OCR

Oxford Cambridge and RSA

Tuesday 19 June 2018 – 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

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.

Turn over

Formulae Sheet: 6989 Foundations of Advanced Mathematics

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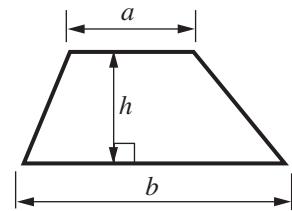
Volume of prism = (area of cross-section) × length
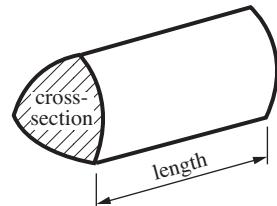
In any triangle ABC

**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 $= \frac{1}{2}ab \sin C$
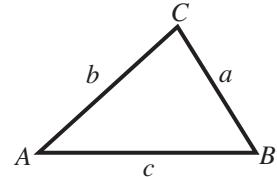
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$
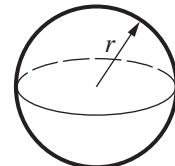
Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$
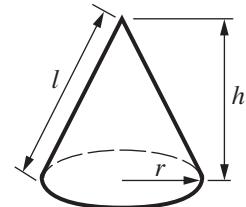
The Quadratic Equation

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

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

3

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

    A   217 has exactly four factors.

    B   The square root of 2018 lies between 44 and 45.

    C   The highest common factor (HCF) of 72 and 120 is 12.

    D   97 is a prime number.

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

    A $9 - 2 \times 4 = 28$

    B $(-3)^3 = -27$

    C $9 - 4 - 1 = 4$

    D $\dfrac{(-6)^2}{2 \times 9} = 2$

3   Alison and Beth are adding fractions.

    Alison claims that $\dfrac{1}{3} + \dfrac{3}{8} = \dfrac{4}{11}$.

    Beth claims that $\dfrac{1}{2} + \dfrac{2}{9} = \dfrac{13}{18}$.

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

    A   Alison and Beth are both correct.

    B   Alison is correct and Beth is incorrect.

    C   Alison is incorrect and Beth is correct.

    D   Alison and Beth are both incorrect.

4

4   Mr Burns donates a lottery win of £9000 to his children, Nathan, Derek 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   Derek receives 30% of the money.

B   Nathan receives $\frac{2}{5}$ of the money.

C   Elsie receives £2400.

D   Nathan receives £600 more than Derek.

5   Abbie, Bill and Ethan each receive a pay rise.

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

A   A 5% pay rise is equivalent to an increase of $\frac{1}{20}$ of the original salary.

B   Abbie receives a pay rise of 5%. Her original annual salary increases from £25 000 to £30 000.

C   Ethan receives a 6% pay rise resulting in a new annual salary of £28 620. His original annual salary was £27 000.

D   Bill receives a pay rise of 5%. His original annual salary of £34 000 rises by more than Ethan's.

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

A $\sqrt{4^4} = 4^2$

B $\dfrac{15^2}{9^3} = \dfrac{5^2}{3^4}$

C $4 \times 10^4 + 3 \times 10^5 = 4.3 \times 10^5$

D $\left(4 \times 10^4\right) \div \left(8 \times 10^{-3}\right) = 5 \times 10^6$

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

A 5 pints is approximately 8.8 litres.

B $72\,\text{km h}^{-1} = 20\,\text{m s}^{-1}$

C 12 inches is approximately 30.5 cm.

D 10 kilograms is approximately 22 pounds.

8 A room in a house is 6 m long, 5 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 $75\,\text{m}^3$.

B A carpet covering 80% of the floor has area $24\,\text{m}^2$.

C The total surface area of the walls (ignoring windows and doors) is $55\,\text{m}^2$.

D A wardrobe with dimensions 130 cm by 80 cm by 250 cm takes up less than 3% of the total volume.

9 Boxes are to be stored on a shelf. Each box has width 7 cm, and the shelf is 160 cm long, both correct to the nearest cm.

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

A The width of a box could be 74 mm.

B The total width of 8 boxes lies between 52 cm and 60 cm.

C It is possible that 24 boxes could fit onto the shelf.

D 22 boxes will definitely fit on the shelf.

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

    A   The average height of a family car is 2.5 metres.

    B   An apple has a mass of about 1.5 kg.

    C   A bottle of wine holds under 1 litre.

    D   A mug contains 250 litres of tea.

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

    A $x^2 - 7x + 10 = 0$

    B $x^2 + 6x - 3 = 0$

    C $x^2 - 1 = 0$

    D $x^2 - 5x + 7 = 0$

12 Paulo is marking out a rectangular area in his garden. The perimeter is 8 m.
Let x m be the length of one side of the rectangle.

