

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

**MEI STRUCTURED MATHEMATICS**

Foundations of Advanced Mathematics

SPECIMEN PAPER

**6989**

Additional materials:

Answer paper (MS4)

Rough paper

To be brought by candidate:

eraser

scientific calculator

soft pencil

**TIME** 2 hours

**INSTRUCTIONS TO CANDIDATES**

**Do not open this booklet until you are told to do so.**

Write your name, Centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.

There are **forty** questions in this paper. Attempt as many questions as possible. For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate answer sheet.

**Read very carefully the instructions on the answer sheet.**

**INFORMATION FOR CANDIDATES**

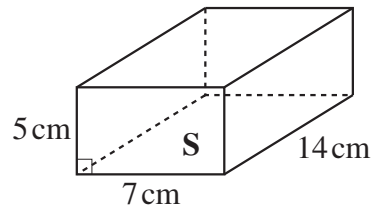
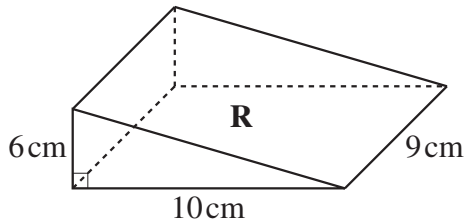
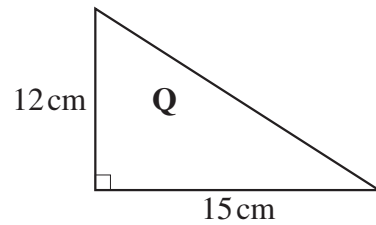
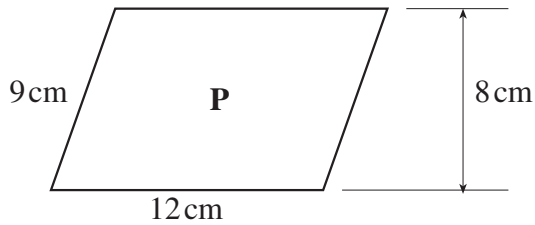
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Paper is provided for rough work; this should not be handed in.

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**This question paper consists of 23 printed pages and 1 blank page.**

- 1 Three of the following statements are true and **one** is false. Which statement is **false**?



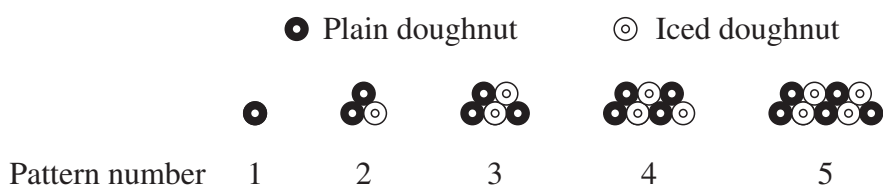
- A The area of the shape P is  $96 \text{ cm}^2$ .
- B The area of shape Q is  $90 \text{ cm}^2$ .
- C The volume of shape R is  $540 \text{ cm}^3$ .
- D The volume of shape S is  $490 \text{ cm}^3$ .
- 2 Which **one** of the following is **not** a factor of 98?
- A 2    B 49    C 3    D 7
- 3 In order to make a concrete mixture for a smooth finish for her patio, Mandy uses cement, sand and gravel in the ratio 2 : 6 : 7.

Three of the following statements are true and **one** is false. Which statement is **false**?

- A If Mandy uses 105 kg of gravel, she needs 30 kg of cement.
- B A 50 kg bag of cement is needed for 375 kg of this concrete mixture.
- C Two fifths of the concrete mixture is sand.
- D More than 500 kg of gravel is required to make 1 tonne of the concrete mixture.
- 4 Three of the following statements are true and **one** is false. Which statement is **false**?
- A  $(3x^5)^2 = 9x^{10}$ .
- B  $x^{-2} = -x^2$ .
- C  $64^{\frac{1}{2}} = 8$ .
- D  $3x^3 + 4x^3 = 7x^3$ .

- 5 Three of the following statements are true and **one** is false. Which statement is **false**?
- A 70% is equivalent to 0.7.
- B 0.001 is equivalent to 1%.
- C 20% is equivalent to  $\frac{1}{5}$ .
- D  $\frac{1}{200}$  is equivalent to 0.005.
- 6 Three of the following statements are true and **one** is false. Which statement is **false**?
- A If the attendance at a football match is 12 543, this can be reported as 12 500 to the nearest 100.
- B Trevor drives 234 miles and claims 24p per mile on his expenses. He will be able to claim an extra £1.44 if he approximates the distance to the nearest 10 miles.
- C 23.675 when written to three significant figures is 23.7.
- D 22.5 litres of petrol at 72.9p per litre costs £16.40 to the nearest penny.
- 7 Amir uses his family car to tow a caravan. Which **one** of the following is a reasonable estimate of the total length of car and caravan?
- A 4.25 m      B 950 cm      C 12 feet      D 65 000 mm

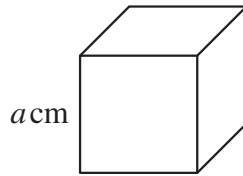
8



Jill is displaying doughnuts in the window of a cake shop. She finds a pattern as she works with plain and iced doughnuts. The pattern is shown in the diagram.

- Three of the following statements are true and **one** is false. Which statement is **false**?
- A There is a total of  $2n + 1$  doughnuts in the  $n$ th pattern.
- B There are  $n$  plain doughnuts in the  $n$ th pattern.
- C There are  $n - 1$  iced doughnuts in the  $n$ th pattern.
- D There is a total of 19 doughnuts in the 10th pattern.

9



The diagram shows a cube with edges of length  $a$  cm.

Three of the following statements about the cube are true and **one** is false. Which statement is **false**?

- A The surface area of the cube is given by  $6a^2$  cm<sup>2</sup>.
- B The volume of the cube is given by  $a^3$  cm<sup>3</sup>.
- C The total length of the edges is given by  $12a$  cm.
- D The number of vertices is given by 8 cm.

10 Use the following values in this question.

$$p = 5 \quad q = 3 \quad r = -4 \quad s = 0$$

Substitute these values into the four expressions below.

Three of the following expressions have been calculated correctly but **one** has been calculated incorrectly. Which has been calculated **incorrectly**?

