

# GCSE Maths

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## Summer Hub network meetings

Example questions and mark schemes

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Published: June 2018



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Remaining questions are all in the A-level Maths 'The thinking behind great assessment' booklet.

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## June, Paper 3, Foundation Tier, Question 21

- 21** Purple paint is made by mixing red paint and blue paint in the ratio 5 : 2  
Yan has 30 litres of red paint and 9 litres of blue paint.

What is the **maximum** amount of purple paint he can make?

**[3 marks]**

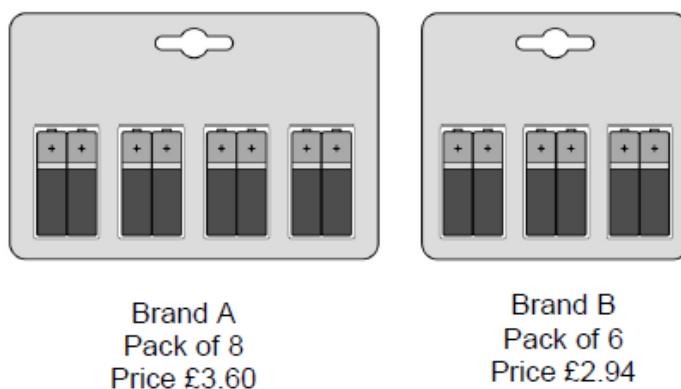
Question	Answer	Mark	Comments
21	<b>Alternative method 1</b>		
	Any correct scaling of the ratio 5 : 2 eg 10 (:) 4 or 20 (:) 8 or 25 (:) 10	M1	oe
	22.5 (:) 9 or 22.5 (red) or 30 (:) 12 or 12 (blue)	M1dep	oe
	31.5 or $31\frac{1}{2}$ or $\frac{63}{2}$	A1	
	<b>Alternative method 2</b>		
	9 ÷ 2 or 4.5 or 30 ÷ 5 or 6	M1	oe 2 ÷ 9 or 0.22... 5 ÷ 30 or 0.16... or 0.17
	5 × their 4.5 or 22.5 or 7 × their 4.5 or 2 × their 6 or 12 or 7 × their 6 or 42	M1dep	oe
	31.5 or $31\frac{1}{2}$ or $\frac{63}{2}$	A1	
	<b>Alternative method 3</b>		
	$\frac{2}{7} \times \text{purple} = \text{blue}$ $\frac{5}{7} \times \text{purple} = \text{red}$	M1	oe $\frac{2}{7} \times \text{purple} = 9$ $\frac{5}{7} \times \text{purple} = 30$
	$9 \times \frac{7}{2}$ or $30 \times \frac{7}{5}$ or 42	M1dep	oe
	31.5 or $31\frac{1}{2}$ or $\frac{63}{2}$	A1	

**Additional Guidance continues on the next page**

21 cont	Additional Guidance	
	$28 + 3.5 = 31.5$	M1M1A1
	$28 + 3.5$	M1M1A0
	31.5, answer 31	M1M1A1
	$31.5 + 42 = 73.5$	M1M1A0
	10 4	M1M0A0
	10, 4	M1M0A0
	$10 + 4$	M1M0A0
	'He has 2.5 times more red than blue'	M1M0A0
	2.5 : 1	M1M0A0
	2.5	M0M0A0
	28 on its own	M0M0A0

## June, Paper 3, Foundation Tier, Question 18

- 18 A shop sells two brands of battery.



One brand A battery powers a toy for 5 hours.

One brand B battery powers the same toy for  $5\frac{1}{2}$  hours.

Which brand is better value?

You **must** show your working.

**[5 marks]**



Question	Answer	Mark	Comments
18	<b>Alternative method 1 of 6 – cost per hour</b>		
	3.6(0) ÷ 8 or (0).45 or 2.94 ÷ 6 or (0).49	M1	360 ÷ 8 or 45 or 294 ÷ 6 or 49
	their (0).45 ÷ 5 or (0).09 or their (0).49 ÷ 5.5 or (0).08(9...)	M1dep	their 45 ÷ 5 or 9 or their 49 ÷ 5.5 or 8.(9...)
	their (0).45 ÷ 5 <b>and</b> their (0).49 ÷ 5.5	M1dep	their 45 ÷ 5 <b>and</b> their 49 ÷ 5.5
	(£)0.09 and (£)0.08(9...)	A1	9(p) and 8.(9...) (p)
	brand B	A1ft	ft correct decision for their values with M3 scored
	<b>Alternative method 2 of 6 – cost per hour from price of pack</b>		
	8 × 5 or 40 or 6 × 5.5 or 33	M1	
	3.6(0) ÷ their 40 or (0).09 or 2.94 ÷ their 33 or (0).08(9...)	M1dep	360 ÷ their 40 or 9 or 294 ÷ their 33 or 8.(9...)
	3.6(0) ÷ their 40 <b>and</b> 2.94 ÷ their 33	M1dep	360 ÷ their 40 <b>and</b> 294 ÷ their 33
	(£)0.09 and (£)0.08(9...)	A1	9(p) and 8.(9...) (p)
	brand B	A1ft	ft correct decision for their values with M3 scored

**Alternative method 3 continues on the next page**

Question	Answer	Mark	Comments
18 cont	<b>Alternative method 3 of 6 – number of hours per unit cost from number of batteries</b>		
	3.6(0) ÷ 8 or (0).45 or 2.94 ÷ 6 or (0).49	M1	360 ÷ 8 or 45 or 294 ÷ 6 or 49
	5 ÷ their (0).45 or 11.1(...) or 5.5 ÷ their (0).49 or 11.2(...)	M1dep	5 ÷ their 45 or (0).111(...) or 5.5 ÷ their 49 or (0).112(...)
	5 ÷ their (0).45 <b>and</b> 5.5 ÷ their (0).49	M1dep	5 ÷ their 45 <b>and</b> 5.5 ÷ their 49
	11.1(...) (hours) and 11.2(...) (hours)	A1	(0).111(...) (hours) and (0).112(...) (hours)
	brand B	A1ft	ft correct decision for their values with M3 scored
	<b>Alternative method 4 of 6 - common number of batteries</b>		
	Scaling towards a cost for a common number of batteries (eg 24 batteries) eg 8 × 3 × 5 or 120 <b>and</b> 6 × 4 × 5.5 or 132	M1	
	eg 3 × 3.60 or 10.8(0) <b>and</b> 4 × 2.94 or 11.76	M1	eg 3 × 360 or 1080 and 4 × 294 or 1176
	eg their 10.8(0) ÷ their 120 or (0).09 <b>and</b> their 11.76 ÷ their 132 or (0).08(9...)	M1dep	eg their 1080 ÷ their 120 or 9 <b>and</b> their 1176 ÷ their 132 or 8.(9...) dependent on M1M1
	(£)0.09 and (£)0.08(9...)	A1	9(p) and 8.(9...) (p)
	brand B	A1ft	ft correct decision for their values with M3 scored

