OCR

Thursday 15 January 2015 – Afternoon

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

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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.
* 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.**
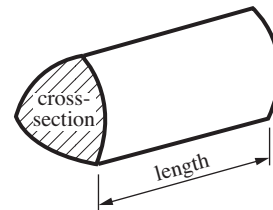
INFORMATION FOR CANDIDATES

* Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
* This document consists of **28** pages. Any blank pages are indicated.

OCR is an exempt Charity

Turn over

Formulae Sheet: 6989 Foundations of Advanced Mathematics

Area of trapezium $= \frac{1}{2}(a+b)h$
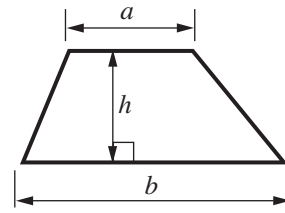
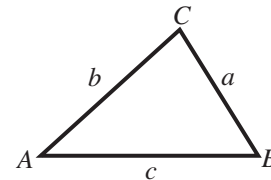**Volume of prism** = (area of cross-section) × length

In any triangle *ABC*

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

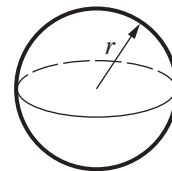**Cosine rule** $\quad a^2 = b^2 + c^2 - 2bc\cos A$
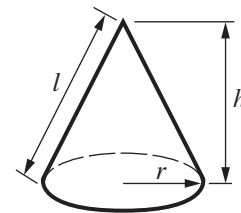
Area of triangle $= \frac{1}{2}ab\sin C$

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   88% is equivalent to $\frac{22}{25}$.

   B $\frac{3}{7}$ of 154 is 66.

   C $\frac{4}{5}$ is smaller than $\frac{7}{9}$.

   D   125% of 780 is 975.

2   The table shows the number of goals scored in 26 matches in a local league on one Sunday morning.

Goals scored	Frequency
0	0
1	6
2	7
3	6
4	5
5	2

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

   A   The mode was 2 goals.

   B   A match is chosen at random. The probability of choosing a match where 4 goals were scored is $\frac{2}{13}$.

   C   The median score was 2.5 goals.

   D   The mean score was 2.6 goals, correct to 1 decimal place.

3 You are given the formula $p = \dfrac{q^r}{s}$.

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

A $p = 2$ when $q = -2$, $r = 3$ and $s = 4$.

B $p = 1$ when $q = \dfrac{1}{2}$, $r = 2$ and $s = \dfrac{1}{4}$.

C $p = -3$ when $q = 9$, $r = \dfrac{1}{2}$ and $s = -1$.

D $p = \dfrac{1}{9}$ when $q = 6$, $r = -2$ and $s = \dfrac{1}{4}$.

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

A $\dfrac{2}{5} \div \dfrac{4}{15} = \dfrac{3}{2}$

B $-4 - (-2) = -6$

C $2\dfrac{1}{2} - 1\dfrac{3}{7} = 1\dfrac{1}{14}$
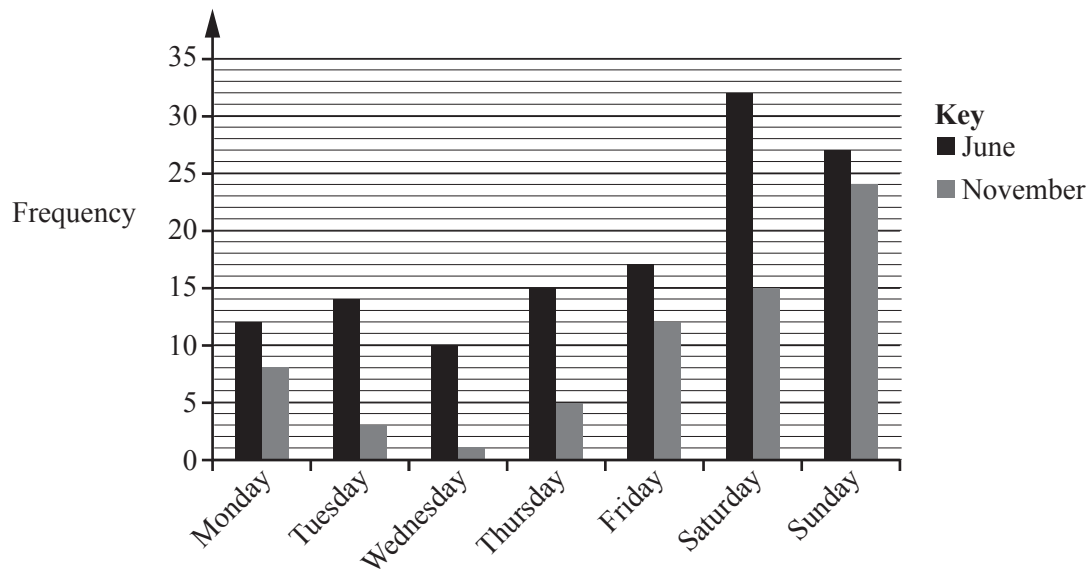
D $3 + 5 \times 2 - 1 = 12$

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

   A A circle of radius 1 cm has an area of π cm^2.

