

**FREE-STANDING MATHEMATICS QUALIFICATION  
INTERMEDIATE LEVEL**

**Foundations of Advanced Mathematics (MEI)**

**6989**

Candidates answer on the Answer Sheet

**OCR Supplied Materials:**

- Answer Sheet (MS4)

**Other Materials Required:**

- Eraser
- Rough Paper
- Scientific calculator
- Soft pencil

**Friday 11 June 2010**

**Morning**

**Duration: 2 hours**



\* 6 9 8 9 \*

**INSTRUCTIONS TO CANDIDATES**

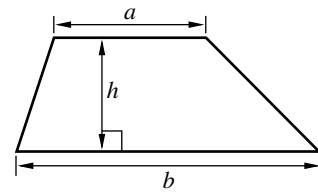
- Write your name clearly in capital letters, your Centre Number and Candidate Number on the Answer Sheet in the spaces provided unless this has already been done for you.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Do **not** write in the bar codes.
- 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**

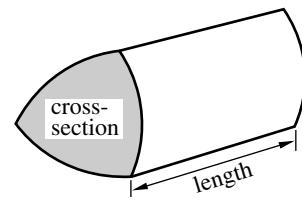
- Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
- Paper is provided for rough work; this should not be handed in.
- This document consists of **24** pages. Any blank pages are indicated.

## Formulae Sheet: 6989 Foundations of Advanced Mathematics

$$\text{Area of trapezium} = \frac{1}{2}(a + b)h$$



$$\text{Volume of prism} = (\text{area of cross-section}) \times \text{length}$$

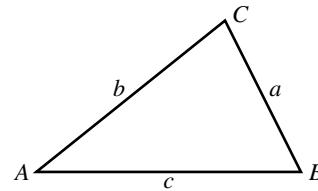


In any triangle  $ABC$

$$\text{Sine rule} \quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

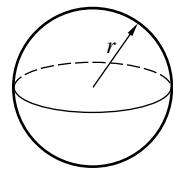
$$\text{Cosine rule} \quad a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area of triangle} = \frac{1}{2}ab \sin C$$



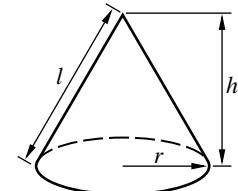
$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

$$\text{Surface area of sphere} = 4\pi r^2$$



$$\text{Volume of cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Curved surface area of cone} = \pi r l$$



### The Quadratic Equation

The solutions of  $ax^2 + bx + c = 0$ , where  $a \neq 0$ , are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- 1 Three of the following statements are true and **one** is false. Which one is **false**?
- A The number 2010 has exactly 4 prime factors.  
 B The square of  $10^3$  is  $10^6$ .  
 C The highest common factor (HCF) of 42 and 70 is 14.  
 D The lowest common multiple (LCM) of 24 and 40 is 240.
- 2 Three of the following statements are true and **one** is false. Which one is **false**?
- A  $(-2) \times (+4) = (-8)$   
 B  $(-6) + (-4) = (-10)$   
 C  $(-2) - (-4) = (-6)$   
 D  $(-3)^2 = (+9)$
- 3 Which **one** of the following is the **correct** answer to the calculation  $\frac{1.7 \times 10^4}{6.8 \times 10^{-2}}$ ?
- A  $2.5 \times 10^2$       B  $4.0 \times 10^2$       C  $2.5 \times 10^5$       D  $4.0 \times 10^{-6}$
- 4 Peter, Richard and Sequoia shared a lottery win in the ratio 5 : 4 : 3 respectively. Sequoia received £288.
- Three of the following statements are true and **one** is false. Which one is **false**?
- A Richard received 25% of the win.  
 B Peter and Richard together received three times as much as Sequoia.  
 C The total amount of the win was £1152.  
 D Peter received £480.

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

- A 0.3461 kilometres, correct to the nearest metre, is 346 metres.
- B 3478 grams, correct to the nearest kilogram, is 4 kilograms.
- C 10.48 seconds, correct to the nearest second, is 10 seconds.
- D 1928 millimetres, correct to the nearest centimetre, is 193 centimetres.

6 You are given that  $a = -3$ ,  $b = 2$  and  $c = -1$ .

- Three of the following statements are true and **one** is false. Which one is **false**?
- A  $\frac{b}{a+c} = -\frac{1}{2}$
  - B  $ab^2 = 36$
  - C  $abc - 3b = 0$
  - D  $ab + bc + ca = -5$