- A  $3p^2 = 75$ .
- B  $3(p + q) = 24$ .
- C  $r^2 = -16$ .
- D  $pqrs = 0$ .

11 Which **one** of the following is a **correct** simplification of  $3(x + 2) + 2(x - 5)$ ?

- A  $5x + 16$
- B  $5x - 4$
- C  $x + 16$
- D  $5x - 3$

12 Which **one** of the following is a **correct** simplification of  $\frac{(x+1)}{2} + \frac{3(x+1)}{2}$ ?

- A  $2x + 2$
- B  $\frac{1}{2}(x + 4)$
- C  $2(x + 2)$
- D  $x + 1$

- 13 Lee says that the formula  $T = 2\pi\sqrt{\frac{l}{g}}$  can be rewritten as  $T^2 = 4\pi^2\frac{l}{g}$ .

Shelley says that the formula  $V = \pi r^2 h$  can be rewritten as  $h = \frac{V}{\pi r^2}$ .

Three of the following statements are false but **one** is true. Which statement is **true**?

- A Both Lee and Shelley are correct.
- B Lee is correct but Shelley is incorrect.
- C Lee is incorrect but Shelley is correct.
- D Both Lee and Shelley are incorrect.

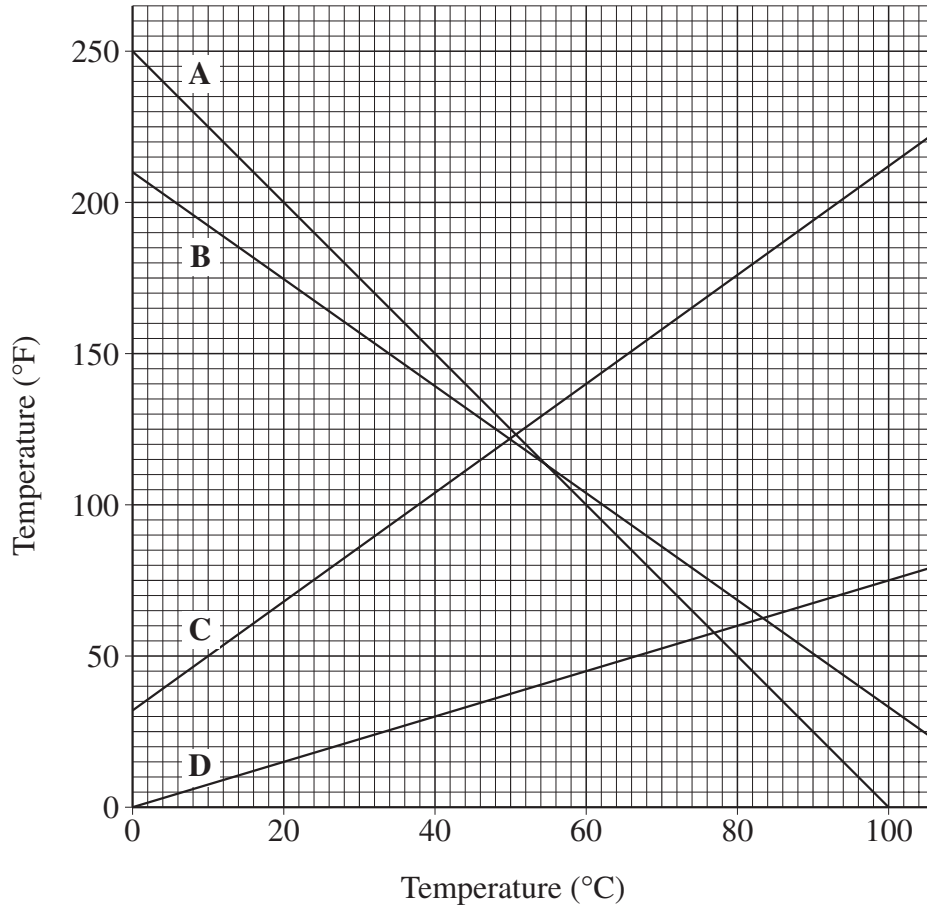
- 14 Three of the following are correct rearrangements of  $x - 5 \geq 2x - 2$  but **one** is incorrect. Which statement is **incorrect**?

- A  $x \geq 2x + 3$ .
- B  $x \leq -3$ .
- C  $3x \geq 7$ .
- D  $-5 \geq x - 2$ .

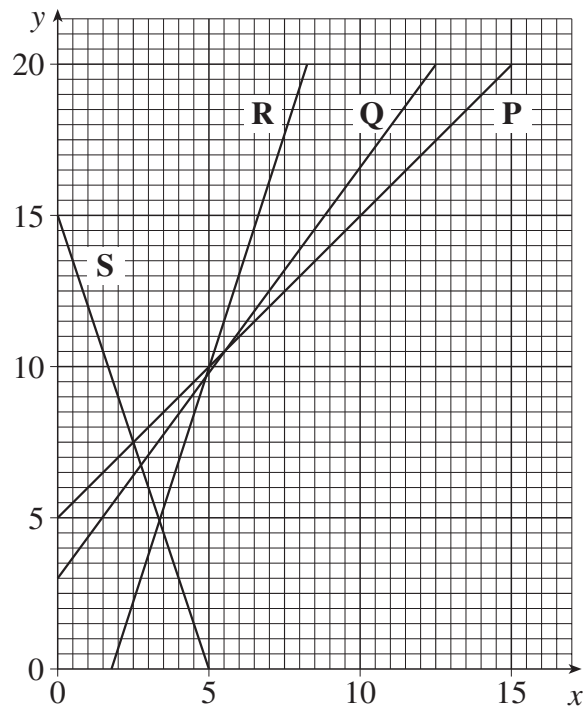
- 15 Which **one** of the following is a root (correct to 2 decimal places) of the equation  $x^2 - 5x = 12$ ?