**Alternative method 5 continues on the next page**

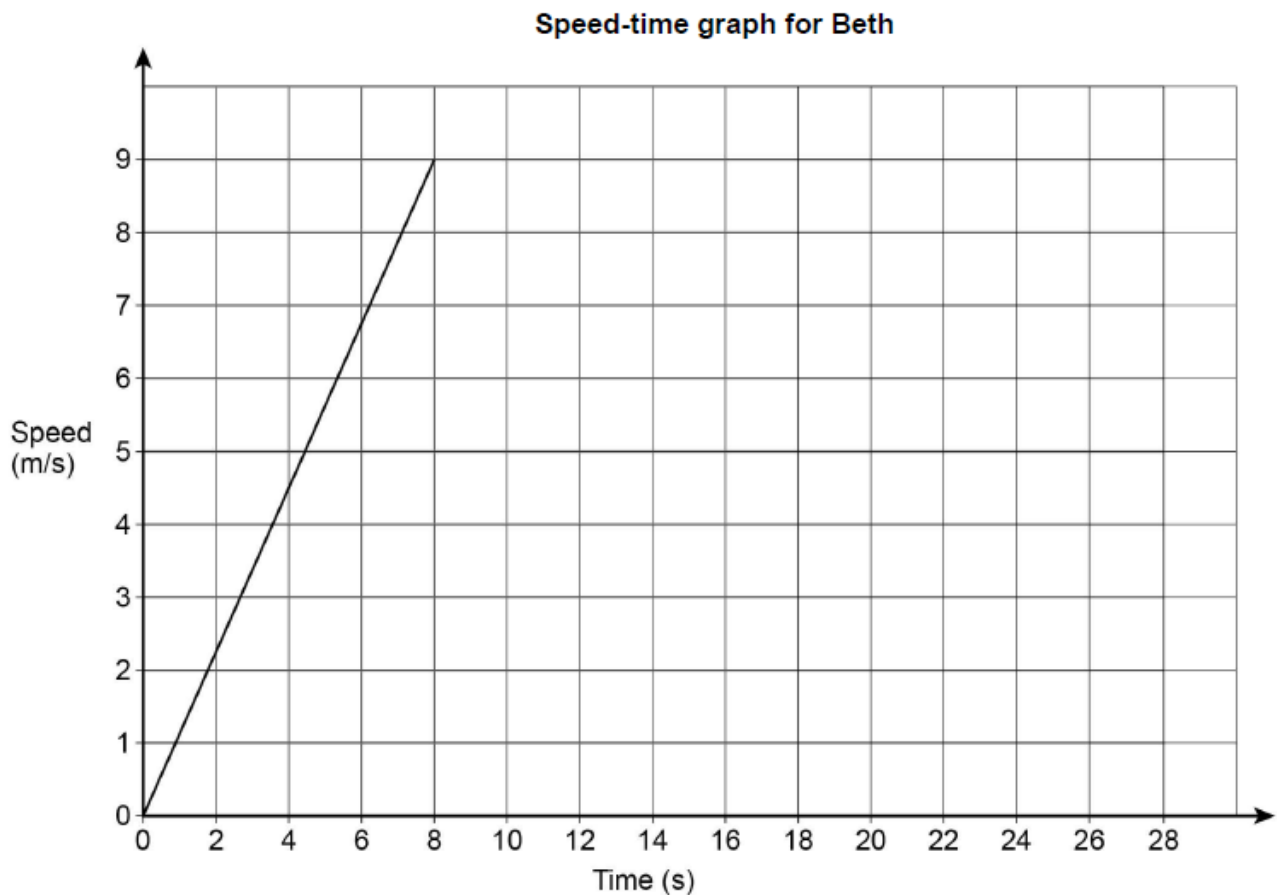
Question	Answer	Mark	Comments
18 cont	<b>Alternative method 5 of 6 – number of hours per unit cost from batteries per unit cost</b>		
	8 ÷ 3.6(0) or 2.2(...) or 6 ÷ 2.94 or 2.04(...)	M1	8 ÷ 360 or 0.022(...) or 6 ÷ 294 or 0.0204(...)
	their 2.2(...) × 5 or 11.1(...) or their 2.04(...) × 5.5 or 11.2(...)	M1dep	their 0.022(...) × 5 or 0.111(...) or their 0.0204(...) × 5.5 or 0.112(...)
	their 2.2(...) × 5 <b>and</b> their 2.04(...) × 5.5	M1dep	their 0.022(...) × 5 <b>and</b> their 0.0204(...) × 5.5
	11.1(...) (hours) and 11.2(...) (hours)	A1	(0).111(...) (hours) and (0).112(...) (hours)
	brand B	A1ft	ft correct decision for their values with M3 scored
	<b>Alternative method 6 of 6 – cost for common number of battery hours</b>		
	3.6(0) ÷ 8 or (0).45 or 2.94 ÷ 6 or (0).49	M1	360 ÷ 8 or 45 or 294 ÷ 6 or 49
	Scaling towards a common number of battery hours (eg 55 hours) eg their (0).45 × 11 or their (0).49 × 10	M1dep	eg their 45 × 11 or their 49 × 10
	eg their (0).45 × 11 <b>and</b> their (0).49 × 10	M1dep	eg their 45 × 11 <b>and</b> their 49 × 10
	eg (£)4.95 and (£)4.9(0)	A1	eg 495(p) and 490(p)
	brand B	A1ft	ft correct decision for their values with M3 scored

**Additional Guidance continues on the next page**

18 cont	Additional Guidance	
	For the first A mark the values must not be rounded to the same value	
	A1ft can be awarded after A0 for the same value for the correct decision eg 0.09 and 0.09 with decision 'both the same'	M3A0A1ft
	$8 \times 5 = 40$ and $40 \div 3.6(0)$ <b>and</b> $6 \times 5.5 = 33$ and $33 \div 2.94$ is equivalent to $8 \div 3.6(0) \times 5$ <b>and</b> $6 \div 2.94 \times 5.5$ on Alt 5	M3
	$8 \times 5 = 40$ and $40 \div 3.6(0)$ is equivalent to $8 \div 3.6(0) \times 5$ on Alt method 5	M2
	$6 \times 5.5 = 33$ and $33 \div 2.94$ is equivalent to $6 \div 2.94 \times 5.5$ on Alt method 5	M2
	$(0).45 \div 5$	M1M1
	$(0).45 \div 5$ and $(0).49 \div 5.5$	M1M1M1
	$(0).45 \div 5$ and $(0).415 \div 5.5$ 0.415 is not from a correct method	M1M1M0
	In Alt method 4 M1M1 can be awarded in either order	
	In Alt method 5 their 2.2(...) must be correct or from correct method their 2.04(...) must be correct or from correct method	
	Accept misread of 4 batteries (A) or 3 batteries (B) for up to M3A0A1ft	
	Accept working with minutes eg in Alt method 3 for 2 <sup>nd</sup> M1dep accept $300 \div 45 = 6.6(\dots)$ or 6.7 or $330 \div 49 = 6.7(\dots)$ for 3 <sup>rd</sup> M1dep accept $300 \div 45$ <b>and</b> $330 \div 49$ for first A mark must see 6.6(...) or 6.67 <b>and</b> 6.7(...) or 6.7 <b>and</b> 6.73(...)	

## November, Paper 2, Higher Tier, Question 24

- 24** Beth ran a 200 metre race.  
Here is a graph of the first 8 seconds of her race.  
She completed the race at a constant speed of 9 m/s



Amy completed the race in 27 seconds.

Did Beth finish before Amy?

You **must** show your working.