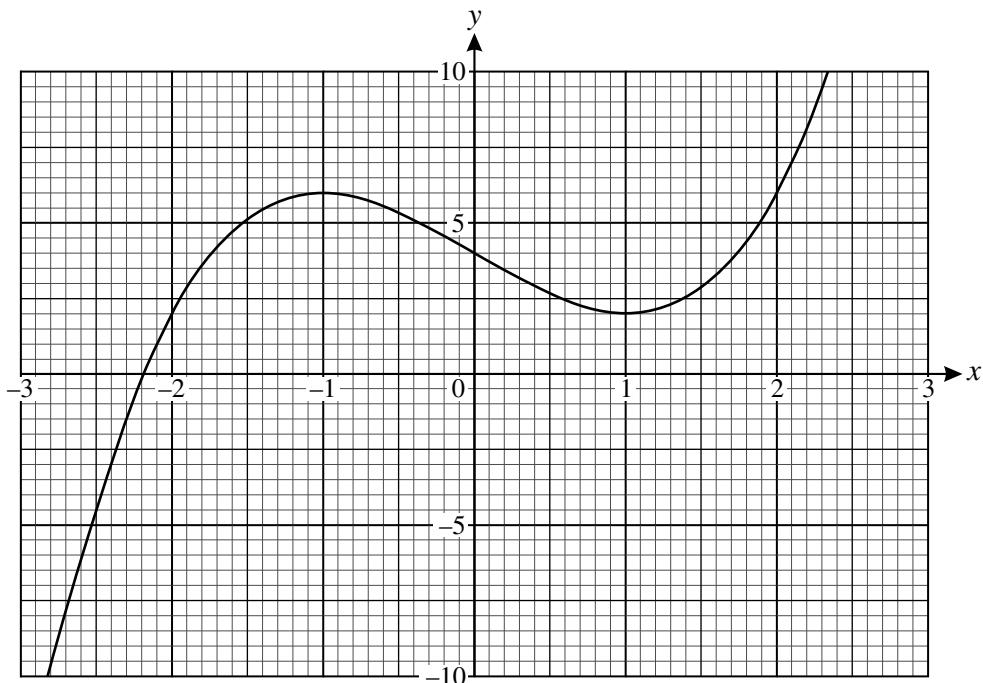
7 Three of the following statements are true and **one** is false. Which one is **false**?

- A The line  $y = 3x + 2$  cuts the  $x$ -axis when  $x = -\frac{2}{3}$ .
- B The line  $3x + 4y = 5$  has gradient  $-\frac{3}{4}$ .
- C The line  $\frac{x}{2} + \frac{y}{3} + 2 = 0$  passes through the point  $(2, 3)$ .
- D The lines  $8x - 3y + 2 = 0$  and  $y = 2$  meet at  $(\frac{1}{2}, 2)$ .

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

- A The solution of  $3x + 1 < 7$  is  $x < 2$ .
- B The solution of  $1 - 3x > 2 - x$  is  $x < -\frac{1}{2}$ .
- C The solution of  $3(x - 4) - x \leq 1 - 2x$  is  $x \leq 2.75$ .
- D The only integer values satisfying  $1 \leq x - 2 < 5$  are 3, 4, 5 and 6.

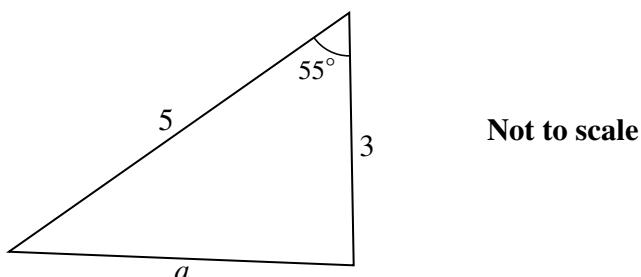
9 The graph shows part of the curve with equation  $y = x^3 - 3x + 4$ .



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

- A When  $x = -2$ ,  $y = 2$ .
- B The solution of  $x^3 - 3x + 4 = 0$  is approximately  $x = -2.2$ .
- C The solution of  $x^3 - 3x + 4 = 7$  is approximately  $x = 2.1$ .
- D The least value of  $k$  for which  $x^3 - 3x + 4 = k$  has 3 roots is approximately 6.

- 10 Aliya and Badra have been given the triangle shown in the diagram.



Aliya says that the value of  $a$ , correct to 1 decimal place, is 4.1.

Badra says that the area of the triangle is  $\frac{15 \sin 55^\circ}{2}$ .

Which **one** of the following statements is **true**?

- A** Aliya and Badra are both correct.
- B** Aliya is correct but Badra is incorrect.
- C** Badra is correct but Aliya is incorrect.
- D** Aliya and Badra are both incorrect.
- 11 At the beginning of February the manager of a shop increased all prices of items for sale by 10%. In March there was a sale in which she reduced all prices by 10%.

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

- A** An item priced at £8.00 in January was priced at £8.80 in February.
- B** An item priced at £8.80 in February was priced at £7.92 in the March sale.
- C** An item priced at £9.00 in the March sale had been priced at £10.00 in February.
- D** An item priced at £12.50 in January was priced at £12.50 in the March sale.

- 12 Damaris records the number of text messages she receives per day over a period of 50 days. She displays the results in the table as shown.

Number of text messages	Number of days
0	1
1	2
2	5
3	12
4	13
5	17
6 or more	0

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

- A The range is 5.
- B The mean number of text messages is 3.7.
- C The median number of text messages is 4.
- D The mode is a more appropriate average to use with these data than the median.
- 13 Amin is attempting to solve the equation  $x(x - 2) = 3(x + 2)$ .  
His working is shown in the four steps below but the final answer is incorrect.

In **which** of the following lines **A**, **B**, **C** or **D** does the **first** error appear?

