

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

GCSE MATHEMATICS

H

Higher Tier

Paper 2 Calculator

Thursday 8 November 2018

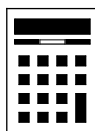
Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments.



Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

For Examiner's Use

Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
TOTAL	

Advice

In all calculations, show clearly how you work out your answer.



N 0 V 1 8 8 3 0 0 2 H 0 1

Answer **all** questions in the spaces provided

- 1** What does $(A \cap B)$ represent in $P(A \cap B)$?
Circle your answer.

[1 mark]

A or B or both

A but not B

not A and not B

A and B

- 2** P is $(4, 9)$ and Q is $(-2, 1)$
Circle the midpoint of PQ .

[1 mark] $(1, 5)$ $(3, 4)$ $(3, 5)$ $(6, 8)$

- 3** Which of these is a geometric progression?
Circle your answer.

[1 mark]

1 3 5 7 9

1 3 6 10 15

1 4 9 16 25

1 3 9 27 81



- 4 The bearing of A from B is 310°
Circle the bearing of B from A .

[1 mark]

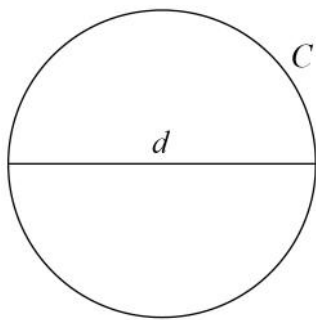
050°

110°

130°

220°

- 5 A circle has circumference C and diameter d .



$$C = kd$$

What **value** does the constant k represent?

[1 mark]

Answer _____



- 6** Here is some information about 20 trains leaving a station.

Number of minutes late, t	Number of trains	Midpoint	
$0 \leq t < 5$	12		
$5 \leq t < 10$	7		
$10 \leq t < 15$	1		
$t \geq 15$	0		

- 6 (a)** Work out an estimate of the mean number of minutes late.

[3 marks]

Answer _____ minutes



- 6 (b)** The station manager looks at the information in more detail.

Number of minutes late, t	Number of trains
$0 \leq t < 2$	12
$2 \leq t < 4$	0
$4 \leq t < 6$	7
$6 \leq t < 8$	0
$8 \leq t < 10$	0
$10 \leq t < 12$	1

He works out an estimate of the mean using this information.

How does his estimate compare with the answer to part (a)?

Tick **one** box.

[1 mark]

☐

Higher than part (a)

☐

Same as part (a)

☐

Lower than part (a)

☐

Not possible to tell

Turn over for the next question

Turn over ►



7

Work out the values of a and b in the identity

$$5(7x + 8) + 3(2x + b) \equiv ax + 13$$

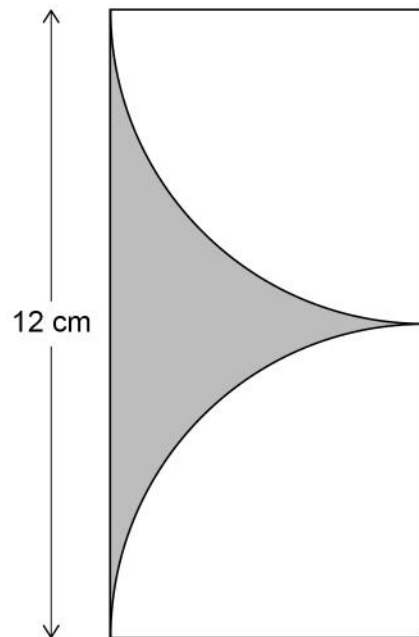
[4 marks]

$$a = \underline{\hspace{2cm}} \quad b = \underline{\hspace{2cm}}$$



8

Two identical quarter circles are cut from a rectangle as shown.



Not drawn
accurately

Work out the shaded area.

[4 marks]

Answer _____ cm^2



9

The diagrams show the position of a tap when off and fully on.

The tap is fully on when the angle of turn is 180°

Off



Fully on



When fully on, water flows out of the tap at 14 litres per minute.

The rate at which water flows out is in direct proportion to the angle of turn.

The tap is turned 135°



The water flows into a tank with a capacity of 79.8 litres.

Will it take **less than** $7\frac{1}{2}$ minutes to fill the tank?

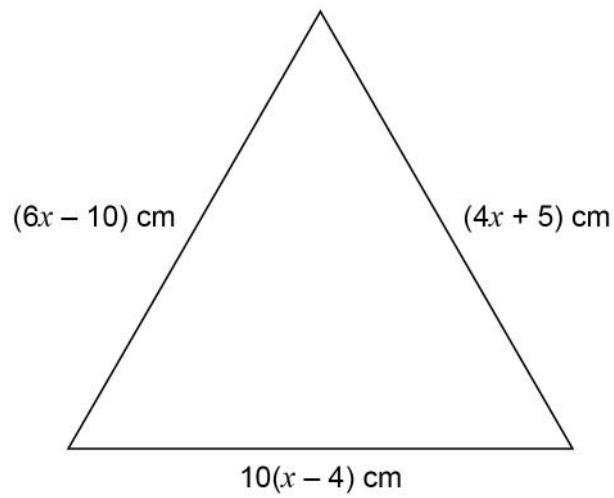
You **must** show your working.

[4 marks]



10

This triangle is equilateral.

Not drawn
accurately

Is the perimeter of the triangle greater than one metre?

You **must** show your working.**[5 marks]**



- 11 An approximation for the value of π is given by

$$4\left(1 - \frac{22}{57} + \frac{22}{85} - \frac{22}{105} + \frac{22}{117} - \frac{22}{242}\right)$$

Use your calculator to show that this approximation is within 0.1 of 3.14

[2 marks]

- 12 Work out

$$\frac{9.12 \times 10^{10}}{3.2 \times 10^4}$$

Give your answer in standard form.

[2 marks]

Answer _____



13

Ashraf is going to put boxes into a crate.

