

GCSE (9–1) Mathematics**J560/06** Paper 6 (Higher Tier)**Tuesday 12 June 2018 – Morning****Time allowed: 1 hours 30 minutes****You may use:**

- a scientific or graphical calculator
- geometrical instruments
- tracing paper



First name

Last name

Centre
numberCandidate
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 barcodes.

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** Ping chooses four numbers.

The mode of these four numbers is 8, the range is 7 and the mean is 11.

Find Ping's four numbers.

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

- 2** A box contains only red, blue and green pens.

The ratio of red pens to blue pens is 5 : 9.

The ratio of blue pens to green pens is 1 : 4.

Calculate the percentage of pens that are blue.

..... % **[4]**

3 Asha worked out $\frac{326.8 \times (6.94 - 3.4)}{59.4}$.

She got an answer of 19.5, correct to 3 significant figures.

Write each number correct to 1 significant figure to decide if Asha's answer is reasonable.

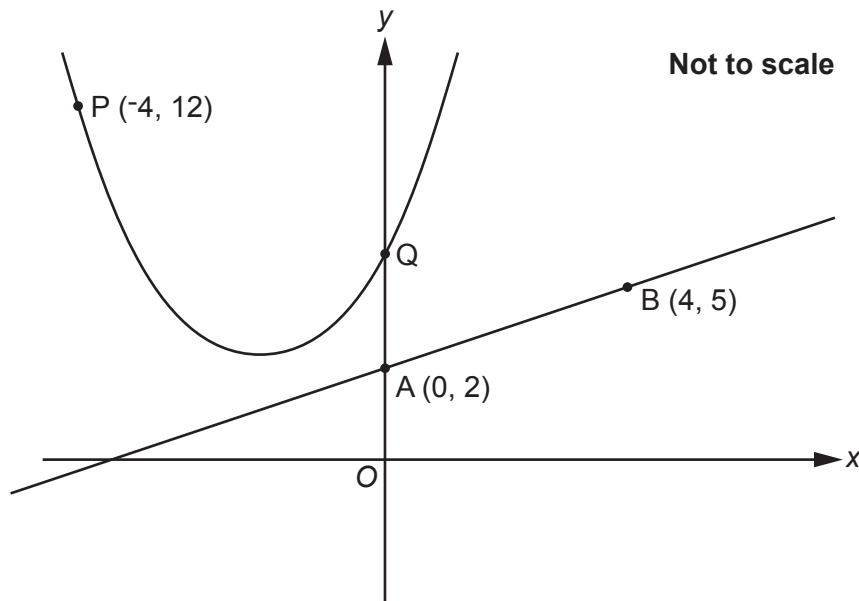
.....
 [3]

4 (a) Show that $a^5 \times (a^3)^2$ can be expressed as a^{11} . [2]

(b) Write $\frac{1}{125} \times 25^9$ as a power of 5.

(b) [3]

- 5 The diagram shows a straight line that passes through points A and B, and a curve that passes through points P and Q.



- (a) Find the equation of the straight line.

(a) [3]

- (b) The equation of the curve is $y = x^2 + kx + 8$.

Find the value of k .

(b) $k =$ [3]

- (c) Diann draws line BQ.
She says

Triangle ABQ is isosceles.

Is Diann correct?
You must show all your working.

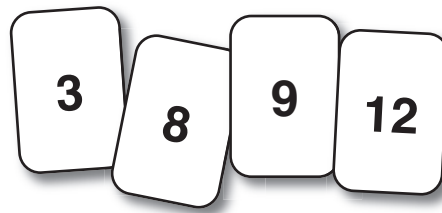
..... [4]

- 6 y is inversely proportional to x .
 $y = 0.04$ when $x = 80$.

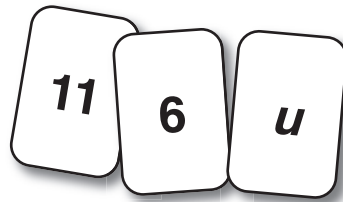
Find the value of y when $x = 32$.

$y =$ [3]

7 Edsel has four number cards.



Sharon has three number cards.
 u represents a number that Sharon knows.



Edsel and Sharon each pick one of their cards at random.
 They calculate the **difference** between the numbers on their cards.
 This is their sample space.

		Edsel			
		3	8	9	12
Sharon	6	3	2	3	6
	11	8	3	2	1
	u	11	6	r	t

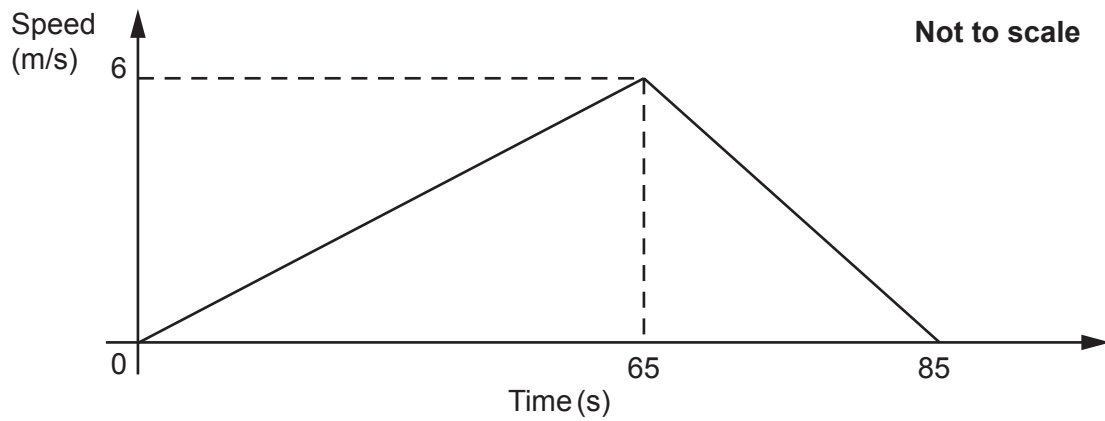
Work out the values of r and t .

$r =$

$t =$

[4]

- 8 The graph shows the speed of a tram as it travels from the library to the town hall.



- (a) Calculate the deceleration of the tram as it approaches the town hall.

