



Tuesday 10 June 2014 – Morning

FSMQ INTERMEDIATE LEVEL

6989/01 Foundations of Advanced Mathematics (MEI)

Candidates answer on the Answer Sheet.

OCR supplied materials:

- Answer Sheet (MS4)

Other materials required:

- Eraser
- Scientific calculator
- Soft pencil
- Ruler

Duration: 2 hours



INSTRUCTIONS TO CANDIDATES

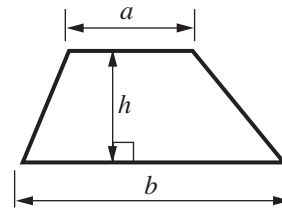
- Write your name clearly in capital letters, your centre number and candidate number on the Answer Sheet in the spaces provided unless this has already been done for you.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- There are **forty** questions 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

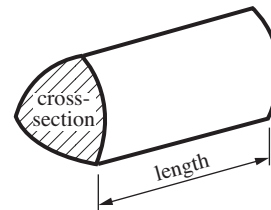
- Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
- This document consists of **24** pages. Any blank pages are indicated.

Formulae Sheet: 6989 Foundations of Advanced Mathematics

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



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

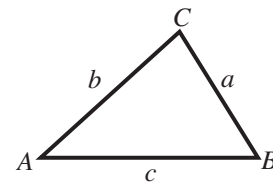


In any triangle ABC

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

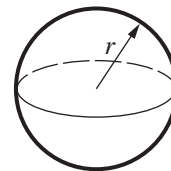
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

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



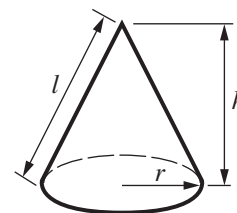
Volume of sphere $= \frac{4}{3}\pi r^3$

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



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

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 $2014 = 2 \times 19 \times 53$
- B The square root of 2014 lies between 44 and 45.
- C There are three prime numbers between 20 and 30.
- D The sum of two consecutive whole numbers is always odd.

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

- A $(-2)^3 = -8$
- B $8 - 2 \times 3 = 18$
- C $9 - 3 - 2 = 4$
- D $\frac{(-4)^2}{2 \times (-8)} = -1$

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

- A $72 \text{ km h}^{-1} = 20 \text{ m s}^{-1}$
- B 1 pint is approximately 1.75 litres.
- C 5 inches is approximately 125 mm.
- D The density of a solid can be measured in g cm^{-3} .

- 4 Mr Smith shares a lottery win of £9000 with his children, Charlie, David and Elsie, in the ratio of their ages which are 12, 10 and 8 respectively.

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

- A David receives one third of the money.
- B Charlie receives 40% of the money.
- C Elsie receives £1125.
- D Charlie receives £1200 more than Elsie.

- 5 Three brothers, Freddie, George and Harold, each receive a pay rise. Currently Freddie earns a salary of £25 000 and George earns £27 000.

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

- A A pay rise of 5% for Freddie increases his salary to £30 000.
- B A pay rise of 5% for George increases his salary by more than Freddie's increase.
- C A pay rise of 6% for Harold results in a new salary of £21 200. His current salary is £20 000.
- D A 6% pay rise is equivalent to an increase of $\frac{3}{50}$ of the original salary.

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

- A The n th term of the sequence 1, 3, 5, 7, ... is $2n - 1$.
- B The n th term of the sequence 17, 14, 11, 8, ... is $20 - 3n$.
- C The n th term of the sequence 2, 6, 18, 54, ... is 2×3^n .
- D The n th term of the sequence 1, 6, 13, 22, ... is $n^2 + 2n - 2$.

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

- A $\frac{12^2}{8^3} = \frac{3^2}{2^5}$
- B $\sqrt{5^6} = 5^3$
- C $4 \times 10^5 + 5 \times 10^6 = 4.5 \times 10^6$
- D $(3 \times 10^3) \div (6 \times 10^{-5}) = 5 \times 10^7$

8 A room in a house is 5 m long, 4 m wide and 2.5 m high.

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

- A The volume of the room is 50 m^3 .
- B The total surface area of the walls is 65 m^2 .
- C A carpet covering 80% of the floor has area 16 m^2 .
- D A wardrobe with dimensions 120 cm by 80 cm by 250 cm takes up less than 5% of the total volume.