The crate is a cuboid measuring 2.5 m by 2 m by 1.2 m

Each box is a cube of length 50 cm

He does these calculations.

volume of crate	=	$2.5 \times 2 \times 1.2$
	=	6 m^3
volume of one box	=	$0.5 \times 0.5 \times 0.5$
	=	0.125 m^3
number of boxes	=	$6 \div 0.125$
	=	48

He claims,

“I can put 48 boxes in the crate.”

Evaluate Ashraf's method **and** claim.

[2 marks]

14

The cross section of a prism has n sides.

Circle the expression for the number of edges of the prism.

[1 mark]

$2n$

$3n$

$n + 2$

$2n + 3$



15

The volume of a medal is 45 cm^3

The medal is made from copper and tin.

volume of copper : volume of tin = 22 : 3

The density of copper is 8.96 g/cm^3

The density of tin is 7.31 g/cm^3

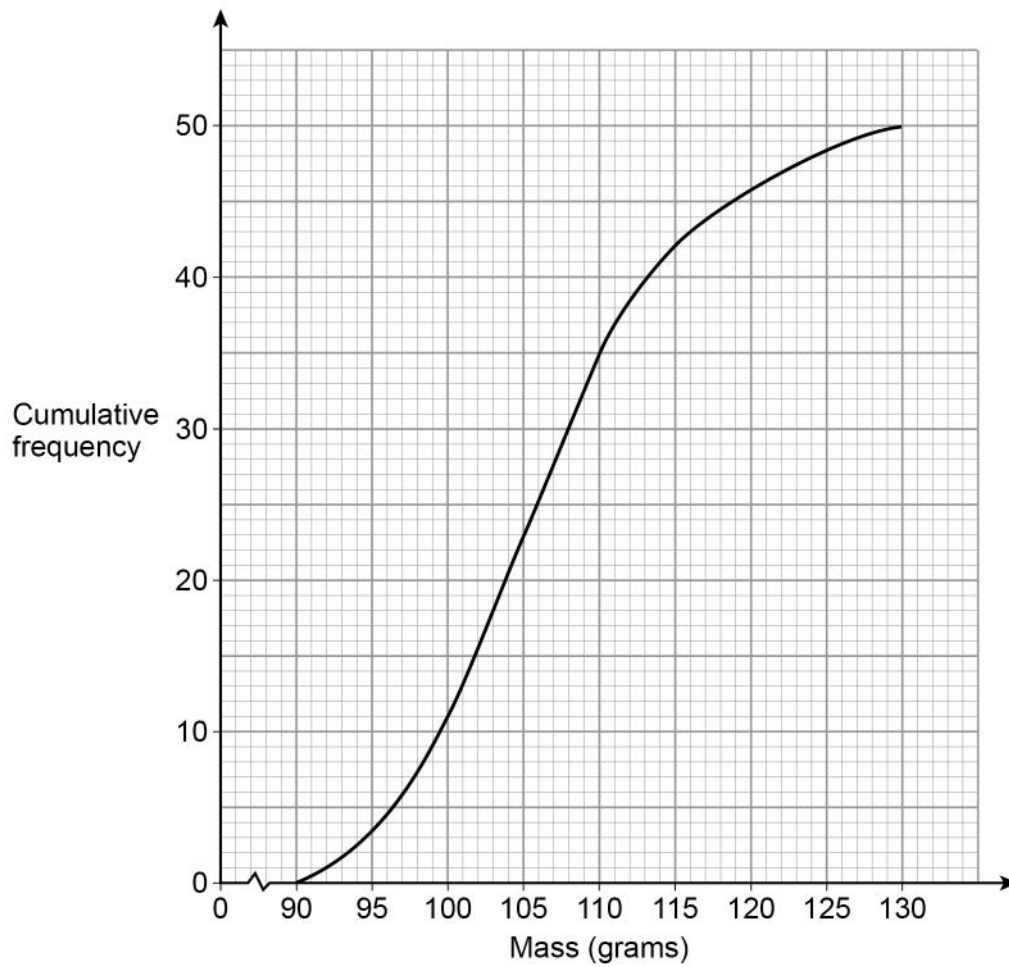
Work out the mass of the medal.

[4 marks]

Answer _____ grams



- 16** The cumulative frequency graph shows information about the masses of 50 apples.



- 16 (a)** Use the graph to estimate the median mass of the apples.

[1 mark]

Answer _____ grams

- 16 (b)** Estimate the proportion of the apples that have a mass greater than 115 grams.

[2 marks]

Answer _____



17

 a is a prime number. b is an even number.

$$N = a^2 + ab$$

Circle the correct statement about N .**[1 mark]**could be
even or odd

always even

always prime

always odd

18

A bag contains 20 discs.

10 are red, 7 are blue and 3 are green.

18 (a)

Marnie takes a disc at random before putting it back in the bag.

Nick then takes a disc at random before putting it back in the bag.

Olly then takes a disc at random.

Work out the probability that they all take a red disc.

[2 marks]

Answer _____



18 (b)

All 20 discs are in the bag.

Reggie takes three discs at random, one after the other.

After he takes a disc he does **not** put it back in the bag.

Reggie's first disc is blue.

Work out the probability that all three discs are different colours.

[3 marks]

Answer _____

Turn over ►

19

Lunch

Choose one starter and one main course

There are four starters and ten main courses to choose from.

Two of the starters and three of the main courses are suitable for vegans.

What percentage of the possible lunches have **both** courses suitable for vegans?**[3 marks]**

Answer _____ %

20

 n is a positive integer.Prove algebraically that $2n^2\left(\frac{3}{n} + n\right) + 6n(n^2 - 1)$ is a cube number.**[3 marks]**



- 21** y is inversely proportional to \sqrt{x}
 $y = 4$ when $x = 9$

- 21 (a)** Work out an equation connecting y and x .

