OCR
Oxford Cambridge and RSA

Friday 13 January 2017 – 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

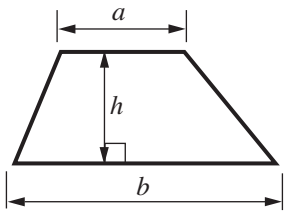
- Write your name clearly in capital letters, your centre number and candidate number on the Answer Sheet in the spaces provided unless this has already been done for you.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do **not** write in the bar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

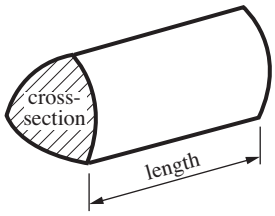
- Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
- This document consists of **28** pages. Any blank pages are indicated.

Formulae Sheet: 6989 Foundations of Advanced Mathematics

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



Volume of prism = (area of cross-section) × length

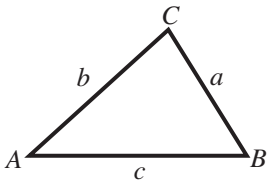


In any triangle *ABC*

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

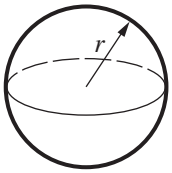
Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

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



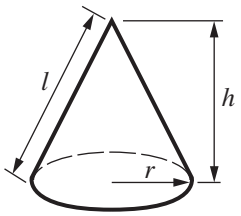
Volume of sphere = $\frac{4}{3}\pi r^3$

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 Here is a list of numbers.

2 3 4 5 6 7 8 9 10

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

A There are exactly three prime numbers in the list.

B Two of the numbers in the list are the square roots of other numbers in the list.

C There are exactly two square numbers in the list.

D There are exactly four factors of 12 in the list.

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

A $4\frac{2}{7} - 1\frac{4}{5} = 2\frac{17}{35}$

B $\frac{2}{5} \div \frac{4}{7} = \frac{7}{10}$

C $2\frac{3}{4} \times 3\frac{2}{3} = 6\frac{1}{2}$

D $\frac{13}{20} + 1\frac{7}{10} = 2\frac{7}{20}$

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

A $\frac{(-3)^2}{3^{-2}} = 81$

B $2 + 5 \times (-3) = -21$

C $\frac{24 \times 4}{6^2} = 2\frac{2}{3}$

D $3^6 \times 9^2 = 3^{10}$

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

A The solution of the inequality $6 < 2x \leqslant 13$ is $3 < x \leqslant 6.5$.

B The solution of the equation $5-2x=-1$ is $x=-2$.

C The solution of the equation $2(x-5)=3x+6$ is $x=-16$.

D The solution of the inequality $\frac{4x}{3}+1>7$ is $x>\frac{9}{2}$.

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

A The mass of an insect is measured in milligrams.

B The floor area of a house is measured in square metres.

C The volume of fuel in a car is measured in litres.

D The length of a bus is measured in millimetres.

6 Asma, Dan and Sophie share £1200. Asma receives 30% of the £1200 and Dan and Sophie share the remainder in the ratio 3 : 4.

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

A Dan receives £360.

B Sophie receives $\frac{2}{5}$ of the total amount.

C Asma receives more money than Sophie.

D Dan and Asma receive the same amount of money.

7 You are given the formula $v = u + at$.

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

A When $v = 5$, $u = -4$ and $t = 10$, then $a = 0.9$.

B When $v = 9$, $u = 3$ and $a = 5$, then $t = 1.2$.

C When $t = 20$, $v = -6$ and $a = 1$, then $u = -26$.

D When $t = 5$, $u = -4$ and $a = -10$, then $v = 54$.

8 'I think of a number n. I subtract 2 from it. I then divide my result by 4 and then add 5.'

Which **one** of the following is a **correct** algebraic expression for the statement above?

A $\dfrac{(n-2)+5}{4}$

B $\left(\dfrac{n}{4}-2\right)+5$

C $\dfrac{(n-2)}{4}+5$

D $(n-2)+\dfrac{4}{5}$

9 Joe is attempting to solve these simultaneous equations.

$$3a + 2c = 50 \quad \text{(i)}$$

$$a - 3c = 47 \quad \text{(ii)}$$

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

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

A	Multiply (ii) by 3	$3a - 9c = 141$ (iii)
B	Subtract (i) from (iii)	$7c = 91$
C	Divide by 7	$c = 13$
D	Substitute into (i)	$3a + 26 = 50$, so $a = 8$

10 A local library needs to reduce its opening hours. The library has 3200 users. It is decided to interview 60 users.

Which **one** of the following will produce a representative sample?