- A 6.77      B 1.77      C -1.78      D -3.54

16



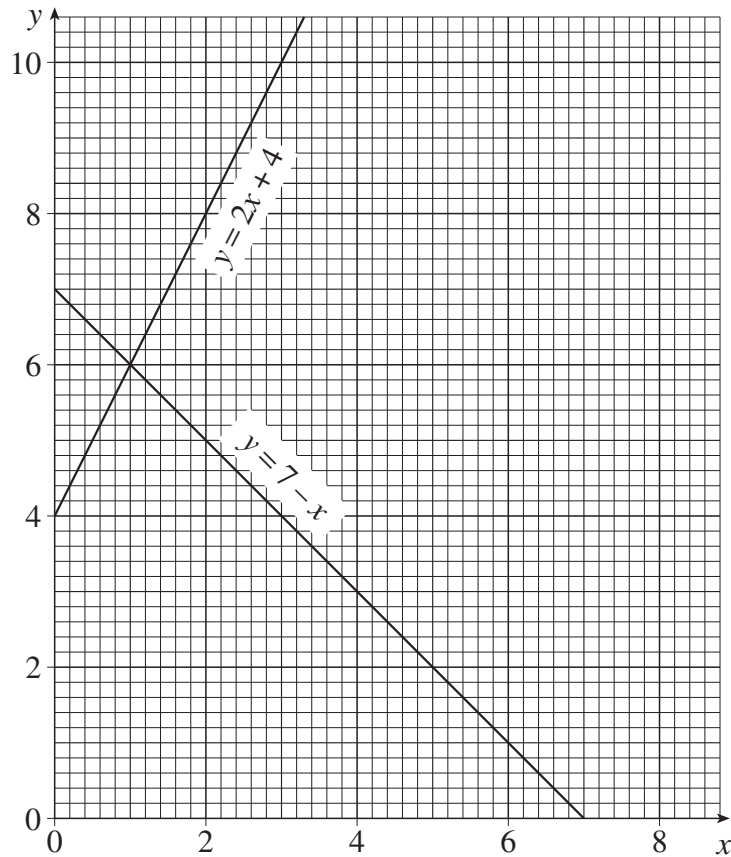
Which **one** of the four lines **A**, **B**, **C** and **D** is the correct graph to convert temperatures expressed in degrees Celsius ( $^{\circ}\text{C}$ ) to temperatures expressed in degrees Fahrenheit ( $^{\circ}\text{F}$ )?



The graph shows four straight lines **P**, **Q**, **R** and **S**.

Three of the following statements are false and **one** is true. Which statement is **true**?

- A** Line **P** has gradient 1.
- B** The gradient of line **Q** is greater than the gradient of line **R**.
- C** Line **R** has gradient 2.
- D** Line **S** has gradient 3.



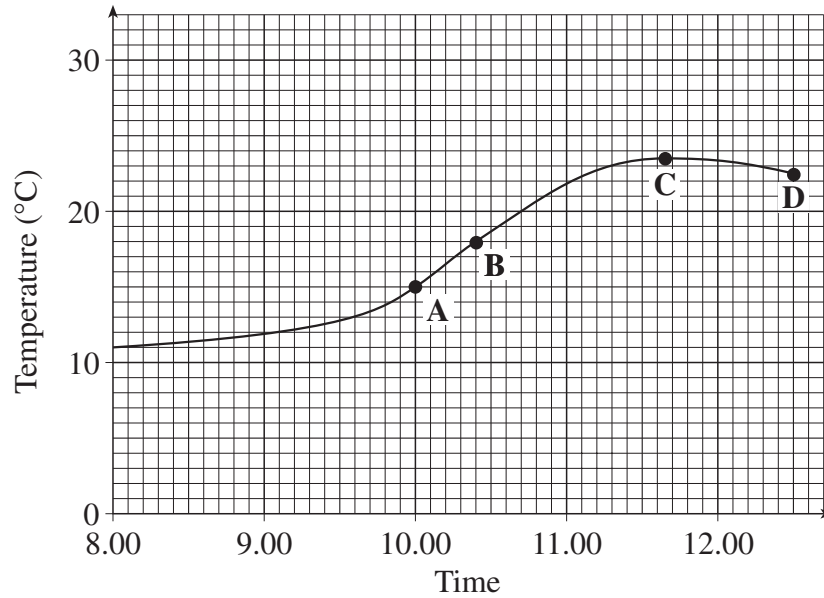
The graph shows the lines  $y = 2x + 4$  and  $y = 7 - x$ . It may help you to answer this question if you draw in the lines  $y = x + 3$  and  $y = x + 1$ .

Three of the following statements are true but **one** is false. Which statement is **false**?

- A The solution of the simultaneous equations  $y = 2x + 4$  and  $y = 7 - x$  is  $x = 1$  and  $y = 6$ .
- B The solution of the simultaneous equations  $y = 7 - x$  and  $y = x + 3$  is  $x = 3$  and  $y = 5$ .
- C The solution of the simultaneous equations  $y = 2x + 4$  and  $y = x + 3$  has a negative value of  $x$  and a positive value of  $y$ .
- D The solution of the simultaneous equations  $y = 7 - x$  and  $y = x + 1$  is  $x = 3$  and  $y = 4$ .