**[3 marks]**

Question	Answer	Mark	Comments
24	<b>Alternative method 1</b>		
	$0.5 \times 8 \times 9$ or 36 or $(27 - 8) \times 9$ or $19 \times 9$ or 171	M1	May be seen on graph
	$0.5 \times 8 \times 9 + (27 - 8) \times 9$ or 207	M1dep	M2 $0.5 \times (27 + 19) \times 9$
	207 and Yes	A1	
	<b>Alternative method 2</b>		
	$0.5 \times 8 \times 9$ or 36	M1	May be seen on graph
	$\frac{200 - \text{their } 36}{9}$ or $\frac{164}{9}$ or 18.2...	M1dep	
	26.2... and Yes or 18.2... and 19 and Yes	A1	
	<b>Alternative method 3</b>		
	$0.5 \times 8 \times 9$ or 36	M1	May be seen on graph
	$\frac{200 - \text{their } 36}{27 - 8}$ or $\frac{164}{19}$ or 8.6...	M1dep	
	8.6... and Yes	A1	
	<b>Alternative method 4</b>		
	$0.5 \times 8 \times 9$ or 36	M1	May be seen on graph
	Attempt at total distance for Beth for $26.2 \leq \text{total time} < 27$	M1dep	eg (time 26.5s) $0.5 \times 8 \times 9 + (26.5 - 8) \times 9$
	Correct total distance for Beth for $26.2 \leq \text{total time} < 27$ and Yes	A1	eg (time 26.5s) 202.5 and Yes
	<b>Additional Guidance</b>		

## Practice papers set 3, Paper 2, Foundation Tier, Question 16(a)

**16** The speed of the International Space Station is 27 576 kilometres per hour.

**16 (a)** The station travels 42 600 kilometres in one orbit.

Work out the number of **full** orbits the station does in one day.

**[3 marks]**

Q	Answer	Mark	Comments
<b>16(a)</b>	<b>Alternative method 1</b>		
	$27\,576 \times 24$ or 661 824	M1	
	their $661\,824 \div 42\,600$ or 15.5...	M1	
	15	A1	
	<b>Alternative method 2</b>		
	$42\,600 \div 27\,576$ or 1.54...	M1	
	$24 \div$ their 1.54... or 15.5...	M1	
	15	A1	
	<b>Alternative method 3</b>		
	$27\,576 \div 42\,600$ or 0.647...	M1	
	their $0.647 \times 24$ or 15.5...	M1	
	15	A1	
	<b>Additional Guidance</b>		

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## Practice papers set 3, Paper 2, Higher Tier, Question 6(b)/ Foundation Tier, Question 22(b)

- 6** Dev invests £1500 for 2 years.  
The compound interest rate is 1.6% per year.

- 6 (b)** Emma invests £1500 for 2 years.

The interest rate is

1.8% for the first year

1.3% for the second year.

Whose investment is worth more after 2 years?

You **must** show your working.

**[4 marks]**



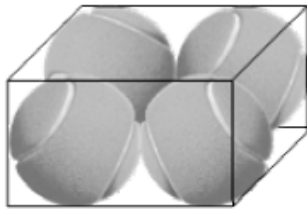
Q	Answer	Mark	Comments
6(b)	<b>Alternative method 1</b>		
	[1548.38, 1548.39]	B1ft	ft their part (a)
	$1500 \times 1.018$ or 1527	M1	oe
	$1500 \times 1.018 \times 1.013$ or $1527 \times 1.013$ or [1546.85, 1546.86]	M1dep	oe
	[1548.38, 1548.39] and [1546.85, 1546.86] and Dev's	A1ft	oe ft their part (a)
	<b>Alternative method 2</b>		
	$1.016^2$ or 1.032(256) or 1.0323	M1	
	1.018 or 1.013 seen	M1	
	$1.018 \times 1.013$ or 1.031(234)	M1dep	
	1.032(256) and 1.031 and Dev's	A1	
	<b>Additional Guidance</b>		
	Note incorrect answers from part (a) for Alt 1 $\text{£}1500 \times 1.6 \times 2 = \text{£}4800$ $\text{£}1500 \times 1.6^2 = \text{£}3840$ $\text{£}1500 \times 1.016 \times 2 = \text{£}3048$		

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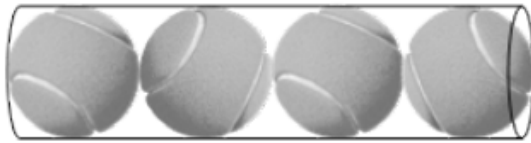
## Practice papers set 3, Paper 2, Higher Tier, Question 17

- 17** Here are two closed containers.  
Four tennis balls just fit in each container.  
Each tennis ball has diameter 64 mm

**Cuboid**



**Cylinder**



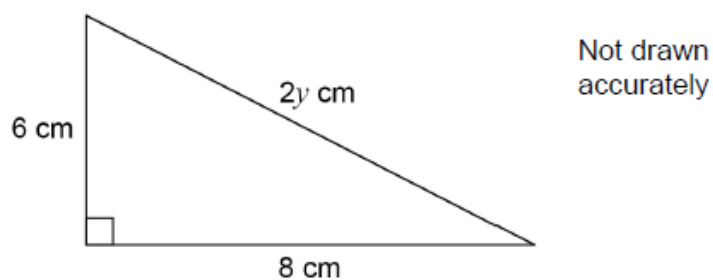
Which container has the smaller surface area?  
You **must** show your working.

**[5 marks]**

Q	Answer	Mark	Comments
17	$128 \times 128 (\times 2)$ or 16 384 or 32 768 or $128 \times 64 (\times 4)$ or 8192 or 32 768	M1	Any one surface area of cuboid May be implied
	$128 \times 128 \times 2 + 128 \times 64 \times 4$ or $16\,384 \times 2 + 8192 \times 4$ or $32\,768 + 32\,768$ or 65 536	M1dep	Total surface area of cuboid
	$\pi \times 32^2 (\times 2)$ or $1024\pi$ or $2048\pi$ or [3215, 3217.41] or [6430.7, 6434.82] or $2 \times \pi \times 32 \times 256$ or $16\,384\pi$ or [51 445.76, 51 478.53]	M1	Any one surface area of cylinder May be implied
	$18\,432\pi$ or [57 876, 57 913.344]	A1	Total surface area of cylinder
	65 536 and [57 876, 57 913.344] and cylinder	A1ft	ft M2 with at least one correct total surface area with correct conclusion
	<b>Additional Guidance</b>		
	Cylinder by [7622.656, 7660]	M1M1M1A1A1	
	Cylinder with no other working	0	

## June, Paper 2, Higher Tier, Question 15(a)

- 15** Sami is trying to work out the exact value of  $y$  using Pythagoras' theorem.



Here is her working.

$$(2y)^2 = 6^2 + 8^2$$

$$2y^2 = 36 + 64$$

$$2y^2 = 100$$

$$y^2 = 100 \div 2$$

$$y^2 = 50$$

$$y = \sqrt{50}$$

- 15 (a)** What error has she made in her working?

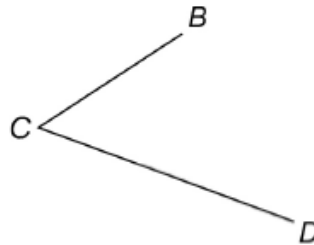
**[1 mark]**

Question	Answer	Mark	Comments
15(a)	Identifies error in working	B1	eg $2y^2$ should be $4y^2$ 2 should be 4 2 should be squared Should have worked out $(2y)^2$ but has only worked out $y^2$
	<b>Additional Guidance</b>		
	Answer may be seen next to Sami's method below the diagram		
	Adding brackets around $2y$ to Sami's working in line 2 (working lines may be blank)		B1
	Showing the error being corrected eg1 $(2y)^2 = 100$ and $2y = 10$ eg2 $4y^2 = 36 + 64$		B1 B1
	She hasn't squared the bracket		B1
	Has only squared $y$		B1
	The brackets have been left out		B1
	$(2y)^2$ is not equal to $2y^2$		B1
	Should have square rooted 100 before dividing by 2 because the $2y$ should not have been taken out of the bracket		B1
	Should have square rooted 100 before dividing by 2 (could be referring to working from line 3 to line 4)		B0
	Line 2 is wrong (has not identified which part of line 2 is wrong)		B0
	Answer should be $y = 5$ (has not shown what the error is)		B0
	Ignore non-contradictory work if correct response seen		

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## November, Paper 1, Foundation Tier, Question 21(a)

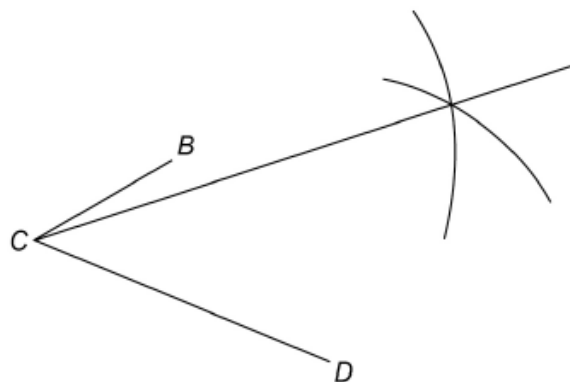
**21 (a)** Joe wants to bisect angle  $BCD$ .