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

    A $A = 4x - x^2$

    B $A = x^2$

    C $A = x(8 - x)$

    D $A = 4x^2$

13 A spinner is constructed with a piece of circular card in the middle of which an arrow is fixed, as shown.
The circle is divided into five equal sectors, numbered 1 to 5.
When the arrow is spun it is equally likely to come to rest pointing at any of the numbers.
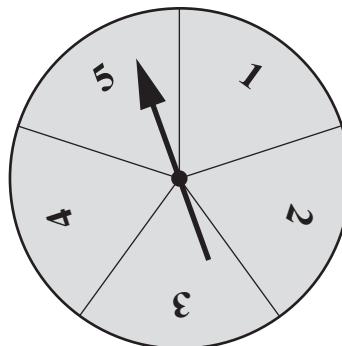
The arrow is spun twice.

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

A   The probability that the two numbers are equal 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 $\frac{1}{5}$.

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

A   In the expression $5x^3 - x^2 + 4x - 6$ the highest power of x is 5.

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

C $x(x-4) + 4 = (x-2)^2$

D   The expression $x(x+1)^2$ contains no constant term.

15 Three of the following statements involve sensible units and **one** does not. Which one does **not**?

    A   The distance from Edinburgh to London is measured in kilometres.

    B   The length of a double decker bus is measured in millimetres.

    C   The capacity of a drinking glass is measured in millilitres.

    D   The total output of coal from British coal mines in 2010 was measured in tonnes.

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

    A   The solution of the equation $2x + 3 = 15 - 2x$ is $x = 3$.

    B   The solution of the equation $2(3x - 1) + 2(x + 1) = 12$ is $x = 1.5$.

    C   The solution of the equation $2(x - 3) - 3(1 - 2x) = 3$ is $x = 1.5$.

    D   The solution of the equation $x + 2 = 2 - 3(4 - x)$ is $x = -3$.

17 When a car accelerates uniformly along a straight road, the distance travelled in t seconds is given by $s = ut + \frac{1}{2}at^2$. The distance is s metres, the acceleration is $a\,\mathrm{m\,s}^{-2}$ and the speed when $t = 0$ is $u\,\mathrm{m\,s}^{-1}$.

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

    A   When $t = 4$, $u = 0$ and $a = 2$ then $s = 16$.

    B   When $t = 5$, $u = 3$ and $a = 4$ then $s = 65$.

    C   When $t = 2$, $u = -2$ and $a = 2$ then $s = 4$.

    D   When $s = 10$, $u = 2$ and $t = 2$ then $a = 3$.

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

    A 56.569 written correct to the nearest whole number is 57.

    B 1.236 written correct to 3 significant figures is 1.24.

    C 43.5499 written correct to 1 decimal place is 43.6.

    D 657 879 written correct to the nearest thousand is 658 000.

19 John wants to make up a formula to work out how many people might attend a match of the local football team.

He gives a rating k from 1 to 5 to each visiting team.
He gives a rating w from 1 to 10 to the weather for the day of the match.

The formula is created as follows:
The number of people, N, expected to attend is 300 plus 100 times the rating for the visiting team, less 30 times the rating given for the weather that day.

Which **one** of the following is the **correct** formula?

    A $N = 300 \times 100k + 30w$

    B $N = 300 + 100k - 30w$

    C $N = 300 + 100 + k + 30 - w$

    D $N = 300 + 100 + k - 30 - w$

20   Three of the following expressions simplify to $3x$ and **one** does not. Which one does **not**?

   A $(3x+4)+x-(x+1)-3$

   B $3(3x-4)-3(2x-1)$

   C $1-3x-3(1-2x)+2$

   D $2(x+1)-3(2-x)+4-2x$

21   The first four of a sequence of patterns of dots is shown below.
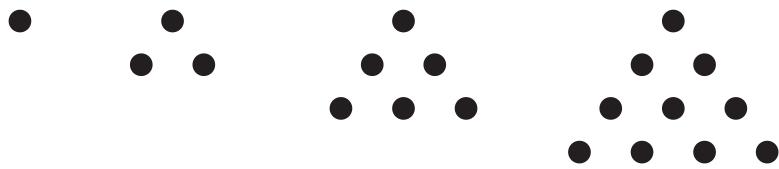
pattern number, n:	1	2	3	4
number of dots, d:	1	3	6	10

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

   A   The next two patterns will have 15 and 21 dots respectively.

   B   When $n = 8$, $d = 36$.

   C   One of the patterns has 55 dots.

   D   The formula that connects n and d is $d = \dfrac{n(n-1)}{2}$.