- A  $x^2 - 2x = 3x + 6$
- B  $x^2 - 5x - 6 = 0$
- C  $(x - 3)(x - 2) = 0$
- D  $x = 2$  or  $x = 3$

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

- A The solution of  $\frac{10}{x} = 5$  is  $x = \frac{1}{2}$ .
- B The solution of  $2x - 8 = 8$  is  $x = 8$ .
- C The solution of  $4x + 3 = 17 - 3x$  is  $x = 2$ .
- D The solution of  $2(2x + 3) = 7$  is  $x = \frac{1}{4}$ .

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

- A  $\frac{3}{8} \times 2 = \frac{3}{4}$
- B  $\frac{2}{7} - \frac{1}{5} = \frac{1}{2}$
- C  $\frac{8}{13} \div 4 = \frac{2}{13}$
- D  $2\frac{3}{4} + \frac{1}{2} = 3\frac{1}{4}$

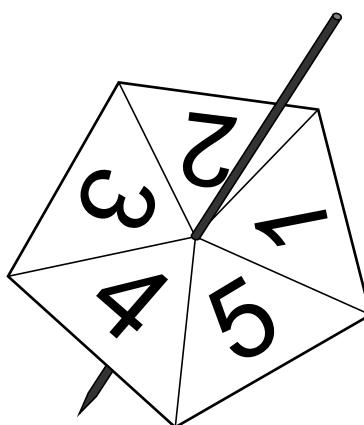
16 Three of the following statements are true and **one** is false. Which one is **false**?

- A  $x^2 + x + 5 = 0$  has no real roots.
- B The solution of  $x^2 - 5x + 6 = 0$  is  $x = 1$  or  $x = 6$ .
- C  $x^2 - 3x = 0$  has two real, distinct, roots.
- D The solution of  $x^2 + 6x - 7 = 0$  is  $x = -7$  or  $x = 1$ .

- 17 Three of the following values for  $x$  satisfy the equation  $x^3 - 27x = 0$  and **one** does not. Which one does **not**?

- A  $x = 0$   
 B  $x = 27$   
 C  $x = \sqrt{27}$   
 D  $x = -\sqrt{27}$

- 18 Paul spins a spinner which has five edges, numbered 1, 2, 3, 4 and 5, as shown. When it is spun it is equally likely to land on each of the 5 edges.



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

- A The probability of obtaining a 5 every time with three spins is 0.6.  
 B The probability of obtaining a 5 at least once with three spins is 0.488.  
 C The probability of obtaining no 5s with six spins is 0.262, correct to 3 significant figures.  
 D The probability of obtaining a 5 every time with six spins is  $6.4 \times 10^{-5}$ .

- 19 You are given that  $a = 8$  and  $b = 3$ , both correct to the nearest integer.

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

- A The value of  $ab$  cannot exceed 29.75.
- B The value of  $\frac{1}{a+b}$  cannot exceed 0.1.
- C The value of  $\frac{a}{b}$  cannot exceed 3.4.
- D The value of  $\frac{1}{a-b}$  is at least 0.25.
- 20 A small tin of baked beans contains 200 g of beans and costs 32 pence. A large tin contains 420 g and costs 52 pence.

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

- A If the tins are similar in shape then the large tin is 2.1 times taller than the small tin.
- B The value of the beans in the small tin is 6.25 g per penny.
- C The beans in the large tin cost 0.124 pence per gram, correct to 3 decimal places.
- D The large tin provides better value for money.
- 21 Gerry is carrying out a survey to find out which is the most popular pet. He chooses a sample from students at his college to obtain some data.

Which **one** of the following diagrams **cannot** be used to display the data?

- A Pictogram
- B Histogram
- C Bar chart
- D Pie chart

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

A  $4^5 \times 4^3 = 4^8$

B  $3^3 \times 5^3 = 15^3$

C  $6^0 \div 2^0 = 1$

D  $4^2 \div 5^2 = 0.8$

23 Three vectors are given by  $\mathbf{a} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$ ,  $\mathbf{b} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$  and  $\mathbf{c} = \begin{pmatrix} 7 \\ 7 \end{pmatrix}$ .

Two numbers,  $k$  and  $l$ , are such that  $k\mathbf{a} + l\mathbf{b} = \mathbf{c}$ .

Which **one** of the following gives the **correct** values for  $k$  and  $l$ ?

A  $k = 1, l = 3$

B  $k = 3, l = 2$

C  $k = 7, l = 0$

D  $k = 3, l = -2$

24 Catherine represents three numbers by  $x$ ,  $y$  and  $z$ . She adds the first two, then multiplies her answer by itself and finally multiplies her result by the third number.

Which **one** of the following is a **correct** algebraic expression for her final answer?

A  $(x + y)^2 z$

B  $[(x + y)z]^2$

C  $x^2 z + y^2 z$

D  $x^2 y^2 z$

- 25 The first four terms of a sequence are  $-7, -2, 3, 8$ .

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

- A The next two terms are 13 and 18.
- B The 20th term is 50 more than the 10th term.
- C The 15th term is 65.
- D The  $n$ th term is  $5n - 12$ .

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

- A  $P = mgh$  can be rearranged to give  $h = \frac{P}{mg}$ .
- B  $v = u + at$  can be rearranged to give  $a = \frac{v - u}{t}$ .
- C  $V = \pi r^2 h$  can be rearranged to give  $r = \pm \sqrt{\frac{V}{\pi h}}$ .
- D  $K = \frac{1}{2}mu^2$  can be rearranged to give  $u = \left(\frac{2K}{m}\right)^{\frac{1}{2}}$ .