- 9 Boxes are to be stored on a shelf. Each box has width 8 cm, correct to the nearest cm, and the shelf is 150 cm long, correct to the nearest cm.

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

- A The width of each box does not exceed 8.5 cm.
- B The shelf is at least 149.5 cm long.
- C It is possible that 20 boxes will fit onto the shelf.
- D 18 boxes will definitely fit on the shelf.

- 10 Abie and Broney are adding fractions.

Abie claims that $\frac{1}{4} + \frac{2}{7} = \frac{3}{11}$.

Broney claims that $\frac{1}{3} + \frac{2}{5} = \frac{11}{15}$.

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

- A Abie and Broney are both correct.
- B Abie is correct and Broney is incorrect.
- C Abie is incorrect and Broney is correct.
- D Abie and Broney are both incorrect.

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

- A $\frac{3.5}{4.6} = 0.8$, correct to 1 significant figure.
- B $\frac{3}{17} = 0.176$, correct to 3 decimal places.
- C $\sqrt{52.1} = 7$, correct to the nearest integer.
- D $53 \times 453 = 20\,000$, correct to the nearest thousand.

12 Which **one** of the following is likely to be **true**?

- A The average height of a group of Year 12 students is 2.7 metres.
- B A bottle of wine holds a little under 1 litre.
- C An orange has a mass of about 1.5 kg.
- D Manchester averages around 2 cm of rainfall in a year.

13 Three of the following quadratic equations have two real roots and **one** does not. Which one does **not**?

- A $x^2 = 8$
- B $x^2 - 4 = 0$
- C $x^2 - 5x + 6 = 0$
- D $x^2 - 5x + 7 = 0$

- 14 A rectangle has perimeter 6 m and the length of one of its sides is x m.

Which **one** of the following is a **correct** formula for the area, $A \text{ m}^2$, of the rectangle?

A $A = x(3 - x)$

B $A = 3x^2$

C $A = 6x - x^2$

D $A = 6x^2$

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

A $3(x + 2y) - 2(x - y) = x + 8y$

B In the expression $2x^3 - 4x^2 + x + 7$ the coefficient of x^2 is 4.

C The expression $(x + 1)(2 - x)$ is a quadratic expression.

D In the expression $x^2 + 3x$ there is no constant term.

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

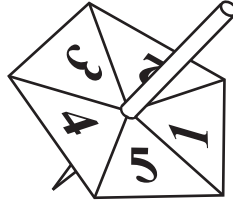
A $(x - 3)(x + 2) = x^2 - x - 6$

B $3(x - 2)^2 = 3x^2 - 12x + 12$

C $(x - 3)(x - 2) = x^2 - 5x - 6$

D $(x + 1)(x - 2) = x^2 - x - 2$

- 17 A spinner consists of a regular pentagon made of card and a spindle, as shown in the diagram. The sides of the pentagon are numbered 1 to 5. The result of a spin is the number on the side in contact with the table when the spinner comes to rest. The five possible results are equally likely to occur.



The spinner is spun twice and the numbers noted.

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

- A The probability of obtaining the same number on both spins is $\frac{1}{5}$.
- B The probability of obtaining exactly one 4 is $\frac{8}{25}$.
- C The probability that the two numbers add up to 4 is $\frac{3}{25}$.
- D The probability that the two numbers differ by 4 is $\frac{1}{5}$.

- 18 Paul claims that $f(n) = n^2 + n + 41$ is prime for all values of n .
John says that substituting $n = 41$ shows that $f(41)$ is not prime.

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

- A $f(1) = 43$ which is prime.
- B $f(2) = 47$ which is prime.
- C $f(3)$ is prime.
- D John is incorrect.

- 19 Which **one** of the following is the **correct** solution to the equation $2x^2 - 6x = 3$?

- A $x = \frac{3 \pm \sqrt{3}}{2}$
- B $x = \frac{3 \pm \sqrt{15}}{2}$
- C $x = \frac{-3 \pm \sqrt{3}}{2}$
- D $x = \frac{-3 \pm \sqrt{15}}{2}$

- 20 When the expressions in **A**, **B**, **C** and **D** are factorised, three of them have a factor in common but **one** does not. Which one does **not** have this common factor?