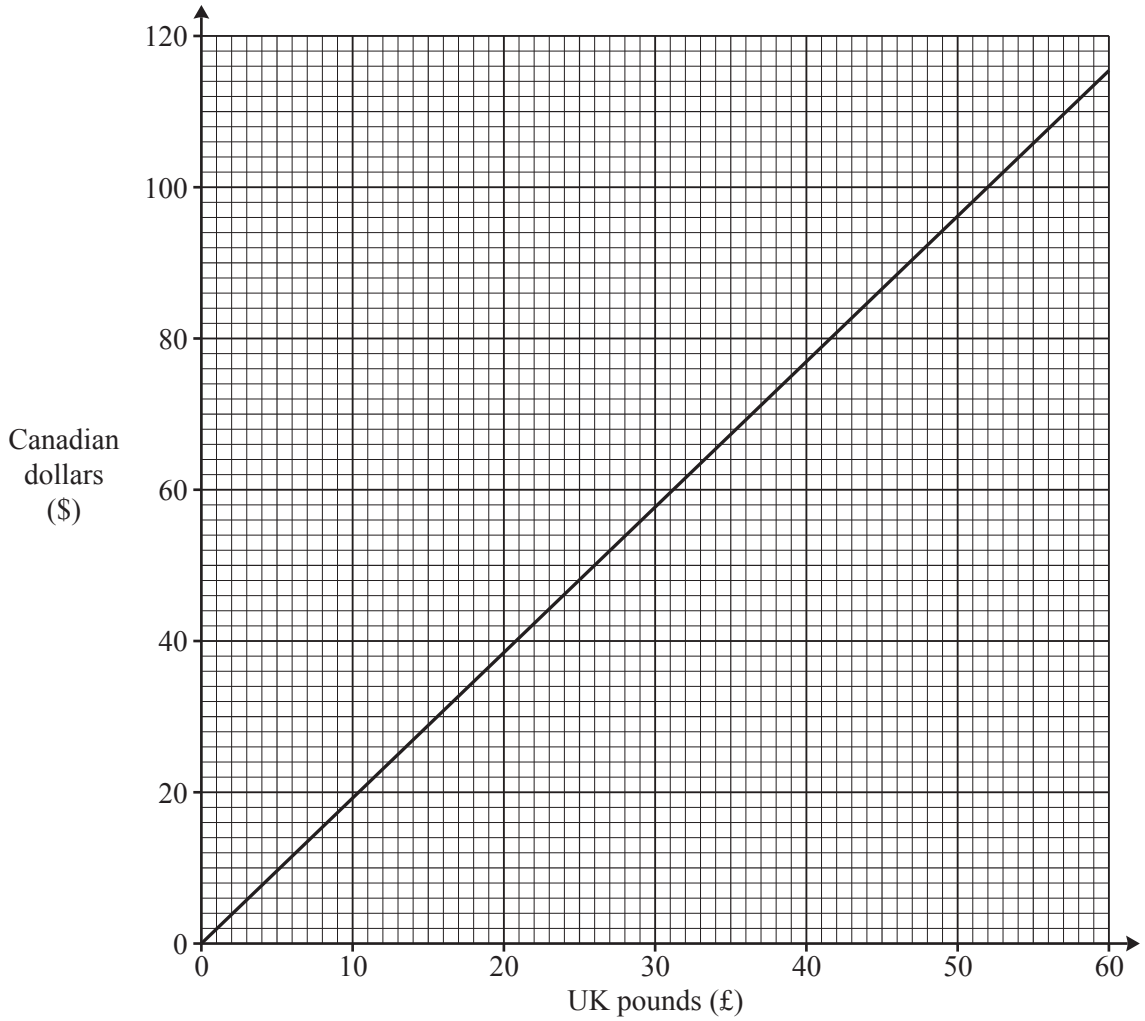
A Interview the first 60 people who come to the library on a Monday morning.

B Choose a page of the telephone directory at random and interview the first 60 people on the page.

C Interview 60 pupils in a local school.

D Write each of the 3200 users' names on a different piece of paper, put the 3200 pieces of paper in a box, shake it and select 60 pieces of paper.

11 The graph below is used to convert between UK pounds (£) and Canadian dollars ($) on one particular day.



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

A The gradient of the line is approximately 1.9.