22 Aaron and Bella are rearranging formulae.

Aaron says that $F = \dfrac{9}{5}C + 32$ can be rearranged to $C = \dfrac{5(F-32)}{9}$.

Bella says that $V = \pi r^2 h + \dfrac{4}{3}\pi r^3$ can be rearranged to $h = \dfrac{V}{\pi r^2} - \dfrac{4}{3}$.

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

A   Aaron and Bella are both correct.

B   Aaron is correct and Bella is incorrect.

C   Aaron is incorrect and Bella is correct.

D   Aaron and Bella are both incorrect.

23 Nikhil is solving a pair of simultaneous equations.

$$5x - 2y = 4 \qquad \text{(i)}$$
$$3x + 4y = 18 \qquad \text{(ii)}$$

His working is shown below but the final answer is incorrect.

At which point has he made his **first** error?

A   Multiply (i) by 2:
$$10x - 4y = 8 \qquad \text{(iii)}$$
$$3x + 4y = 18 \qquad \text{(ii)}$$

B   Subtract (ii) from (iii): $7x = -10$

C   Divide both sides by 7: $x = -\dfrac{10}{7}$

D   Substitute into (ii): $-\dfrac{30}{7} + 4y = 18 \Rightarrow 4y = \dfrac{156}{7} \Rightarrow y = \dfrac{39}{7}$

24 Three of the following quadratic expressions can be factorised into the form $(x-a)(x-b)$ where a and b are positive or negative integers, and **one** cannot. Which one **cannot**?

A $x^2 - 3x + 2$

B $x^2 - 4$

**C** $x^2 - x + 20$

D $x^2 + x - 20$

25 The velocity-time graph below models the motion of a car which accelerates from rest leaving a set of traffic lights, then moves at a constant speed of $15\,\text{ms}^{-1}$ and then decelerates to rest at a second set of traffic lights.
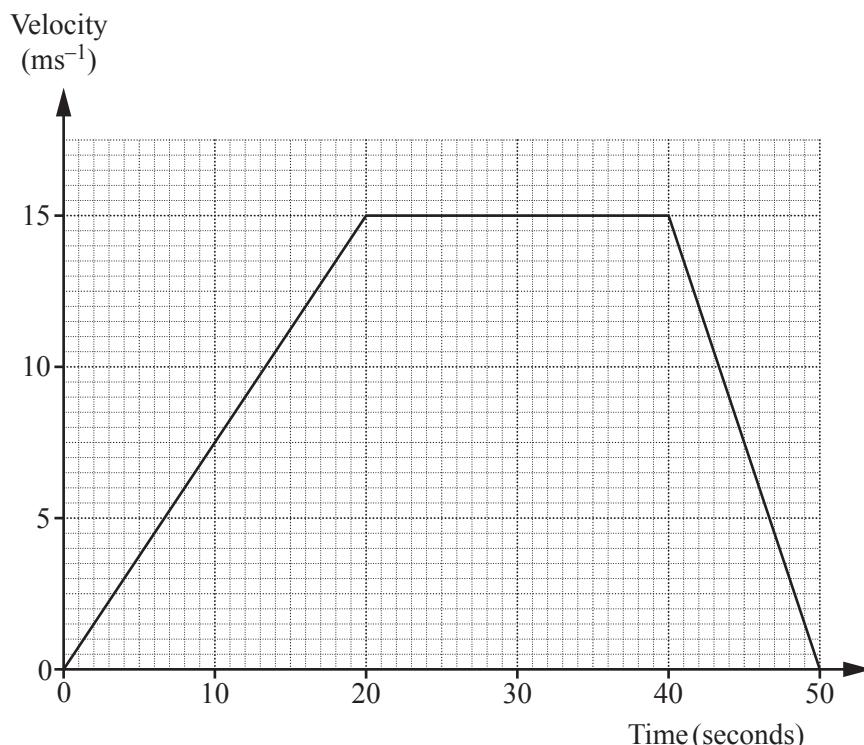
Which **one** of the following is the **correct** distance between the two sets of traffic lights?

A 52.5 m

B 525 m

C 75 m

D 750 m

26 The right-angled triangle PQR has angle Q = 90°, PR = 12 cm and QR = 10 cm.

Not to scale
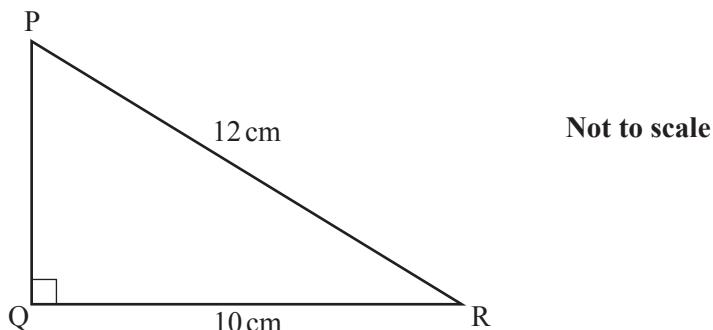
Three of the following statements are true and **one** is false. Which one is **false**?