- A $x^2 - 2x - 3$
- B $x^2 - 4x + 3$
- C $x^2 + 4x - 5$
- D $x^2 - 1$

21 Which **one** of the following is the **correct** simplification of $\frac{3x+2}{4} - \frac{2x-3}{5}$?

- A $\frac{7x-2}{20}$
- B $\frac{7x+22}{20}$
- C $\frac{x-1}{20}$
- D $\frac{x+5}{20}$

22 Michael is attempting to solve the following simultaneous equations.

$$\begin{aligned}x + 6y &= 31 & \text{(i)} \\ 3x - 2y &= 13 & \text{(ii)}\end{aligned}$$

His working is shown in the four steps below, but his final answer is incorrect.

In which of the following steps **A**, **B**, **C** or **D** does his **first** error occur?

A Multiply (ii) by 3 to give

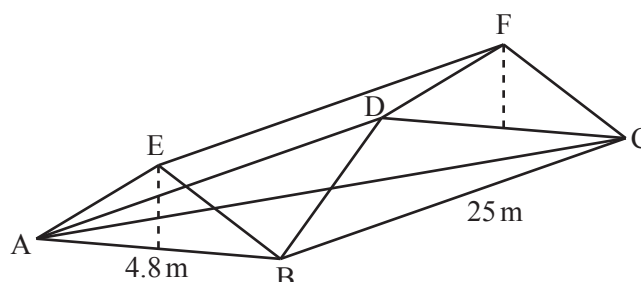
$$\begin{aligned}x + 6y &= 31 & \text{(i)} \\ 9x - 6y &= 39 & \text{(iii)}\end{aligned}$$

B Subtract (i) from (iii) to give $8x = 8$ and so $x = 1$.

C Substitute this value of x into (i) to give $1 + 6y = 31$.

D Solve this equation to give $6y = 30$ and so $y = 5$ giving the answer $x = 1$, $y = 5$.

- 23 A cover for a cricket pitch is constructed from lengths of wood and is as shown in the diagram. The horizontal rectangular base ABCD measures 4.8 m by 25 m. Each end is a vertical isosceles triangle ABE and DCF of height 1 m. The structure includes lengths of wood EF and diagonals AC and BD. The rectangular faces EBCF and AEFD are covered with canvas to protect the pitch from rain.



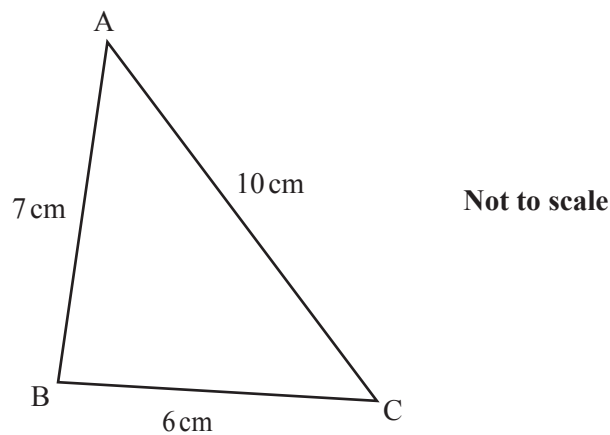
Three of the following statements are true and **one** is false. Which one is **false**?

- A $EB = 260 \text{ cm}$
- B The canvas that covers both faces AEFD and BEFC has an area of 13 m^2 .
- C The distance $AC = 25.5 \text{ m}$, correct to 1 decimal place.
- D Angle $ABE = 22.6^\circ$, correct to 1 decimal place.

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

- A $\theta = 240^\circ$ is a root of the equation $\cos \theta = -0.5$.
- B $\sin 153^\circ = -\sin 207^\circ$
- C For $0^\circ \leq \theta \leq 360^\circ$, $-1 \leq \tan \theta \leq 1$.
- D A value of θ for which $\sin \theta = \cos \theta$ is $\theta = 45^\circ$.

- 25 In the triangle shown, $AB = 7\text{ cm}$, $BC = 6\text{ cm}$ and $CA = 10\text{ cm}$.



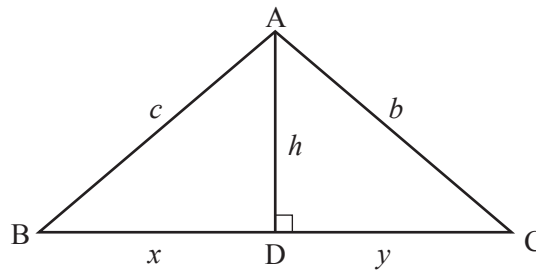
Which **one** of the following is the **correct** value for angle A?