   B A rectangle with a perimeter of 24 cm could have an area of 27 cm^2.

   C A circle of diameter 10 cm has a circumference of 5π cm.

   D A triangle of base 8 cm and height 6 cm has area 24 cm^2.

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

   A The solution of $4x - 8 = 7x + 4$ is $x = -4$.

   B The solution of $\dfrac{x-2}{5} = 3$ is $x = 13$.

   C $3(x+4) - (2x-3) = x + 15$

   D $4x^2 + 6x = 2x(2x+3)$

 Turn over

7 The chart below shows the numbers of tennis players attending a tennis club during one week in June and one week in November.

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

A The attendance during the week in November was 73.

B The attendance on Monday in November was more than 50% of Monday in June.

C During both weeks the lowest attendance was on Wednesday.

D The difference in daily attendance between the two weeks was greatest on Saturday.

8 Here is a list of numbers.

$$8 \qquad 13 \qquad 27 \qquad 64 \qquad 71 \qquad 169 \qquad 36 \qquad 22$$

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

A Exactly two numbers in the list are the square roots of other numbers in the list.

B There are exactly three cube numbers in the list.

C Exactly three numbers in the list are integer powers of 2.

D There are exactly two prime numbers in the list.

9 Two formulae have been rearranged.

X $\quad s = ut + \dfrac{1}{2}at^2$ has been re-arranged to give $\quad a = \dfrac{2(s+ut)}{t^2}$.

Y $\quad A = \pi r^2 + 2\pi rh$ has been re-arranged to give $\quad h = \dfrac{1}{2}\left(\dfrac{A}{2\pi} - r\right)$.

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

A X is incorrect and Y is correct.

B Both X and Y are incorrect.

C X is correct and Y is incorrect.

D Both X and Y are correct.

10 Bronze is a metal alloy composed of 88% copper and 12% tin.

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

A The ratio of copper : tin is 22 : 3.

B A bronze statue of mass 400 kg contains 352 kg of copper and 48 kg of tin.

C The fraction of tin in bronze is $\frac{3}{22}$.

D If there is plenty of copper but only 33 kg of tin, the largest bronze statue that can be made will have a mass of 275 kg.

11 An electrical shop reduces all of its prices by 30% in a sale.

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

A The price of a dishwasher is £384.99 in the sale. Its original price was £549.99.

B A television costing £299 before the sale costs £209.30 in the sale.

C To calculate the sale price of an item in the sale, the shop owner should divide the original price by 1.3.

D To work out the original price from the sale price, the sale price should be divided by 0.7.

12 Sally and Jamie are baking some cakes. Sally bakes x cakes and puts n cherries on each cake. Jamie bakes y cakes and puts m cherries on each cake.

Which **one** of the following formulae to calculate the total number of cherries (T) needed is **correct**?

A $T = (x+y)(m+n)$

B $T = xm + yn$

C $T = xn + ym$

D $T = xy + mn$

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

A   The point with coordinates (2, 3) lies on the line $y = 2x - 1$.

B   The gradient of the line $2x - 3y + 1 = 0$ is 2.

C   The intercept on the y-axis of the line $3y - x = 4$ is $\frac{4}{3}$.

D   The line $y = 4x - 3$ crosses the line $y = 9 - 2x$ at the point (2, 5).

14 Gemma is carrying out a probability experiment. She rolls a die 60 times. The table below shows her results.

Number on the die	Frequency
1	12
2	9
3	17
4	2
5	8
6	12
Total	60

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

A On a pie chart the sector representing the number 1 will have an angle of 72°.

B The die may be biased.

C Based on the results of the experiment, the estimated probability of **not** rolling an even number is $\frac{37}{60}$.

D Based on the results of the experiment, the estimated probability of rolling a number greater than 4 is $\frac{11}{30}$.

15 You are given that $p = 5 \times 10^7$, $q = 8 \times 10^{-5}$, $r = 4.2 \times 10^9$.

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

A $\dfrac{p}{q} = 62.5$

B $p + r = 4.25 \times 10^9$

C $qr = 3.36 \times 10^5$

D $\dfrac{r}{pq} = 1\,050\,000$

16 Three of the following involve sensible units of measurement and **one** does not. Which one does **not**?

A The mass of a family saloon car is measured in tonnes.

