M1 84.7(...) seen implies 4</p>
14	2	<p>3</p> <p>1 AO1.3a 2 AO3.1b</p>	<p>M1 for any correct $\frac{\text{change in } y}{\text{change in } x}$</p> <p>M1 for $\frac{s - q}{r - p} = \frac{4}{2}$</p> <p>If zero scored SC1 for $\frac{\text{change in } x}{\text{change in } y} = \frac{1}{2}$</p>

Question			Answer	Marks	Part marks and guidance	
15			Correct solutions, e.g. $\frac{1}{4} = \frac{1}{6} + \frac{1}{12}$ $\frac{1}{5} = \frac{1}{6} + \frac{1}{30}$ $\frac{1}{6} = \frac{1}{9} + \frac{1}{18}$	3 1 AO1.1 2 AO3.1a	B1 for each Allow any correct example, e.g. $\frac{1}{4} = \frac{1}{5} + \frac{1}{20}$ $\frac{1}{6} = \frac{1}{7} + \frac{1}{42}$	
16	(a)	(i)	70.71[0678...]	3 1 AO1.1 2 AO3.1a	M2 for $8 \times \frac{1}{2} \times 5 \times 5 \times \sin 45$ or M1 for $\frac{1}{2} \times 5 \times 5 \times \sin 45$	
		(ii)	85 – 85.4	5 2 AO1.3b 3 AO3.1b	M4 for $(2 \times 5 \cos 22.5)^2$ or $(2 \times 5 \sin 67.5)^2$ or M3 for $2 \times 5 \cos 22.5$ or $2 \times 5 \sin 67.5$ or M2 for $5 \cos 22.5$ or $5 \sin 67.5$ or M1 for $\cos 22.5 = \frac{x}{5}$ or $\sin 67.5 = \frac{x}{5}$	9.238... 4.619...
	(b)		64 : 1 or 1 : $\frac{1}{64}$	2 2 AO3.2	M1 for making the link to, and using, enlargement eg $(\frac{1}{8})^2$ or 8^2 soi	

Question		Answer	Marks	Part marks and guidance	
17		$-\frac{1}{6}$ with working shown including explanation for discounting $w = -3$	6 1 AO1.3b 1 AO2.4a 4 AO3.1b	B1 for $x^2 = (w + 1)$ M1 for $y = 6(\text{their } x^2)^2 + 7(\text{their } x^2)$ M1 for $\text{their } y = 10$ and make = 0 M1 for solving a three term quad with $a \neq 1$ B1 for discounting a value of w less than -1	$w = -\frac{1}{6}$ and -3 OR $w = -3$ implies 5 marks

Assessment Objectives (AO) Grid

Question	AO1	AO2	AO3	Total
1(a)	1	1		2
1(b)	2		2	4
2(a)(i)	3			3
2(a)(ii)	1			1
2(b)	2			2
2(c)	3			3
3(a)(i)	2			2
3(a)(ii)	1	1		2
3(b)		2		2
3(c)	2		2	4
4(a)	3		2	5
4(b)		1		1
5(a)	1	1	1	3
5(b)			1	1
5(c)		1	1	2
6(a)(i)		1		1
6(a)(ii)		2		2
6(b)		1	1	2
7		2		2
8(a)		3		3
8(b)		2		2
9	2		2	4
10(a)	2			2
10(b)	1	3		4
10(c)		1	1	2
11(a)		3		3
11(b)(i)	2			2
11(b)(ii)	2			2
12	1	4		5
13	3		2	5
14	1		2	3
15	1		2	3
16(a)(i)	1		2	3
16(a)(ii)	2		3	5
16(b)			2	2
17	1	1	4	6
Totals	40	30	30	100