Here is his method.

Use a pair of compasses to draw arcs of the same radius from  $B$  and  $D$ .

Draw a straight line from  $C$  through the intersection of the arcs.



Write down the error in his method.

**[1 mark]**

Question	Answer	Mark	Comments
21a	The arcs should be drawn from C or from points the same distance from C or The lines are different lengths, so you can't go from the ends	B1	oe
	<b>Additional Guidance</b>		
	CB $\neq$ CD		B1
	Not drawn an arc from C		B1
	He put compass in wrong place. He should have started at C but he started at B and D		B1
	Should be an arc on each line CB and CD		B0
	Arcs in wrong place		B0
	Arcs aren't equal		B0
	His line isn't in the centre of B and D		B0
	D has a longer line than B		B0
	Arcs aren't the same radius		B0
	Should be an arc from B to D		B0
	Should be an arc from B to the line CD		B0
	Should be an intersection on CB and CD		B0

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## November, Paper 2, Higher Tier, Question 21(b)

- 21 (b)** Levi is solving  $2x^2 + 5x = 0$   
He uses this method.

$$2x^2 + 5x = 0 \quad \text{subtract } 5x \text{ from both sides}$$

$$2x^2 = -5x \quad \text{divide both sides by } x$$

$$2x = -5 \quad \text{divide both sides by 2}$$

$$x = -2.5$$

Evaluate his method and his answer.

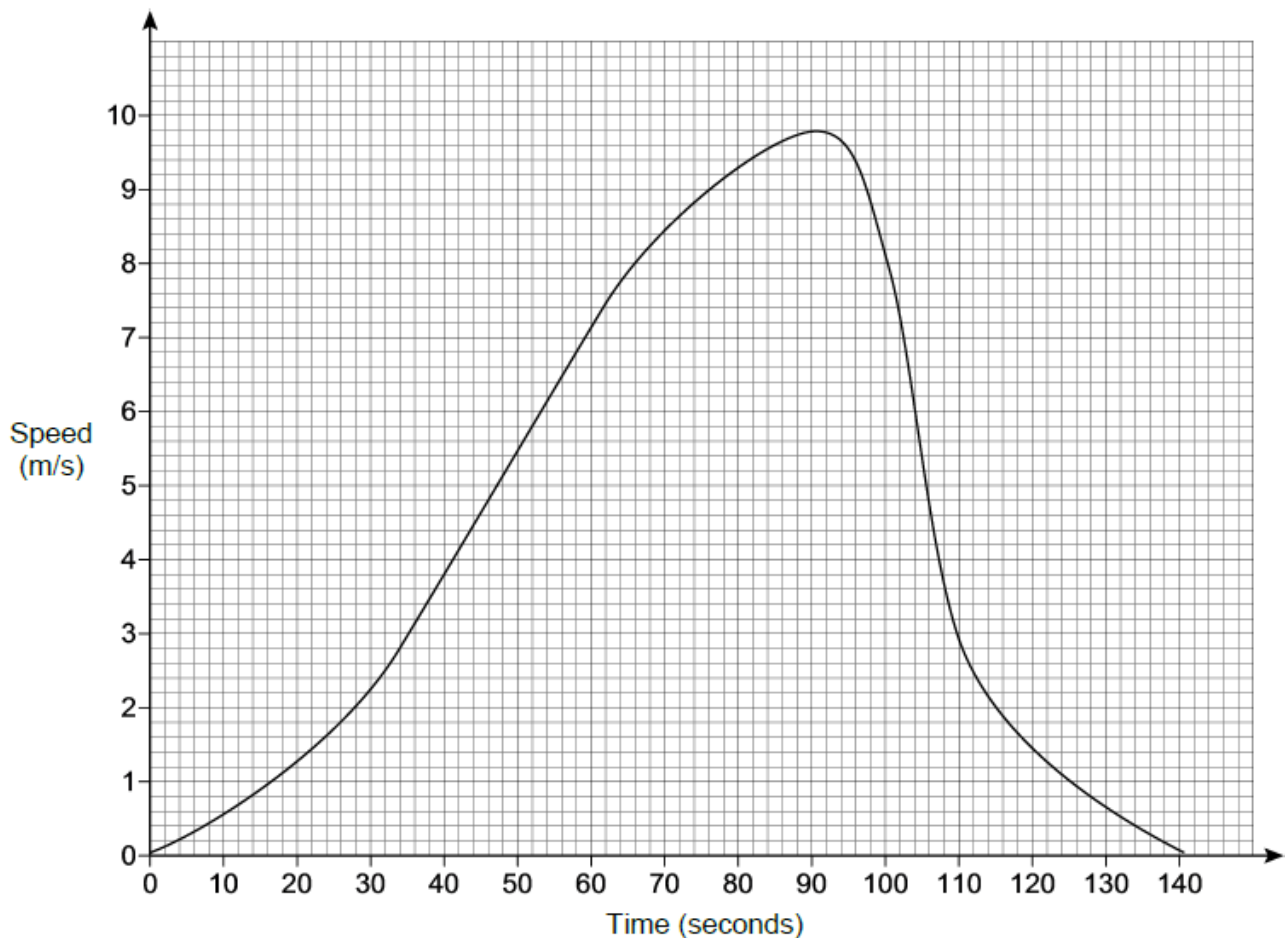
**[2 marks]**



Question	Answer	Mark	Comments
21(b)	Full evaluation of method and answer	B2	eg1 Cannot divide by $x$ as it could be zero eg2 Should have factorised and then he would have also found that $x = 0$ eg3 Should have used the formula and then he would have also found that $x = 0$ eg4 Should have used a graphical method then he would have also found that $x = 0$ eg5 Should have completed the square then he would have also found that $x = 0$  B1 Partial evaluation eg1 $x = 0$ has been omitted eg2 Should have factorised eg3 Should have used the formula eg4 Should have drawn a graph eg5 Only found one solution eg6 Cannot divide by zero
	<b>Additional Guidance</b>		
	For B2 there needs to be an evaluation of the method and an indication that $x = 0$ has been omitted from the answer		
	$x(2x + 5) = 0$ $x = 0$ and $x = -2.5$		B2
	Should be two solutions		B1
	What about $x = 0$		B1
	The answer is wrong		B0
	Ignore non-contradictory further work		

## Practice papers set 3, Paper 2, Higher Tier, Question 21(a)

- 21** The graph shows the speed of a skier.  
Nick wants to estimate the distance travelled by the skier in 140 seconds.



- 21 (a)** He works out the area of the triangle with vertices  $(0, 0)$ ,  $(140, 0)$  and  $(90, 9.8)$

Does Nick's method give a good estimate?