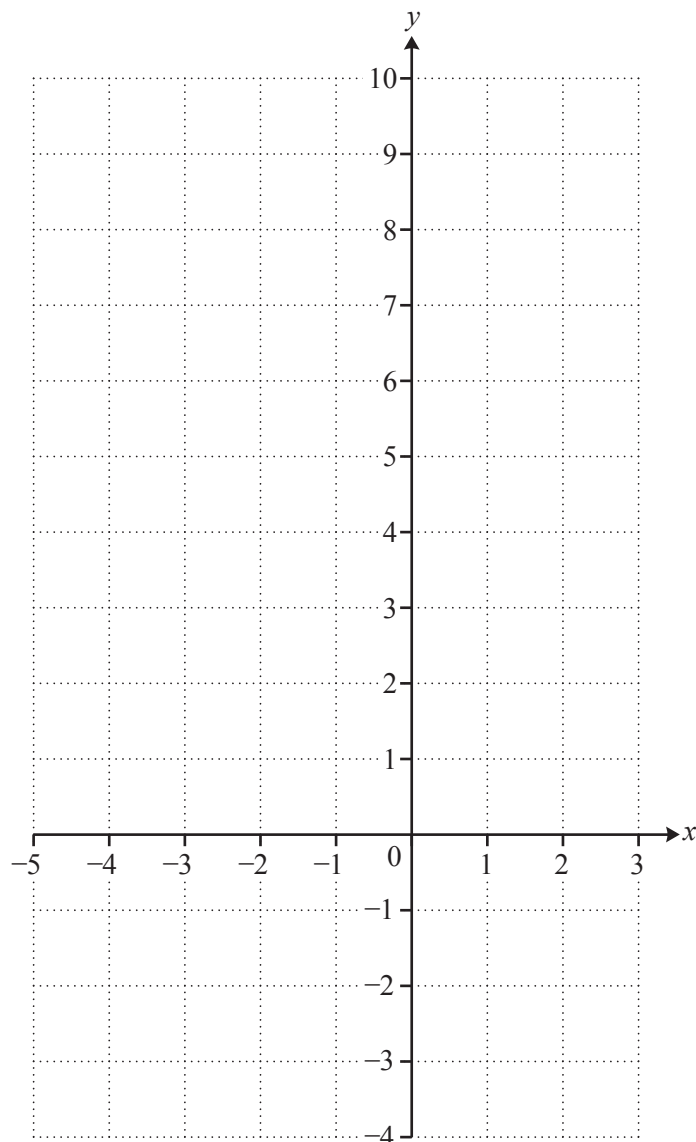**B** The dimensions of a full-size football pitch are measured in yards.

C The capacity of a can of a fizzy drink is measured in gallons.

D The diameter of a one penny piece is measured in millimetres.

17 The equation of a curve is $y = (x-1)(x+3)$.

In order to answer this question you are advised to complete the table and draw the curve on the grid below.

x	-4	-3	-2	-1	0	1	2
y	5			-4			

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

A The curve crosses the y-axis at $(0, -3)$.

B $x = -1$ is the line of symmetry of the curve.

C The gradient of the curve is positive where $x = -2$.

D The area enclosed by the curve and the x-axis is between 10 and 12 square units.

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

A The solution of $-6 < 2x < 5$ is $-3 < x < \dfrac{5}{2}$.

B The solution of $x + 3 < 4x$ is $x > 1$.

C The solution of $5 - 3x < -10$ is $x < 5$.

D The solution of $5 < 2x + 3 < 7$ is $1 < x < 2$.

19 The diagram below shows the journey Rajni made when he went to visit his grandmother.

- He walked from his home to his grandmother's house.

- He stayed for tea.

- He then walked to the bus stop and waited for a bus.

- He caught a bus that stopped outside his home.
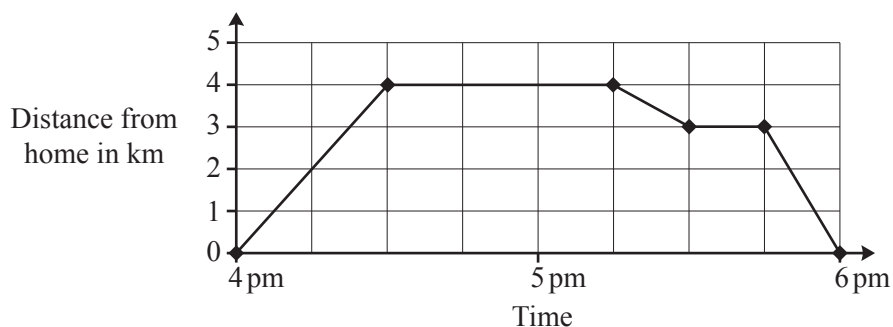
Three of the following statements are true and **one** is false. Which one is **false**?

A Rajni walked at a speed of 8 kilometres per hour on his way to his grandmother's house.

B Rajni stayed at his grandmother's house for 45 minutes.

C The bus stop is 1 kilometre away from his grandmother's house.

D Rajni's average speed on the journey home was greater than his speed on the way to his grandmother's house.