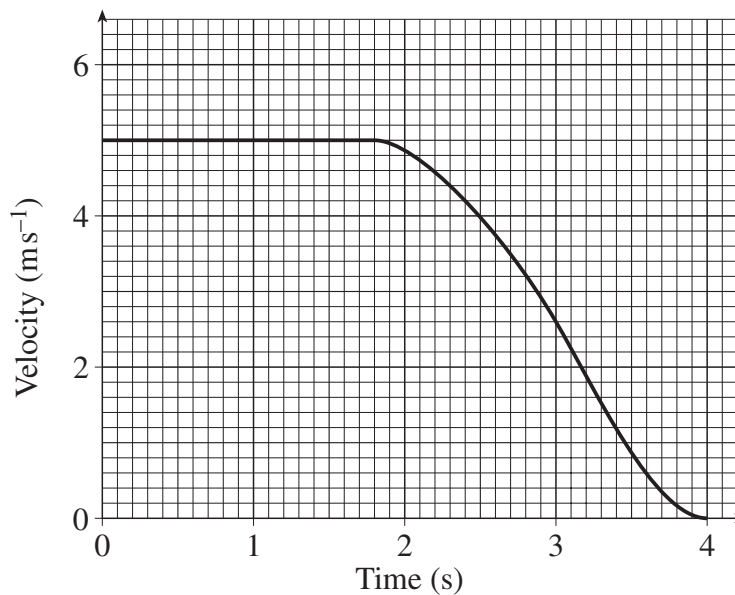


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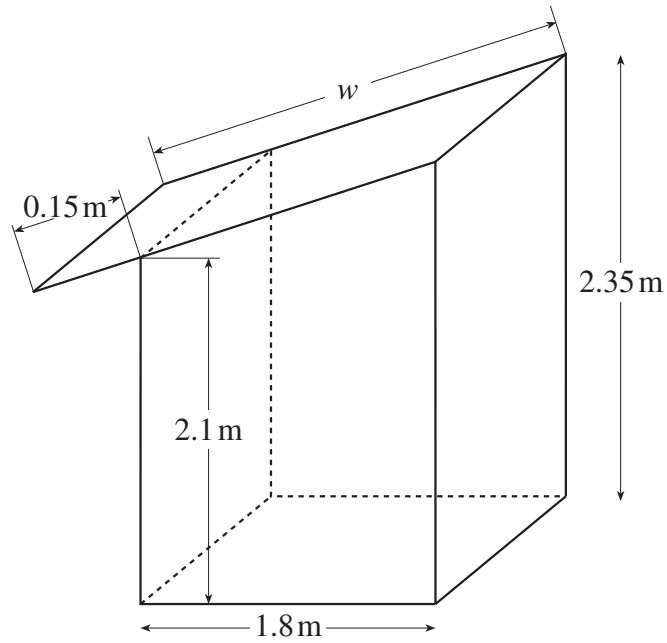
The graph shows the air temperature during the morning of a day in early summer. At which **one** of the four points **A**, **B**, **C** or **D** is the temperature rising most rapidly?

20



A trolley that had been travelling at a constant velocity is brought to a stop. The graph shows the velocity of the trolley during this four second period. Use the graph to estimate the distance travelled in this time. Which **one** of the following is the best estimate of the distance travelled?

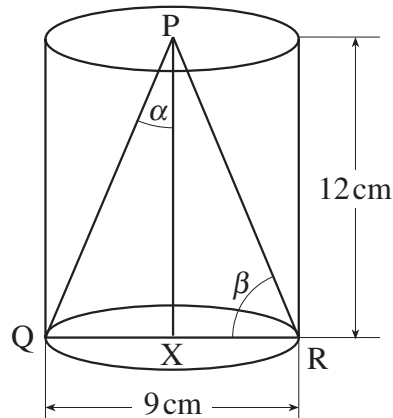
- A** 20 m      **B** 10 m      **C** 15 m      **D** 25 m



The diagram shows a garden shed in which the rectangular roof projects over the front. The back section is 2.35 metres high and the front section is 2.1 metres high. The roof of the shed rests on these two sections and extends 0.15 metres beyond the front section. The front and back sections are vertical and are 1.8 metres apart.

Three of the following statements are true and **one** is false. Which statement is **false**?

- A The length of  $w$  is 1.97 m, correct to 2 decimal places.
- B Two of the walls of the shed are trapezia and the other two are rectangles.
- C The areas of three of the walls of the shed are less than  $4 \text{ m}^2$ .
- D The angle of the slope of the roof to the horizontal is  $7.9^\circ$ , to the nearest  $0.1^\circ$ .



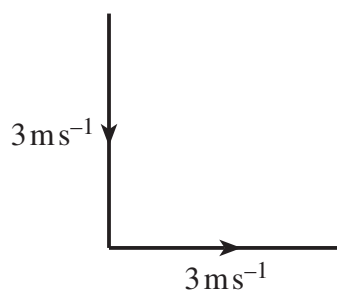
The diagram shows a cylinder of diameter 9 cm and height 12 cm. The points P and X are mid-points of the circular ends of the cylinder. QXR is a diameter of one end.

The angle QPX is marked  $\alpha$  and the angle PRX is marked  $\beta$ .

Three of the following statements are true and **one** is false. Which statement is **false**?

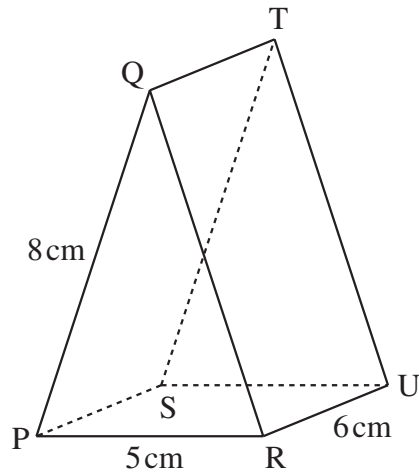
- A QP = 12.8 cm (to the nearest 0.1 cm).
- B  $\tan \alpha = \frac{3}{8}$ .
- C  $\cos \beta = \frac{4.5}{12}$ .
- D Angle  $\alpha = 21^\circ$  (to the nearest degree).

- 23 A boat is pointing due South and is travelling through the water at 3 metres per second. There is a current flowing due East at 3 metres per second.



Three of the following statements are true and **one** is false. Which statement is **false**?

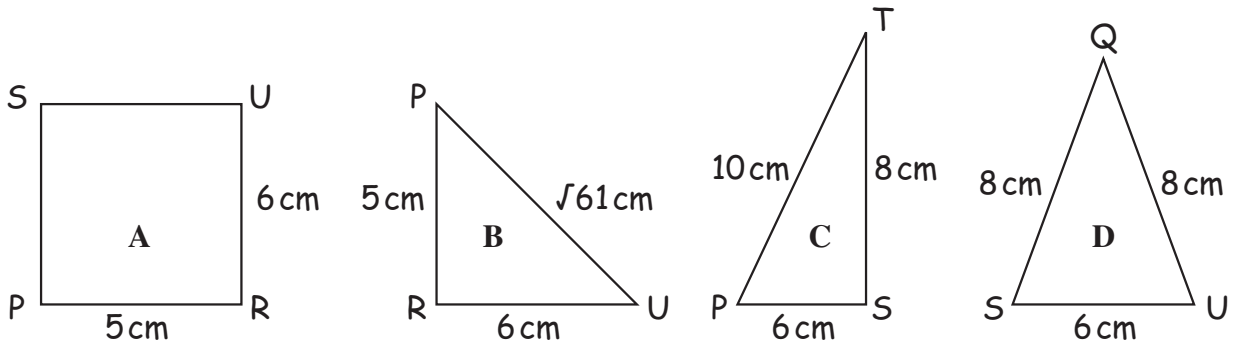
- A The boat is travelling in the direction South East.
- B The speed of the boat is approximately  $4.24 \text{ m s}^{-1}$ .
- C In order to travel due South the boat must point in the direction South West.
- D If the boat points West it does not move at all.