[3 marks]

Answer _____

- 21 (b)** Work out the value of y when $x = 25$

[2 marks]

Answer _____

Turn over for the next question



- 22 Simplify fully $\frac{x^5 - 4x^3}{3x - 6}$ [3 marks]

Answer _____

- 23 PQR is a straight line.
 $PQ : QR = 3 : 1$
 $\overrightarrow{PQ} = \mathbf{a}$

Not drawn
accurately



Circle the vector \overrightarrow{RQ}

[1 mark]

$$\frac{1}{3} \mathbf{a}$$

$$\frac{1}{4} \mathbf{a}$$

$$-\frac{1}{3} \mathbf{a}$$

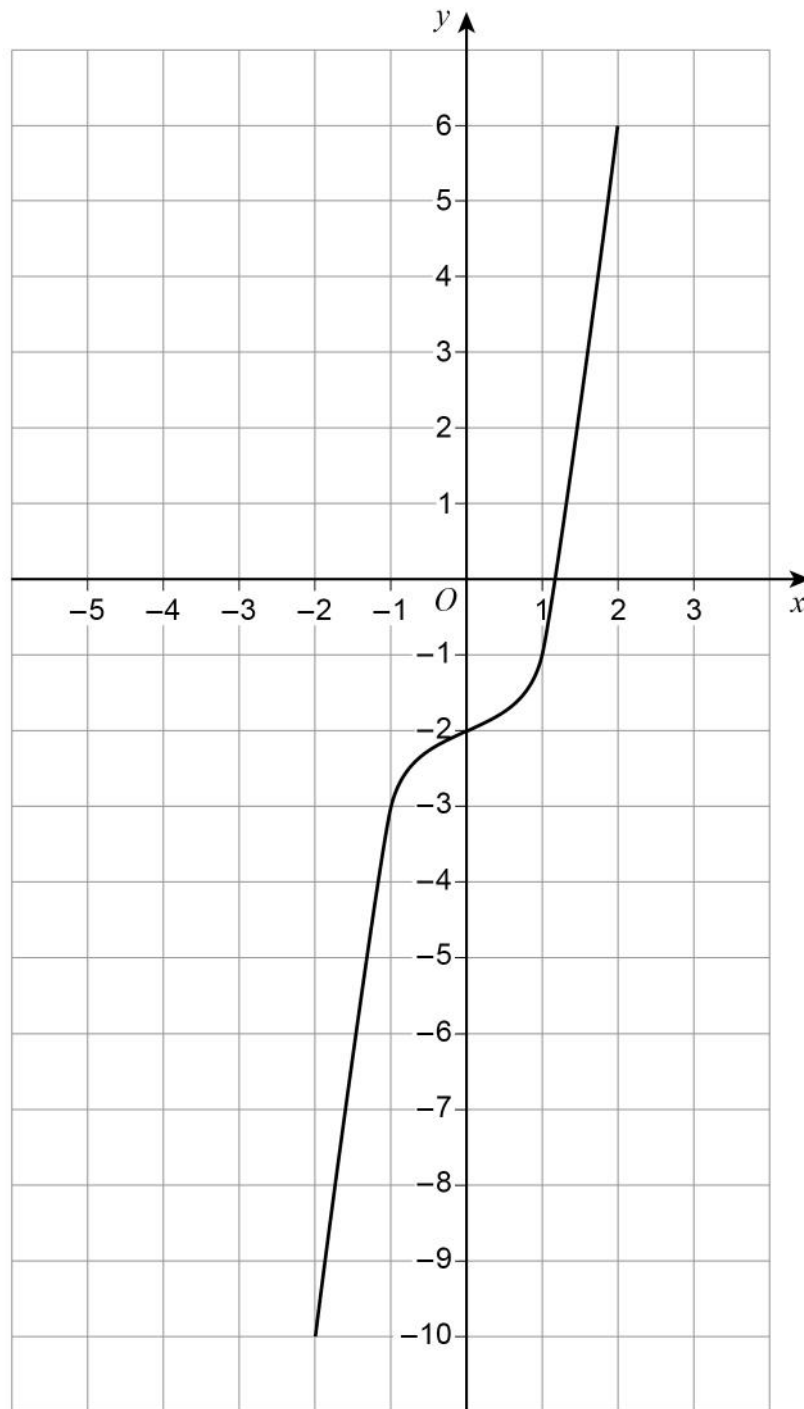
$$-\frac{1}{4} \mathbf{a}$$



24

Here is a sketch of $y = f(x)$

The curve passes through the points

 $(-2, -10)$ $(-1, -3)$ $(0, -2)$ $(1, -1)$ $(2, 6)$ On the grid, sketch the curve $y = f(x + 2)$

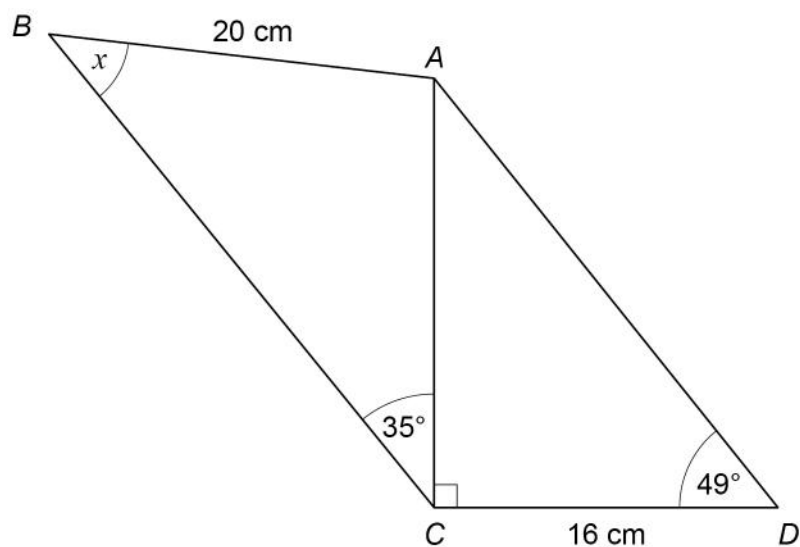
[2 marks]

6

Turn over ►



25

 ABC and ACD are triangles.Work out the size of angle x .**[5 marks]**

Answer _____ degrees



26

$$f(x) = \frac{x}{x+2}$$

$$g(x) = x^2 - 2$$

Work out $fg(x)$

Give your answer in the form $a + bx^n$ where a , b and n are integers.