20 The chart below shows the exchange rate at noon one day in December in 2014 of Pounds Sterling (£) against the Japanese Yen (¥).
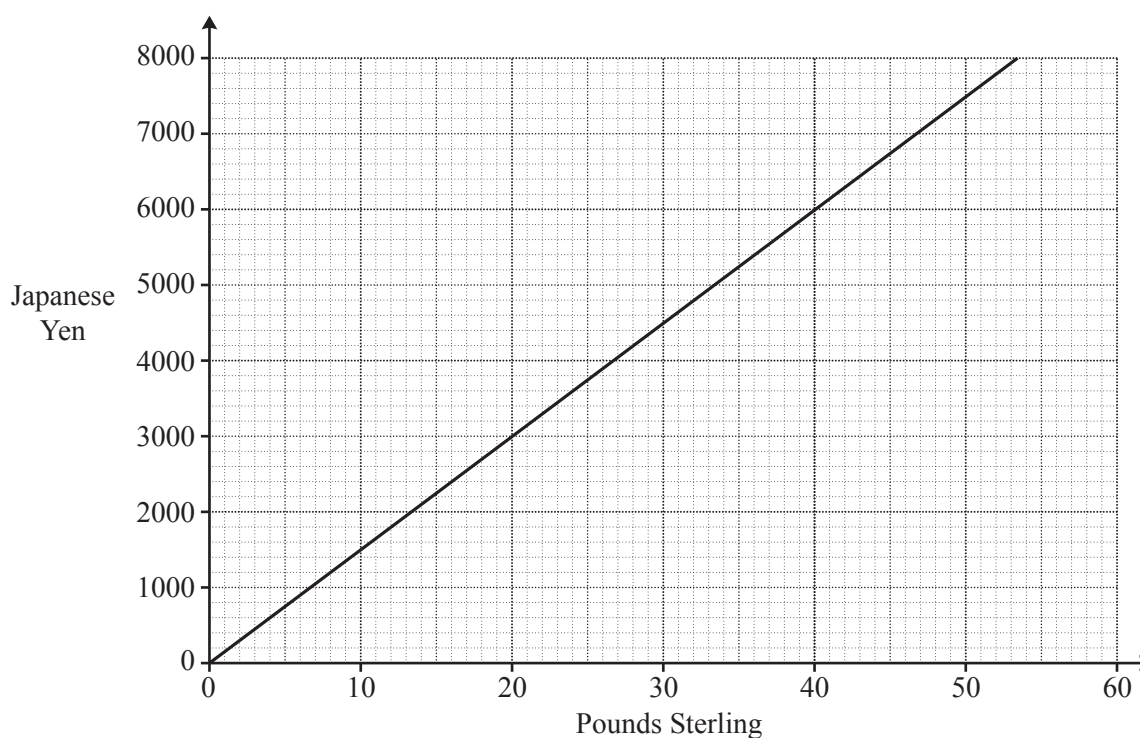
Three of the following statements are true and **one** is false. Which one is **false**?

A 3 000 000 ¥ was worth the same as approximately £20 000.

B A Japanese tourist in London would have received £400 for 60 000 ¥.

C £ 32 was worth less than 5000 ¥.

D The gradient of the line is 1500 Yen per Pound.

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

A A mass of 11 kg is approximately 5 lbs (pounds).

B An area of $1 \, m^2$ is exactly $1 \, 000 \, 000 \, mm^2$.

C A volume of $2500 \, cm^3$ is exactly 2.5 litres.

D 1 metre is approximately 39 inches.

22 The diagram shows a prism. The cross-section is a triangle. Angle PQR is 90º. Side PQ is 7 cm, side QR is 24 cm and the length of the prism is 50 cm.
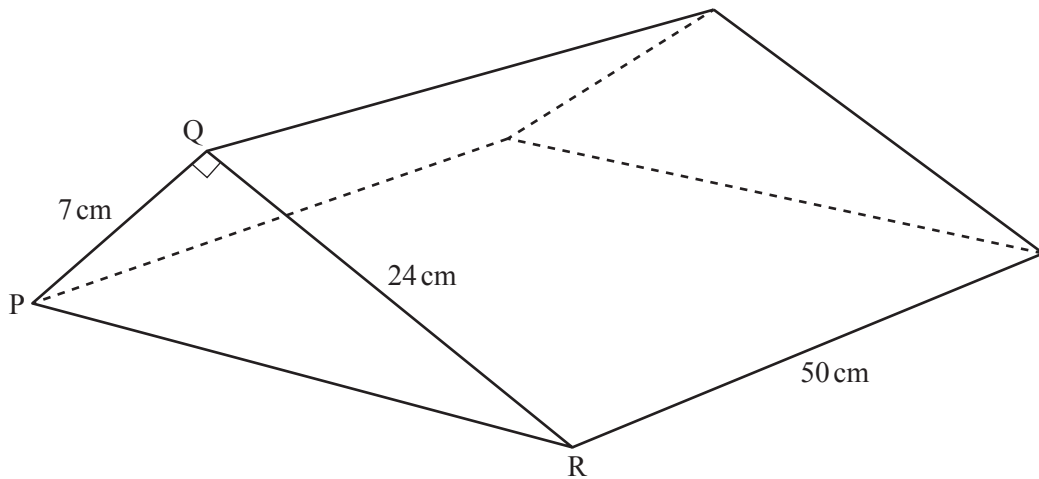
Three of the following statements are true and **one** is false. Which one is **false**?