(a) m/s^2 [2]

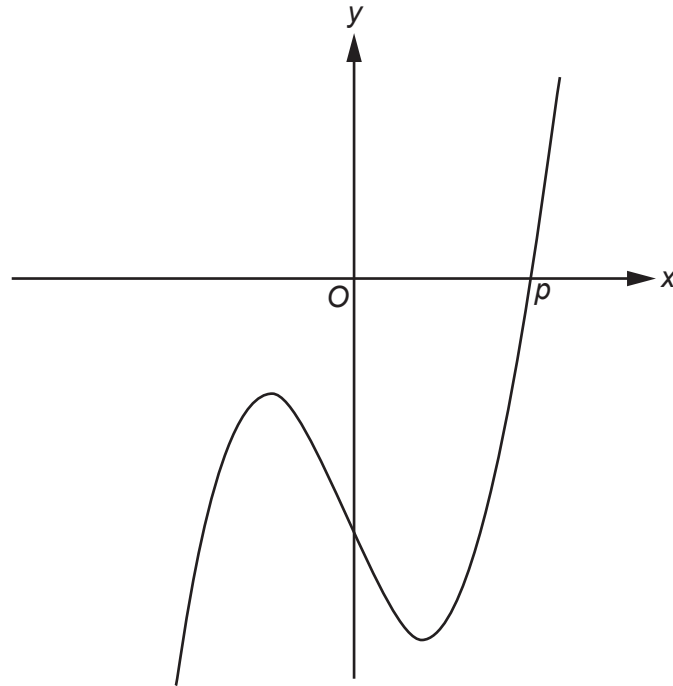
- (b) Calculate the distance travelled by the tram between the library and the town hall.

(b) m [3]

- (c) What was the maximum speed of the tram as it travelled between the library and the town hall?
Give your answer in **kilometres per hour**.

(c) km/h [4]

- 9 The graph of $y = x^3 - 7x - 12$ is shown below.
The root of the equation $x^3 - 7x - 12 = 0$ is p .



- (a) Calculate y when $x = 3$.

(a) $y = \dots\dots\dots$ [1]

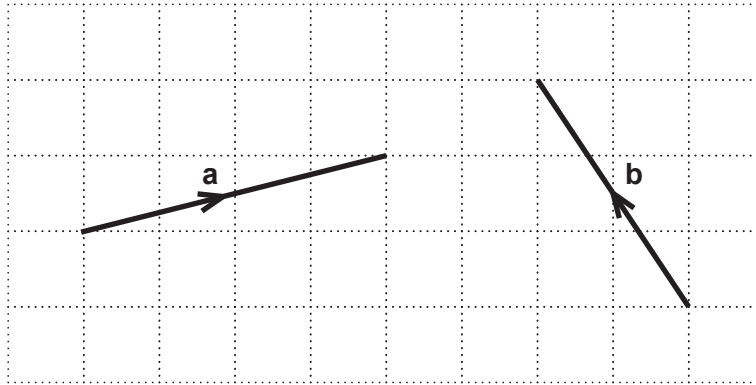
- (b) Show that $3 < p < 4$.

[2]

- (c) Find a smaller interval that contains the value of p .
You must show calculations to support your answer.

(c) $\dots\dots\dots < p < \dots\dots\dots$ [3]

- 10 Two vectors, **a** and **b**, are shown on the 1 centimetre grid below.

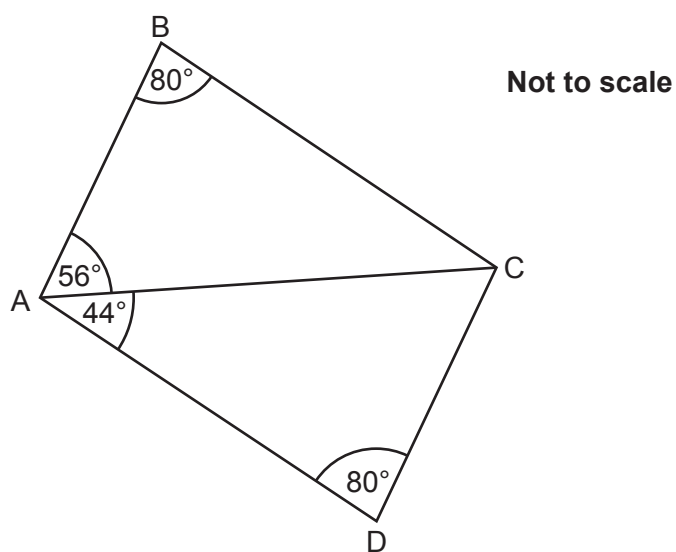


Show that the vector $\mathbf{a} + 2\mathbf{b}$ has length 7 cm.
You may use the grid below.



[3]

- 11 The diagram below shows two triangles.



Prove that triangle ABC is congruent to triangle ACD.

.....

.....

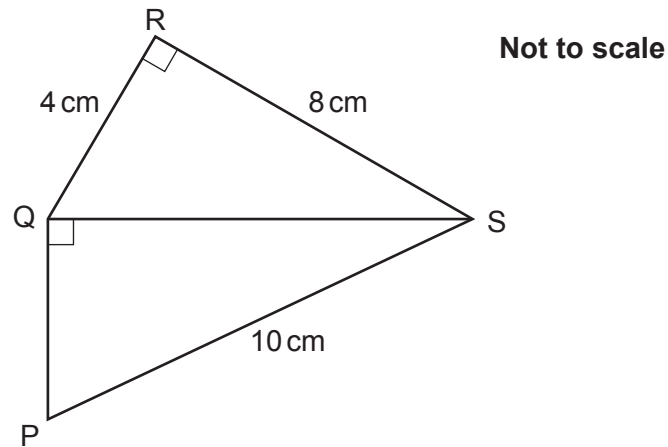
.....

.....

.....

..... [4]

- 12 The diagram below shows two right-angled triangles.



Prove that triangles PQS and QRS are similar.

.....

.....

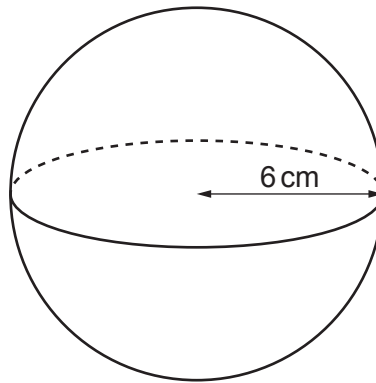
.....

.....

.....