B $60 is approximately equivalent to £31.

C £52 is approximately equivalent to $100.

D On another day, £200 is equivalent to $354. The line on the conversion graph for this exchange rate is steeper than the line on the graph above.

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

A $p^2 \times p^{-4} = \frac{1}{p^2}$

B $(3q^4)^2 = 3q^8$

C $\frac{x^6 \times x^3}{x^{-4}} = x^{13}$

D $y^0 = 1$

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

A $11.04\,\text{km} = 1.104 \times 10^6\,\text{cm}$.

B $275\,\text{cl} = 27\,500\,\text{ml}$.

C 400 mm is 16 inches, correct to the nearest inch.

D 150 lb is 68 kg, correct to the nearest kg.

14 Which **one** of the following is a **correct** simplification of $2(2x+3)-4(3x-5)$?

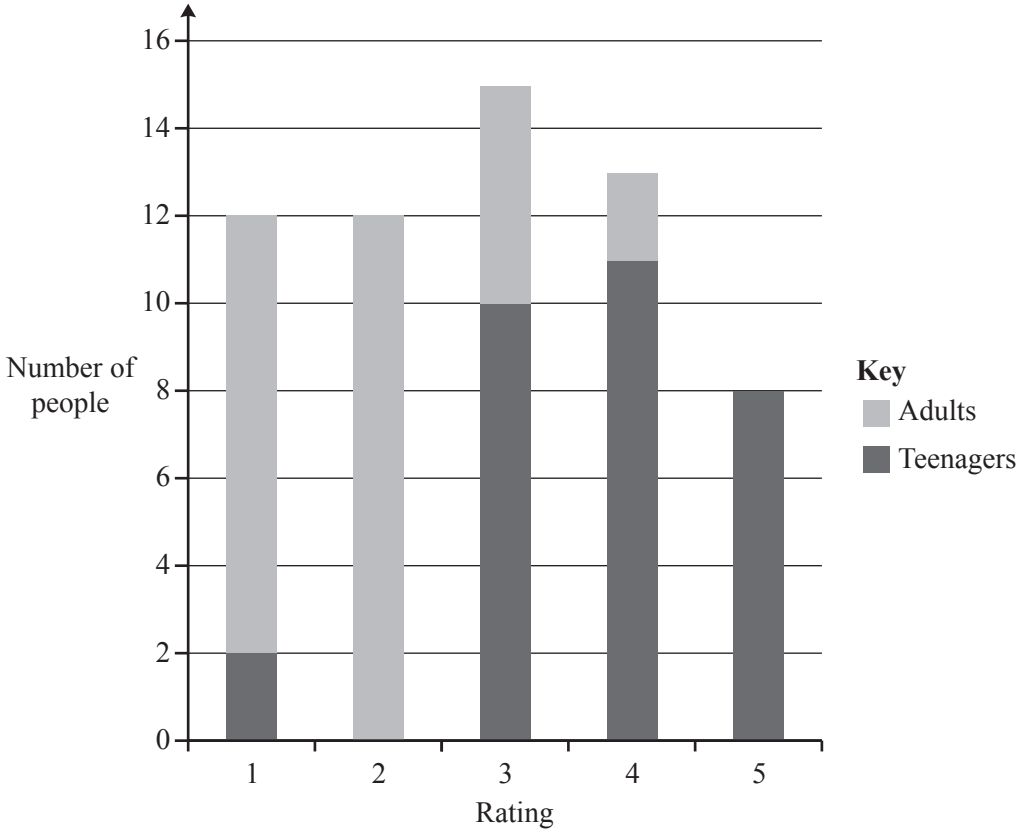
A $-8x-2$

B $8-8x$

C $-8x-26$

D $26-8x$

15 A group of teenagers and adults were asked to rate a music magazine on a scale from 1 to 5. The chart shows the results of the survey.



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

A A total of 50 people were asked to rate the music magazine.

B No teenager gave a rating of 2.

C There were 31 teenagers in the group.

D Twice as many teenagers as adults gave a rating of 3.

16 You are given the first five terms of a quadratic sequence with the incomplete difference table for the sequence.

Sequence	0	1	6	15	28	…..	…..
First difference		1	5	9	…..	…..	…..
Second difference			4	.....	.....	.....	…..

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

A Each second difference is 4.

B The value of the 6th term of the sequence is 45.

C The value of the 6th first difference is 25.

D The nth term of the quadratic sequence is $2n^2 - 5n + 3$.