A   The volume of the prism is $8400 \, \text{cm}^3$.

B   The perimeter of the triangle PQR is 56 cm.

C   The total surface area of the prism is $2968 \, \text{cm}^2$.

D $\tan \text{QRP} = \dfrac{7}{24}$

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

   A $3ab(a+2b) = 3a^2b + 6ab^2$

   B   One of the roots of the equation $(x-3)(x+4) = 0$ is $x = 3$.

   C   The solution of the equation $x^2 + 1 = 2x$ is $x = 1$.

   D $4x(3-x) + 9 = 0$ can be written as $(2x-3)^2 = 0$.

24 A wooden garage door has a height of 210 cm and a width of 620 cm, both correct to the nearest cm. The thickness of the door is 20 mm, correct to the nearest mm.

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

   A   The thickness of the door is not greater than 2.05 cm.

   **B**   The minimum possible width of the door is 6.19 m.

   C   The greatest possible area of the front of the door is less than $13.2 \, \text{m}^2$.

   D   The volume of the door is more than $250\,000 \, \text{cm}^3$.

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

A The nth term of the sequence 5, 8, 11, 14, ... is $2 + 3n$.

B The 10th term of the sequence 3, 8, 13, 18, 23, ... is 46.

C A sequence with nth term $n^2 - 3n + 3$ is positive for all values of n.

D The 6th term of the sequence with nth term $2n + 1$ is equal to the 20th term of the sequence with nth term $\frac{n}{2} + 3$.

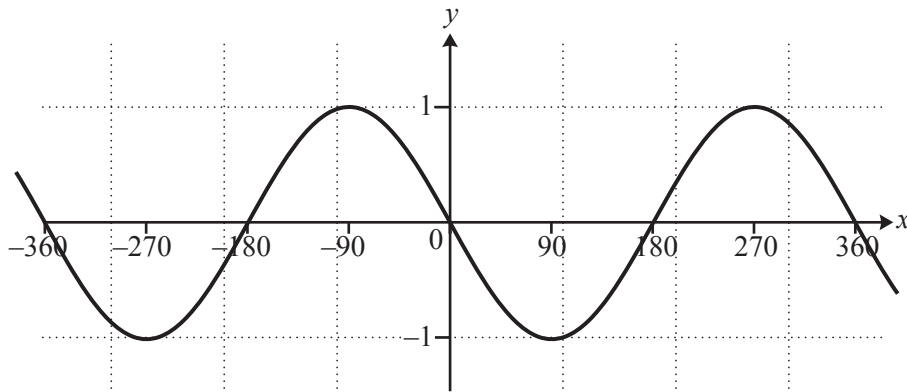**26** In the triangle EFG below the ratio of EH : HG is 1 : 3.
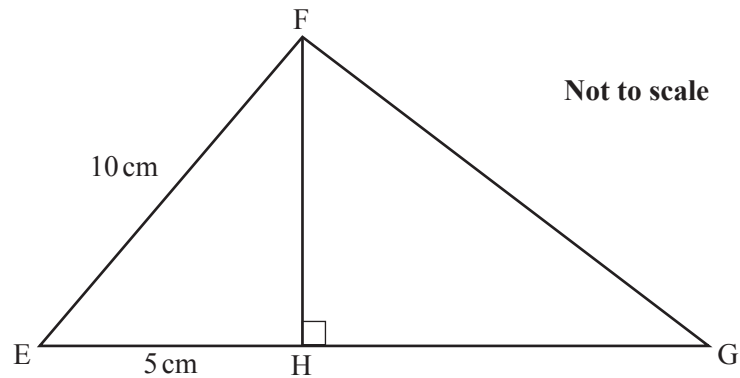
Three of the following statements are true and **one** is false. Which one is **false**?

A Angle EFH is 30°.

B The length FH is $5\sqrt{3}$ cm.

C The length EG is 15 cm.
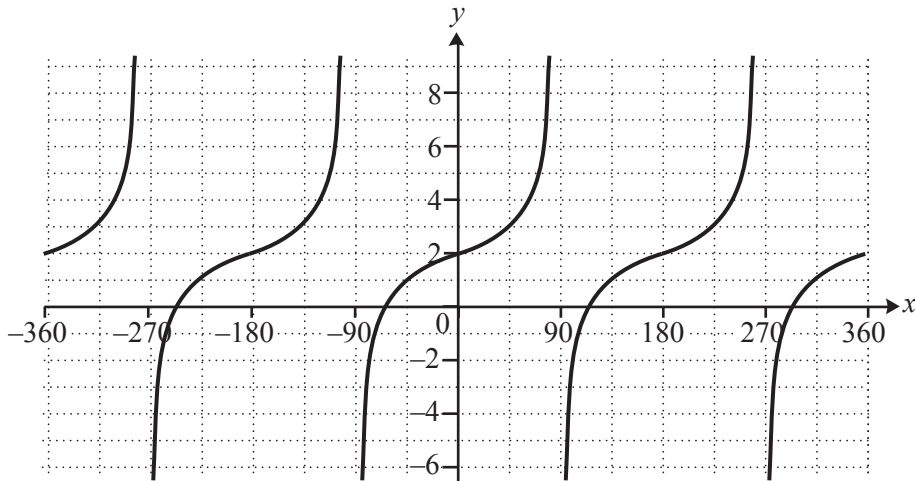
D cos FEH = 0.5