A   PQ = 8 cm

B $\sin QPR = \dfrac{5}{6}$

C   Angle PRQ = 34°, correct to the nearest degree.

D   Area PQR = 33 cm^2, correct to 2 significant figures.

**27** In the triangle PQR, PQ = 10 cm, QR = 7 cm and RP = 9 cm.

Not to scale
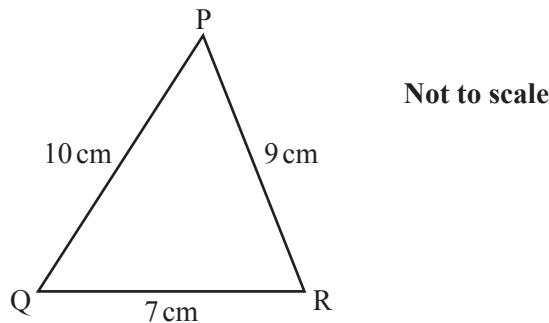
Which **one** of the following is the size of the **largest** angle in the triangle?

A   76.2°, correct to 1 decimal place.

B   43.8°, correct to 1 decimal place.

C   87.7°, correct to 1 decimal place.

D   122.7°, correct to 1 decimal place.

28 Three lines, L, M and N, have been drawn on the graph below.

The equations of L and M are $y = 2x + 1$ and $y = 7 - 3x$ respectively.
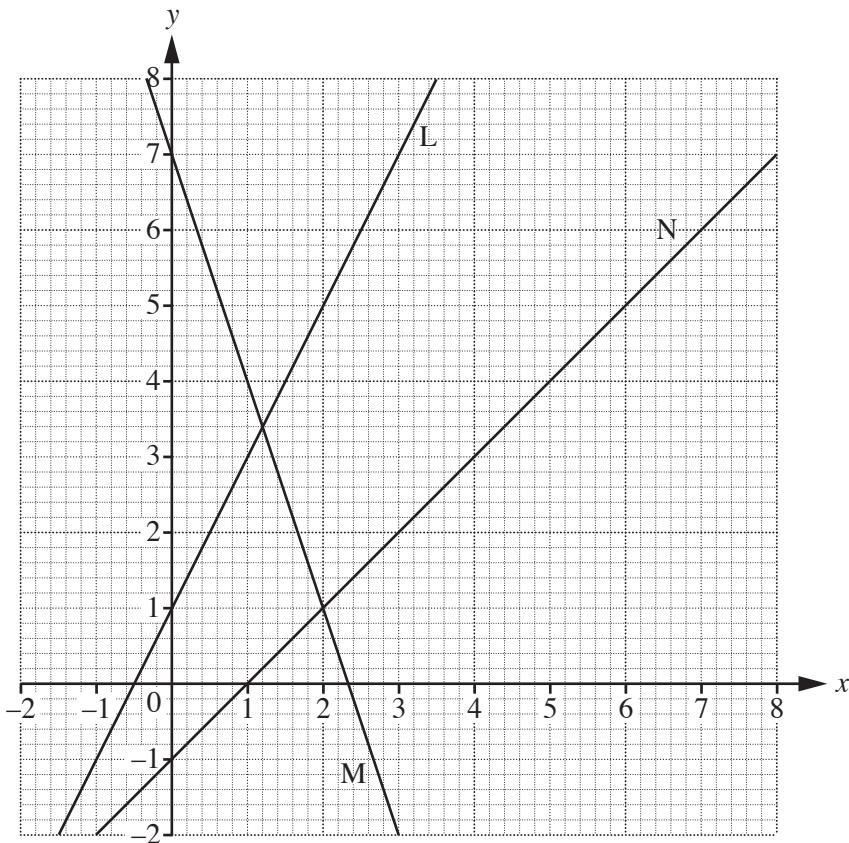
The line P (not drawn) passes through the points (0, 3) and (4, 7).

In order to complete this question you are advised to draw the line P on the grid above.

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

A   The equation of line N is $y = x - 1$.

B   Lines P and N are parallel.

C   The lines P and M intersect at the point with coordinates (4, 1).

D   The solution to the simultaneous equations $y = 2x + 1$ and $y = 7 - 3x$ is given by the coordinates of the point where L and M intersect.