The diagram shows a triangular prism PQRSTU where PQR is an isosceles triangle.  $PQ = 8\text{ cm}$ ,  $PR = 5\text{ cm}$ ,  $RU = 6\text{ cm}$ .

Wendy draws sketches of sections of the prism and indicates the lengths of the sides. The sketches are not to scale.

One of the four sketches contains an error whilst the other three are correct. Which sketch contains an error?



- 25 Jason works every day over a period of three weeks but the number of hours that he works each day is very variable. He lists the number of hours that he works each day.

Week 1	$5\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{4}$	$3\frac{3}{4}$	3	$2\frac{1}{4}$	7
Week 2	$3\frac{3}{4}$	$4\frac{1}{2}$	$6\frac{1}{2}$	8	8	$7\frac{1}{2}$	$6\frac{3}{4}$
Week 3	$1\frac{3}{4}$	$3\frac{1}{4}$	$4\frac{1}{2}$	$5\frac{3}{4}$	$6\frac{1}{4}$	$6\frac{1}{4}$	$6\frac{1}{2}$

Jason decides to show this information in the form of a frequency table.

Number of hours, $h$ , worked each day	Mid-point	Frequency
$0 \leq h < 2$	1	1
$2 \leq h < 4$	3	5
$4 \leq h < 6$	5	4
$6 \leq h < 8$	7	9
$8 \leq h < 10$	9	2

Three of the following statements are true but **one** is false. Which statement is **false**?

- A Jason has completed the frequency table correctly.
- B Using the values in the frequency table, the mean time each day that Jason worked is more than 5.5 hours but less than 5.7 hours.
- C Jason worked for  $34\frac{1}{2}$  hours in Week 3.
- D The mean time each day that Jason worked in Week 3 is 4.9 hours (to one decimal place).

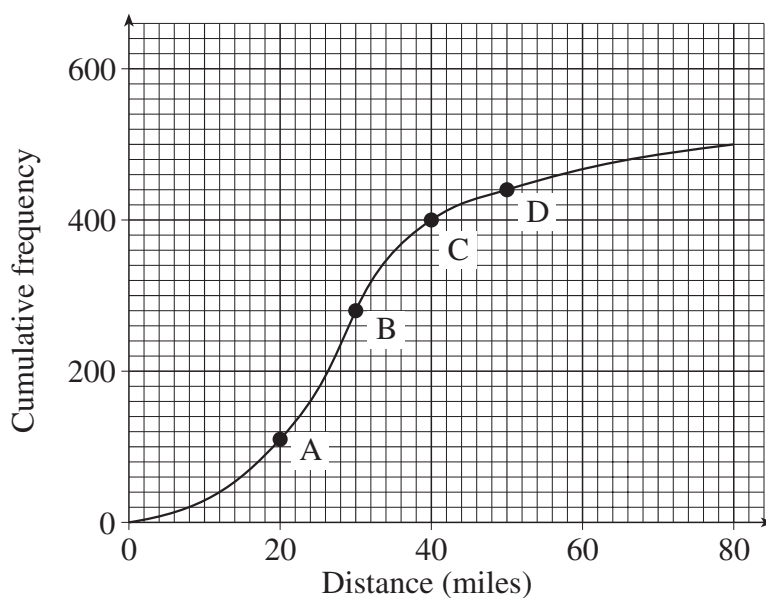
26

Distance travelled, $d$ miles	Frequency	Cumulative frequency
$0 \leq d < 10$	42	
$10 \leq d < 20$	69	
$20 \leq d < 30$	198	
$30 \leq d < 40$	89	
$40 \leq d < 50$	45	
$50 \leq d < 60$	36	
$60 \leq d < 70$	15	
$70 \leq d < 80$	6	

In a traffic census 500 motorists were stopped and asked how far they had travelled that day so far. The results are shown in the table.

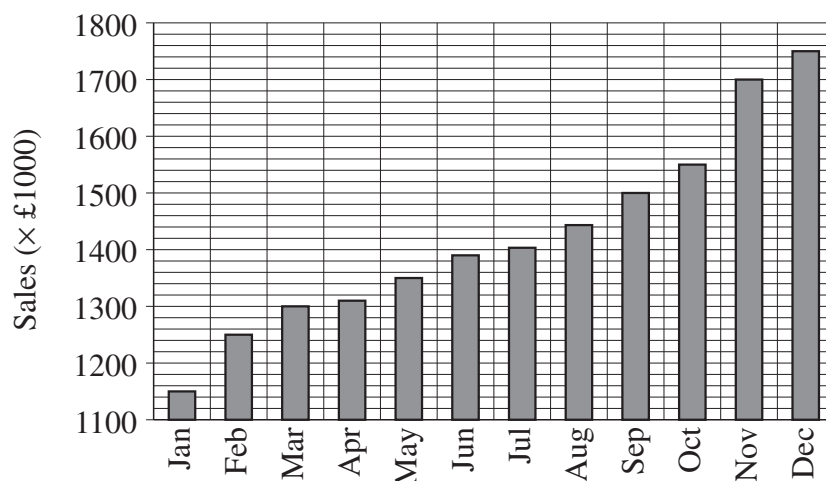
The results are shown in the cumulative frequency curve but **one** of the points A, B, C and D has been plotted incorrectly.

Which point has been plotted **incorrectly**?



27

### Look How Sales Have Increased!!!!



The graph shows the monthly sales of a large company over a period of one year.

Three of the following statements are true but **one** is false. Which statement is **false**?

- A Monthly sales have increased by approximately 50% over this period.
- B The greatest increase in monthly sales occurred during November.
- C Total sales over the first four months exceeded five million pounds.
- D Sales in September were double the sales in March.

- 28 The owner of a small boutique makes a note of the numbers of dresses sold during a particular week. He lists the number sold according to the size of each dress.

Dress size	Number sold
8	3
10	14
12	23
14	12
16	4

Three of the following statements are true and **one** is false. Which statement is **false**?

- A The mean dress size is 11.2.
- B The mode is size 12.
- C 56 dresses were sold during the week.
- D The range of dress sizes is 8.



Vinotha throws a dome-headed tack 200 times and records whether the tack lands with its point up or down. She records the results in a table.

Point up	Point down
48	152

Vinotha uses these results to estimate the probabilities of outcomes if she were to throw the tack again.

She then makes the following statements of which three are true and **one** is false. Which statement is **false**?