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

A $(2x-4)(2x+4) = 4x^2 - 16$.

B The roots of the equation $x^2 - 2x - 15 = 0$ are $x = -5$ and $x = 3$.

C $(x+4)$ is a factor of $2x^2 + 7x - 4$.

D In the expression $5 - 6x + 8x^2 - x^3$ the coefficient of x^3 is –1.

18 In June last year, Abraham recorded the midday temperatures in his garden in degrees Celsius (°C), correct to the nearest degree. These temperatures are summarised in the table below.

Temperature (°C)	Frequency
16	5
17	8
18	2
19	4
20	6
21	2

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

A The mode is 17 °C.

B The mean is approximately 18 °C.

C The mode is greater than the median.

D Abraham did not record the temperature every day.

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

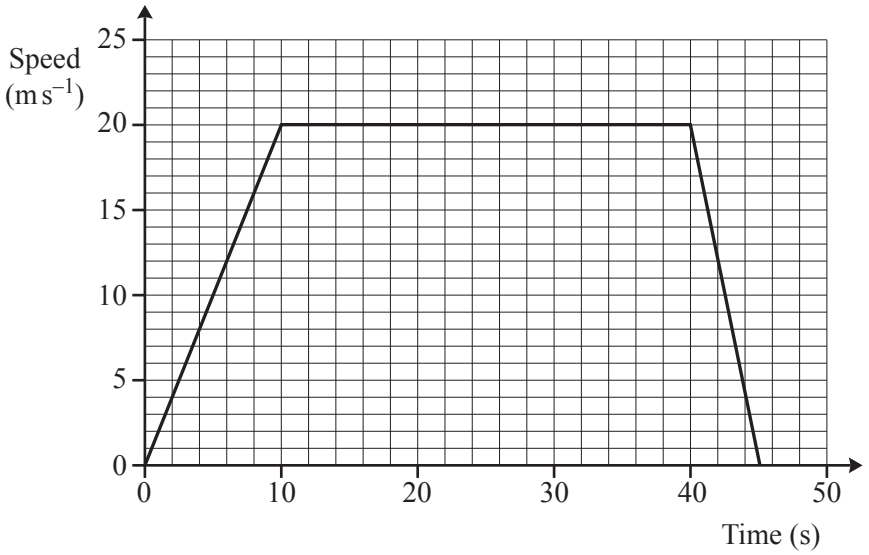
A 42 495 is 43 000, correct to the nearest 1000.

B 0.001 293 427 is 0.001, correct to 3 decimal places.

C 0.001 293 427 is 1.3×10^{-3}, correct to 2 significant figures.

D When 7.28×3.97 is calculated the answer is 29, correct to the nearest whole number.

20 The graph below shows the speed of a car as it travels between two sets of traffic lights.



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

A The car is travelling at a constant speed of 20 ms^{-1} between 10 and 40 seconds.

B The distance travelled in the first 10 seconds is 200 m.

C The acceleration of the car in the first 10 seconds was 2 ms^{-2}.

D The distance travelled at constant speed was 600 m.

21 Matt walks due South from his home. After 4 km he changes direction and walks 5 km East. From that point he runs directly back home in a straight line.

Which **one** of the following is the **correct** bearing for his direction (correct to the nearest degree) and the distance (correct to 1 decimal place) he runs to return home?

A 039° and 9.0 km

B 051° and 6.4 km

C 309° and 6.4 km

D 321° and 9.0 km

22 In a sale all suits are reduced by 25%. All prices in the sale are rounded to the nearest penny.

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

A A suit that cost £299.99 before the sale is now priced £224.99.

B In order to calculate the sale price, the original price is multiplied by 0.75 and rounded to the nearest penny.

C A suit costing £337.49 in the sale was £449.99 before the sale.

D In order to calculate the original from the sale price, the sale price is multiplied by 1.25.

23 Sunil rearranges the formula $y = 8 - \frac{1}{\sqrt{x}}$ to give $x = \frac{1}{(8-y)^2}$.

Kirsty rearranges the formula $s = \frac{t(u+v)}{2}$ to give $v = \frac{2s-u}{t}$.

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

A Both Sunil and Kirsty are correct.

B Sunil is correct and Kirsty is incorrect.

C Sunil is incorrect and Kirsty is correct.

D Both Sunil and Kirsty are incorrect.