- A 36.2° , correct to 1 decimal place.
 - B 36.9° , correct to 1 decimal place.
 - C 40.6° , correct to 1 decimal place.
 - D 45.6° , correct to 1 decimal place.
- 26 You are given the vectors $\mathbf{a} = 3\mathbf{i} + 4\mathbf{j}$, $\mathbf{b} = -2\mathbf{i} + \mathbf{j}$ and $\mathbf{c} = -4\mathbf{i} + 2\mathbf{j}$.

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

- A The vector \mathbf{a} has magnitude 5.
- B The vectors \mathbf{b} and \mathbf{c} have the same direction.
- C The angle between vectors \mathbf{b} and \mathbf{i} is approximately 153.4° .
- D $\mathbf{a} + 4\mathbf{b} = 11\mathbf{i}$

27 Look at the following diagram.



BDC is a straight line and AD is perpendicular to BC.

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

- A $\tan ABD = \frac{x}{h}$
- B $\text{Area } ABC = \frac{1}{2}h(x+y)$
- C $c^2 - x^2 = b^2 - y^2$
- D $\frac{\sin B}{b} = \frac{\sin C}{c}$

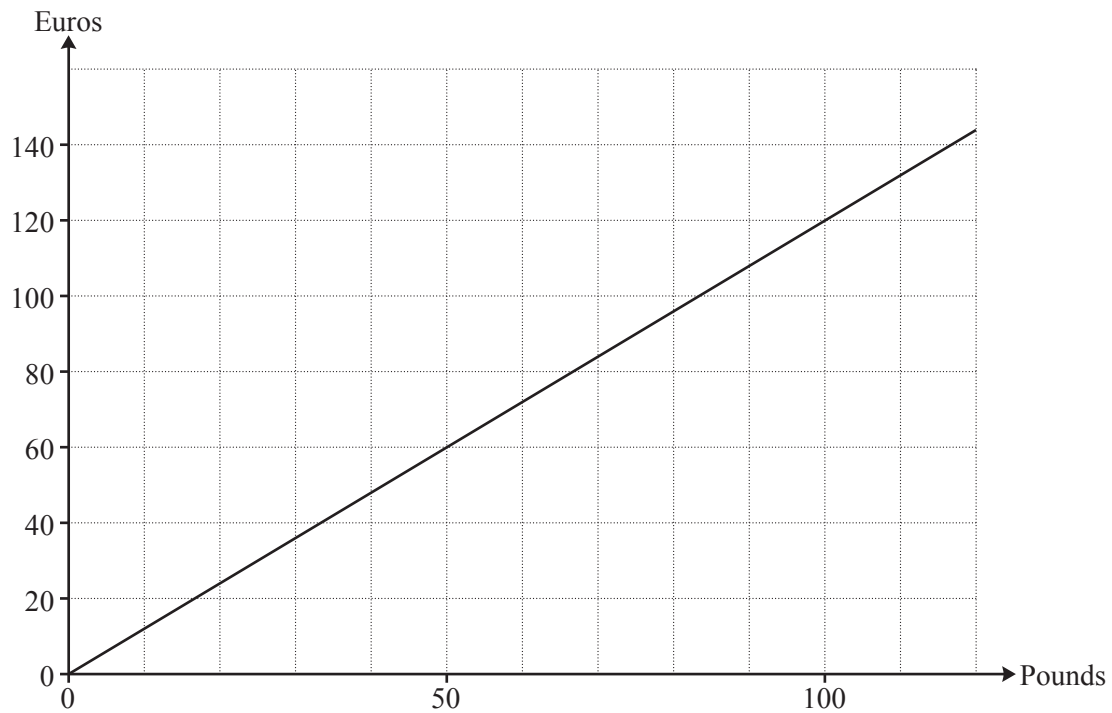
28 Here are three statements about equations and inequalities.

- The solution of the equation $3x - 4 = 5$ is $x = 3$.
- The solution of the equation $\frac{3}{2x} - 1 = 2$ is $x = \frac{1}{2}$.
- The solution of the inequality $2x - 1 < 3 - 2(2x - 1)$ is $x < \frac{1}{6}$.

How **many** of the solutions are **correct**?