..... [5]

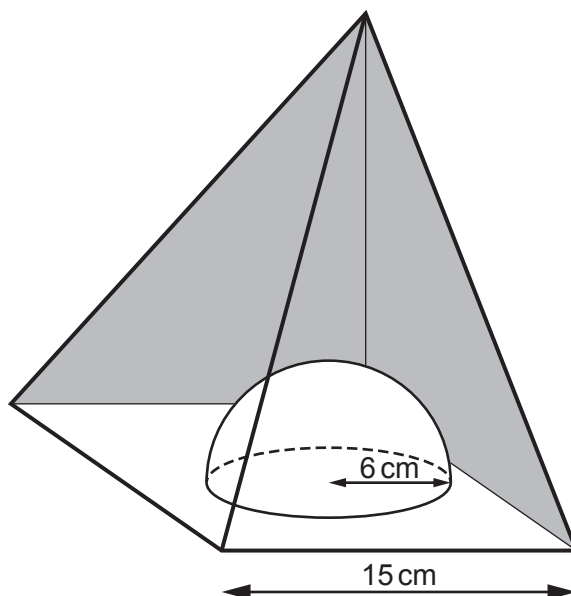
- 13 (a) Calculate the volume of a sphere with radius 6 cm.



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

(a) cm³ [2]

- (b) An ornament is made from a solid glass square-based pyramid. The base has side length 15 cm. A hemisphere with radius 6 cm is cut out of the base of the pyramid. This reduces the volume of glass contained in the ornament by 30%.



Calculate the perpendicular height of the pyramid.

[The volume of a pyramid is $\frac{1}{3} \times \text{area of base} \times \text{perpendicular height}$.

A hemisphere is half a sphere.]

(b) cm [5]

- 14 (a)** Standard bricks have dimensions 21.5 cm by 10.3 cm by 6.5 cm, correct to 1 decimal place.

A house is built using 4663 standard bricks.

Joslin says

Placed end to end, the bricks from the house would definitely reach over 1 km.

Show that Joslin's statement is correct.

[4]

- (b)** A standard brick should weigh 2.8 kg, correct to 1 decimal place.

A truck can carry a maximum load of 20 tonnes.

- (i)** Calculate the maximum number of standard bricks that the truck should be able to carry.

(b)(i) **[3]**

- (ii)** Explain why your answer to **(b)(i)** may not be possible to achieve.

.....

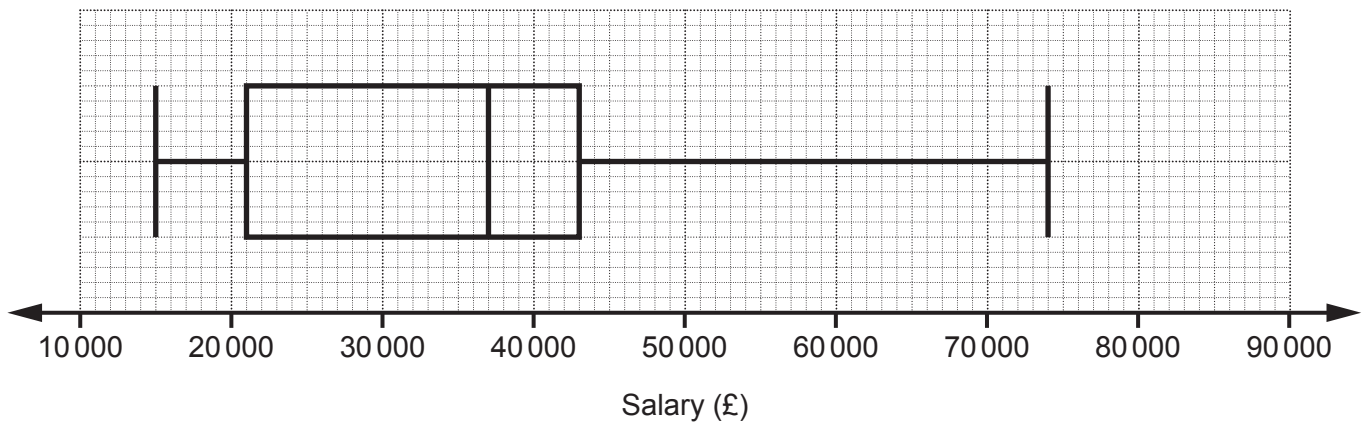
..... **[1]**

- 15** Ratna invests £1200 for 2 years in a bank account paying r % per year compound interest. At the end of 2 years, the amount in the bank account is £1379.02.

Calculate r .

$r = \dots\dots\dots$ [4]

16 The box plot shows the distribution of the salaries for the workers at Bexbridge Biscuits.



(a) State the median salary.

(a) £ [1]

(b) Find the interquartile range.

(b) £ [2]

(c) The following salary information is true for workers at Camford Cookies.

- The highest paid worker earns £85 000.
- The lowest paid worker earns 20% of the salary of the highest paid worker.
- 25% of the workers earn more than £50 000.
- 25% of the workers earn less than £28 000.
- The median salary is £37 000.

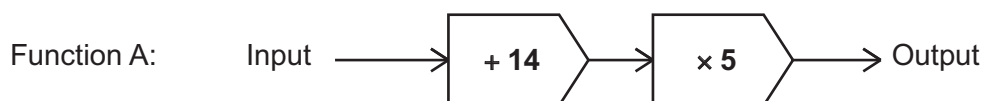
Draw a box plot to show the salaries of the workers at Camford Cookies.



(d) Make two different comparisons between the distribution of the salaries at Bexbridge Biscuits and the salaries at Camford Cookies.

- 1:.....
-
- 2:.....
- [2]

17 Here is a function.



(a) The **output** of function A is x .

Write an algebraic expression, in terms of x , for the input of function A.

(a) [2]

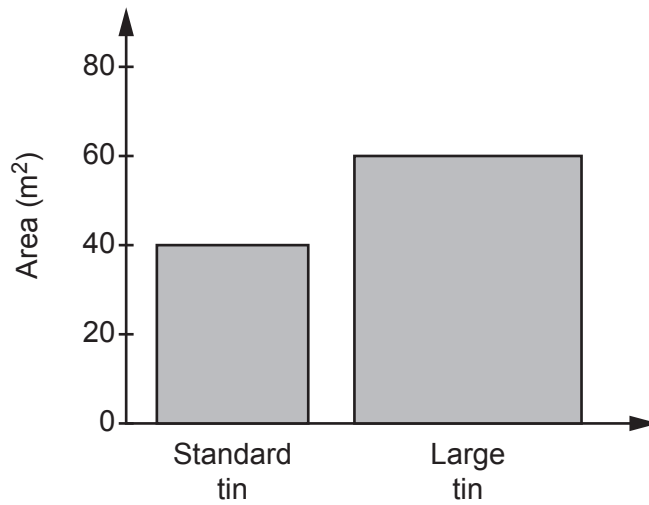
(b) A number, k , is put into function A.
The output is also k .