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

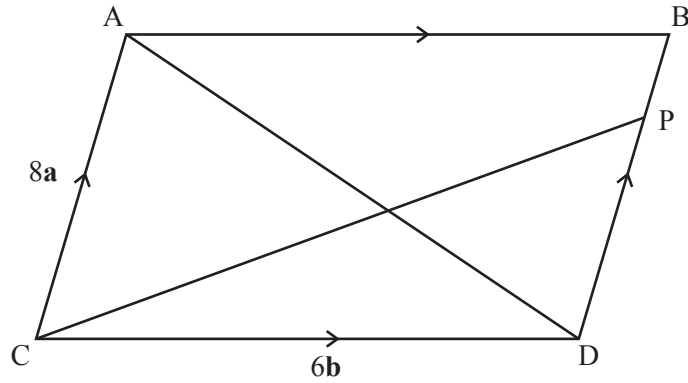**A** The diagram below shows part of the curve $y = \sin x$.

B Given that $\sin \theta = \frac{3}{5}$, $\cos \theta = \frac{4}{5}$ where $0 \leqslant \theta \leqslant 90°$.

C The following shows part of the graph of $y = \tan x + 2$.

D Given that $\tan \theta = \frac{2}{3}$, $\tan(90 - \theta) = \frac{3}{2}$ where $0 \leqslant \theta \leqslant 90°$.

28

A   B

P

8**a**

C   6**b**   D

In the diagram AC is parallel to BD and CD is parallel to AB.

Point P divides the line DB in the ratio DP : PB = 3 : 1.

The vector $\overrightarrow{CA}$ = 8**a** and the vector $\overrightarrow{CD}$ = 6**b**.

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

A   The vector $\overrightarrow{AD}$ = 2(3**b** − 4**a**).

B   The length of the vector $\overrightarrow{PB}$ is $\frac{1}{4}$ of the length of the vector $\overrightarrow{DP}$.

C   The vector $\overrightarrow{CP}$ = 6(**a** + **b**).

D   A vector 16**a** has double the length of the vector $\overrightarrow{CA}$.

Turn over

29   Which **one** of the following is the **correct** solution of the equation $3M^2 + 7M = 13$?

A $\dfrac{-7 \pm \sqrt{107}}{6}$

B $\dfrac{7 \pm \sqrt{205}}{6}$

C $\dfrac{-7 \pm \sqrt{205}}{6}$

D $\dfrac{7 \pm \sqrt{107}}{6}$

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

A $6^4 \times 6^{-2} = 6^{-8}$

B $3^4 \div (4.8)^0 = 81$

C $4^2 + 2^4 = 2^5$

D $1 \div x^2 = x^{-2}$

31 A researcher measured the lengths (l cm) of 46 branches of young trees.

The following table shows the results.

length (l cm)	$60 \leqslant l < 70$	$70 \leqslant l < 80$	$80 \leqslant l < 90$	$90 \leqslant l < 100$
frequency	17	16	9	4

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

A   The estimated mean length is 75 cm.

B   9 branches had a length of at least 80 cm.

C   The modal class is $60 \leqslant l < 70$.

**D**   The range of the lengths is not more than 40 cm.

32 Which **one** of the following is a **correct** simplification of $\dfrac{2x-1}{4} - \dfrac{x+4}{2}$?

A $\dfrac{x+3}{4}$

B $-\dfrac{9}{4}$

C $\dfrac{x-5}{8}$

D $-\dfrac{9}{8}$

33 There are 12 blue marbles and 15 red marbles in a bag. One marble is taken at random from the bag. It is **not** replaced. Then another marble is taken.

In order to answer this question you are advised to complete the probability tree diagram.

First Marble   Second Marble

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

A   The probability that the first marble taken is red is $\frac{5}{9}$.

B   The probability of taking two marbles of different colours is $\frac{10}{39}$.

C   The probability of taking two red marbles is $\frac{35}{117}$.

D   The probability of taking two marbles of the same colour is $\frac{19}{39}$.

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

A A model aeroplane is constructed on a scale of 1 : 15. The wingspan of the model is 95 cm. The wingspan of the full size aeroplane is 14.25 m.

B A field is drawn on a scale of 1 : 100 on a map. The field has an area of 9600 m^2. The area of the field on the map is 0.96 m^2.

C Each side of a 2 cm × 2 cm × 3 cm cuboid is enlarged in the ratio 1 : 3. The volume of the enlarged cuboid is 324 cm^3.

D Each side of a square of area 30 cm^2 is reduced in the ratio 2 : 1. The area of the reduced square is 15 cm^2.