- 27 Which **one** of the following is a **correct** simplification of  $\frac{2x-3}{5} - \frac{x-2}{3}$ ?

- A  $\frac{x-19}{15}$
- B  $\frac{x-5}{2}$
- C  $\frac{x-1}{2}$
- D  $\frac{x+1}{15}$

- 28 Jilly is carrying out a statistical investigation that involves recording the scores,  $x$ , of 20 students in an examination.

The scores are as follows.

176 156 144 135 179 175 164 145 158 136  
158 142 147 159 152 145 137 158 171 174

She asks four of her friends to group the scores. The four results are shown below, but only one of them is correct.

Which **one** is a **correct** table for these data?

A

$135 \leq x < 145$	$145 \leq x < 155$	$155 \leq x < 165$	$165 \leq x < 175$	$175 \leq x < 185$
3	6	6	2	3

B

$135 \leq x < 145$	$145 \leq x < 155$	$155 \leq x < 165$	$165 \leq x < 175$	$175 \leq x < 185$
4	5	6	2	3

C

$135 \leq x < 145$	$145 \leq x < 155$	$155 \leq x < 165$	$165 \leq x < 175$	$175 \leq x < 185$
5	4	6	2	3

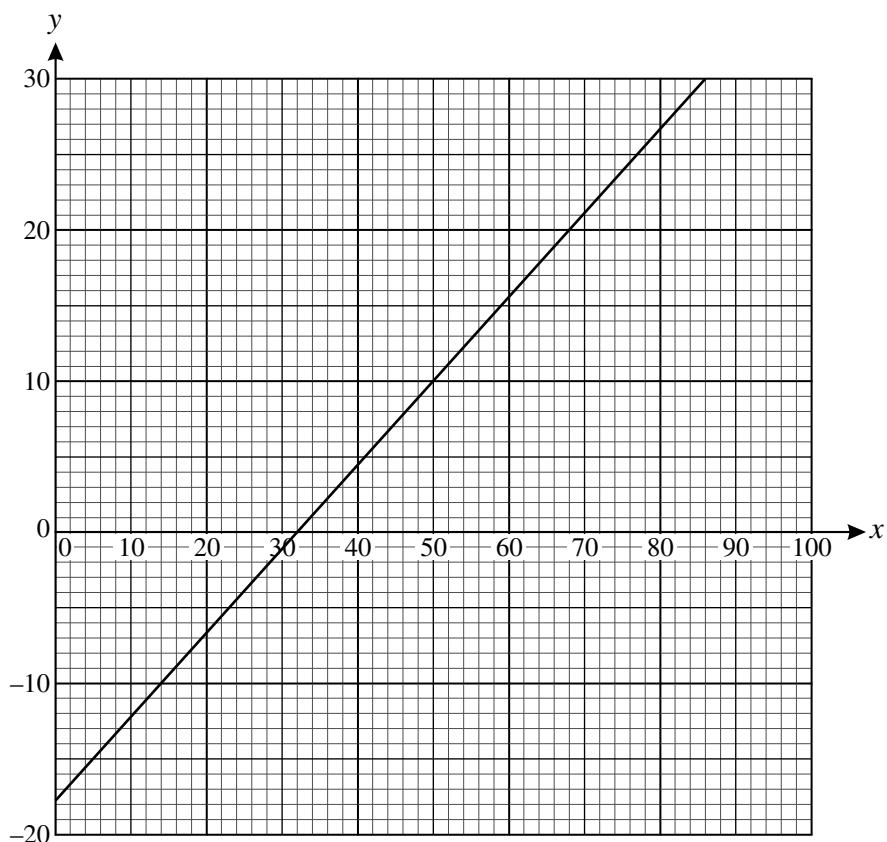
D

$135 \leq x < 145$	$145 \leq x < 155$	$155 \leq x < 165$	$165 \leq x < 175$	$175 \leq x < 185$
4	5	6	3	2

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

- A The sine of an angle is less than or equal to 1.
- B If  $x > 1$  then  $x^2 > 1$ .
- C If  $x < -1$  then  $x^2 < 1$ .
- D If  $0 < x < 1$  then  $x < \sqrt{x}$ .

30 The graph can be used to convert temperatures in degrees Fahrenheit ( $^{\circ}\text{F}$ ) to degrees Centigrade ( $^{\circ}\text{C}$ ). A temperature of  $x^{\circ}\text{F}$  corresponds to  $y^{\circ}\text{C}$ .