**A** The probability that the next throw will land point up is approximately  $\frac{1}{4}$ .

**B** An estimate of the probability that the tack is point down is 0.76.

**C** The ratio

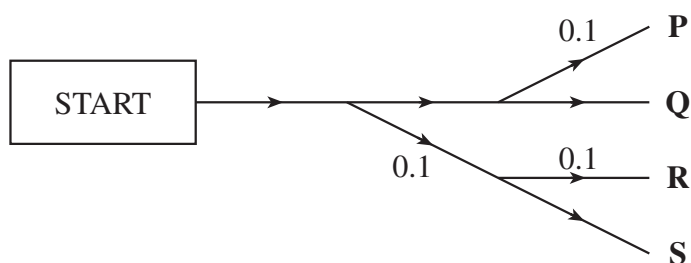
Probability (point up) : Probability (point down)

is very nearly 1 : 3.

**D** If the tack is thrown 30 more times, the most likely number of times that the tack would land point up is ten.



30



In an experiment rats are released from a box and need to pass through a maze to reach food. It is known that, when the rats encounter a junction, they are more likely to go straight on than turn left or right. At each junction the probability that they do not go straight on is 0.1, independently of previous junctions.

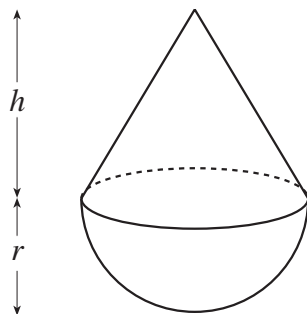
The probability of a rat reaching each of the end-points **P**, **Q**, **R** and **S** is calculated by one of the research team but only **one** is calculated correctly; the other three are incorrect. Which probability is correct?

- A The probability of reaching end-point **P** is 0.09.
- B The probability of reaching end-point **Q** is 0.9.
- C The probability of reaching end-point **R** is 0.02.
- D The probability of reaching end-point **S** is 0.9.

31 Three of the following statements are true and **one** is false. Which statement is **false**?

- A  $\frac{x}{2} + \frac{x}{3}$  can be written as  $\frac{5x}{6}$ .
- B  $2x(x + y) - x^2 = x^2 + xy$ .
- C  $3(x + 1) + 2(x - 3) - (2 - x)$  can be written as  $6x - 5$ .
- D  $\frac{x+1}{3} + \frac{2x+1}{4}$  can be written as  $\frac{10x+7}{12}$ .

- 32 A solid is formed of a hemisphere of radius  $r$  and a cone of height  $h$  and radius  $r$ .

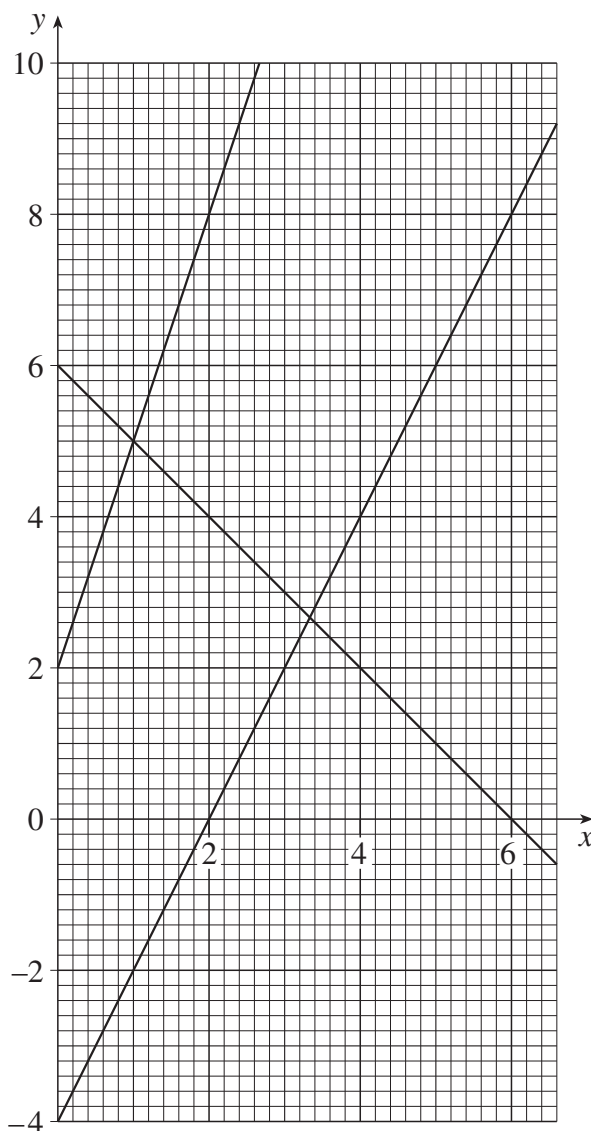


The volume of the hemisphere is  $\frac{2}{3}\pi r^3$  and the volume of the cone is  $\frac{1}{3}\pi r^2 h$ .

Three of the following statements are true and **one** is false. Which statement is **false**?

- A The volume of the solid is given by  $V = \frac{1}{3}\pi r^2(2r + h)$ .
- B The volume of the cone is greater than the volume of the hemisphere when  $h > 2r$ .
- C When  $r = 3$  cm and  $h = 4$  cm the volume of the solid is approximately  $63$  cm<sup>3</sup>.
- D When  $h = 2r$  the volume of the solid is the same as the volume of a sphere of radius  $r$ .

- 33 The graphs show the three straight lines  $x + y = 6$ ,  $y = 2x - 4$  and  $y = ax + b$ .



Three of the following statements are true and **one** is false. Which statement is **false**?

- A The lines  $x + y = 6$  and  $y = 2x - 4$  meet at  $(3\frac{1}{3}, 2\frac{2}{3})$ .
- B  $b = 2$ .
- C  $a = 3$ .
- D The line  $y = ax + b$  meets the  $x$ -axis at  $x = -\frac{3}{2}$ .

34 The formula for simple interest is

$$I = \frac{PRT}{100},$$

where  $P$  is the sum of money invested,  $R$  is the rate % per year offered and  $T$  is the time in years.

Three of the following statements are true and **one** is false. Which statement is **false**?

- A When the rate is doubled the interest is doubled.
- B When £1000 is invested at a rate of 3% per year then the interest earned in 4 years is £120.
- C The formula is equivalent to  $P = 100I - RT$ .
- D The amount of money that needs to be invested at 5% per year for 3 years to obtain £75 interest is £500.