35
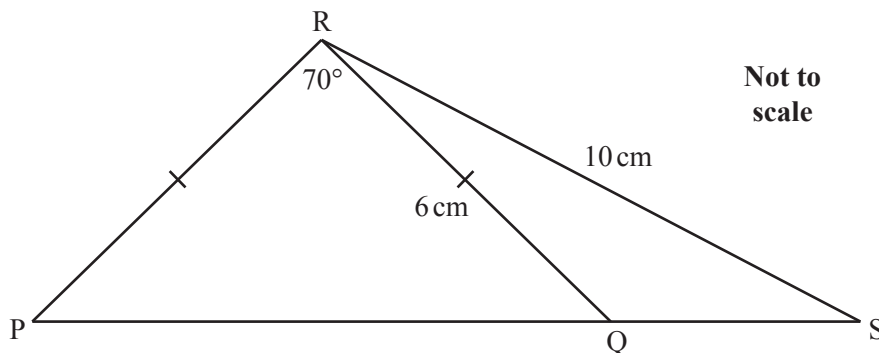
In the diagram, angle PRQ = 70º and PR = QR.

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

A Angle RPQ is 55º.

B Angle RSP is 29.4º, correct to 1 decimal place.

C The area of triangle RPQ is 33.8 cm^2, correct to 3 significant figures.

D The length of PQ is 6.88 cm, correct to 2 decimal places.

36 Which **one** of the following is the **correct** solution of these simultaneous equations?

$$5x + 4y = 5$$
$$3x - 5y = -34$$

A $x = -3, y = 5$

B $x = -5, y = 3$

C $y = -3, x = 5$
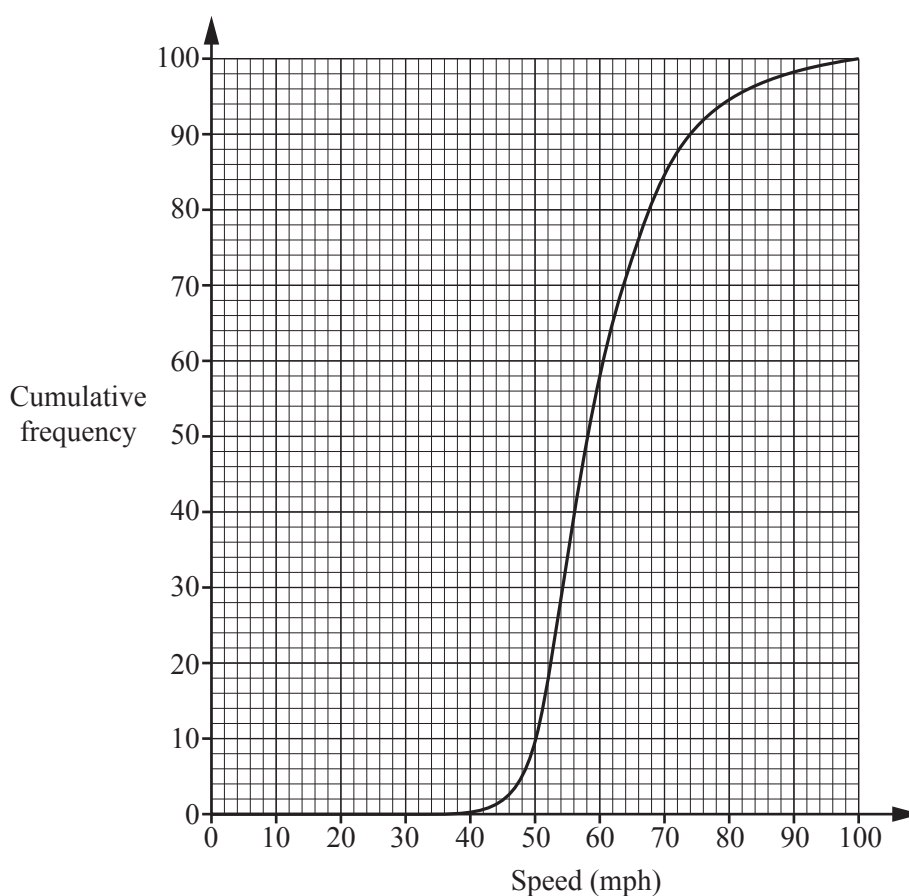
D $x = 3, y = -5$

37 The diagram shows part of the curve $y = 1 + 3x - x^3$
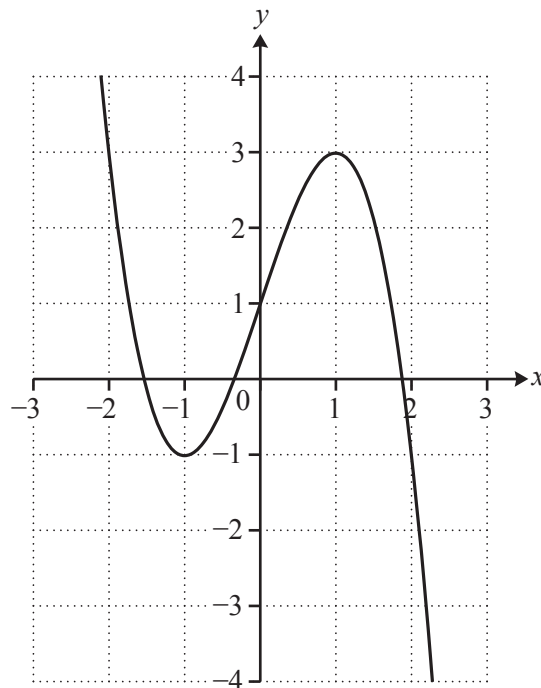
Three of the following statements are true and **one** is false. Which one is **false**?