[3 marks]

Answer _____

27

The point $\left(3, \frac{1}{64}\right)$ lies on the curve $y = k^{-x}$ where k is a constant.

Show that the point $\left(\frac{1}{2}, \frac{1}{2}\right)$ lies on the curve.

[3 marks]



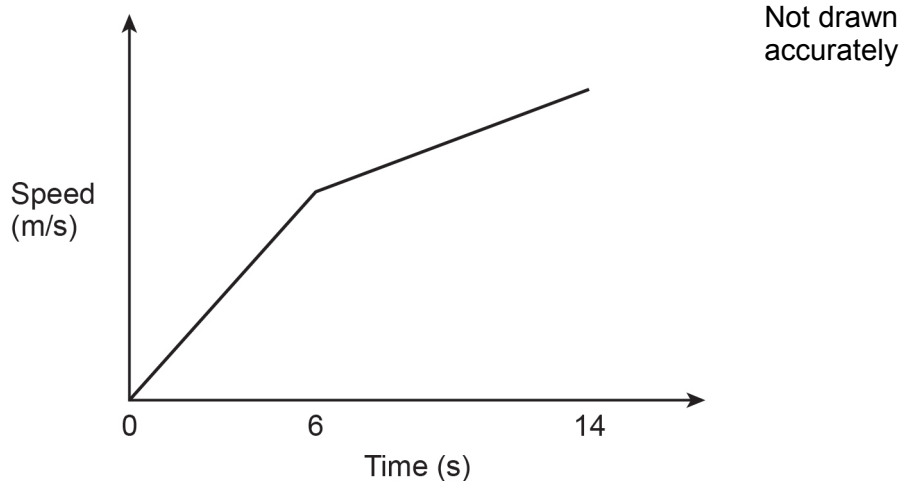
28 Izzy runs an 80-metre race in 14 seconds.

During the first 6 seconds her speed increases at a constant rate.

During the last 8 seconds her speed increases at a different constant rate.

Her speed at 14 seconds is 2 m/s more than her speed at 6 seconds.

Here is a sketch of her speed-time graph.



28 (a) Work out her acceleration during the last 8 seconds.

State the units of your answer.

[2 marks]

Answer _____



28 (b) When Izzy finishes the 80-metre race, her speed is v m/s

Work out the value of v .

[4 marks]

Answer _____

END OF QUESTIONS



There are no questions printed on this page

*Do not write
outside the
box*

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ANSWER IN THE SPACES PROVIDED**

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GCSE MATHEMATICS 8300/2H

Higher Tier Paper 2 Calculator

Mark scheme

November 2018

Version: 1.0. Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
oe	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leq \text{value} < b$
3.14 ...	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Examiners should consistently apply the following principles

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

Questions which ask students to show working

Instructions on marking will be given but usually marks are not awarded to students who show no working.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced

Erased or crossed out work that is still legible should be marked.

Work replaced

Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

Continental notation

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

Question	Answer	Mark	Comments
1	A and B	B1	
	Additional Guidance		
2	(1, 5)	B1	
	Additional Guidance		
3	1 3 9 27 81	B1	
	Additional Guidance		
4	130°	B1	
	Additional Guidance		
5	Pi or π	B1	accept a value in range [3.14, 3.142]
	Additional Guidance		
	Accept incorrect spelling if intention is clear eg accept pie		
	Answer ($C =$) πd		B0
	Answer ($C =$) πd ($k =$) π		B1

Question	Answer	Mark	Comments
6(a)	2.5×12 or 30 and 7.5×7 or 52.5 and $12.5 (\times 1)$ or 95	M1	allow one incorrect midpoint or $[2, 3] \times 12$ and $[7, 8] \times 7$ and $[12, 13] (\times 1)$ ignore $t \geq 15$ row
	$\frac{\text{their } 30 + \text{their } 52.5 + \text{their } 12.5}{12 + 7 + 1}$ or $95 \div 20$	M1dep	$t \geq 15$ product must be 0 if seen condone bracket error seen eg $30 + 52.5 + 12.5 \div 20$
	4.75	A1	accept 4.8 or 5 if full working shown using correct midpoints
	Additional Guidance		
	Two correct from 30, 52.5 and 12.5 implies the first mark and could be used to score up to M2	M1	
	Midpoints used in the ranges [2, 3], [7, 8] and [12, 13] must be seen eg 2.5×12 and 7×7 and $12 (\times 1)$ or 3×12 and 7×7 and $13 (\times 1)$ NB These could be used to score up to M2	M1	
	Correct products seen in the table but a different method shown in the working lines eg $20 \div 4 = 5$	M0	
6(b)	Lower than part (a)	B1	
	Additional Guidance		

Question	Answer	Mark	Comments
7	Alternative method 1		
	$35x + 6x = ax$ or $35 + 6 = a$ or $41x = ax$	M1	
	$a = 41$	A1	
	$40 + 3b = 13$	M1	oe
	$b = -9$	A1	SC3 $a = 41, b = -27$ or $a = 41, b = \frac{5}{3}$
	Alternative method 2		
	$35x + 40 + 6x + 3b$ or $41x + 40 + 3b$	M1	
	$35x + 6x = ax$ or $35 + 6 = a$ and $40 + 3b = 13$	M1dep	oe eg $41x = ax$ and $3b = -27$
	$a = 41$	A1	implies first M1 only
	$b = -9$	A1	SC3 $a = 41, b = -27$ or $a = 41, b = \frac{5}{3}$
	Additional Guidance		
	$a = 41$ and $b = -9$	M1A1M1A1	
	$a = 41$ or $b = -9$	M1A1	
	$35x, 40, 6x$ and $3b$ seen without addition signs shown or implied	M0	
	$35x + 40 + 6x + b$ leading to an answer of $a = 41$ and $b = -27$	SC3	
	$35x + 8 + 6x + 3b$ leading to an answer of $a = 41$ and $b = \frac{5}{3}$	SC3	
	$35x + 8 + 6x + b$ leading to an answer of $a = 41$ and $b = 5$	M1A1	
	$a = 41x$	M0	
	For $\frac{5}{3}$ accept 1.66... or 1.67		
	Condone multiplication signs eg $35 \times x$ for $35x$		