Find the value of k .

(b) $k =$ [3]

- 18 Percy sells paint in standard tins and large tins.
The standard tin covers 40 m^2 and the large tin covers 60 m^2 .

(a) Percy publishes this chart showing the area that can be covered with each tin of paint.



Explain why the chart is misleading.

.....
 [1]

- (b) The standard tin and the large tin are mathematically similar.
 The **volume** of the large tin is 50% more than the volume of the standard tin.
 Both tins are cylinders.
 The radius of the standard tin is 10 cm.

Calculate the radius of the large tin.

(b) cm [4]

- 19 Show that $\frac{2x^2 + 13x + 20}{2x^2 + x - 10}$ simplifies to $\frac{x + a}{x - b}$ where a and b are integers. [4]

END OF QUESTION PAPER

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GCSE

Mathematics (9-1)

Unit **J560/06**: Paper 6 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2018

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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1. Annotations used in the detailed Mark Scheme.

Annotation	Meaning
✓	Correct
✗	Incorrect
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working (after correct answer obtained), provided method has been completed
M0	Method mark awarded 0
M1	Method mark awarded 1
M2	Method mark awarded 2
A1	Accuracy mark awarded 1
B1	Independent mark awarded 1
B2	Independent mark awarded 2
MR	Misread
SC	Special case
^	Omission sign

These should be used whenever appropriate during your marking.

The **M**, **A**, **B** etc annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks.

It is vital that you annotate these scripts to show how the marks have been awarded.

It is not mandatory to use annotations for any other marking, though you may wish to use them in some circumstances.

Subject-Specific Marking Instructions

2. **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.
3. 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.

4. 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, eg FT $180 \times (\text{their '37' + 16})$, or FT $300 - \sqrt{(\text{their '5^2 + 7^2'})}$. Answers to part questions which are being followed through are indicated by eg FT $3 \times \text{their (a)}$.

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.

5. 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.
6. The following abbreviations are commonly found in GCSE Mathematics mark schemes.
- **cao** means **correct answer only**.
 - **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point eg 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).
 - **nfw** 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**.
7. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise, indicated for example by the instruction 'mark final answer'.
8. As a general principle, if two or more methods are offered, mark only the method that leads to the answer on the answer line. If two (or more) answers are offered, mark the poorer (poorest).
9. 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.

10. 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.
11. If the correct answer is seen in the body and the answer given in the answer space is a clear transcription error allow full marks unless the mark scheme says 'mark final answer' or 'cao'. Place the annotation ✓ next to the correct answer.

If the answer space is blank but the correct answer is seen in the body allow full marks. Place the annotation ✓ next to the correct answer.

If the correct answer is seen in the working but a completely different answer is seen in the answer space, then accuracy marks for the answer are lost. Method marks would still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation ✗ next to the wrong answer.
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			8, 8, 13 and 15	3	<p>B2 for 3 or 4 numbers with at least two conditions met out of:</p> <ul style="list-style-type: none"> At least two numbers are 8 The range is 7 The total is 44 <p>or</p> <p>B1 for 4 numbers with one condition met or 44 seen</p>	<p>Accept any order</p> <p>Examples: B2 for 8, 8, 10.5, 17.5 B2 for 8, 8, 8, 20 B2 for 8, 8, 28 B2 for 1, 8, 8 B1 for 8, 8, 8, 8 B0 for 8, 8</p>
2			18 nfw	4	<p>B1 for [green] 36 or ratio(s) equivalent to 5 : 9 : 36</p> <p>AND</p> <p>M2 for $\frac{\text{their } 9}{\text{their } (5 + 9 + 36)} [\times 100]$ or M1 for <i>their</i> (5 + 9 + 36) soi</p>	<p>For B1 accept 5 : 36 or 9 : 36 or ratio(s) involving a common term for blue eg 10 : 18 and 18 : 72 eg 1 : 1.8 : 7.2 eg $\frac{5}{9} : 1$ [: 4] (decimals should be accurate rot to 3 figs)</p> <p><i>Their</i> (5 + 9 + 36) must come from a ratio (or ratios) with a common term. 1 + 4 + 5 + 9 = 19 followed by $\frac{5}{19}$ scores 0.</p>

Question			Answer	Marks	Part marks and guidance	
3			$\frac{300 \times (7-3)}{60} = 20$ <p>AND</p> <p>it is close to 19.5 oe or 19.5 rounds to 20 oe or [Asha's estimate] is reasonable</p>	3	<p>B2 for 300, 7, 3 and 60 seen or B1 for two of 300, 7, 3 and 60 seen or 300, 4 and 60 seen or 300.0, 7.0, 3.0. 60.0</p> <p>AND</p> <p>B1dep for result 20 and correct conclusion following B1 or B2</p>	<p>Actual answer 19.475959...(may be rounded) scores 0</p> <p>Accept "Yes" or "She's right" or "It is" or equivalent comment</p>
4	(a)		$a^5 \times a^6 = a^{5+6} = a^{11}$ <p>or</p> $a^5 \times a^3 \times a^3 = a^{5+3+3} = a^{11}$	2	<p>B1 for $[(a^3)^2 =] a^6$ or $a^3 \times a^3$</p> <p><u>Alternative:</u> B2 for $[a^5 \times (a^3)^2 =]$ $a \times a \times \dots \times a [= a^{11}]$ or B1 for $[(a^3)^2 =] a \times a \times a \times a \times a \times a$</p>	<p>a^{5+6} or a^{5+3+3} or intent to add indices stated or unambiguously indicated (eg 5 + 6, add indices etc)</p> <p>written in full with eleven a's.</p> <p>written in full with six a's May be implied by $(a \times a \times a \times a \times a \times a)$ seen within an incorrect lengthier product.</p>
	(b)		5^{15}	3	<p>B1 for $\left[\frac{1}{125} =\right] 5^{-3}$ or $[125 =] 5^3$</p> <p>B1 for 5^{18}</p>	