24 Harneet and Chloe are playing a game with a spinner. It has five equal sections labelled 1 to 5.

- Each player spins once in each round and the player with the higher score wins the round. The loser receives no points.
- If the winner spins a 5, she receives 2 points.
- If the winner spins less than a 5, she receives 1 point.
- If both players spin the same number, including 5, both players receive no points.

In order to complete this question, you are advised to complete the following table to show Chloe's points in one round.

Harneet's score

Chloe's score	**1**	**2**	**3**	**4**	**5**
1	0	0	0	0	0
2	1	0	0	0	0
3	1				
4	1				
5	2				0

Chloe's points

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

A The probability that Chloe receives 1 point in the first round is $\frac{6}{25}$.

B The probability that Harneet receives 1 point in the first round is $\frac{6}{25}$.

C The probability that Chloe receives exactly 4 points in the first two rounds is $\frac{8}{25}$.

D The probability that there is no winner in the first round is $\frac{1}{5}$.

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

A $(x-4)^2 = x^2 + 16$

B $(2x-y)(4x+3y) = 8x^2 + 2xy - 3y^2$

C $3xy^3 + 6x^2y^2 = 3xy^2(y+2x)$

D $4xy(x+3y) = 4x^2y + 12xy^2$

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

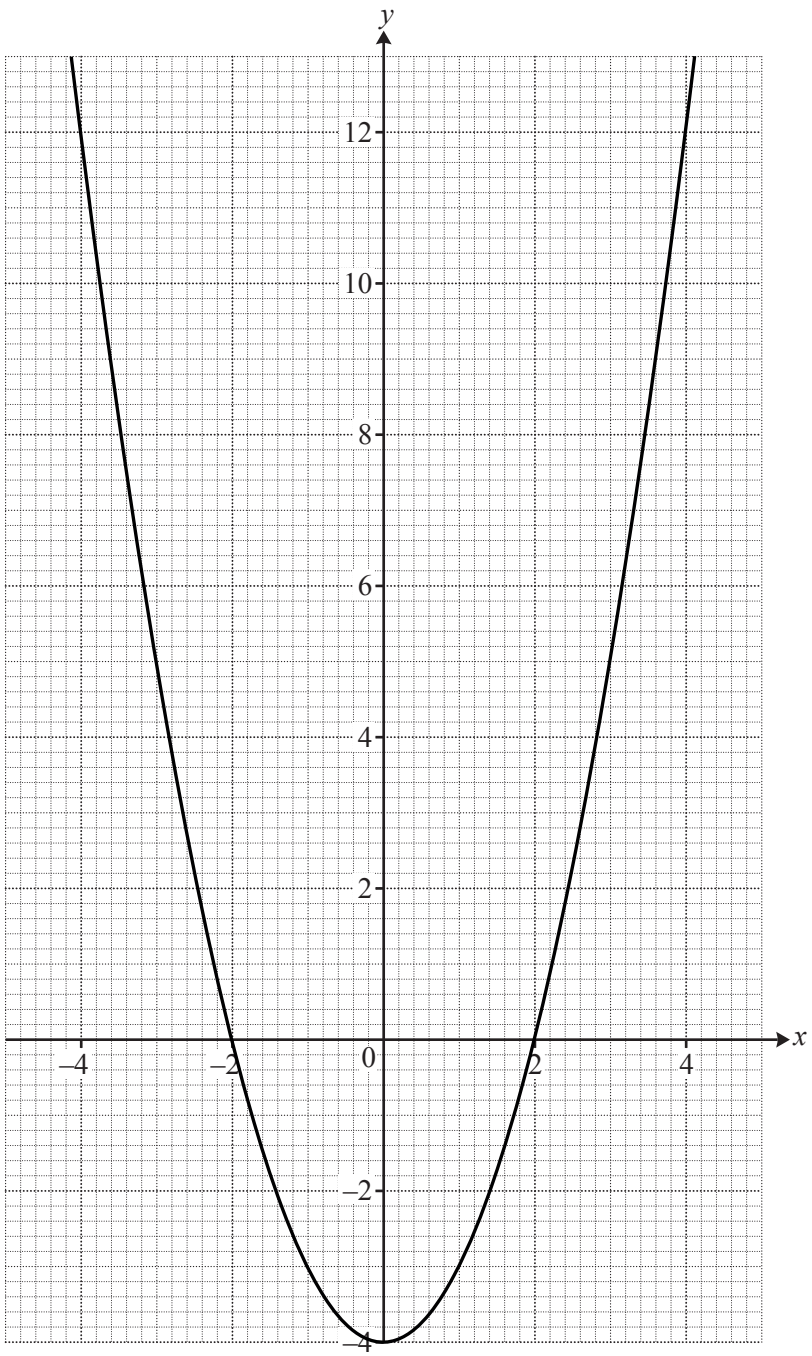
A $\frac{x+5}{12}$

B $x+5$

C $\frac{2x+15}{12}$

D $2x+15$

27 The graph below shows the curve of $y = x^2 - 4$.



In order to complete this question you are advised to draw the line $2x + 3y = 6$.