Question	Answer	Mark	Comments
8	12×6 or 72	M1	oe area of rectangle
	$\pi \times 6^2$ or 36π or [113, 113.112]	M1	oe may be implied eg $\pi \times 6^2 \div 4$ or 9π or [28.2, 28.3]
	$\pi \times 6^2 \div 2$ or 18π or [56.4, 56.6]	M1dep	oe dep on 2nd M1
	[15.4, 15.5] or $72 - 18\pi$	A1	
	Additional Guidance		
	$72 - 18\pi = 54\pi$		M1M1M1A0
	$\pi \times 6^2 \div 2$ scores 2nd and 3rd M1		
	$12 \times 6 = 72$ $72 \div 2 = 36$ (unless identified as half of rectangle)		(1st) M0
	$\pi \times 6^2$ scores 2nd M1 even if subsequently used incorrectly eg $\pi \times 6^2 = 36\pi$ $36\pi \times 2 = 72\pi$		(2nd) M1
	Ignore units throughout		

Question	Answer	Mark	Comments
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9	Alternative method 1 comparing with 7.5 minutes		
	$180 \div 135$ or $180 \div 14$ or $79.8 \div 14$ or $79.8 \div 135$	M1	oe or reciprocals
	$\frac{14 \times 135}{180}$ or 10.5 or $\frac{79.8 \times 180}{135}$ or 106.4	M1dep	oe or reciprocals
	$\frac{79.8 \times 180}{14 \times 135}$ or 7.6	M1dep	oe eg $79.8 \div 10.5$ or $106.4 \div 14$
	No and 7.6 (and 7.5)	A1	oe eg No and 7 minutes 36 seconds (and 7 minutes 30 seconds)
	Alternative method 2 comparing with 79.8 litres		
	$135 \div 180$ or $14 \div 180$ or 7.5×14 or $7.5 \div 180$	M1	oe or reciprocals
	$\frac{14 \times 135}{180}$ or 10.5 or $\frac{7.5 \times 135}{180}$ or 5.625	M1dep	oe or reciprocals
	$\frac{7.5 \times 135 \times 14}{180}$ or 78.75	M1dep	oe eg 10.5×7.5 or 5.625×14
	No and 78.75	A1	

Alternative methods and Additional Guidance continued on the next two pages

Question	Answer	Mark	Comments
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9 cont	Alternative method 3 comparing with 14 litres per minute		
	180 ÷ 135 or 180 ÷ 7.5 or 79.8 ÷ 135 or 79.8 ÷ 7.5	M1	oe or reciprocals
	$\frac{7.5 \times 135}{180}$ or 5.625 or $\frac{79.8 \times 180}{135}$ or 106.4	M1dep	oe or reciprocals
	$\frac{79.8 \times 180}{7.5 \times 135}$ or [14.18, 14.19]	M1dep	oe
	No and [14.18, 14.19]	A1	
	Alternative method 4 comparing new rate of flow with rate required		
	135 ÷ 180 or 14 ÷ 180	M1	oe or reciprocals
	$\frac{14 \times 135}{180}$ or 10.5	M1dep	oe
	79.8 ÷ 7.5 or 10.64	M1	oe
	No and 10.5 and 10.64	A1	
	Alternative method 5 comparing with 135 degrees		
	180 ÷ 14 or 180 ÷ 7.5 or 79.8 ÷ 14 or 79.8 ÷ 7.5	M1	oe or reciprocals
	180 ÷ 14 and 79.8 ÷ 7.5 or 180 ÷ 7.5 and 79.8 ÷ 14	M1dep	oe or matching reciprocals
	$\frac{79.8 \times 180}{7.5 \times 14}$ or 136.8	M1dep	dep on M2
	No and 136.8	A1	

Additional Guidance continued on the next page

Question	Answer	Mark	Comments
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9 cont	Additional Guidance		
	No may be implied eg It takes more		
	7.3(0) used for 7.5 may score up to M3		
	$7\frac{1}{2}$ minutes converted to 7.3(0) or 7 minutes 50 seconds		A0
	Ignore incorrect conversion of 7.6 to minutes and seconds if 7.6 seen		
	Use the scheme that awards the most marks and ignore choice		

Question	Answer	Mark	Comments
10	$4x + 5 = 6x - 10$ or $4x + 5 = 10(x - 4)$ or $6x - 10 = 10(x - 4)$	M1	oe eg $4x + 5 + 6x - 10 = 2 \times 10(x - 4)$ condone $10x - 4$ for $10(x - 4)$
	$4x - 6x = -10 - 5$ or $-2x = -15$ or $4x - 10x = -40 - 5$ or $-6x = -45$ or $6x - 10x = -40 + 10$ or $-4x = -30$	M1dep	oe collection of terms eg $4x + 6x - 20x = -80 - 5 + 10$ or $-10x = -75$ condone $10x - 4$ for $10(x - 4)$ eg $4x - 10x = -4 - 5$ or $6x - 10x = -4 + 10$
	$(x =) 7.5$	A1	oe may be implied by (side length =) 35 or (perimeter =) 105
	$(6 \times \text{their } 7.5 - 10) \times 3$ or $(4 \times \text{their } 7.5 + 5) \times 3$ or $10 \times (\text{their } 7.5 - 4) \times 3$ or 35×3 or $6 \times \text{their } 7.5 - 10 + 4 \times \text{their } 7.5 + 5$ $+ 10 \times (\text{their } 7.5 - 4)$ or $20 \times \text{their } 7.5 - 45$ or 105	M1dep	oe dep on M1M1 condone $10x - 4$ for $10(x - 4)$ must show working if M1M1A0
	105 and Yes	A1	oe eg 1.05 and Yes
	Additional Guidance		
	$4x + 5 = 6x - 10 = 10(x - 4)$	M1	
	Condone $10x - 4$ for $10(x - 4)$ for up to M3		