29   A hillside is in the form of a wedge as shown in the diagram.
The base PQRS is horizontal with PQ = RS = 100 m and QR = PS = 60 m.
The rectangle RSFE is vertical with SF = ER = 30 m and RS = FE = 100 m.
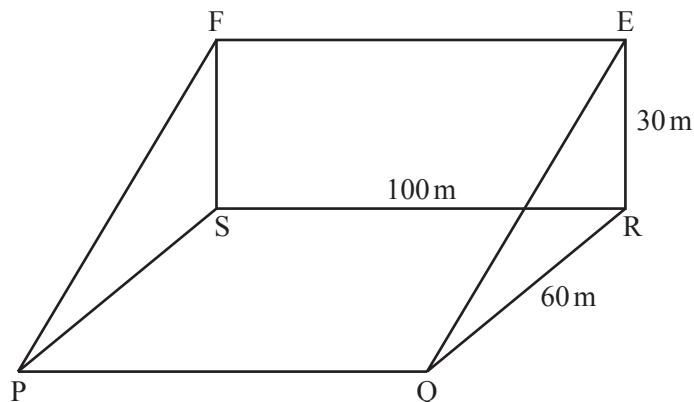
Three of the following statements are true and **one** is false. Which one is **false**?

A   The angle EQR = 27°, correct to the nearest degree.

B   The angle EPR = 13°, correct to the nearest degree.

C   The direct path from P to F is 67 m, correct to the nearest metre.

D   The direct path from P to E is 120 m, correct to the nearest metre.

30 Jahir and Jane are investigating the number of books that the students in their year group have read in the last term.

Jahir asks all 120 members of his year group. Jane stands at the entrance to the school library and asks the first 50 people of her year group who enter the library.

The data for Jahir are given in the table below.

Number of books read	0	1	2	3	4	5	6	7	8
Frequency	22	26	28	20	16	4	2	2	0

The data for Jane are given in the table below.

Number of books read	0	1	2	3	4	5	6	7	8
Frequency	7	8	9	11	5	4	3	2	1

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

A   Jane has not chosen a random sample.

B   In Jahir's sample the median number of books read is 2.

C   In Jane's sample the mean number of books read is 2.78.

D   The range of the number of books read in the samples for both Jahir and Jane is the same.

31 You are given the vectors $\mathbf{a} = \mathbf{i} - \mathbf{j}$, $\mathbf{b} = 2\mathbf{i} - \mathbf{j}$, $\mathbf{c} = 3\mathbf{i} + 4\mathbf{j}$.

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

A   The magnitude of $\mathbf{c}$ is 5.

B $2\mathbf{a} - \mathbf{b} = \mathbf{j}$

C $2\mathbf{b} - \mathbf{c} = \mathbf{i} - 6\mathbf{j}$

D $11\mathbf{a} - 7\mathbf{b} + \mathbf{c} = \mathbf{0}$

**32** Which **one** of the following is the correct solution of the inequality $2(2x+1) < 5-x$?

A $\quad x < \dfrac{9}{4}$

B $\quad x < 1$

C $\quad x < \dfrac{2}{3}$

D $\quad x < \dfrac{3}{5}$

33 A river runs west-east with a current of $2\,\text{ms}^{-1}$. Point Q is on the north bank due north of point P which is on the south bank as shown in the diagram. The river is 36 metres wide.
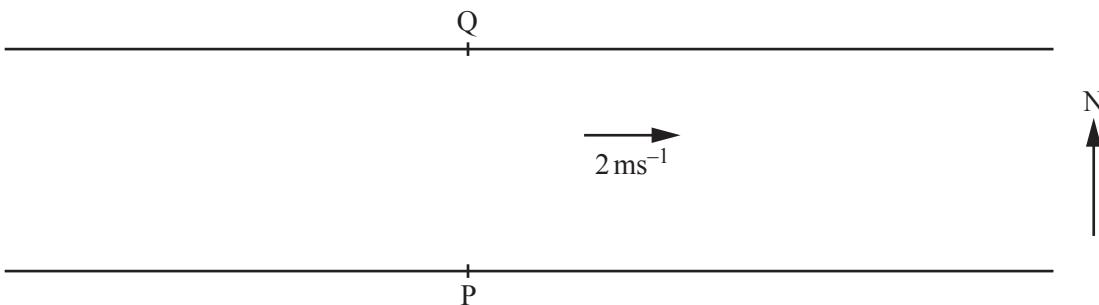
Jim starts his model boat at P, pointing it at the point Q. As it crosses the river the boat constantly points north.
The boat travels at $3\,\text{ms}^{-1}$ in still water.

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

A The direction of the boat is approximately 33.7° to the bank.