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

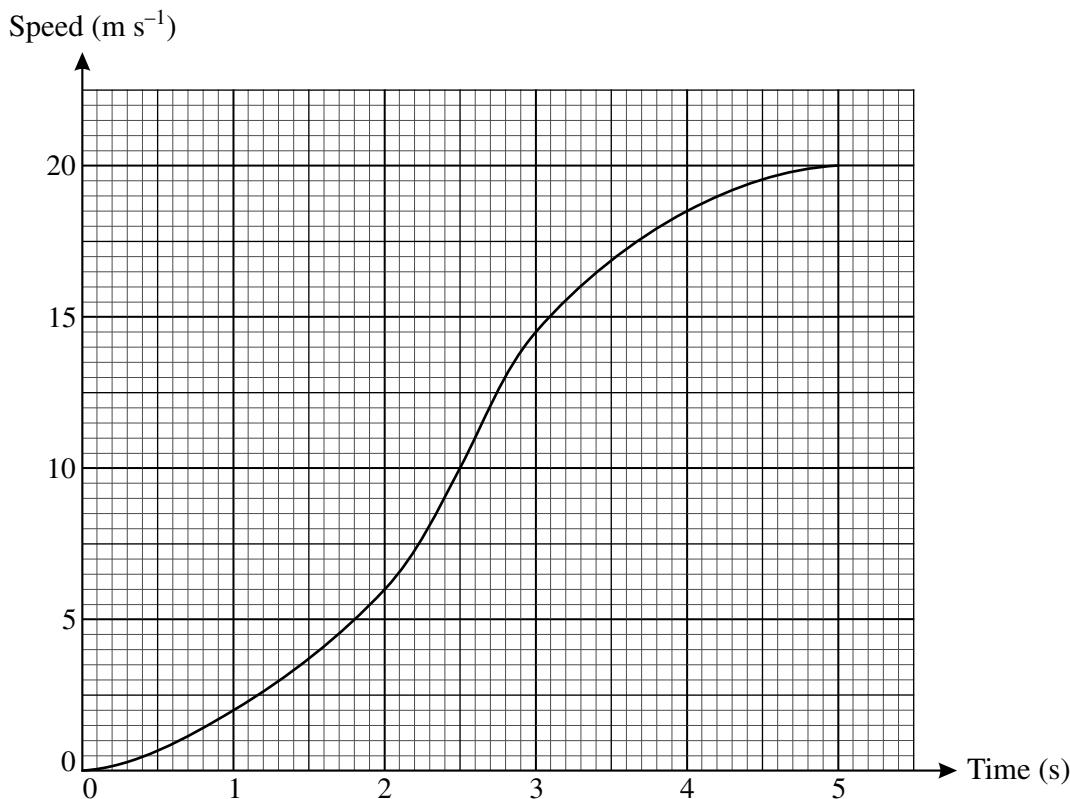
- A If  $x = 68$  then  $y = 20$ .
- B The gradient of the line is 1.8.
- C If  $x = 0$  then  $y$  is approximately  $-18$ .
- D The equation of the line can be written  $9y = 5x - 160$ .

- 31 Two unbiased dice, one red and one green, are used in a game. They are both thrown at the same time and the score is the sum of the numbers showing on the two dice.

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

- A There are 36 possible outcomes, all equally likely.
- B There are 4 possible outcomes that give a score of 9.
- C The probability that the score is 3 is the same as the probability that the score is 11.
- D The probability of a score of 6 is  $\frac{1}{6}$ .

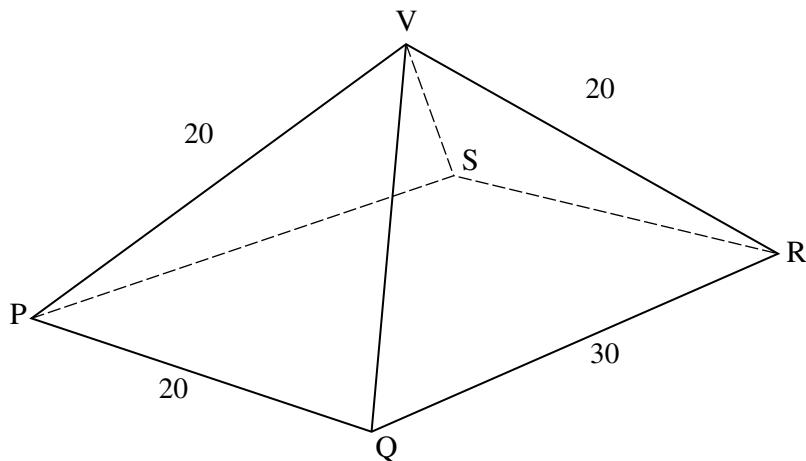
- 32 The graph shows the speed of a car moving from rest to a speed of  $20 \text{ m s}^{-1}$ .



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

- A In the first 5 seconds, the car moves approximately 50 metres.
- B The acceleration is greatest at 2.5 seconds.
- C At 1 second the acceleration is approximately  $3 \text{ m s}^{-2}$ .
- D The car is stationary after 5 seconds.

- 33 The diagram shows a pyramid PQRSV with a rectangular base PQRS.  $PQ = 20$  cm,  $QR = 30$  cm,  $VP = VQ = VR = VS = 20$  cm.

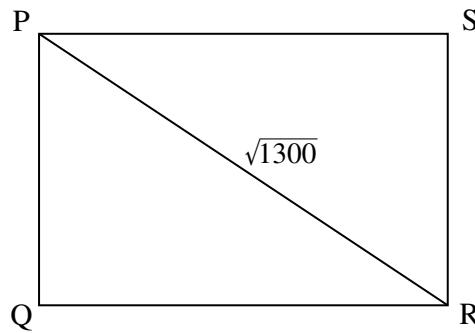


Imran makes four sketches of sections and faces of the pyramid. He labels these sketches **A**, **B**, **C** and **D**.