Question			Answer	Marks	Part marks and guidance	
5	(a)		$y = 0.75x + 2$ oe	3	<p>B2 for $y = 0.75x [+ c]$ or answer $0.75x + 2$</p> <p>OR</p> <p>M1 for attempt at $\frac{\text{change in } y}{\text{change in } x}$ soi by $\frac{\pm(5-2)}{\pm(4-0)}$ or ± 0.75</p> <p>and</p> <p>B1 for $y = kx + 2$ with $k \neq 0$</p>	<p>ISW after a correct equation if attempting rearrangement</p> <p>Accept oe throughout eg B2 for $4y = 3x$</p> <p>Examples: M1B1 for $y = -0.75x + 2$ M1B0 for $0.75, 0.75x, -0.75, -0.75x$ If gradient inverted: M0B1 for $y = 1.3x + 2$ M0B0 for $1.3x + 2, y = 1.3x$</p> <p>Condone poorly written $\frac{3}{4}x$ unless clearly 3 over 4x.</p>
	(b)		3 nfww	3	<p>M2 for $12 = 16 - 4k + 8$ or better</p> <p>OR</p> <p>M1 for $12 = -4^2 + -4 \times k + 8$ or sign errors in $12 = 16 - 4k + 8$ or better or $k = \frac{y - x^2 - 8}{x}$</p>	<p>Condone -4 not in brackets but $12 = -4^2 + k - 4 + 8$ with no times sign or dot between k and -4 scores 0 unless subsequently clarified.</p>

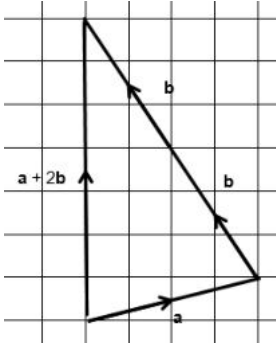
Question		Answer	Marks	Part marks and guidance	
(c)		<u>Using symmetry:</u> Q is (0, 8)	1	dep mark is always dependent on 3 marks being achieved	For first mark in all methods, condone [Q =] 8 or [QA =] 8-2 or 6, seen in working or on diagram.
		Midpoint, M, of AQ is at (0, 5)	1	Accept implied symmetry	eg $8 - 5 = 3$ and $5 - 2 = 3$ so B is in the middle of A and Q May see “midpoint” or any other letter for M
		MB is perpendicular to QA	1		
		So isosceles/Diann is correct	1dep		
		OR	OR		
		<u>Using Pythagoras:</u> Q is (0, 8)	1	<u>Using gradients, vectors or descriptions of translations</u> 1 for Q is (0, 8)	Condone poor notation, such as missing vector brackets or fraction lines in vectors if intention is clear.
		$AB^2 = 4^2 + 3^2$ oe or $AB = 5$ nfw or $QB^2 = 4^2 + (their\ 8 - 5)^2$ or $QB = 5$ nfw	1	1 for gradients/vectors/descriptions of translations for both AB and QB (must be seen together in part (c): eg	
		$AB = 5$ and $QB = 5$ or $AB^2 = 25$ and $QB^2 = 25$	1	gradients: $AB = \frac{3}{4}$ and $QB = -\frac{3}{4}$ (may be implied from the equations of the two lines) descriptions: AB is 4 along (treat as in positive sense) and 3 up and QB is 4 along and 3 down oe	eg gradient $AB = \frac{3}{4}$ and gradient $QB = -\frac{3}{4}$ scores a max of 1 1 0 0 eg gradient $AB = \frac{3}{4}$ and gradient $QB = -\frac{3}{4}$, so triangle is isosceles also scores a max of 1 1 0 0
		$AB = QB$ or “two sides are equal” oe so isosceles/Diann is correct	1dep	To score more than 2 marks, the approach needs to be developed to justify isosceles, such as by switching to the 3rd and 4th marks of the Pythagoras or trig methods.	
		OR	OR		
		<u>Using trig:</u> Q is (0, 8)	1		Warnings: dimensions of triangle shown as (8 – 2), 4, 4 and isosceles stated is B1 only; blank answer space but BQ drawn on diagram is 0 not NR .
		$\tan BAQ = \frac{4}{3}$ [=53.1]	1		
		$\tan BQA = \frac{4}{3}$ [= 53.1]	1		
		$BAQ = BQA$ or “two angles are equal” oe so isosceles/Diann is correct	1dep		
				9	

Question			Answer	Marks	Part marks and guidance	
6			0.1 oe nfww	3	<p>M2 for $80 \times 0.04 = y \times 32$ or $3.2 = 32y$ or $y = \frac{3.2}{32}$ oe</p> <p>OR</p> <p>M1 for 80×0.04 soi by 3.2 or $\frac{16}{5}$</p> <p>or $y = \frac{k}{x}$ soi</p>	
7			$r = 5$ $t = 2$	4	<p>M2 for $u = 14$, may be seen in table</p> <p>A1 for $r = 5$ or $t = 2$</p> <p>OR</p> <p>M1 for $\pm(u - 3) = 11$ oe soi by $u = -8$ or $\pm(u - 8) = 6$ oe soi by $u = 2$</p> <p>A1FT for $r = 17$ and $t = 20$ following $u = -8$ or $r = 7$ and $t = 10$ following $u = 2$</p>	<p>If no credit-worthy working</p> <p>B2 for $r = 5$</p> <p>B2 for $t = 2$</p> <p>FT only from a partially correct value for u (ie. -8 or 2)</p>

Question			Answer	Marks	Part marks and guidance	
8	(a)		0.3 oe	2	<p>M1 for $\frac{[\pm]6}{85-65}$ oe or answer -0.3</p> <p>If 0 scored, allow SC1 for 0.092[3...]</p> <p>or $\frac{6}{65}$ as final answer</p>	<p>Allow unsimplified equivalents for full marks</p> <p>eg. $\frac{6}{20}$</p>
	(b)		255	3	<p>M2 for valid method to find complete area under the graph using one or more parts</p> <p>OR</p> <p>M1 for attempt to find partial area below the graph</p>	<p>M2 examples:</p> <p>eg $\frac{85 \times 6}{2}$ oe</p> <p>or two triangles soi by 195 and 60</p> <p>or [rectangle] 6×85 – two triangles oe</p> <p>M1 examples</p> <p>a triangle between $t = 0$ and 65</p> <p>or a triangle between $t = 65$ and 85</p> <p>or [rectangle] 6×85 – one triangle</p> <p>M0 for [rectangle] 6×85</p> <p>Allow full marks for equivalent with units stated eg. 0.255 km</p>