B The boat reaches the opposite bank at a point which is 24 metres downstream of Q.

**C** The boat actually travels at approximately $3.6\,\text{ms}^{-1}$.

D The boat takes 12 seconds to reach the opposite bank.

34 A doctor records the number of patients she sees each day over a period of 20 days.

$$13 \quad 22 \quad 10 \quad 21 \quad 24 \quad 22 \quad 19 \quad 17 \quad 16 \quad 21$$

$$28 \quad 12 \quad 24 \quad 8 \quad 14 \quad 16 \quad 17 \quad 21 \quad 20 \quad 19$$

The doctor creates a frequency table and draws a bar chart to illustrate the data.
These are shown below.

Interval	Frequency
5 – 9	1
10 – 14	4
15 – 19	6
20 – 24	8
25 – 29	1
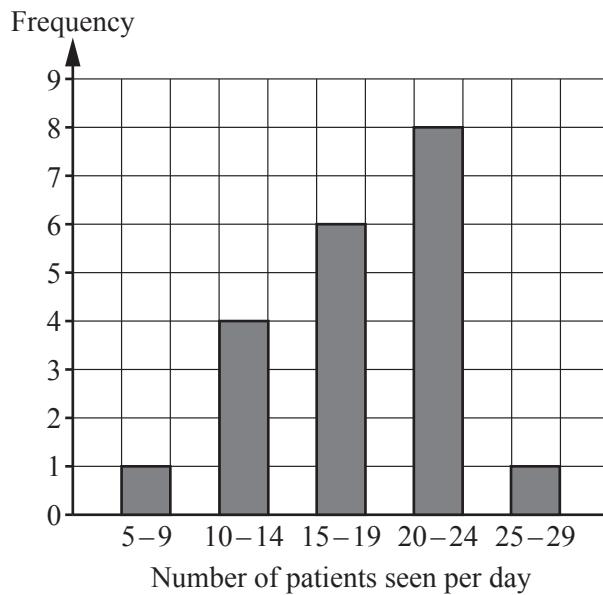
Three of the following statements are true and **one** is false. Which one is **false**?

A The doctor's frequency table is correct.

B The doctor's bar chart is correct for her frequency table.

C The modal group is 20 – 24.

D Using her frequency table, the mean number of patients seen per day is 16.

35 Paul monitors his heart rate over a period of 12 minutes. For the first 6 minutes he runs as fast as he can and for the next 6 minutes he rests.
He displayed his results on a spreadsheet chart, shown below.
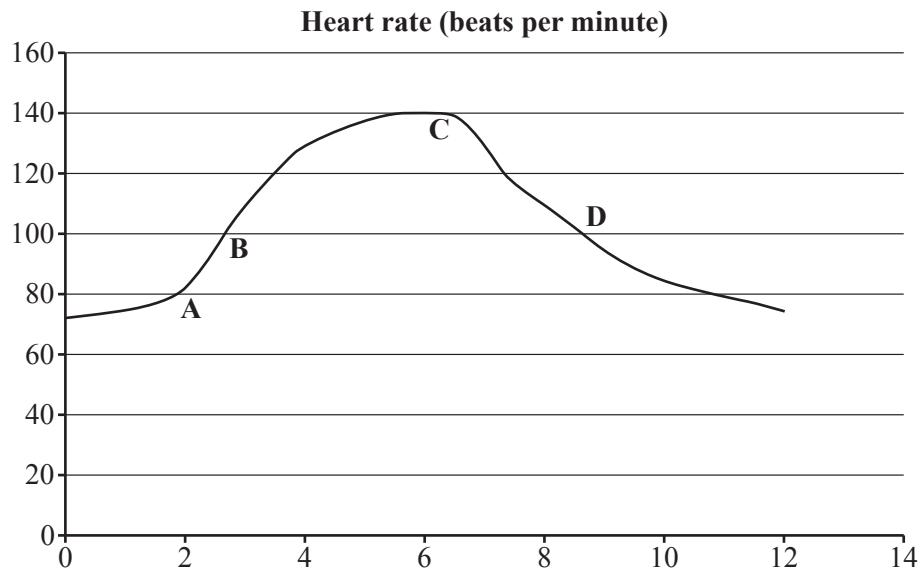
At which **point** on the graph, **A**, **B**, **C** or **D** is his heart rate increasing at the **fastest** rate?