A   The equation $1 + 3x - x^3 = 0$ has three roots.

B   The equation $-2 = 1 + 3x - x^3$ has three roots.

C   There are two points on the curve $y = 1 + 3x - x^3$ where the gradient is 0.

D   When $y = -3$, x lies between 2 and 3.

38 The cumulative frequency graph below shows the speeds in miles per hour (mph) of 100 cars recorded on a motorway.

The cumulative frequency table below shows the speeds of 80 lorries recorded on the same stretch of the motorway.

Speed (*s* mph)	Cumulative frequency
$0 \leqslant s < 30$	0
$0 \leqslant s < 40$	10
$0 \leqslant s < 50$	28
$0 \leqslant s < 60$	62
$0 \leqslant s < 70$	80

In order to answer this question you are advised to enter the above data on the cumulative frequency graph.

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

A   The median speed of the lorries was slower than the median speed of the cars.

B   The interquartile range of the speed of the lorries was less than the interquartile range of the speed of the cars.

C   Approximately 15 cars were being driven at a speed greater than 70 mph.

D   28 lorries were being driven at a speed less than 50 mph.

39 In the diagram below, PQRST is a pyramid with a rectangular base. TP is perpendicular to SP and QP.
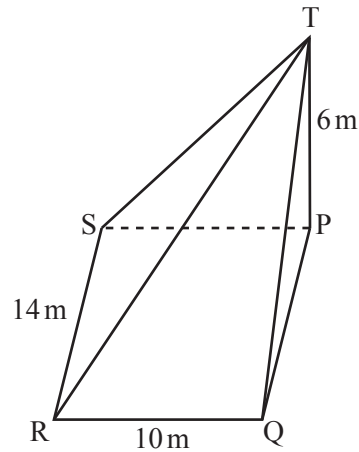

Three of the following statements are true and **one** is false. Which one is **false**?

A   The area of triangle TPQ is $42\,\text{m}^2$.

B   The length of the diagonal RP is $17.2\,\text{m}$, correct to 1 decimal place.

C   The volume of the pyramid is $280\,\text{m}^3$.

D   The angle that ST makes with the base is $59.0°$, correct to 1 decimal place.

(The volume of a pyramid is given by $V = \frac{1}{3} \times$ base area $\times$ height).

40 The diagram shows a river. The river is 45 m wide and has a constant current of $0.5\,\mathrm{ms}^{-1}$ East to West.

A

$0.5\,\mathrm{ms}^{-1}$

45 m

Not to scale

B
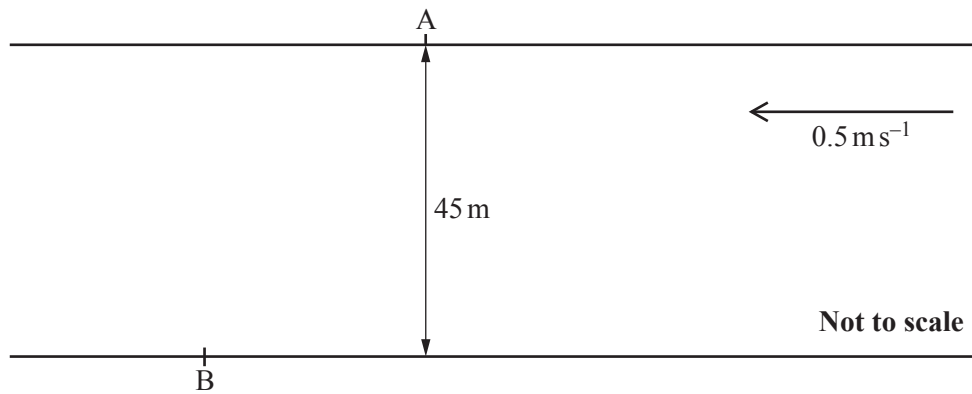
Jill can swim at a constant speed of $1.5\,\mathrm{ms}^{-1}$ in still water. Jill swims across the river. She starts at point A and heads due South, but the current takes Jill downstream to point B.

Which **one** of the following is the bearing of B from A and the time she takes to cross the river?

A   072° in a time of 32 seconds.

B   198° in a time of 30 seconds.

C   198° in a time of 32 seconds.

D   072° in a time of 30 seconds.

END OF QUESTION PAPER