Question			Answer	Marks	Part marks and guidance	
	(c)		21.6 or $\frac{108}{5}$ or $21\frac{3}{5}$ nfw	4	<p>B1 for 6 soi</p> <p>AND</p> <p>M2 for $\frac{their 6 \times 60 \times 60}{1000}$ oe</p> <p>or</p> <p>M1 for $their 6 \times 60 \times 60$ oe soi 21 600</p> <p>or $their 6 \div 1000$ oe soi 0.006</p> <p>or $\frac{60 \times 60}{1000}$ oe soi 3.6</p>	<p>Condone missing or incorrect units in working eg 6 m for 6 m/s</p> <p><i>their</i> 6 could be the average speed 255/85</p> <p>21600 or 0.006 imply B1M1</p>
9	(a)		-6	1		
	(b)		<p>$[x = 4,] y = 24$</p> <p>Change of sign, so p lies between 3 and 4 oe</p>	2	<p>B1 for 24 seen</p> <p>If using $3.27 < x < 4$ rather than 4:</p> <p>SC2 evaluate y correctly (see table in (c)), state change of sign oe and that because $3 < p < their\ x\text{-value}$, then so $3 < p < 4$.</p> <p>0 for just evaluating y.</p>	<p>After $x = 4, y = 24$ scored:</p> <p>Examples just sufficient for second mark include:</p> <p>change of sign</p> <p>$-6 < 0 < 24$</p> <p>$x = 3$ gives an answer < 0 and</p> <p>$x = 4$ gives an > 0</p> <p>Examples insufficient for second mark:</p> <p>so p lies between 3 and 4</p>

Question		Answer	Marks	Part marks and guidance																	
	(c)	Examples: when $x = 3.5$, $y = 6.4$, so $3 < p < 3.5$ when $x = 3.1$, $y = -3.9$, so $3.1 < p < 4$ when $x = 3.1$, $y = -3.9$ and when $x = 3.5$, $y = 6.4$, so $3.1 < p < 3.5$	3	<p>M2 for one further value of y evaluated correctly, possibly rot to 2 or more sf, for a value of x such that $3 < x < 4$</p> <p>OR</p> <p>M1 for working shown to calculate one further value of y for a value of x such that $3 < x < 4$</p> <p>Note after SC considered in (b): if SC2 was awarded then they must use a value of x that produces a smaller interval than $3 < x < 4$ applies</p> <p>If 0 scored, award SC1 or SC2 if evidence for M1 or M2 has not yet been credited in (b)</p>	<p>Solution is approx. 3.2670</p> <p>Common values:</p> <table><tr><th>x</th><th>y</th></tr><tr><td>3.1</td><td>-3.909</td></tr><tr><td>3.2</td><td>-1.632</td></tr><tr><td>3.25</td><td>-0.422</td></tr><tr><td>3.26</td><td>-0.174</td></tr><tr><td>3.27</td><td>0.0758</td></tr><tr><td>3.3</td><td>0.837</td></tr><tr><td>3.4</td><td>3.504</td></tr></table> <p>A correct narrower range scores 0 unless accompanied by the relevant correct calculation(s). eg M2 only for when $x = 3.1$, $y = -3.9$ so $3.1 < p < 3.5$ (as 3.5 has not been correctly justified) Calculations in support of $x = 3$ or $x = 4$ need not be repeated from parts (a) or (b).</p>	x	y	3.1	-3.909	3.2	-1.632	3.25	-0.422	3.26	-0.174	3.27	0.0758	3.3	0.837	3.4	3.504
x	y																				
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10	<p>Correct triangle drawn with $\mathbf{a} + 2\mathbf{b}$ labelled and with correct arrows or \mathbf{a} and $2\mathbf{b}$ labelled and with correct arrows AND length 7cm indicated on diagram</p>  <p>OR</p> $\begin{pmatrix} 4 \\ 1 \end{pmatrix} + 2\begin{pmatrix} -2 \\ 3 \end{pmatrix} = \begin{pmatrix} 0 \\ 7 \end{pmatrix} \text{ with brackets}$	3	<p>M1 for vector $2\mathbf{b}$ drawn on grid</p> <p>M1 $\mathbf{a} + k\mathbf{b}$ drawn on grid The two vectors must be joined end to end but arrows may be contradictory. $k\mathbf{b}$ should be in the direction of \mathbf{b}</p> <p>OR</p> <p>B1 for $\begin{pmatrix} 4 \\ 1 \end{pmatrix}$</p> <p>B1 for $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ or $\begin{pmatrix} -4 \\ 6 \end{pmatrix}$</p>	<p>If both methods shown/started, mark the better one For M marks condone missing or incorrect arrows and labels on vectors</p> <p>Mark intent: end of vectors within 2mm of vertices of relevant square</p> <p>Examples (ignore arrows): M1M1 for $\mathbf{a} + 2\mathbf{b}$ drawn (3 marks if labelled and 7 cm indicated) M1M1 for $\mathbf{a} - 2\mathbf{b}$ M1M0 for $2\mathbf{b}$ or $-2\mathbf{b}$ M0M1 for $\mathbf{a} + \mathbf{b}$, $\mathbf{a} - 1.5\mathbf{b}$ etc</p> <p>For B1 marks, condone missing brackets and fraction lines</p>

Question	Answer	Marks	Part marks and guidance	
11	<p>angle $BCA = 44^\circ$ and angles [in a] triangle [= 180°] or angle $DCA = 56^\circ$ and angles [in a] triangle [= 180°]</p> <p>Best two statements from: (i) [side] AC is common (ii) [angle] $ACB =$ [angle] CAD (iii) [angle] $BAC =$ [angle] ACD (iv) angle $B =$ angle D or [angle] $ABC =$ [angle] CDA</p> <p>Conclusion and third statement [congruent because] ASA after stating (i), (ii), (iii) AAS after stating (i), (ii), (iv) or (i), (iii), (iv)</p>	<p>1</p> <p>2</p> <p>1</p>	<p>B1 for each to a max of 2</p> <p>If 0 (or 1 for statements) scored then, to a maximum total of 2 marks, allow: SC1 for angle $BCA = 44^\circ$ and angle $DCA = 56^\circ$ stated or on diagram and SC1 for a correct statement lacking precision eg "both triangles have a common side", "both triangles have an angle of 80°", "all the angles are the same"</p>	<p>$C = 44$ (or 56) is not sufficient. Accept angles shown on diagram.</p> <p>0 if alternate angles is given as the reason unless the parallelogram has been justified</p> <p>Notation needed for these marks.</p> <p>$44 = 44$ is not sufficient. $56 = 56$ is not sufficient "angle" required if using just B or D</p> <p>Final mark needs a third statement (ignore superfluous ones) and the appropriate congruence conclusion.</p> <p>Possible marks (without SC): 1 + 2 + 1, 1 + 2 + 0, 1 + 1 + 0, 0 + 2 + 1, 0 + 2 + 0, 0 + 1 + 0, 0 + 0 + 0.</p>