Tick a box.

Yes

☐

No

☐

Give a reason for your answer.

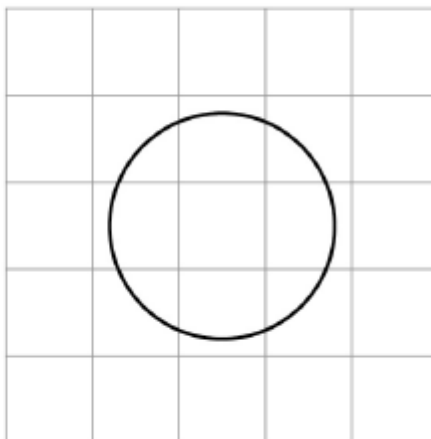
**[2 marks]**

Q	Answer	Mark	Comments
21(a)	Yes and full explanation involving areas  eg Yes, the extra areas are (about) the same as the areas that are left out	B2	B1 for partial explanation  eg Some parts are included that shouldn't be and some parts are left out  B2 or B1 may be awarded from working on the diagram
	Additional Guidance		

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## June, Paper 3, Foundation Tier, Question 13(b)

- 13** A circle is drawn on a centimetre grid.



- 13 (b)** Grace works out that the area of the circle is more than  $9 \text{ cm}^2$

Why must this be wrong?

**[1 mark]**

Question	Answer	Mark	Comments
13(b)	Valid reason for the area of the circle or the square around the circle	B1	
	<b>Additional Guidance</b>		
	The area of the circle stated to be [4.5, 6.2] without incorrect working		B1
	Area of circle of radius 1.5 (cm) is 7(.06...) or 7.07 or 7.1		B1
	The square around it is only 9 cm <sup>2</sup> or 9 squares or 3 × 3 square		B1
	There aren't 9 squares in the circle		B1
	The circle fits into a 9 cm <sup>2</sup> square or 9 squares or 3 × 3 square		B1
	It only covers about [4.5, 6.2] squares		B1
	Circle does not (completely) cover nine separate boxes		B1
	There is one whole square and 8 part squares in the circle		B1
	Because all of the space for 9 is not used up		B1
	Calculate radius = 1.6(9...) (cm) or 1.7 (cm) from area of circle 9 (cm <sup>2</sup> ) and states radius of circle drawn is smaller		B1
	She uses 9 squares that are half in and half out of the circle, she needed to work it out only using the squares inside the circle		B0
	Does not fill up the whole square (no reference to 9)		B0
	Because the radius is not big enough for it to be 9		B0

## November, Paper 2, Foundation Tier, Question 13(b)

**13 (a)** Use your calculator to work out the exact value of  $\frac{18\,953 \times 437}{11}$

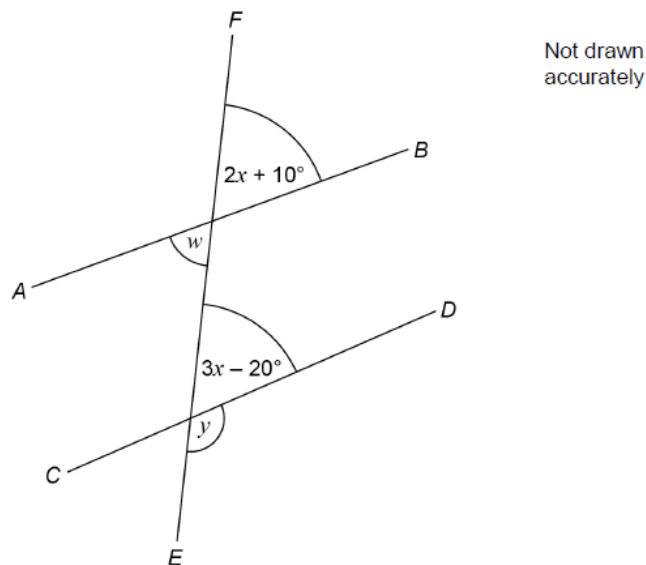
**13 (b)** Use approximations to 1 significant figure to check if your answer to part (a) is sensible.

**[3 marks]**

Question	Answer	Mark	Comments
<b>13b</b>	20 000 and 400 and 10 and 800 000 and Yes	B3ft	ft correct decision for their answer to (a) oe decision eg it is sensible B2 20 000 and 400 and 10 B1 20 000 or 400 or 10
	<b>Additional Guidance</b>		
	800 000 (and Yes) with no other values		B0
	If answer to (a) is 800 000 to 1sf then the correct ft decision in (b) is Yes eg1 (a) 770 000 (b) decision should be Yes eg2 (a) 1762 (b) decision should be No eg3 (a) 752.951 (b) allow decision to be Yes or No		

## June, Paper 3, Foundation Tier, Question 24(b)

24  $AB$ ,  $CD$  and  $EF$  are straight lines.



- 24 (a) Ava assumes that  $AB$  and  $CD$  are parallel.
- What answer should she get for the size of angle  $y$ ?

[4 marks]

- 24 (b) In fact,  
 $AB$  and  $CD$  are **not** parallel  
angle  $w$  is  $60^\circ$

What effect does this have on the size of angle  $y$ ?

Tick a box.

☐

$y$  is bigger

☐

$y$  is the same

☐

$y$  is smaller

Show working to support your answer.

[3 marks]

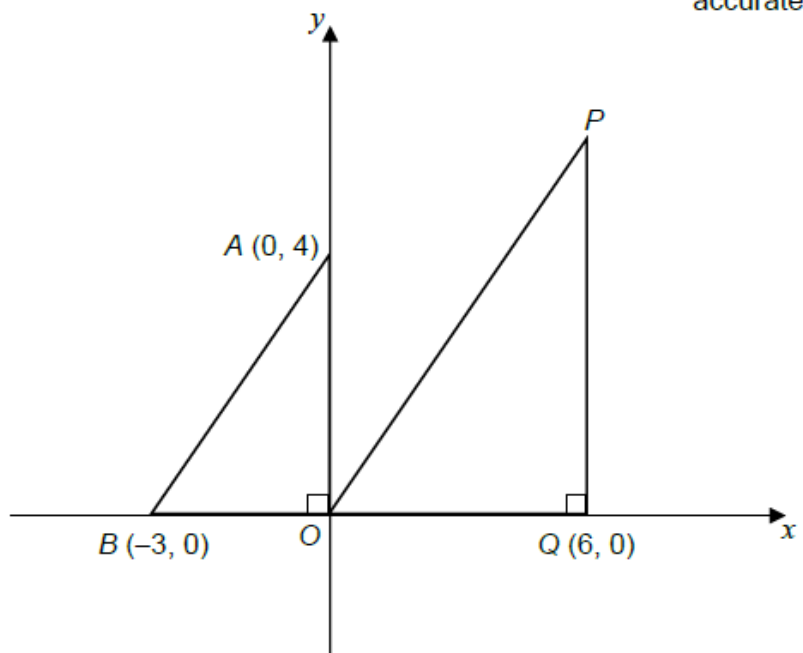
Question	Answer	Mark	Comments
<b>24(b)</b>	$2x + 10 = 60$ or $2x = 60 - 10$ or $2x = 50$ or $x = 25$	M1	
	$3 \times \text{their } 25 - 20 \text{ or } 55$ or $180 - 55 \text{ or } 125$	M1dep	oe
	$(y =) 125 \text{ and bigger}$ or $(y \text{ is}) 15 \text{ bigger}$	A1ft	oe ft their (a)
	<b>Additional Guidance</b>		
	Note: A complete logical explanation of the effect of lines not being parallel eg $w$ is smaller so $2x + 10$ is smaller so $x$ is smaller so $3x - 20$ is smaller so $y$ is bigger		M1M1A1
	$2 \times 25 + 10 = 60$		M1M0A0
	$y$ is bigger ticked but no valid working		M0M0A0



Practice papers set 3, Paper 3, Foundation Tier, Question 19(b)

19 Here are two right-angled triangles.

Not drawn accurately



19 (a) Assume that triangles  $AOB$  and  $PQO$  are similar.  
Work out the area of triangle  $PQO$ .