Question	Answer	Mark	Comments
11	3.041...	M1	condone 3.042
	$3.14 - 3.041... = 0.09...$ or $3.041... + 0.1 = 3.141...$ or $3.041... \text{ and } 3.14 - 0.1 = 3.04$	A1	oe condone 3.042 for 3.041...
	Additional Guidance		
	Must see calculation for the A mark		
	Do not allow use of a more precise value of π for the A mark		

Question	Answer	Mark	Comments
12	2.85×10^6	B2	B1 correct value not in standard form eg 2 850 000 or 28.5×10^5 or 2.9×10^6
	Additional Guidance		
	Condone different spacing or commas eg 2850000 or 28,50,000		B1
	$2.85.10^6$		B1
	2.85×10^6 in working with 2.9×10^6 on answer line		B2
	2.85×10^6 in working with 3×10^6 on answer line		B2
	2.9×10^6 in working with 3×10^6 on answer line		B1
	3×10^6 only		B0
	2.85×10^6 in working with 2 850 000 on answer line		B1
	2 850 000 in working with 2 900 000 on answer line		B1
	2 900 000 only		B0
	2 850 000 in working with 2.8×10^6 on answer line		B1
	2.8×10^6 only		B0

Question	Answer	Mark	Comments
13	Evaluates method	B1	eg1 his method does not work because 1.2 m does not divide exactly by 50 cm eg2 there are not a whole number of 50 cm in 1.2 m eg3 50 cm will not fit in 0.2 m eg4 $1.2 \div 0.5 = 2.4$ which is not a whole number eg5 $120 \div 50 = 2.4$ and cannot have 2.4 boxes eg6 can only fit 2 layers of boxes
	Evaluates claim	B1	eg1 he can only fit 40 eg2 he will not fit (as many as) 48
	Additional Guidance		
	Volume divided volume doesn't always work		(1st) B0
	He is wrong as he can put 42 boxes		(2nd) B0
	Only 2 layers will fit so he can't fit 48 boxes		B1B1
	Can't have 0.4 of a box so he can only fit 45 boxes		B1B0
	$5 \times 4 \times 2 = 40$		B0B1

Question	Answer	Mark	Comments
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14	$3n$	B1	
	Additional Guidance		

15	Alternative method 1		
	$45 \div (22 + 3)$ or $45 \div 25$ or 1.8	M1	oe eg $\frac{45}{25}$
	22 \times their 1.8 or 39.6 or 3 \times their 1.8 or 5.4	M1dep	
	their 39.6×8.96 + their 5.4×7.31 or [354, 355] + [39, 40]	M1dep	
	394.29 or 394.3	A1	
	Alternative method 2		
	$45 \div (22 + 3)$ or $45 \div 25$ or 1.8	M1	oe eg $\frac{45}{25}$
	their 1.8×8.96 or [16.1, 16.13] or their 1.8×7.31 or [13.1, 13.2]	M1dep	
	their [16.1, 16.13] \times 22 + their [13.1, 13.2] \times 3 or [354, 355] + [39, 40]	M1dep	
	394.29 or 394.3	A1	

Alternative method and Additional Guidance continued on the next page

Question	Answer	Mark	Comments
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15 cont	Alternative method 3		
	$45 \div (22 + 3)$ or $45 \div 25$ or 1.8	M1	oe eg $\frac{45}{25}$
	22×8.96 or [197, 197.12] or 3×7.31 or [21.9, 22]	M1	
	their [197, 197.12] \times their 1.8 + their [21.9, 22] \times their 1.8 or [354, 355] + [39, 40]	M1dep	oe dep on M1M1
	394.29 or 394.3	A1	
	Additional Guidance		
	Allow up to M2 even if not subsequently used		
	Ignore units throughout		

16(a)	106	B1	
	Additional Guidance		

Question	Answer	Mark	Comments
16(b)	50 – 42 or 8 or $\frac{42}{50}$ or $\frac{21}{25}$ or 0.84 or 84%	M1	oe
	$\frac{8}{50}$ or $\frac{4}{25}$ or 0.16 or 16%	A1	oe
	Additional Guidance		
	Ignore incorrect conversion if correct answer seen		
	$\frac{8}{42}$		M1A0
17	could be even or odd	B1	
	Additional Guidance		

Question	Answer	Mark	Comments
18(a)	$\frac{10}{10+7+3}$ or $\frac{10}{20}$ or $\frac{5}{10}$ or $\frac{1}{2}$ or 0.5	M1	oe eg 50%
	$\frac{1}{8}$ or 0.125 or 12.5%	A1	oe eg $\frac{1000}{8000}$ or $\frac{125}{1000}$
	Additional Guidance		
	Ignore incorrect conversion if correct answer seen		
	Answer $\frac{1}{2}$		M1
	10 out of 20		M0
	10 : 20		M0
	Answer 1 out of 8		M1A0
	Answer 1 : 8 is A0 but M1 is possible		
	$\frac{10}{20}$ $\frac{7}{20}$ $\frac{3}{20}$		M1

Question	Answer	Mark	Comments
18(b)	$\frac{10}{19}$ or $\frac{3}{19}$	M1	oe allow [0.52, 0.53] or [0.15, 0.16]
	$\frac{10}{19} \times \frac{3}{18} (\times 2)$ or $\frac{3}{19} \times \frac{10}{18} (\times 2)$ or $\frac{5}{57} (\times 2)$ or [0.087, 0.088] ($\times 2$)	M1dep	oe eg $1 \times \frac{10}{19} \times \frac{3}{18}$ or $\frac{30}{342}$ allow [0.52, 0.53] \times [0.16, 0.17] or [0.15, 0.16] \times [0.55, 0.56]
	$\frac{10}{57}$ or 0.175... or 17.5...%	A1	oe eg $\frac{60}{342}$ SC2 $\frac{7}{38}$ or 0.184... oe
	Additional Guidance		
	$\frac{7}{20} \times \frac{10}{19} \times \frac{3}{18}$		M1M0A0
	$\frac{7}{20} \times \frac{3}{19} \times \frac{10}{18}$		M1M0A0
	If more than one product is seen, the correct one(s) must be selected for 2nd M1 $\frac{10}{19} \times \frac{6}{18} + \frac{3}{19} \times \frac{10}{18}$		M1M0A0
	Both correct products selected but multiplied together scores M1 only $\frac{10}{19} \times \frac{3}{18} \times \frac{3}{19} \times \frac{10}{18}$		M1M0A0
	Ignore incorrect conversion if correct answer seen		
	5 out of 57 cannot score 2nd M1 but implies 1st M1		
	5 : 57 cannot score 2nd M1 but 1st M1 is possible		
	Answer 10 out of 57		M1M1A0
	Answer 10 : 57 is A0 but M2 or M1M0 is possible		