Question		Answer	Marks	Part marks and guidance	
12		<p>[QS =] $\sqrt{80}$, $4\sqrt{5}$ oe or 8.9[4..]</p> <p>Best two from: (i) shows a pair of corresponding angles are equal (ii) shows a second pair of corresponding angles are equal or states [angle] QRS = [angle] PQS (iii) shows two pairs of corresponding sides are in the same ratio (iv) shows the third pair of corresponding sides have the same ratio. Ratios of corresponding sides need to be seen in equivalent form.</p> <p>Conclusion: two (or three) equal angles oe after showing (i) and (ii) or three pairs of corresponding sides in the same ratio after showing (iii) and (iv) or two pairs of corresponding sides in the same ratio and an equal angle between them oe after showing relevant combination of (i)/(ii) and (iii)</p>	<p>2</p> <p>2</p> <p>1</p>	<p>M2 for [QS =] $\sqrt{4^2 + 8^2}$ oe or M1 for $4^2 + 8^2$</p> <p>B1 for each to a max of 2 For these marks, answers to calculations are sufficient, but corresponding pairs must be either exact or the same when rot to 3sf. In (ii) accept QRS and PQS are both right angles oe (iii) and (iv) can be shown using scale factors eg QS = $1.118 \times RS$ and PS = $1.118 \times QS$</p> <p>Note: there is no mark for just finding QP = $\sqrt{20}$</p> <p>In all cases, it must be clear which angles and ratios are being used to support the conclusion made, usually by using labels or from values on a diagram. If it is not clear, withhold the final mark. Where more than two facts are shown, allow the final mark if the conclusion is fully supported.</p>	<p>Accept QS on diagram First M2 may be implied by QP = $2\sqrt{5}$ oe or 4.47[...]</p> <p>Example values: angle RSQ = $\tan^{-1}\left(\frac{4}{8}\right) = \cos^{-1}\left(\frac{8}{\sqrt{80}}\right)$ = $\sin^{-1}\left(\frac{4}{\sqrt{80}}\right) = 26.5(\dots)$ or 26.6 angle QSP = $\tan^{-1}\left(\frac{\sqrt{20}}{\sqrt{80}}\right) = \cos^{-1}\left(\frac{\sqrt{80}}{10}\right)$ = $\sin^{-1}\left(\frac{\sqrt{20}}{10}\right) = 26.5(\dots)$ or 26.6</p> <p>Accept as fractions or ratios. $\frac{PS}{QS} = \frac{10}{\sqrt{80}} = \frac{\sqrt{5}}{2} = 1.118[\dots]$ PS : QS = 10 : $\sqrt{80}$ oe $\frac{QS}{RS} = \frac{\sqrt{80}}{8}$ with any of the above $\frac{PS}{QS}$ is insufficient for (iii) and (iv) as it is not clear that the ratios are the same.</p>
13	(a)	288 π or 904.3 to 905	2	M1 for $\frac{4}{3}(\times)\pi(\times)6^3$	Accept 904 if M1 scored

Question	Answer	Marks	Part marks and guidance
(b)	20.0[9...] to 20.1[...] or $\frac{32}{5}\pi$ oe nfw	5	<p>Accept answer 20 after full working. No requirement at any stage for a formal equation. Values below provided as a guide to method being used, but mark method not accuracy: ie hemisphere (144π or $452(..)$) or pyramid ($75[h]$) ie hemisphere (144π or $452(..)$) and pyramid ($75[h]$)</p> <p>OR 30% of pyramid ($22.5[h]$) or “reverse %” using hemisphere (480π or $1507(..)$) ie hemisphere (144π or $452(..)$) and 30% of pyramid ($22.5[h]$)</p> <p>OR “reverse %” using hemisphere (480π or $1507(..)$) and pyramid ($75[h]$). To receive M1M1M1 they should have both parts of the “ands” correct</p> <p>If correct, at this stage, it should be (480π or $1507(..)$) $\div 75$ oe</p> <p>$1507(..) \div 225$ is likely to score M1M1M0M1</p> <p>M1 for [hemisphere=] $0.5 \times \text{their (a)}$ soi or $0.5 \times \frac{4}{3} (\times) \pi (\times) 6^3$ or [pyramid=] $\frac{1}{3} \times 15 \times 15 [\times'h']$ soi</p> <p>M1 for [hemisphere=] $0.5 \times \text{their (a)}$ soi or $0.5 \times \frac{4}{3} (\times) \pi (\times) 6^3$ and [pyramid=] $\frac{1}{3} \times 15 \times 15 [\times'h']$ soi</p> <p>OR $0.3 \times \text{their pyramid } [\times'h']$ or $\frac{\text{their hemisphere}}{0.3}$ oe</p> <p>M1 for hemisphere soi and $0.3 \times \text{their pyramid } [\times'h']$</p> <p>OR $\frac{\text{their hemisphere}}{0.3}$ oe and pyramid $[\times'h']$ soi</p> <p>M1 for $\frac{\text{their hemisphere}}{0.3} \div \text{their pyramid}$ oe</p> <p>If 0 scored, allow SC3 for $\frac{64}{5}\pi$ or $40.[1..]$ to $40.2[...]$ as final answer</p>