- A 0
- B 1
- C 2
- D 3

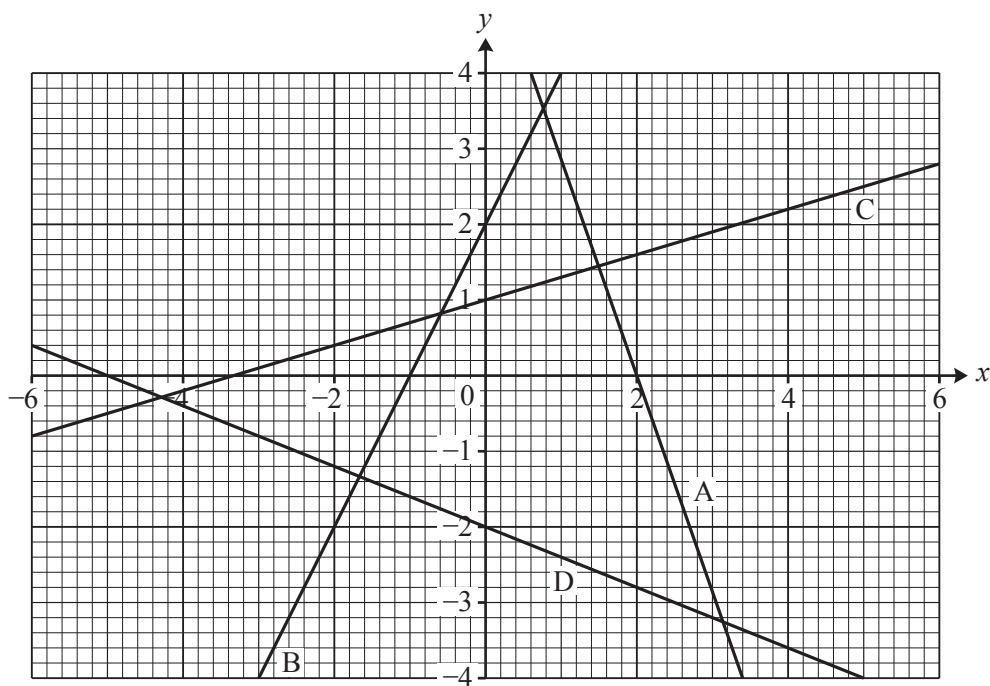
- 29 The graph below represents the conversion between pounds and euros one day.



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

- A £1 is worth approximately €1.20.
- B €100 is worth a little more than £80.
- C £70 is roughly equivalent to €84.
- D On a later occasion I received €130 for £100. The conversion graph for this exchange rate would be less steep than that drawn above.