Question	Answer	Mark	Comments
19	4×10 or 40 and 2×3 or 6 or $\frac{2}{4}$ and $\frac{3}{10}$ or 0.5 and 0.3	M1	oe eg 50% and 30%
	$\frac{2 \times 3}{4 \times 10}$ or $\frac{\text{their } 6}{\text{their } 40}$ or 0.15	M1dep	oe eg $\frac{3}{20}$ or $\frac{2}{4} \times \frac{3}{10}$ or 0.5×0.3
	15	A1	
	Additional Guidance		
	2 : 4 and 3 : 10		M0

Question	Answer	Mark	Comments
20	$\frac{6n^2}{n} + 2n^3$ or $6n + 2n^3$ or $6n^3 - 6n$	M1	expands one bracket correctly allow $3 \times 2n$ for $\frac{6n^2}{n}$
	$\frac{6n^2}{n} + 2n^3 + 6n^3 - 6n$ or $6n + 2n^3 + 6n^3 - 6n$	M1dep	fully correct expansion allow $3 \times 2n$ for $\frac{6n^2}{n}$
	$8n^3$ and $(2n)^3$	A1	must have seen M1M1 oe eg $8n^3$ and $2n \times 2n \times 2n$ or $8n^3$ and $\sqrt[3]{8n^3} = 2n$ condone $8n^3$ and 2^3n^3
	Additional Guidance		
	Do not allow $\frac{2n^2 \times 3}{n}$ for $\frac{6n^2}{n}$		

Question	Answer	Mark	Comments
21(a)	Alternative method 1		
	$y = \frac{k}{\sqrt{x}}$	M1	oe equation implied by $4 = \frac{k}{\sqrt{9}}$ oe
	$(k =) 4 \times \sqrt{9}$ or $(k =) 12$	M1dep	oe
	$y = \frac{12}{\sqrt{x}}$	A1	oe equation
	Alternative method 2		
	$ky = \frac{1}{\sqrt{x}}$	M1	oe equation implied by $4k = \frac{1}{\sqrt{9}}$ oe
	$(k =) \frac{1}{\sqrt{9}} \div 4$ or $(k =) \frac{1}{12}$	M1dep	oe
	$\frac{1}{12}y = \frac{1}{\sqrt{x}}$	A1	oe equation
	Additional Guidance		
	Alt 1 $(k =) 12$ or $(k \propto) 12$ with no incorrect working		M1M1
	Condone use of \propto for up to M1M1A0 eg (Alt 1) $y \propto \frac{k}{\sqrt{x}}$ $k \propto 12$ $y \propto \frac{12}{\sqrt{x}}$		M1 M1dep A0
	$y = \frac{12}{\sqrt{x}}$ oe		M1M1A1

Question	Answer	Mark	Comments
21(b)	$\frac{12}{\sqrt{25}}$ or $\frac{\text{their } k}{\sqrt{25}}$	M1	oe their k from (a)
	2.4 or $\frac{12}{5}$ or $2\frac{2}{5}$	A1ft	ft $\frac{\text{their } k}{5}$
	Additional Guidance		
	$y \propto 2.4$		M1A0
	$y = \frac{\frac{4}{3}}{\sqrt{x}}$ in (a) $\frac{\frac{4}{3}}{\sqrt{25}}$ $\frac{4}{15}$ (allow [0.266, 0.267])		M1 A1ft

Question	Answer	Mark	Comments
22	$3(x-2)$ or $x^3(x^2-4)$ or $x^2(x^3-4x)$ or $x(x^4-4x^2)$ or $(x^4+2x^3)(x-2)$ or $x^3(x+2)(x-2)$ or $x^2(x^2+2x)(x-2)$ or $x(x^3+2x^2)(x-2)$	M1	numerator or denominator factorised oe eg $x^2(x+2)(x^2-2x)$
	$3(x-2)$ and $x^3(x+2)(x-2)$ or $3(x-2)$ and $(x^4+2x^3)(x-2)$ or $3(x-2)$ and $x^2(x^2+2x)(x-2)$ or $3(x-2)$ and $x(x^3+2x^2)(x-2)$	A1	numerator and denominator factorised each with factor $(x-2)$
	$\frac{x^3(x+2)}{3}$ or $\frac{x^2(x^2+2x)}{3}$ or $\frac{x(x^3+2x^2)}{3}$ or $\frac{x^4+2x^3}{3}$	A1	oe fully simplified expression eg $\frac{1}{3}x^3(x+2)$ or $\frac{x^4}{3} + \frac{2x^3}{3}$
	Additional Guidance		
	$\frac{x^3(x+2)}{3}$ followed by further incorrect work		M1A1A0
	$\frac{x^3 \times (x+2)}{3}$ or $\frac{1}{3} \times x^3(x+2)$		M1A1A0
	$3 \times (x-2)$ and $x^3 \times (x+2) \times (x-2)$		M1A1
	$3 \times (x-2)$ or $x^3 \times (x^2-4)$		M1
	$1(3x-6)$ or $-1(6-3x)$		M0
	$-3(2-x)$		M1
	$-3(2-x)$ and $-x^3(x+2)(2-x)$		M1A1