The line $2x + 3y = 6$ intersects the curve $y = x^2 - 4$ at P and Q.

Which **one** of the following gives the coordinates of P and Q correct to 1 decimal place?

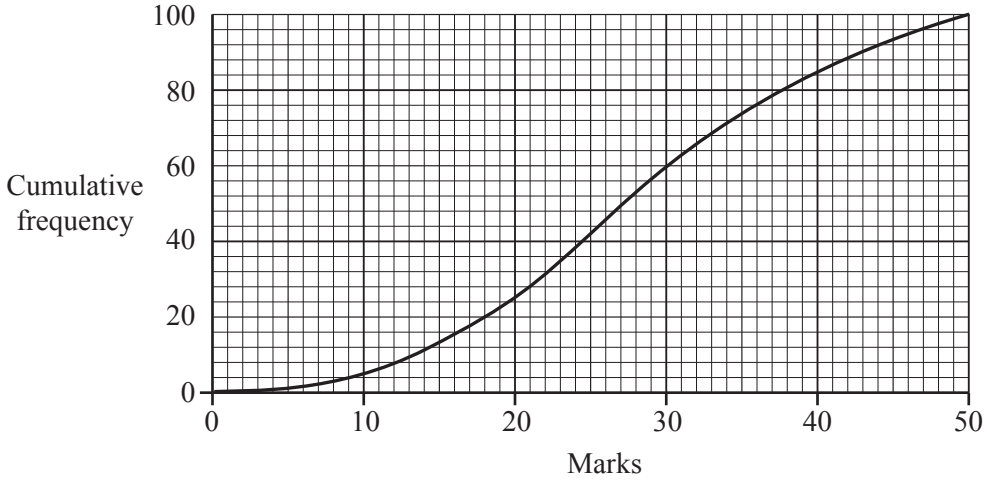
A (3.0, 0.0) and (0.0, 2.0)

B (–2.8, 3.9) and (2.1, 0.6)

C (2.8, 3.9) and (–2.1, 0.6)

D (2.0, 0.0) and (–3.5, 8.3)

28 The following graph summarises the marks out of 50 achieved by a group of students in an aptitude test for flying. The pass mark in the test was 70%.



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

A The median mark was approximately 27 marks.

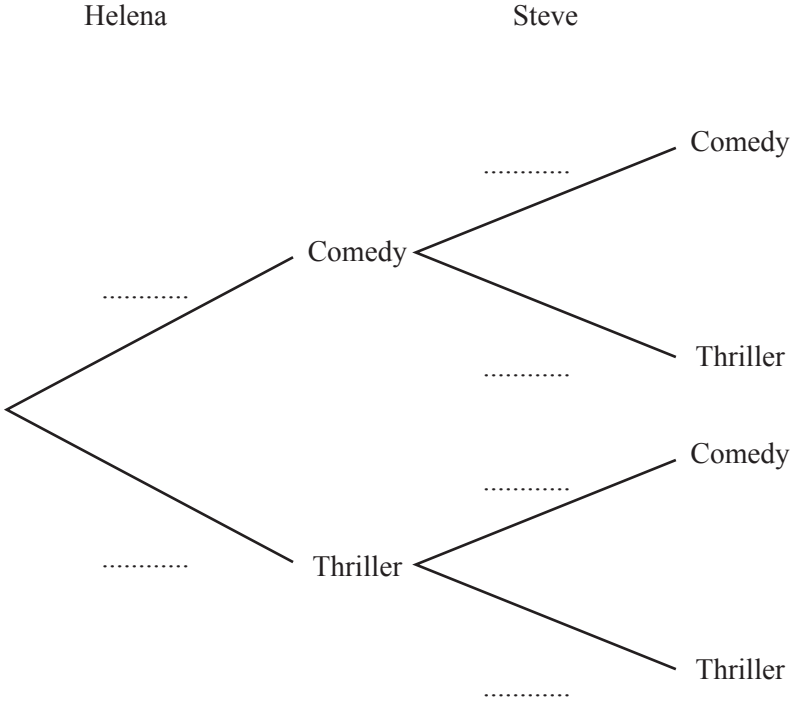
B There were 100 students in the group.