35 Harnel is investigating the connections between the number of dots,  $d$ , in each pattern and the pattern number,  $n$ . The first four patterns are given below.

	●		●	●		●	●		●	●	●	●
			●		●	●		●	●	●		
				●	●	●		●	●	●		
Pattern	●	●	●	●	●	●	●	●	●	●	●	●
Pattern number, $n$	1		2		3		4					
Number of dots, $d$	1		3		6		10					

Three of the following statements are true and **one** is false. Which statement is **false**?

- A  $d = \frac{1}{2}n^2 + \frac{1}{2}n$ .
- B  $d = \frac{n^2 + n}{2}$ .
- C  $2d = n^2 + 2n$ .
- D  $d = \frac{1}{2}n(n + 1)$ .

36 When the expressions **A**, **B**, **C** and **D** are factorised, three of them have a factor in common.

The other **one** has different factors. Which one has **different** factors?

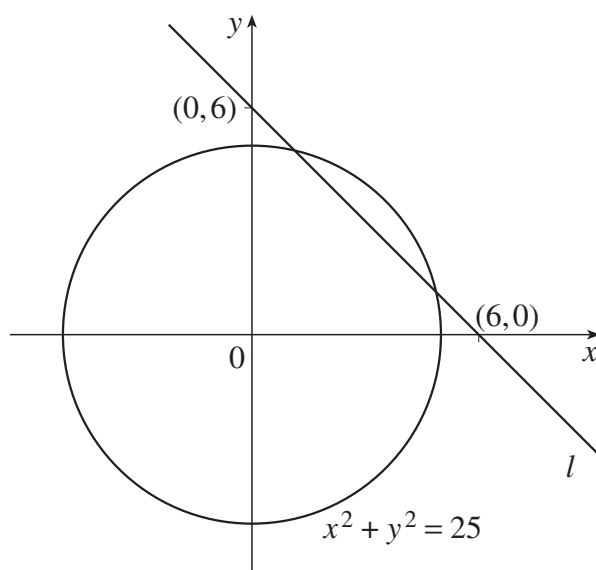
- A  $x^2 - 36$
- B  $x^2 - 9x - 36$
- C  $x^2 + 5x + 6$
- D  $x^2 - x - 12$

37 James is solving the equation  $x^2 - 6x + c = 0$  for different values of  $c$ .

Three of the following statements are true and **one** is false. Which statement is **false**?

- A When  $c = 7$ , there are two roots,  $x = 1$  and  $x = 7$ .
- B When  $c = 9$ , there is a repeated root,  $x = 3$ .
- C When  $c = 10$ , there are no real roots.
- D When  $c = -10$ , there are two roots,  $x = 3 \pm \sqrt{19}$ .

38 Jane needs to calculate the  $x$ -coordinates of the points of intersection of the line  $l$  and the circle  $x^2 + y^2 = 25$ .

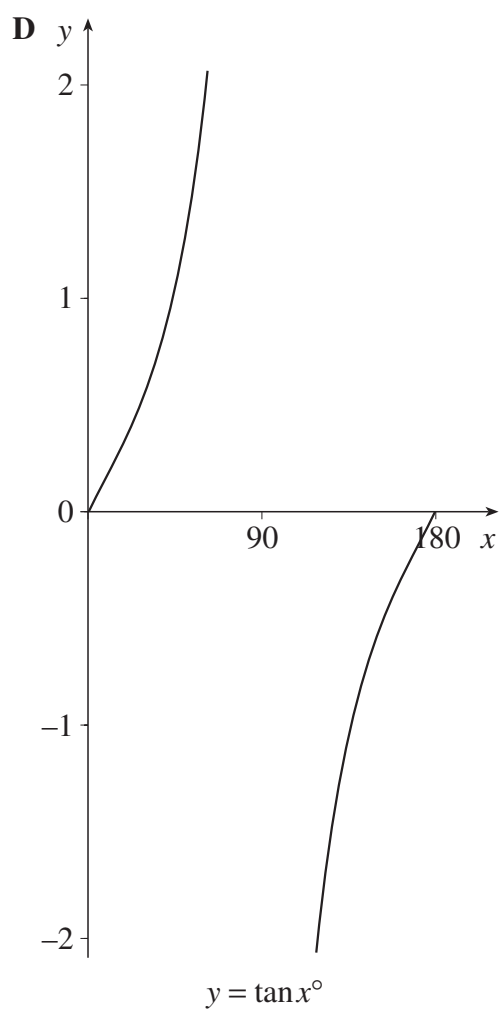
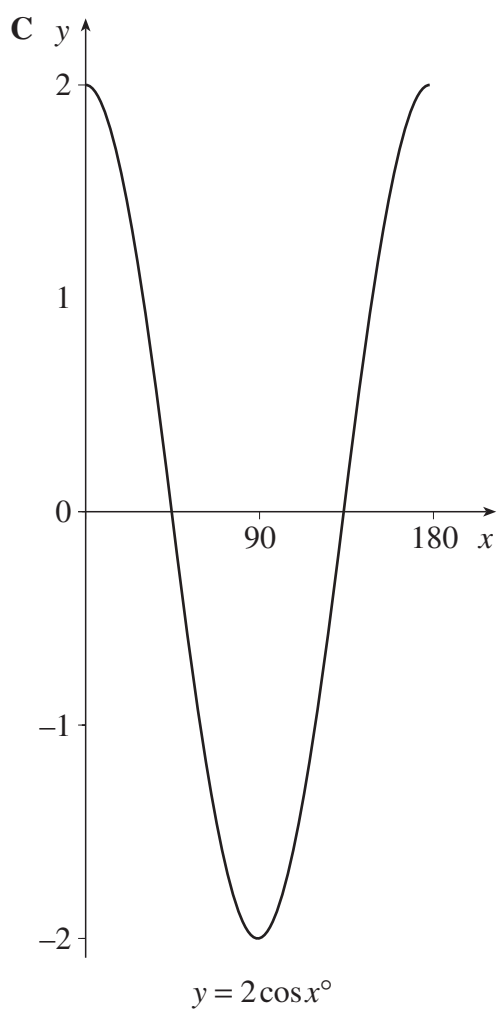
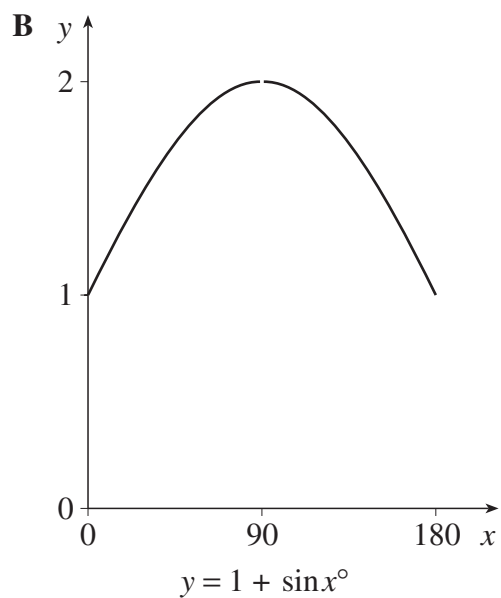
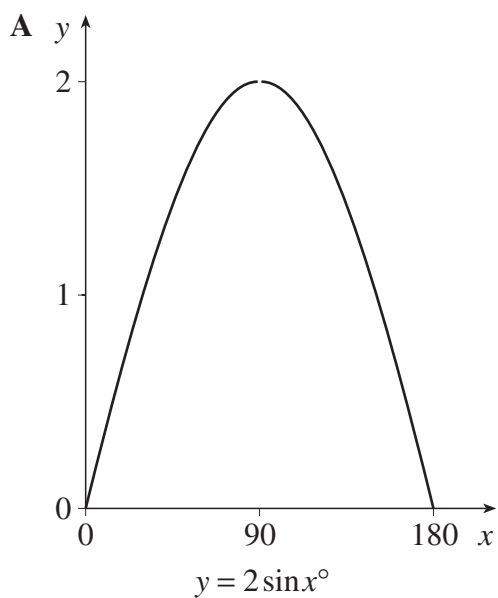