Question	Answer	Mark	Comments
23	$-\frac{1}{3}a$	B1	
	Additional Guidance		
24	Plots at least three of (0, 6) (–1, –1) (–2, –2) (–3, –3) (–4, –10)	M1	points may be implied by a curve passing through the points tolerance ± 2 mm
	Plots (0, 6) (–1, –1) (–2, –2) (–3, –3) (–4, –10) and joins with a smooth curve	A1	points may be implied by a curve passing through the points tolerance ± 2 mm
	Additional Guidance		
	Draws $y = f(x - 2)$ or $y = f(x) + 2$ or $y = f(x) - 2$		M0A0

Question	Answer	Mark	Comments
25	$\tan 49 = \frac{AC}{16}$	M1	oe eg $\tan (90 - 49) = \frac{16}{AC}$ or $AC^2 + 16^2 = \left(\frac{16}{\cos 49}\right)^2$
	$\tan 49 \times 16$ or [18.4, 18.41]	M1dep	oe eg $\frac{16}{\tan (90 - 49)}$ or $\sqrt{\left(\frac{16}{\cos 49}\right)^2 - 16^2}$
	$\frac{\sin x}{\text{their [18.4, 18.41]}} = \frac{\sin 35}{20}$ or $\frac{\text{their [18.4, 18.41]}}{\sin x} = \frac{20}{\sin 35}$	M1dep	oe eg $\frac{\sin x}{16 \tan 49} = \frac{\sin 35}{20}$ dep on 1st M1
	$\sin x = \frac{\sin 35}{20} \times \text{their [18.4, 18.41]}$	M1dep	oe eg $\sin x = \frac{16 \tan 49 \sin 35}{20}$ or $\sin^{-1}\left(\frac{\sin 35}{20} \times \text{their [18.4, 18.41]}\right)$ or $\sin^{-1}[0.527, 0.528]$ dep on 1st and 3rd M1
	[31.8, 31.9]	A1	allow 32 with full method seen
	Additional Guidance		
	Answer [31.8, 31.9] possibly from scale drawing		5 marks
	Answer 32 possibly from scale drawing		Zero

Question	Answer	Mark	Comments
26	$\frac{x^2 - 2}{x^2 - 2 + 2}$ or $\frac{x^2 - 2}{x^2}$	M1	
	$\frac{x^2}{x^2} - \frac{2}{x^2}$ or $1 - \frac{2}{x^2}$	A1	implied by correct final answer must be two terms oe eg $x^2x^{-2} - 2x^{-2}$
	$1 - 2x^{-2}$ or $a = 1$ and $b = -2$ and $n = -2$	A1	
	Additional Guidance		
27	$\frac{1}{64} = k^3$ or $\sqrt[3]{\frac{1}{64}}$	M1	oe equation in k
	$(k =) \frac{1}{4}$ or $(k =) 0.25$	A1	must see working for M1 implied by $y = \left(\frac{1}{4}\right)^x$ $\left(\frac{1}{4}\right)^3 = \frac{1}{64}$ is M1A1
	$\left(\frac{1}{4}\right)^{\frac{1}{2}} = \frac{1}{2}$ or $0.25^{\frac{1}{2}} = 0.5$	A1	must see working for M1A1 allow $\sqrt{\frac{1}{4}} = \frac{1}{2}$ or $\sqrt{0.25} = 0.5$
	Additional Guidance		

Question	Answer	Mark	Comments
28(a)	0.25 or $\frac{1}{4}$ or $\frac{2}{8}$	B1	
	m/s^2 or ms^{-2} or m/s/s or $\frac{\text{m}}{\text{s}^2}$	B1	oe eg metres per second per second SC2 acceleration and unit not in m/s^2 eg 25 cm/s^2 or 3240 km/h^2
	Additional Guidance		
	$\frac{2}{14-6}$ with no further simplification		(1st) B0

28(b)	Alternative method 1		
	$\frac{1}{2} \times 6 \times (v-2)$ or $\frac{1}{2} \times (14-6) \times (v+v-2)$ or $(14-6) \times (v-2)$ or $\frac{1}{2} \times (14-6) \times 2$ or 8	M1	oe partial area any letter
	$\frac{1}{2} \times 6 \times (v-2)$ + $\frac{1}{2} \times (14-6) \times (v+v-2)$ or $3(v-2) + 8(v-2) + 8$ or $11v - 14$	M1dep	oe full area in one variable eg $14 \times v - \frac{1}{2} \times 6 \times (v-2)$ $-\frac{1}{2} \times 2 \times (6+14)$ implies M2
	$\frac{1}{2} \times 6 \times (v-2)$ + $\frac{1}{2} \times (14-6) \times (v+v-2) = 80$ or $94 \div 11$	A1	oe full area in one variable equated to 80
	8.5(4...) or 8.55 or $\frac{94}{11}$ or $8\frac{6}{11}$	A1	

Alternative method and Additional Guidance continued on the next page

Question	Answer	Mark	Comments
28(b) cont	Alternative method 2		
	$\frac{1}{2} \times 6 \times x$ or $\frac{1}{2} \times (14 - 6) \times (x + x + 2)$ or $(14 - 6) \times x$ or $\frac{1}{2} \times (14 - 6) \times 2$ or 8	M1	oe partial area x is the speed at 6 seconds any letter
	$\frac{1}{2} \times 6 \times x$ $+ \frac{1}{2} \times (14 - 6) \times (x + x + 2)$ or $3x + 8x + 8$ or $11x + 8$	M1dep	oe full area in one variable eg $14 \times (x + 2) - \frac{1}{2} \times 6 \times x$ $- \frac{1}{2} \times 2 \times (6 + 14)$ implies M2
	$\frac{1}{2} \times 6 \times x$ $+ \frac{1}{2} \times (14 - 6) \times (x + x + 2) = 80$ or $72 \div 11$ or $6.5(4\dots)$ or 6.55 or $\frac{72}{11}$ or $6\frac{6}{11}$	A1	oe full area in one variable equated to 80
	8.5(4...) or 8.55 or $\frac{94}{11}$ or $8\frac{6}{11}$	A1	
	Additional Guidance		
	First M1 Do not allow 8 from $14 - 6$		
	Ignore units throughout		