C The interquartile range was between 14 and 16.

D Approximately 74 students passed the test.

29 Helena owns 12 DVDs, 3 of which are thrillers and the rest are comedies. Steve owns 15 DVDs of which 10 are thrillers and the rest are comedies. They each independently select one of their DVDs at random to watch together over the weekend.

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



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

A The probability that they will watch two comedies is $\frac{1}{4}$.

B The probability that they will watch a comedy and a thriller is $\frac{7}{12}$.

C The probability that they will watch two films of the same kind is $\frac{5}{12}$.

D The probability that they that will not watch two thrillers is $\frac{1}{12}$.

30 Which **one** of the following are the **correct** roots (rounded to 2 decimal places) of the following equation?

$$3M^2 - 5M = 11$$

A $M = 2.92,\ M = -1.25$

B $M = -2.92,\ M = 1.25$

C $M = 2.92,\ M = 1.25$

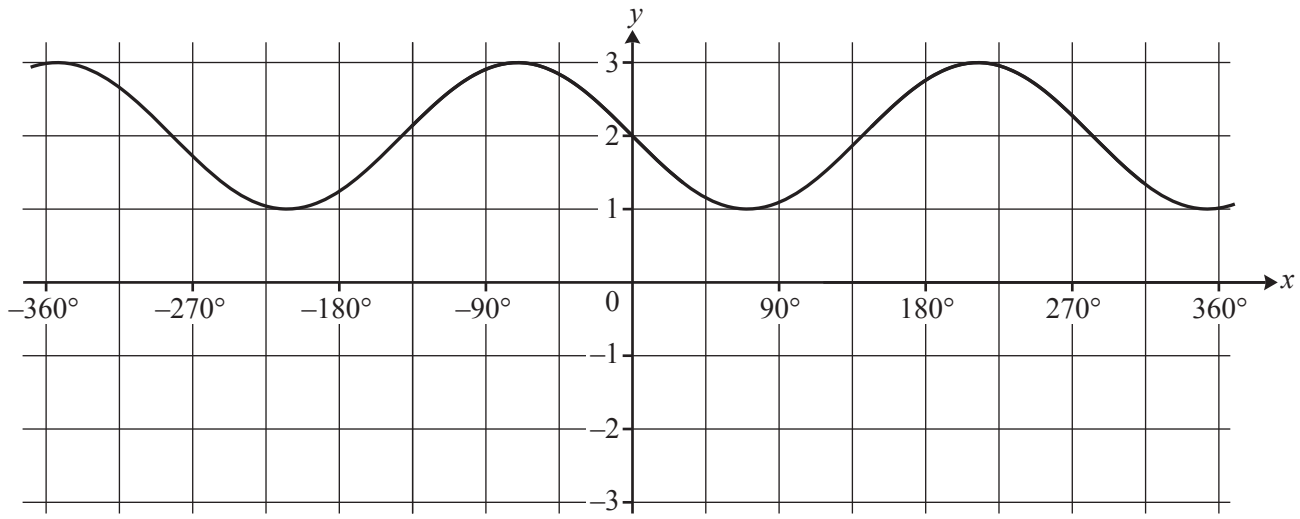
D $M = -2.92,\ M = -1.25$

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

A Given that θ is acute and $\sin\theta = \frac{3}{4}$, then $\tan\theta = \frac{3\sqrt{7}}{7}$.