30 Look at the graphs of four equations below.

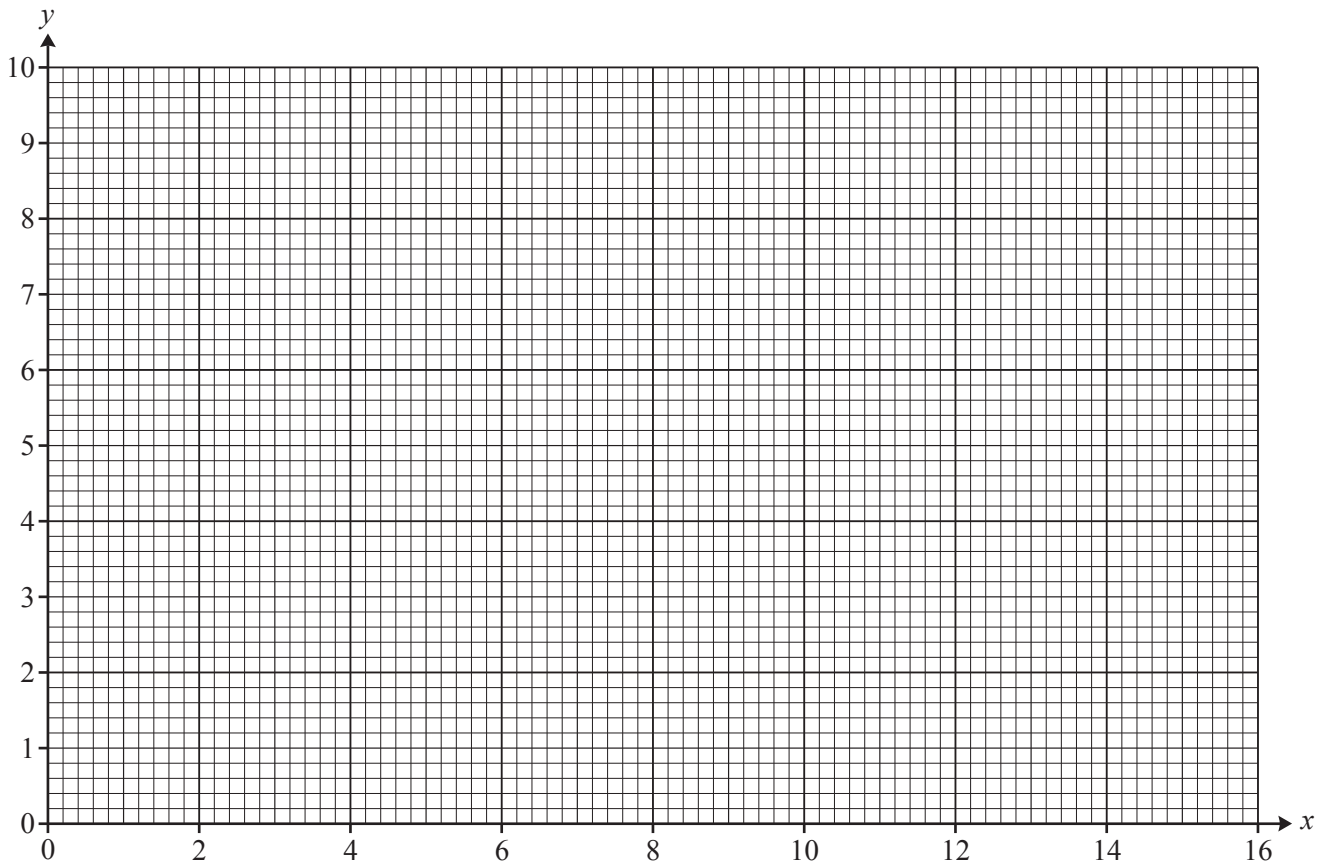


Three of the following statements about the graphs are true and **one** is false. Which one is **false**?

- A The gradient of line A is 3.
- B For line B, when $x = -2$, $y = -2$.
- C When the equation for line C is written in the form $y = mx + c$ the value of c is 1.
- D The line $5y + 2x = 7$, if drawn on the diagram, would be parallel to the line D.

31 This question is about the curve $y = \frac{10}{x}$.

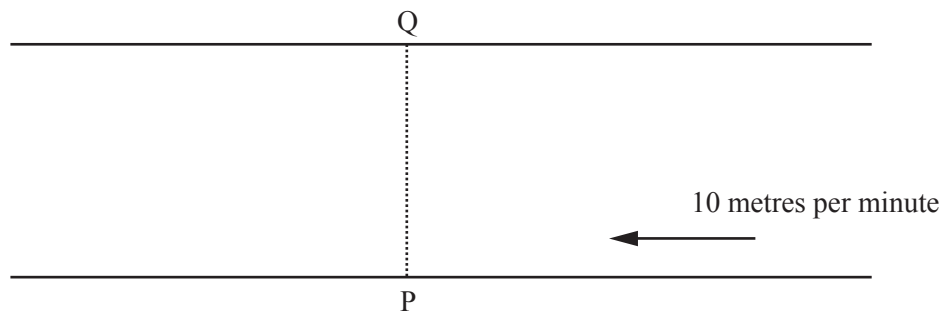
In order to complete this question you are advised to draw the graph of $y = \frac{10}{x}$ on the grid below.



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

- A The graph never meets the x -axis whatever the value of x .
- B When $x = 2.5$, $y = 4$.
- C At the point $(2, 5)$ the gradient of the curve is between -2 and -3 .
- D The area between the curve, the x -axis and the lines $x = 1$ and $x = 3$ is between 7 and 9.

- 32 John can swim in still water at 30 metres per minute. He sets out to swim across a river which is 45 m wide. The current is 10 metres per minute.



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

- A If John heads across the river at 90° to the banks, starting at P, he will arrive at the opposite bank 15 m downstream from Q.
 - B If John heads across the river at 90° to the banks, starting at P, he will take 1.5 minutes to swim across the river.
 - C If John heads across the river at 90° to the banks, starting at P, the angle at which he will swim is 70.5° to the bank, correct to 1 decimal place.
 - D If John wishes to arrive on the other bank at Q, directly opposite his starting point, P, then he will have to head upstream at an angle of 70.5° to the bank, correct to 1 decimal place.
- 33 Emily and Fred are rearranging equations.