[3 marks]

19 (b) In fact,  $QP$  is longer than it would be if the triangles were similar.  
How does this affect your answer to part (a)?

[1 mark]

Q	Answer	Mark	Comments
19(b)	(It is) larger	B1	oe My answer was too small
	Additional Guidance		

## Practice papers set 3, Paper 1, Foundation Tier, Question 23(b)

**23** The air pressure in a tyre measures 7.2 bar.  
Air is leaking out at the rate of 0.2 bar per day.

**23 (a)** Assume that the air continues to leak at the same rate.  
After how many days will the pressure measure 4.8 bar?

**[2 marks]**

**23 (b)** In fact, the rate that the air leaks out increases each day.  
How does this affect your answer to part (a)?

**[1 mark]**

Q	Answer	Mark	Comments
23(b)	It will take fewer days	B1	oe the answer would be lower eg it will be less than 12
	<b>Additional Guidance</b>		
	Quicker/faster than 12 days		B1
	Quicker/faster alone		B0

## L3 Mathematical Studies 2017 Paper 1 Question 4

- 4 Estimate the number of litres of liquid drunk by the population of a small English town in one month.

State any assumptions that you have made.  
You **must** show your working.

[5 marks]

Q	Answer	Mark	Comments
4	<p>Makes an assumption about number of litres per person per day in the range 1 litre to 10 litres (or ml equivalents)</p> <p><b>and</b></p> <p>assumes a number of days in a month in the range 28 to 31</p> <p><b>and</b></p> <p>Makes an assumption about number of people in a small town in the range 1000 to 100000</p>	B3	<p>Must state units eg Minimum for B3 (Assume) 5 litres, 28 days, 15000 people or B2 for 2 correct assumptions (one missing or not in range) eg (Assume) 3 litres, 30 days, 300000 people or B2 for all 3 values within range but not stated as assumptions eg <math>4 \times 30 \times 10000</math> seen gets B2 M1 or B1 Any one correct assumption stated eg drink about 3 litres per day or Multiplication of 3 values with 2 in range and no units eg <math>12 \times 31 \times 20000</math></p>
	Multiplies their 3 values together	M1	This may be done in two steps
	Accurate answer to their calculation	A1ft	ft their 3 values May be rounded

	Additional Guidance	
	Ignore any calculations to get the number of litres per day eg $4 \times 300\text{ml}$ glass is 1.5 litres scores B1 for 1.5 litres (even though arithmetic is wrong)	
	The amount of liquid they multiply by must be per person not per household	
	28 to 31 days can come from various calculations eg $7 \text{ days} \times 4 \text{ weeks}$ , $365(.25) \div 12$ Again just award the B1 for a number of days within the range	
	they could use households to estimate population eg small town 2000 houses $\times 4 \text{ people} = 8000 \text{ population}$	
	If working in ml they can still gain the method mark but they must convert to litres for the accuracy mark	
	The three values may be multiplied in 2 steps eg litres per day $\times$ days in month at one point in their working, then this answer $\times$ number of people	
	If they just state a number of litres per month eg 65 litres per month they do not score the marks for assumptions but can score M1 and A1 for multiplying this correctly by their population	
	Allow rounding at any point eg uses 7 litres and 31 days in a month, $7 \times 31 = 217$ and rounds to 200 or 220	
	Final answer must be an integer	

## New L2 Certificate in Further Maths Specimen Paper 2 Q21

21 Show that  $(2n + 3)^3 + n^3$  is divisible by 9 for all integer values of  $n$ .

[4 marks]

Q	Answer	Mark	Comments
21	$4n^2 + 6n + 6n + 9$ or $4n^2 + 12n + 9$	M1	allow one error implied by $4n^2 + 12n + k$ or $an^2 + 12n + 9$
	$8n^3 + 12n^2 + 24n^2 + 36n + 18n + 9$	M1dep	oe ft their $4n^2 + 6n + 6n + 9$ allow one error
	$8n^3 + 36n^2 + 54n + 9$ or $9n^3 + 36n^2 + 54n + 9$	A1	
	$9n^3 + 36n^2 + 54n + 9$ and $9(n^3 + 36n^2 + 6n + 1)$	A1	oe eg $(9n^3 + 36n^2 + 54n + 9) \div 9$ $= n^3 + 36n^2 + 6n + 1$ or $9n^3 + 36n^2 + 54n + 9$ and all coefficients are divisible by 9
	Additional Guidance		

## New L2 Certificate in Further Maths Specimen Paper 1 Q19

**19**       $f(x) = 2x^3 - 12x^2 + 25x - 11$

Use differentiation to show that  $f(x)$  is an increasing function for all values of  $x$ .

**[4 marks]**

<b>19</b>	$6x^2 - 24x + 25$	M1	allow one error
	$6(x^2 - 4x) \dots$	M1dep	ft their $6x^2 - 24x + 25$ must have 3 term quadratic
	$6(x - 2)^2 \dots$	M1dep	ft their $6(x^2 - 4x) \dots$
	$6(x - 2)^2 + 1$ and valid argument that this is $> 0$	A1	
	<b>Additional Guidance</b>		

## AS Maths Specimen Paper 1 Question 6

- 6 A parallelogram has sides of length 6 cm and 4.5 cm.  
The larger interior angles of the parallelogram have size  $\alpha$

Given that the area of the parallelogram is  $24 \text{ cm}^2$ , find the exact value of  $\tan \alpha$

[4 marks]

Q	Marking Instructions	AO	Marks	Typical Solution
6	Translates given information into an equation by using the formula for the area of triangle or parallelogram to form a correct equation	AO3.1a	M1	$AB \times AD \times \sin \alpha = 24$ hence $6 \times 4.5 \times \sin \alpha = 24$
	Rearranges 'their' equation to obtain a correct value of $\sin \alpha$	AO1.1b	A1F	$\sin \alpha = \frac{24}{27} = \frac{8}{9}$
	Uses 'their' $\sin \alpha$ value to identify an appropriate right-angled triangle or uses identities and deduces exact ratio of $\tan \alpha$ – positive or negative Condone only positive ratio seen	AO2.2a	M1	Sides of right angled triangle are 8, 9 and $\sqrt{17}$ Hence $\tan \alpha = \pm \frac{8}{\sqrt{17}}$
	Relates back to mathematical context of problem and hence chooses negative ratio – accept any equivalent exact form FT 'their' $\tan$ values for obtuse $\alpha$	AO3.2a	A1F	$\alpha$ is one of the largest angles and must be obtuse hence tangent is negative $\tan \alpha = -\frac{8}{\sqrt{17}} = -\frac{8\sqrt{17}}{17}$
Total			4	

## AS Maths Set 2 Practice Paper 2 Question 5 (draft)

- 5 The line joining  $A(4, -5)$  to  $B(18, k)$  has gradient  $\frac{9}{7}$   
Find the exact length of  $AB$ .