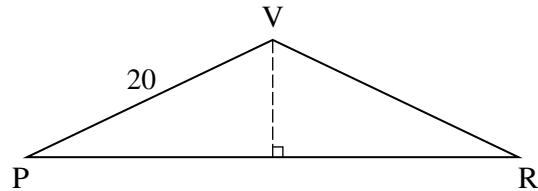
Three of the sketches contain correct information but one of the sketches contains an error.

Which **one** of the following sketches contains an **error**?

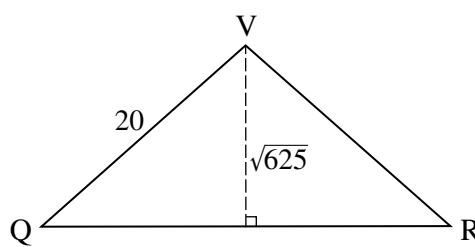
**A**



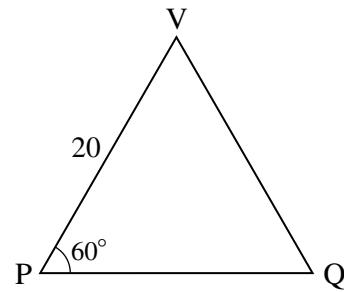
**B**



**C**



**D**



- 34 A company packs chocolates in two sizes of cubical boxes. The small boxes measure 5 cm by 5 cm by 5 cm and hold 8 chocolates when full. The large boxes measure 10 cm by 10 cm by 10 cm.

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

- A The volume of a small box is 125 cm<sup>3</sup>.
  - B A large box can hold 32 chocolates when full.
  - C If the company only sells chocolates in the small boxes then it is not possible to sell exactly 1310 chocolates.
  - D The surface area of a large box is 600 cm<sup>2</sup>.
- 35 When a pendulum of length  $l$  metres swings through a small angle, the time of the swing,  $T$  seconds, is given by the formula

$$T = 2\pi\sqrt{\frac{l}{g}}.$$

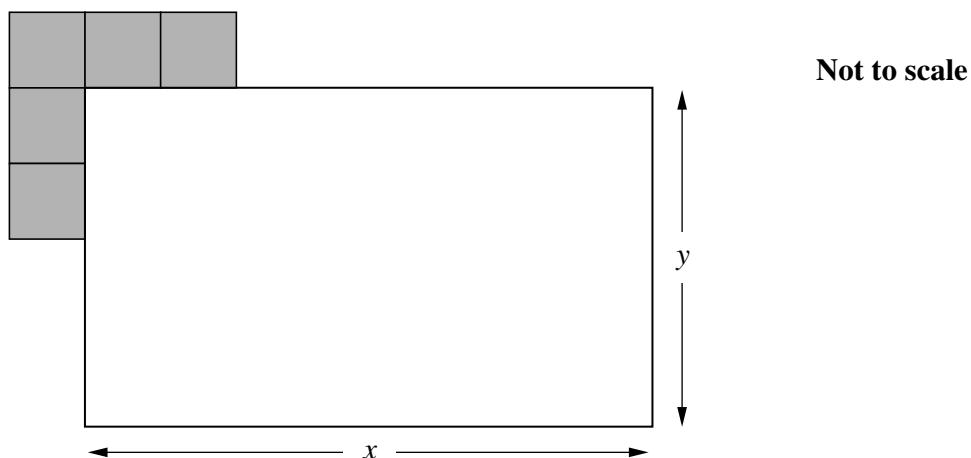
You are given that  $g = 9.8$  and that  $l = 0.8$ .

Which **one** of the following gives the **correct** value of  $T$ ?

- A 17.59, correct to 2 decimal places.
- B 1.8, correct to 1 decimal place.
- C 6, correct to 1 significant figure.
- D 0.57, correct to 2 significant figures.

- 36 A rectangular swimming pool is surrounded by square paving stones of side 1 metre. The pool measures  $x$  metres by  $y$  metres, where  $x$  and  $y$  are integers.