36 Which **one** of the following is a **correct** simplification of $\dfrac{2x+1}{7} - \dfrac{1-3x}{5}$?

A $\dfrac{-x}{2}$

B $-\dfrac{11x+2}{35}$

C $\dfrac{5x}{2}$

D $\dfrac{31x-2}{35}$

37 You are given the equation of the curve $y = x^3 - 4x^2 + 2x + 6$.

The following table of values should be completed and the curve of the equation drawn on the coordinate grid in order to complete this question.

x	-1	0	1	2	3
x^3	-1	0	1	8	
$-4x^2$	-4	0	-4		
$2x$	-2	0	2		
6	6	6	6	6	6
y	-1	6	5		
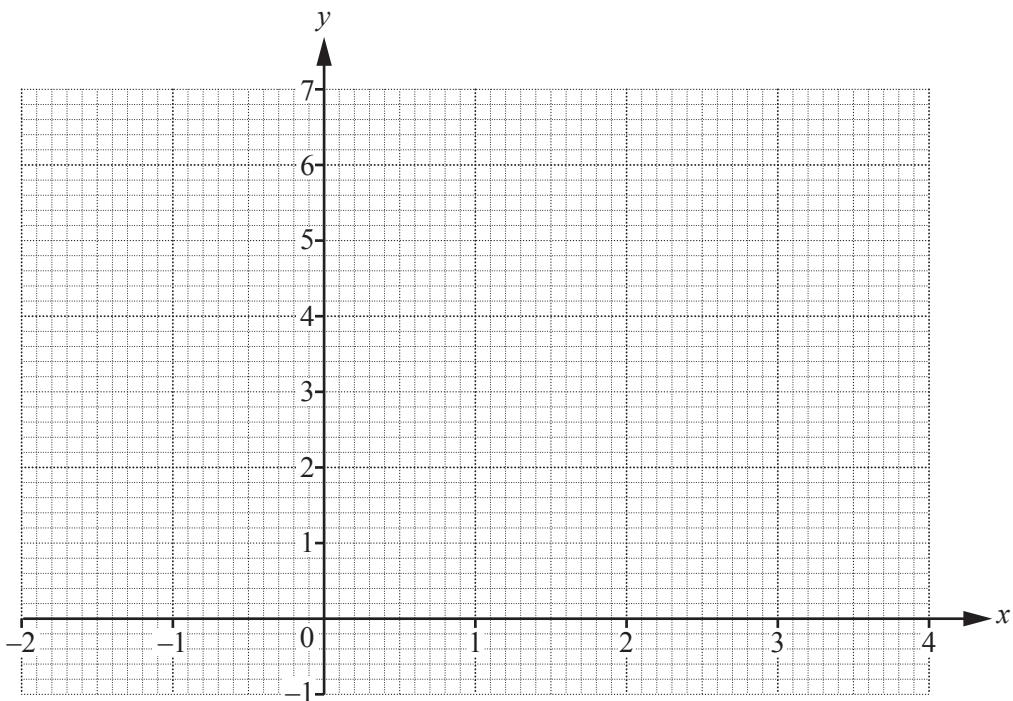
Three of the following statements are true and **one** is false. Which one is **false**?

A When $x = 1$ the gradient of the curve is positive.

B The curve crosses the x-axis once.

C The equation $x^3 - 4x^2 + 2x + 6 = 3$ has three real roots.

D The curve has a local maximum at approximately (0.3, 6.3).

38 Dale takes his younger sister, Dasha, to buy an ice cream. Dale chooses his ice cream first. There are only two flavours – strawberry and chocolate. Dale tosses a coin to decide which flavour he should buy – if the coin comes down heads he buys chocolate and if it comes down tails he chooses strawberry.

If Dale buys a chocolate ice cream then the probability that Dasha also chooses a chocolate ice cream is 0.8.
If Dale buys a strawberry ice cream then the probability that Dasha also buys a strawberry ice cream is 0.6.

In order to answer this question you are advised to complete the tree diagram below.
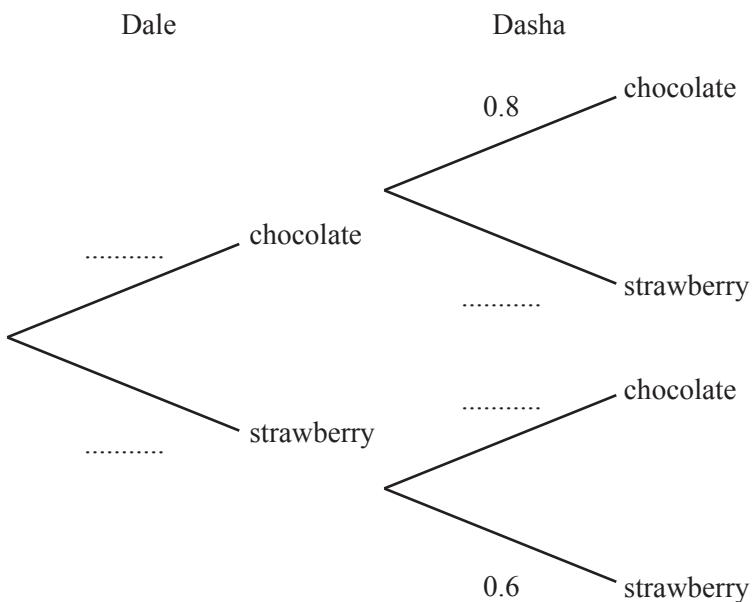
Dale   Dasha