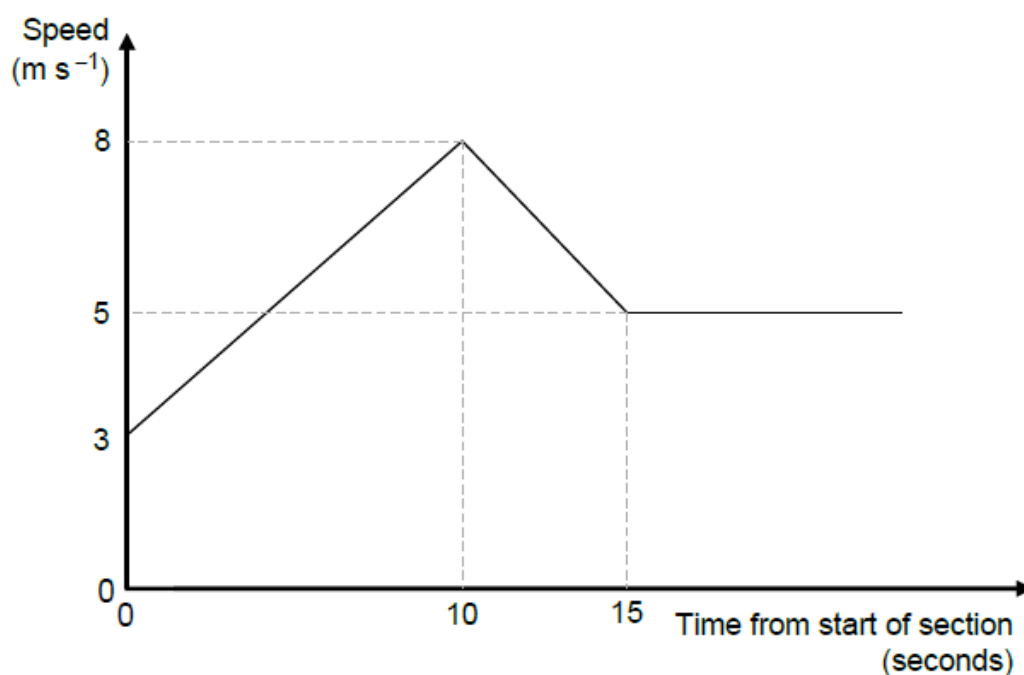
[4 marks]

Q	Marking Instructions (Approach one)	AO	Marks	Typical Solution
5	Selects an appropriate method by finding an expression for the gradient and forming an equation	AO3.1a	M1	Gradient = $\frac{k - (-5)}{18 - 4} = \frac{k + 5}{14}$ $\frac{k + 5}{14} = \frac{9}{7}$ $k = 13$ $\sqrt{18^2 + 14^2}$ $= \sqrt{520}$ $= 2\sqrt{130}$
	Solves the equation to find the correct value of $k$	AO1.1b	A1	
	Substitutes 'their' value of $k$ and applies Pythagoras' rule to obtain the required distance	AO1.1a	M1	
	Obtains 'their' correct exact value for the distance $AB$	AO1.1b	A1F	
Total			4	
Q	Marking Instructions (Approach two)	AO	Marks	Typical Solution
5	Selects an appropriate method by forming the right angled triangle $ACB$ with right angle at $C$ , vertically below $B$ and expresses the given gradient in terms of a $\tan A$	3.1a	M1	$\tan A = \frac{9}{7}$ $\cos A = \frac{7}{\sqrt{130}}$ $AB = \frac{AC}{\cos A}$ $AB = \frac{14\sqrt{130}}{7} = 2\sqrt{130}$
	Finds the exact value of $\cos A$ correctly	1.1b	A1	
	Uses $AB = \frac{AC}{\cos A}$	1.1a	M1	
	Obtains their correct exact value for the distance $AB$	1.1b	A1F	
Total			4	



## AS Maths Specimen Paper 1 Question 15b

- 15 The graph shows how the speed of a cyclist varies during a timed section of length 120 metres along a straight track.



- 15 (b) After the first 15 seconds, the cyclist travels at a constant speed of  $5 \text{ m s}^{-1}$  for a further  $T$  seconds to complete the 120-metre section.  
Calculate the value of  $T$ .

[4 marks]

Q	Marking Instructions	AO	Marks	Typical Solution
(b)	Identifies $5T$ as the distance travelled after the first 15 seconds	AO3.4	B1	Distance at constant speed = $5T$
	Uses the information given to form an equation to find $T$ (award mark for either trapezium expression separate, totalled or implied)	AO3.1b	M1	Distance in first 15 secs = $\frac{1}{2} \times (3 + 8) \times 10 + \frac{1}{2} \times (8 + 5) \times 5$ $= 55 + 32.5 = 87.5$ $5T + 87.5 = 120$
	Correctly calculates the distance for the first 15 secs	AO1.1b	A1	So $T = 6.5$
	Deduces the values of $T$ from the mathematical models applied	AO2.2a	A1	

## AS Maths Specimen Paper 1 Question 11

- 11 Chris claims that, “for any given value of  $x$ , the gradient of the curve  $y = 2x^3 + 6x^2 - 12x + 3$  is always greater than the gradient of the curve  $y = 1 + 60x - 6x^2$ ”.

Show that Chris is wrong by finding all the values of  $x$  for which his claim is not true.

[7 marks]

Q	Marking Instructions	AO	Marks	Typical Solution								
11	Obtains $\frac{dy}{dx}$  for both the given curves – at least one term must be correct for each curve	AO3.1a	M1	$\frac{dy}{dx} = 6x^2 + 12x - 12$ $\frac{dy}{dx} = 60 - 12x$								
	States both derivatives correctly	AO1.1b	A1									
	Translates problem into an inequality	AO3.1a	M1	Chris's claim is <b>incorrect</b> when  $6x^2 + 12x - 12 \leq 60 - 12x$ $2x^2 + 8x - 24 \leq 0$ $x^2 + 4x - 12 \leq 0$ $(x + 6)(x - 2) \leq 0$  Critical values are $x = -6$ and $2$ <table border="1"><tr><td>region</td><td><math>x &lt; -6</math></td><td><math>-6 &lt; x &lt; 2</math></td><td><math>x &gt; 2</math></td></tr><tr><td>sign</td><td>+</td><td>-</td><td>+</td></tr></table>	region	$x < -6$	$-6 < x < 2$	$x > 2$	sign	+	-	+
	region	$x < -6$	$-6 < x < 2$		$x > 2$							
	sign	+	-		+							
	States a correct quadratic inequality  FT from an incorrect $\frac{dy}{dx}$ provided both M1 marks have been awarded	AO1.1b	A1									
	Determines a solution to 'their' inequality	AO1.1a	M1		$-6 \leq x \leq 2$  Chris's claim is incorrect for values of $x$ in the range $-6 \leq x \leq 2$ , so he is <b>wrong</b>							
Obtains correct range of values for $x$  Must be correctly written with both inequality signs correct	AO1.1b	A1										
Interprets final solution in context of the original question, must refer to Chris's claim	AO3.2a	R1										
	<b>Total</b>		<b>7</b>									

## AS Maths Specimen Paper 2 Question 7

7 Solve the equation

$$\sin \theta \tan \theta + 2 \sin \theta = 3 \cos \theta \quad \text{where } \cos \theta \neq 0$$

Give all values of  $\theta$  to the nearest degree in the interval  $0^\circ < \theta < 180^\circ$

Fully justify your answer.