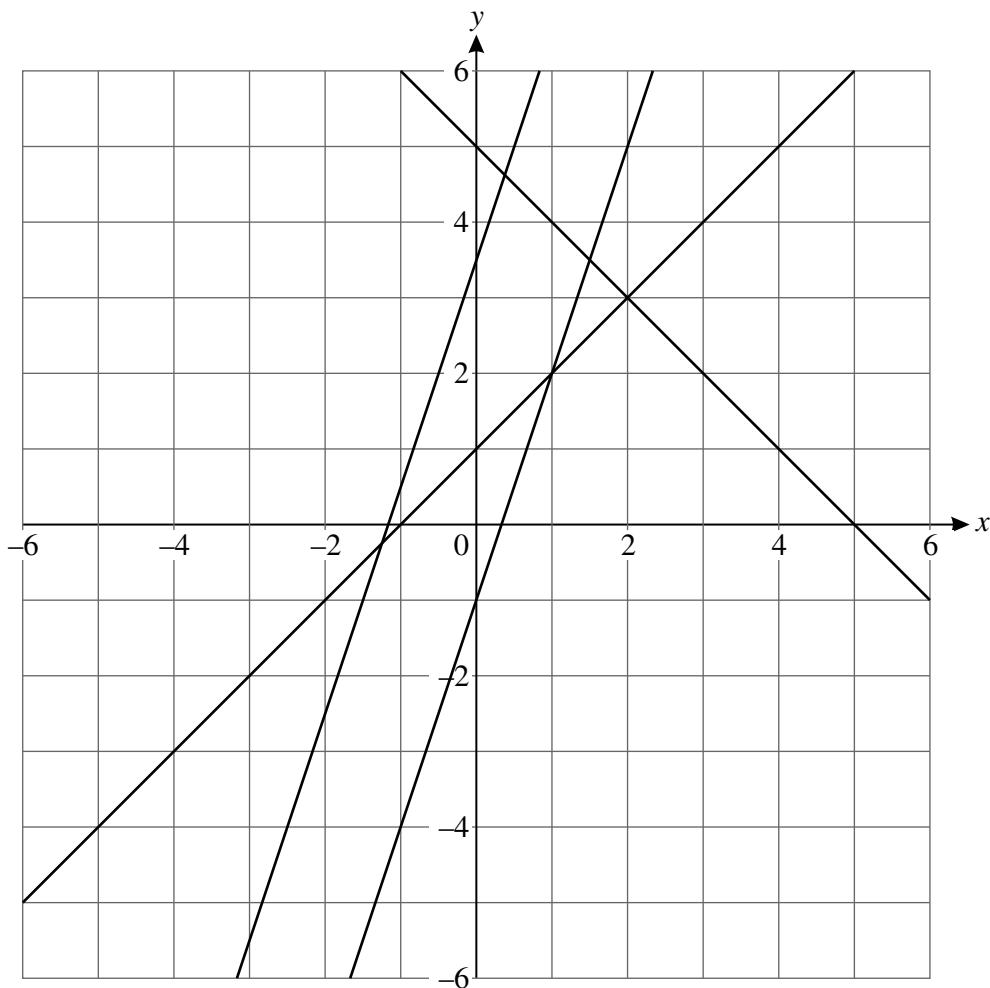
The diagram shows the paving stones at one corner.



Which **one** of the following gives the **correct** total number of paving stones?

- A**  $xy$
- B**  $2x + 2y$
- C**  $2x + 2y + 2$
- D**  $2(x + y + 2)$

- 37 The graph shows four straight lines with equations  $y = x + 1$ ,  $x + y = 5$ ,  $y = 3x - 1$  and  $2y = 6x + 7$ .

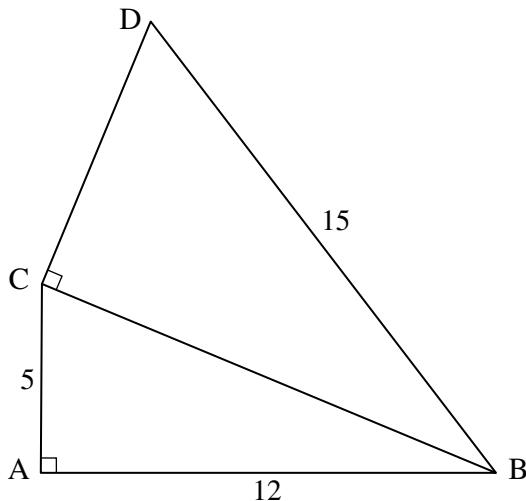


Three of the following statements are true and **one** is false. Which one is **false**?

- A The solution of the simultaneous equations  $y = 3x - 1$  and  $y = x + 1$  is  $(1, 2)$ .
- B The solution of the simultaneous equations  $2y = 6x + 7$  and  $x + y = 5$  is approximately  $(0.4, 4.7)$ .
- C There is no solution to the simultaneous equations  $y = 3x - 1$  and  $2y = 6x + 7$ .
- D The point where the line with equation  $2y = 6x + 7$  meets the  $y$ -axis can be found by solving the equation  $6x + 7 = 0$ .

20

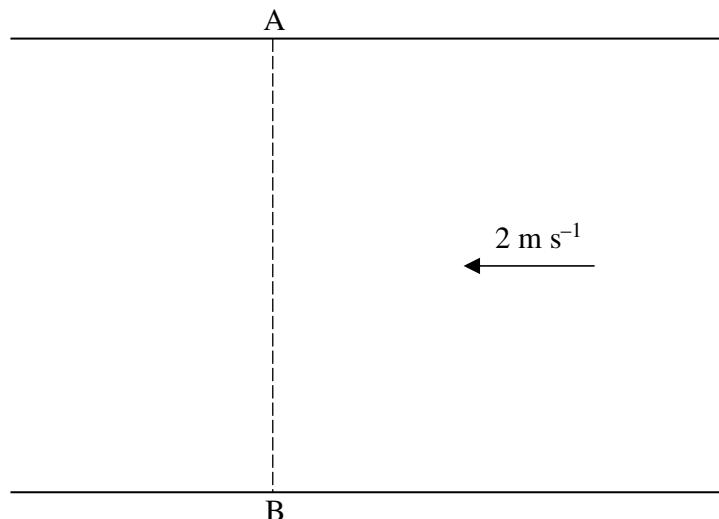
- 38 In the diagram,  $BAC$  and  $BCD$  are right-angled triangles.  $AC = 5\text{ cm}$ ,  $AB = 12\text{ cm}$  and  $BD = 15\text{ cm}$ .  
Angle  $BAC$  = Angle  $BCD$  =  $90^\circ$ .