          0.8   chocolate

....   chocolate

         ....   strawberry

         ....   chocolate

....   strawberry

         0.6   strawberry

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

A   The probability that both children buy a chocolate ice cream is 0.4.

B   The probability that no chocolate ice cream is bought is 0.6.

C   The probability that at least one chocolate ice cream is bought is 0.7.

D   The probability that Dasha chooses a strawberry ice cream depends on whether Dale buys a strawberry ice cream.

39 Two companies have published the salaries they pay to their full-time staff as shown in the table below.

Salary	Frequency for Company P	Frequency for Company Q
£15 001 – £18 000	2	5
£18 001 – £21 000	7	10
£21 001 – £24 000	10	13
£24 001 – £27 000	9	12
£27 001 – £30 000	7	8
£30 001 – £33 000	6	0
£33 001 – £36 000	5	0
£36 001 – £39 000	3	0
£39 001 – £42 000	1	0
£42 001 – £45 000	0	2
Number of staff	50	50

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

A   The arithmetic mean is the most appropriate measure for central tendency for company P.

B   The median is the most appropriate measure for central tendency for company Q.

C   For company Q the median lies in the modal group.

D   For company P the median lies in the modal group.

40 This plan of a small bungalow is drawn on a 1 cm grid.
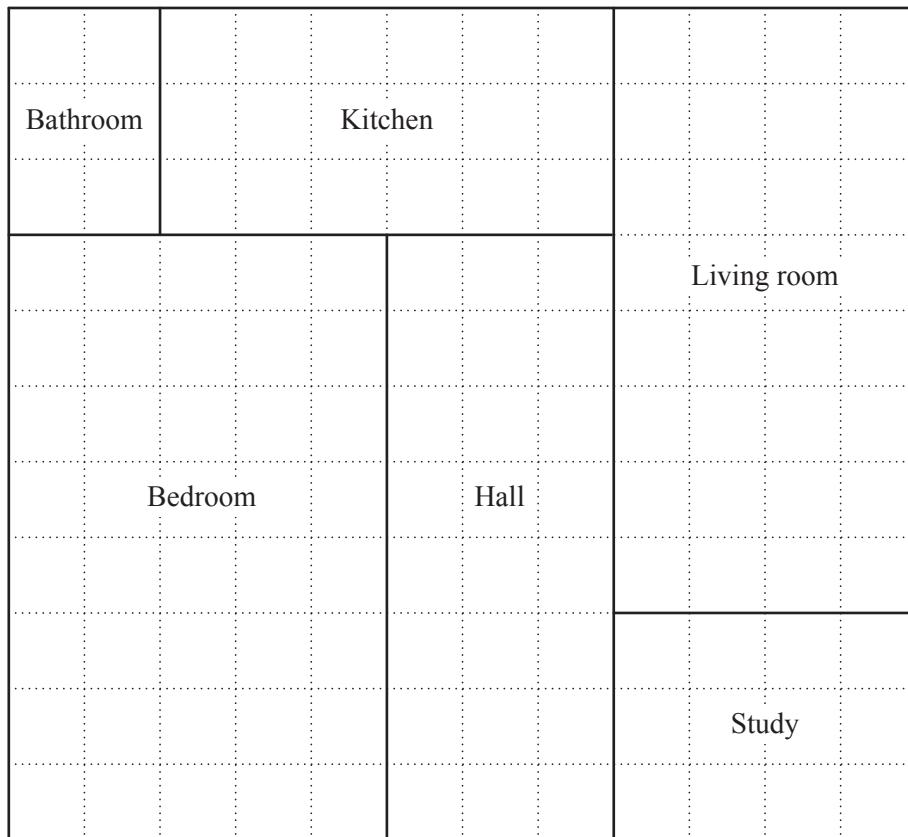
The hall measures 3 m by 8 m.

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

A The scale of the plan is 1:100.

B The actual area of the bungalow is $132 \, \text{m}^2$.

C The actual perimeter of the bungalow is 44 m.

D The size of the bedroom is 5 m by 8 m.

END OF QUESTION PAPER

OCR
Oxford Cambridge and RSA