Question			Answer	Marks	Part marks and guidance	
14	(a)		$21.45 \times 4663 \div 100\,000 = 1.000\,2[1..]$ (km) or $21.45 \times 4663 =$ $100\,020$ to $100\,021.4 > 100\,000$ (cm) or. $100\,000 \div 21.45 = 4662[0..] < 4663$ or $100\,000 \div 4663 = 21.44[5..] < 21.45$ Note the first method does not require a comparison against 1 (km)	4	<p>B1 for (minimum length =) 21.45 seen</p> <p>B1 for 1 km = 100 000 cm so i.e. such as $\div 100$ then $\div 1000$ or use of 1m = 100cm and 1km = 1000m if working in metres.</p> <p>M1 for <i>their</i> $21.45 \times 4663 (\div 100\,000)$ or $100\,000 \div \text{their } 21.45$ or $100\,000 \div 4663$</p> <p>If M0 scored, allow SC1 for $k \times 4663 (\div 100\,000)$ or $100\,000 \div k$ with k in the range 10.25 to 10.35 or 6.45 to 6.55</p>	<p>Allow access to all marks if brick and 1 km are in consistent units.</p> <p>Allow these conversions even with <i>their</i> volume or surface area. eg $21.5 \times 10.3 \times 6.5 = 1439.425$ $\text{cm}/\text{cm}^2/\text{cm}^3 = 0.014\,394\,25 \text{ km}$</p> <p><i>their</i> 21.45 must be in the range 21.45 to 21.55 but accept equivalent if attempting the unit conversion first eg B0B0M1 for 21.5 cm = 0.0215 km followed by 0.0215×4663</p> <p>Thus, use of width or height of the brick may score B0,B1,SC1 whereas use of volume may score B0/1,B1,SC0</p> <p>Accept equivalent if working in m or km</p>
	(b)	(i)	7017 to 7020	3	<p>B1 for 20 000 or 2.849[...] or 2.85 or 0.0028[...] seen</p> <p>M1 for <i>their</i> $20\,000 \div \text{their } 2.85$ or $20 \div \text{their } 0.00285$</p>	<p>Ignore other bound</p> <p>ie a division after an attempt to reach consistent units <i>their</i> 2.85 must be in the range 2.75 to 2.85 inc.; <i>their</i> 0.00285 must be in the range 0.00275 to 0.00285. B0M0 for $20 \div 2.8$ as no attempt to reach consistent units</p>

Question			Answer	Marks	Part marks and guidance	
		(ii)	The truck may not have enough room oe Safety regulations may not allow it	1		Mark their best reason. 0 for we do not know the exact weight of the bricks oe 0 for because the truck may need to carry other loads 0 there may not be enough bricks available
15			7.2[0] or 7.19[9...] nfw	4	<p>M3 for $\sqrt{\frac{1379.02}{1200}}$ oe soi by 1.067[...] to 1.072{...}</p> <p>OR</p> <p>M2 for $\frac{1379.02}{1200}$ oe soi by 1.14 to 1.15</p> <p>OR</p> <p>M1 for $1200x^2 = 1379.02$</p> <p>Trials or no working: SC4 for correct answer 7.2[0] or 7.19[9...] on answer line OR SC3 for $1200 \times 1.072[0]^2 = 1379.02$ or $1200 \times 1.0719[9...]^2 = 1379.02$ OR SC1 for use of $1200x^2$ oe</p>	<p>Condone % symbol with correct answer.</p> <p>Warning: $1200 \div 179.02 = 6.7$</p> <p>Allow $(1 + \frac{r}{100})$ or any letter, including r, in place of x.</p>

[illegible]

Question			Answer	Marks	Part marks and guidance	
17	(a)		$\frac{x}{5} - 14$ oe	2	<p>M1 for $\frac{x}{5}$</p> <p>If 0 scored then SC1 for $\frac{x-14}{5}$ oe</p>	<p>Condone use of another letter for M1 max</p> <p>Must use x in SC1 0 for $x - 14 \div 5$</p>
	(b)		-17.5 or $-\frac{35}{2}$ oe nfw	3	<p>M1 for $5('k' + 14) = 'k'$ or $'k' = \frac{k}{5} - 14$</p> <p>M1FT for $4'k' = -70$ or better or re-arrangement of <i>their</i> comparable $f(k) = g(k)$ equation into the form $ak = b$.</p> <p>M1FT solving their $ak = b$</p> <p>Alternative (FT as above): M1 for $'k' = \frac{k}{5} - 14$ M1FT for $\frac{4k}{5} = -14$ or better M1FT solving <i>their</i> $ak = b$</p> <p>Trials or no working: SC3 for -17.5</p>	<p>eg $5k+14=k$ becomes $4k=-14$ and then $k=-3.5$ scores M0 M1FT M1FT $k + 70 = k$ is not comparable</p> <p>Answers may be in decimal or fractional form but fractions equating to integers should be simplified</p>

Question			Answer	Marks	Part marks and guidance	
18	(a)		Bars are of different width oe	1		0 for large tin looks larger than it is 0 for the bars are different sizes 0 for incorrect/no x-axis
	(b)		11.4[...] nfww	4	<p>B1 for 1.5 or $\frac{3}{2}$ or 3 : 2 soi</p> <p>AND</p> <p>M2 for $10 \times \sqrt[3]{1.5}$</p> <p>or</p> <p>M1 for $\sqrt[3]{1.5}$ soi by 1.14(47...)</p> <p>If 0 scored allow SC1 for 15 as final answer or seen radius of large tin</p> <p><u>Alternative:</u></p> <p>B1 for 0.666 to 0.667 or $\frac{2}{3}$ or 2 : 3</p> <p>soi</p> <p>AND</p> <p>M2 for $10 \div \sqrt[3]{0.666 \text{ to } 0.667}$ oe</p> <p>or</p> <p>M1 for $\sqrt[3]{0.666 \text{ to } 0.667}$ oe soi</p> <p>0.873(...)</p>	

Question	Answer	Marks	Part marks and guidance
19	$\frac{(2x+5)(x+4)}{(2x+5)(x-2)} = \frac{x+4}{x-2}$	4	<p>M3 for $(2x+5)(x+4)$ and $(2x+5)(x-2)$ seen</p> <p>OR</p> <p>M2 for $(2x+5)(x+4)$ or $(2x+5)(x-2)$ seen</p> <p>OR</p> <p>M1 for any two linear factors giving two correct terms in numerator or denominator</p> <p><u>Alternative:</u></p> <p>M1 for $(2x^2 + 13x + 20)(x - b)$ and $(2x^2 + x - 10)(x + a)$ seen</p> <p>M1 two correct from $-10a = -20b$ oe $a - 10 = 20 - 13b$ oe $2a + 1 = 13 - 2b$ oe</p> <p>M1dep (on M1M1) valid attempt to solve <i>their</i> simultaneous equations (condone one error)</p> <p>If 0 scored, allow SC2 for $\frac{x+4}{x-2}$ as final answer from incomplete working, or SC1 for $\frac{x+4}{x-2}$ seen.</p> <p>Warning: $\frac{2(x+5)(x+4)}{2(x+5)(x-2)} = \frac{x+4}{x-2}$ scores SC1</p> <p>eg. $(2x+10)(x+2)$ which gives $2x^2$ and 20</p>

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