Emily says that $V = \frac{4}{3}\pi r^3$ can be rearranged to $r = \sqrt[3]{\frac{3V}{4\pi}}$.

Fred says that $S = 2\pi r^2 + 2\pi rh$ can be rearranged to give $h = \frac{S}{2\pi r} - r$.

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

- A Emily and Fred are both correct.
- B Emily is incorrect, but Fred is correct.
- C Emily is correct, but Fred is incorrect.
- D Emily and Fred are both incorrect.

- 34 Dan is investigating the number of people who are in cars travelling towards the centre of his town. He records the numbers as follows.

1 1 3 2 1 1 1 4 2 1 1 1 1 2 3 1 2 4 1 1 1 2 2 2 1 2 1 3 1 2

In order to answer this question you are advised to complete the table below.

Number of people in each car	Tally	Frequency
1		
2		
3		
4		
More than 4		

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

- A The number of cars in Dan's investigation is 30.
- B The mode is 1.
- C The median is 2.5.
- D The mean is 1.7.
- 35 Maddie is paid £ P per hour up to a maximum of 40 hours per week. If she works more than 40 hours in a week she is paid £ $(P+x)$ per hour for each extra hour. In one week she works for h hours ($h > 40$) and earns £ S .

Which **one** of the following is a **correct** formula for S ?

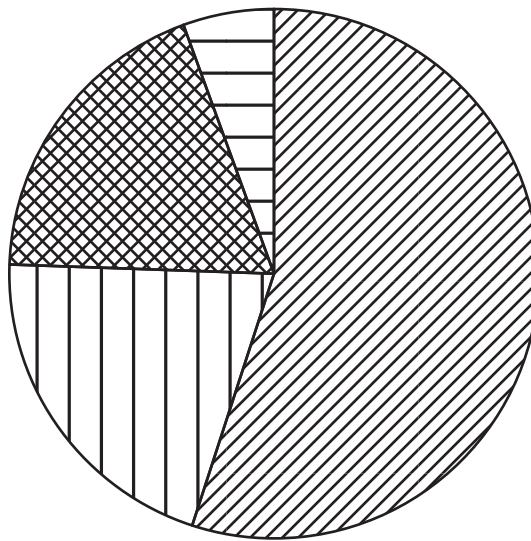
- A $S = 40P + (h - 40)(P + x)$
- B $S = hP + (h - 40)(P + x)$
- C $S = (P + x)h - 40P$
- D $S = (P + x)h - 40h$

- 36 The manager of a gym has divided the membership into 4 groups.

The numbers in each group are shown in the table.

	Men	Women
Over 25	220	82
25 and under	76	22

The pie chart represents these data.



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

- A There are 400 members of the gym.
- B $\frac{41}{200}$ of the membership are women.
- C The smallest angle in the pie chart is one tenth of the largest angle.
- D The angle of the sector representing men over 25 is 198° .

- 37 A year group in a school consists of 75 students. They are split into sets P, Q and R for Mathematics. Each set has 25 students.

2 students are selected at random from the year group.

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

- A The probability that the first student is not in set P is $\frac{2}{3}$.
- B The probability that both students are in set R is $\frac{1}{9}$.
- C The probability that one student is from set P and the other is from set Q is $\frac{25}{111}$.
- D The probability that both students are in the same set is $\frac{12}{37}$.

- 38 Two large groups of students take a test which is marked out of 100. Both groups contain the same number of students. The results are summarised in the table below.