[5 marks]

Q	Marking Instructions	AO	Marks	Typical Solution
7	Divides or multiplies by $\cos \theta$	AO3.1a	M1	$\frac{\sin \theta \tan \theta}{\cos \theta} + 2 \frac{\sin \theta}{\cos \theta} = 3$
	Obtains correct quadratic	AO1.1b	A1	$\tan^2 \theta + 2 \tan \theta - 3 = 0$
	Applies a correct method to solve 'their' quadratic PI	AO1.1a	M1	$(\tan \theta + 3)(\tan \theta - 1) = 0$ $\tan \theta = 1$ or $-3$
	Finds two correct values of $\tan \theta$ from 'their' quadratic	AO1.1b	A1F	$\theta = 45^\circ$ or $108^\circ$
	Obtains two correct answers CAO	AO1.1b	A1	ALT $\sin \theta \tan \theta \cos \theta + 2 \sin \theta \cos \theta = 3 \cos^2 \theta$ $\sin^2 \theta + 2 \sin \theta \cos \theta - 3 \cos^2 \theta = 0$ $(\sin \theta + 3 \cos \theta)(\sin \theta - \cos \theta) = 0$ $\tan \theta = 1$ or $-3$ $\theta = 45^\circ$ or $108^\circ$
Total			5	

## AS Maths Specimen Paper 2 Question 8

8 Prove that the function  $f(x) = x^3 - 3x^2 + 15x - 1$  is an increasing function.

[6 marks]

Q	Marking Instructions	AO	Marks	Typical Solution
8	Explains clearly that $f(x)$ is increasing $\Leftrightarrow f'(x) > 0$ (for all values of $x$ )  or  Explains $\Rightarrow f(x)$ is increasing $f'(x) > 0$ for all values of $x$ This may appear at any appropriate point in their argument	AO2.4	E1	For all $x$ , $f'(x) > 0 \Rightarrow f(x)$ is an increasing function  $f(x) = x^3 - 3x^2 + 15x - 1$ $\Rightarrow f'(x) = 3x^2 - 6x + 15$ $\Rightarrow f'(x) = 3(x-1)^2 + 12$ $\therefore f'(x)$ has a minimum value of 12 therefore $f'(x) > 0$ for all values of $x$
	Differentiates – at least two correct terms	AO1.1a	M1	<b>OR</b> for $f'(x)$ , $b^2 - 4ac = -144$ $\therefore f'(x) \neq 0$ for any real $x$ , so $f'(x)$ is either always positive or always negative. $f'(0) = 15$
	All terms correct	AO1.1b	A1	therefore $f'(x) > 0$ for all values of $x$
	Attempts a correct method which could lead to $f'(x) > 0$	AO3.1a	M1	<b>OR</b> $f''(x) = 6x - 6$ , which = 0 when $x = 1$ so min $f'(x)$ is $f'(1) = 12$ therefore $f'(x) > 0$ for all values of $x$
	Correctly deduces $f'(x) > 0$ (for all values of $x$ )	AO2.2a	A1	
	Writes a clear statement that links the steps in the argument together, the deduction about a positive gradient for all values of $x$ proves that the given function is increasing for all values of $x$	AO2.1	R1	Thus, since, $f'(x) > 0$ for all values of $x$ it is proven that $f(x)$ is an increasing function.
Total			6	

## A-level Maths Specimen Paper 1 Question 15

- 15 The height  $x$  metres, of a column of water in a fountain display satisfies the differential equation  $\frac{dx}{dt} = \frac{8\sin 2t}{3\sqrt{x}}$ , where  $t$  is the time in seconds after the display begins.

- 15 (a) Solve the differential equation, given that initially the column of water has zero height.  
Express your answer in the form  $x = f(t)$

[7 marks]

- 15 (b) Find the maximum height of the column of water, giving your answer to the nearest cm.

[1 mark]

Q	Marking Instructions	AO	Marks	Typical Solution
15(a)	Separates variables, at least one side correct.	AO3.1a	M1	$3\sqrt{x} \frac{dx}{dt} = 8\sin 2t$
	Obtains correct separation PI	AO1.1b	A1	$\int 3\sqrt{x} dx = \int 8\sin 2t dt$
	integrates 'their' expressions, at least one of 'their' sides correct	AO1.1a	M1	$\int 3x^{\frac{1}{2}} dx = \int 8\sin 2t dt$
	Obtains correct integral (condone missing + c) CAO	AO1.1b	A1	$2x^{\frac{3}{2}} = -4\cos 2t (+c)$
	Substitutes initial conditions, to find + c.	AO3.1b	M1	$2 \times (0)^{\frac{3}{2}} = -4\cos(2 \times 0) + c$ $c = 4$
	Obtains a correct solution ACF	AO1.1b	A1	$x^{\frac{3}{2}} = 2 - 2\cos 2t$
	Obtains correct solution of the form $x = f(t)$	AO2.5	A1	$x = (2 - 2\cos 2t)^{\frac{2}{3}}$
(b)	Obtains correct max height, in cm  Award FT from correct substitution into incorrect equation $x = f(t)$ but only if all three M1 marks have been awarded, must have correct units.	AO3.4	A1F	Max height $= 4^{\frac{2}{3}} = 252$ cm
Total			8	

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## A-level Maths Specimen Paper 3 Question 15

15

A sample of 200 households was obtained from a small town.

Each household was asked to complete a questionnaire about their purchases of takeaway food.

$A$  is the event that a household regularly purchases Indian takeaway food.

$B$  is the event that a household regularly purchases Chinese takeaway food.

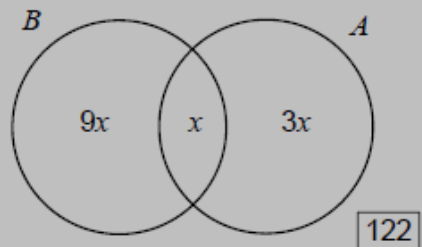
It was observed that  $P(B|A) = 0.25$  and  $P(A|B) = 0.1$

Of these households, 122 indicated that they did **not** regularly purchase Indian or Chinese takeaway food.

A household is selected at random from those in the sample.

Find the probability that the household regularly purchases **both** Indian and Chinese takeaway food.

**[6 marks]**

Q	Marking Instructions	AO	Marks	Typical Solution
15	Uses conditional probability, either ① or ②	AO3.1b	M1	$\frac{P(A \cap B)}{P(A)} = \frac{1}{4}$ ① $\Rightarrow P(A) = 4P(A \cap B)$
	Obtains both equations ① and ② correctly	AO1.1b	A1	$\frac{P(A \cap B)}{P(B)} = \frac{1}{10}$ ② $\Rightarrow P(B) = 10P(A \cap B)$
	Evaluates $P(A \cup B)$ correctly <b>PI</b>	AO1.1b	B1	$P(A \cup B) = 1 - \frac{122}{200} = \frac{39}{100}$
	Uses addition law	AO1.1a	M1	$P(A) + P(B) - P(A \cap B) = \frac{39}{100}$ ③
	Combines the <b>three</b> equations	AO1.1a	M1	$4P(A \cap B) + 10P(A \cap B) - P(A \cap B) = \frac{39}{100}$
	Obtains correct probability, as a fraction or decimal	AO2.2b	A1	$P(A \cap B) = \frac{3}{100}$
ALT	Produces a relevant Venn diagram	AO3.1b	M1	OR <div style="border: 1px solid black; display: inline-block; padding: 2px;">200</div>
	Labels Venn diagram correctly	AO1.1b	A1	
	Forms correct equation to find x <b>PI</b>	AO1.1b	B1	$9x + x + 3x = 200 - 122$
	Combines terms	AO1.1a	M1	$13x = 78$
	Solves equation	AO1.1a	M1	$x = 6$
	Obtains correct probability	AO2.2b	A1	$P(A \cap B) = \frac{6}{200}$ or 0.03
	<b>Total</b>		<b>6</b>	
	<b>TOTAL</b>		<b>100</b>	



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# Notes

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# Notes



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