Three of the following statements are true and **one** is false. Which statement is **false**?

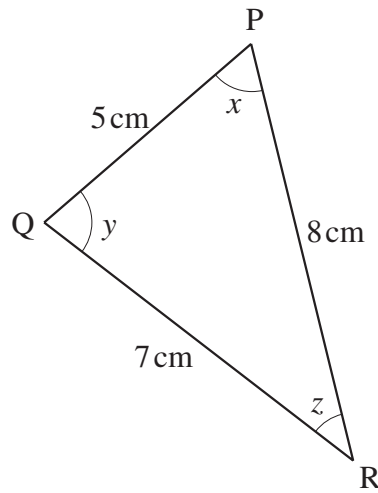
- A The circle goes through the points  $(5, 0)$  and  $(0, 5)$ .
- B The equation of the line  $l$  is  $x + y = 6$ .
- C The values of  $x$  are given by  $x^2 + (6 - x)^2 = 25$ .
- D  $x = \frac{12 \pm \sqrt{(144 - 88)}}{2}$ .

39 Look at the graphs of the trigonometrical functions in the range  $0^\circ$  to  $180^\circ$  below.

Three of the graphs are correct and **one** is incorrect. Which graph is **incorrect**?



- 40 Three of the following statements about the triangle PQR are true and **one** is false. Which statement is **false**?



Not to scale

- A  $\frac{\sin x}{7} = \frac{\sin y}{8}$ .
- B  $y$  is the largest angle.
- C  $\cos x = \frac{1}{2}$ .
- D The area of the triangle is  $17.5 \text{ cm}^2$ .

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# FAM Specimen Paper

## Assessment grid

Question	AO	Arithmetic	Algebra	Graphs	Trig	Statistics
1	1	FB11				
2	1	FB1				
3	2	FB4				
4	2	FB7	FA7			
5	2	FB5, FB6				
6	5	FB13, FB14				
7	5	FB16				
8	2		FA3			
9	1	FB9	FA7			
10	2		FA6			
11	2		FA8			
12	2		FA11			
13	2		FA7, FA12			
14	2		FA7, FA17			
15	2		FA15			
16	1			FG3		
17	1			FG5		
18	1			FG7		
19	3			FG9		
20	3			FG10, FG11		
21	4				FT1	
22	1				FT1, FT3, FT5, FT8	
23	4				FV3	
24	3				FT8	
25	1					FD1, FD3
26	4					FD2
27	4					FD6
28	1					FD7
29	5					FU2
30	1					FU6
31	2		FA7, FA8			
32	2		FA6, FA7, FA17			
33	1			FG4, FG9		



# FAM Specimen Paper

## Assessment grid

Question	AO	Arithmetic	Algebra	Graphs	Trig	Statistics
1	1	FB11				
2	1	FB1				
3	2	FB4				
4	2	FB7	FA7			
5	2	FB5, FB6				
6	5	FB13, FB14				
7	5	FB16				
8	2		FA3			
9	1	FB9	FA7			
10	2		FA6			
11	2		FA8			
12	2		FA11			
13	2		FA7, FA12			
14	2		FA7, FA17			
15	2		FA15			
16	1			FG3		
17	1			FG5		
18	1			FG7		
19	3			FG9		
20	3			FG10, FG11		
21	4				FT1	
22	1				FT1, FT3, FT5, FT8	
23	4				FV3	
24	3				FT8	
25	1					FD1, FD3
26	4					FD2
27	4					FD6
28	1					FD7
29	5					FU2
30	1					FU6
31	2		FA7, FA8			
32	2		FA6, FA7, FA17			
33	1			FG4, FG9		

Question	AO	Arithmetic	Algebra	Graphs	Trig	Statistics
34	2		FA7, FA12			
35	2		FA3, FA6			
36	2		FA10			
37	2		FA15			
38	2		FA15, FA16, FA18	FG5		
39	1				FT4	
40	1				FT7	

### Total allocation

AO	Achieved	Target
1	13	12-16
2	17	16-20
3	3	2-6
4	4	2-6
5	3	2-6

### Answers

1	C	21	C
2	C	22	C
3	D	23	C
4	B	24	D
5	B	25	C
6	B	26	B
7	B	27	D
8	A	28	A
9	D	29	D
10	C	30	A
11	B	31	B
12	A	32	C
13	A	33	D
14	C	34	C
15	A	35	C
16	C	36	A
17	A	37	A
18	B	38	D
19	B	39	C
20	C	40	D