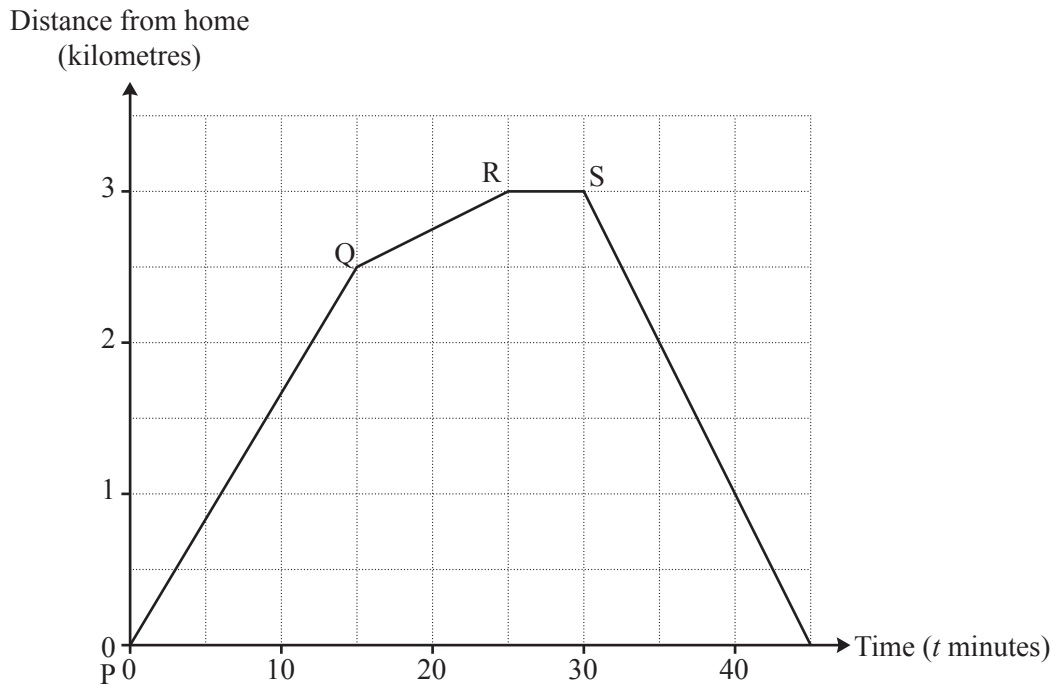
	Lowest mark	Lower quartile	Median	Upper quartile	Highest mark
Group A	10	31	42	57	87
Group B	5	22	35	50	80

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

- A The range of group A is greater than that of group B.
- B The interquartile range of Group B is greater than that of group A.
- C 50% of students in Group B scored 50 or more.
- D If the pass mark is set at 42 then at least 50% from group B would fail.

- 39 James cycles on a straight road from his house to a shop, which is a distance of 3 km. After shopping he rides home.

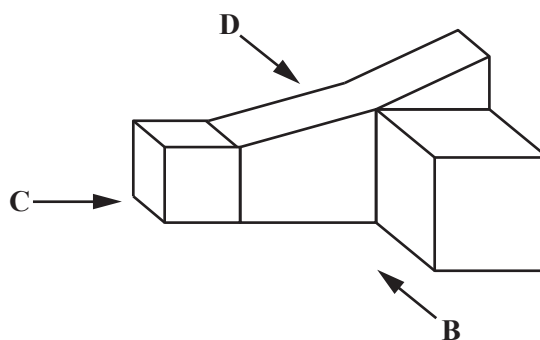
The distance-time graph below shows the distance that James is from home t minutes after leaving.



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

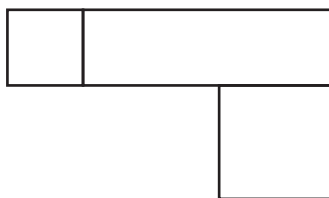
- A The line RS indicates that James was stationary between the times $t = 25$ and $t = 30$.
- B On his ride to the shop, James was slower over the last half a kilometre.
- C The fastest speed is indicated by the line PQ.
- D The average speed was 8 kilometres per hour.

- 40 The diagram illustrates a set of 3 attached farm buildings.

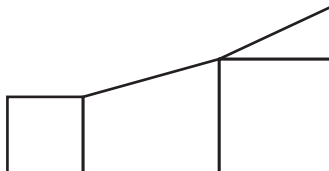


Three of the following diagrams are correct and **one** is incorrect. Which one is **incorrect**?

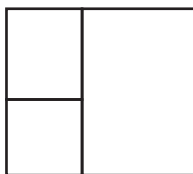
- A This is the plan.



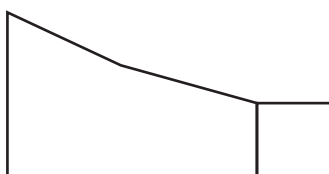
- B This is the side view from B.



- C This is the side view from C.



- D This is the side view from D.



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