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

- A  $CB = 13\text{ cm}$
- B Angle  $ABC = 22.6^\circ$ , correct to 1 decimal place.
- C Angle  $CBD = 28.1^\circ$ , correct to 1 decimal place.
- D  $CD = 7.5\text{ cm}$ , correct to 1 decimal place.

- 39 Gemma can paddle a canoe in still water at  $5 \text{ m s}^{-1}$ . One day she sets out to cross a wide river from A to B as shown in the diagram. B is due south of A. The river flows from East to West at  $2 \text{ m s}^{-1}$ .

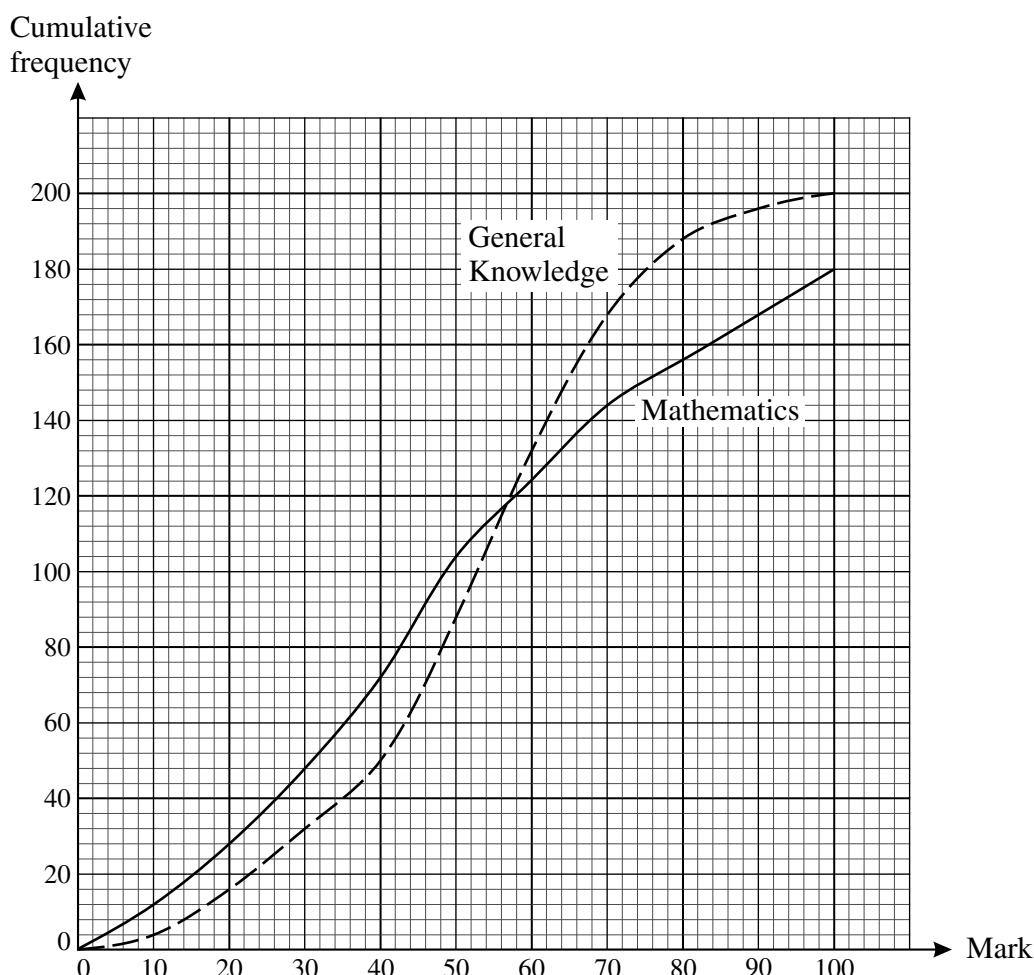


Three of the following statements are true and **one** is false. Which one is **false**?

- A If Gemma heads due south she will travel at  $68^\circ$  to the bank, correct to the nearest degree.
- B If Gemma heads due south then her speed will be  $5.4 \text{ m s}^{-1}$ , correct to 1 decimal place.
- C In order to cross directly to B, Gemma must head upstream at  $68^\circ$  to the bank, correct to the nearest degree.
- D If Gemma heads in a direction that will enable her to cross directly to B then she will be travelling at  $4.6 \text{ m s}^{-1}$ , correct to 1 decimal place.

[Question 40 is printed overleaf.]

- 40 The marks scored by students in a Mathematics test and a General Knowledge test are analysed. The cumulative frequency curves for each set of marks are shown below. The pass mark in each test was 60.



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

- A The total number of students in the General Knowledge test was greater than the total number of students in the Mathematics test.
- B More students passed the Mathematics test than the General Knowledge test.
- C The median mark for Mathematics test was less than the median mark for the General Knowledge test.
- D The interquartile range of marks for the General Knowledge test was about 25.





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