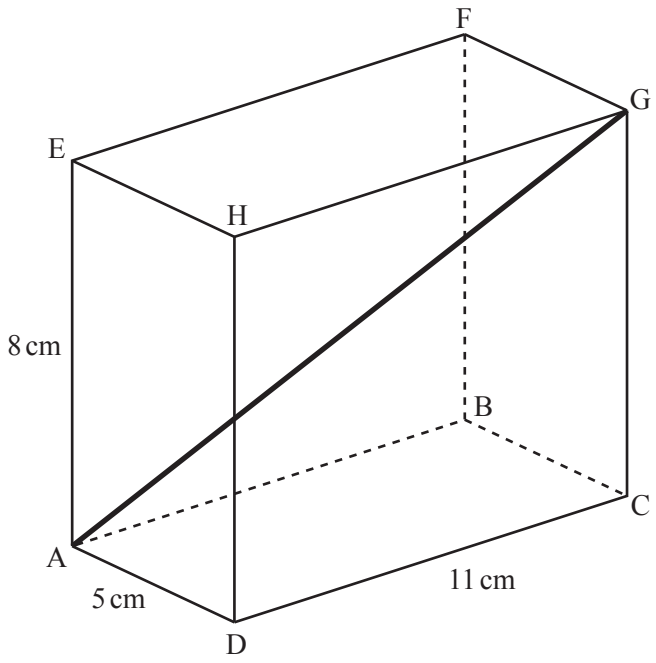
B $\cos(40°) = -\cos(-140°)$

C Part of the curve of $y = 2 + \sin x$ is shown below.



D The graph of $y = 1 + 3\cos x$ intersects the y-axis at $y = 4$.

32 The dimensions of the cuboid ABCDEFGH shown below are as follows.
AE = 8 cm, DC = 11 cm and AD = 5 cm.



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

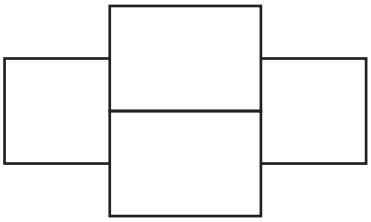
A The surface area of the cuboid is $0.366\,\text{m}^2$.

B The volume of the cuboid is $440\,000\,\text{mm}^3$.

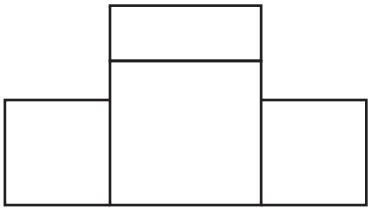
C The length of the diagonal AG is $\sqrt{5^2 + 11^2 + 8^2}$ cm.

D The angle GDC is 36° correct to the nearest degree.

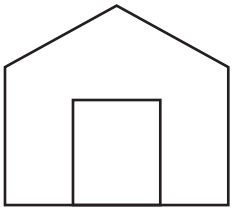
33 These are the plan and elevations of a building.



Plan View



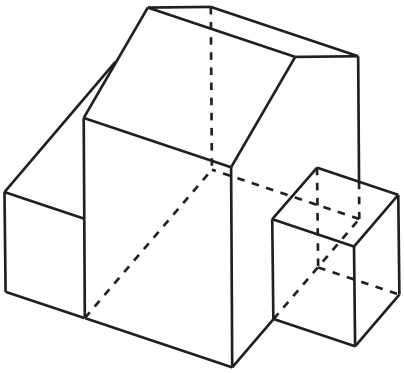
Front Elevation



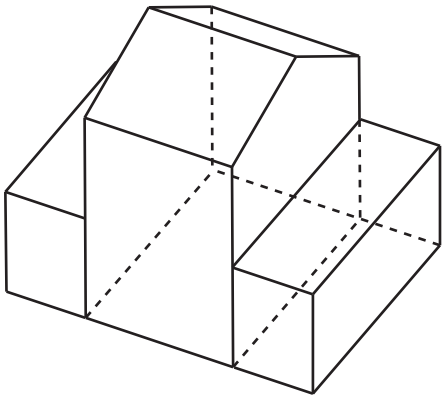
Side Elevation

Which **one** of the 3D shapes below is a **correct** representation of this building?

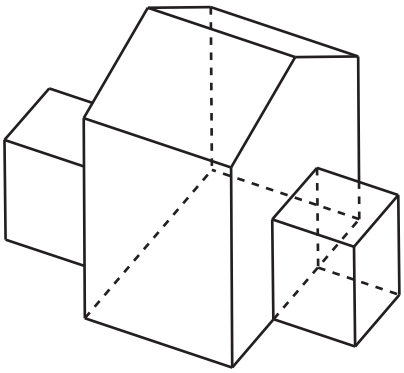
A



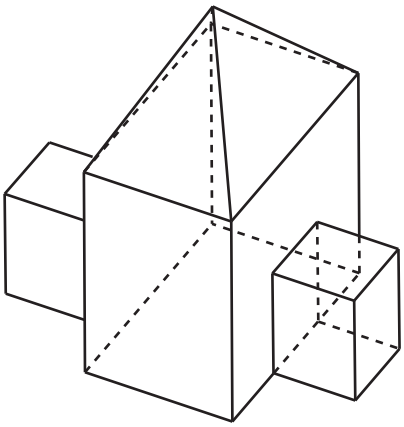
B



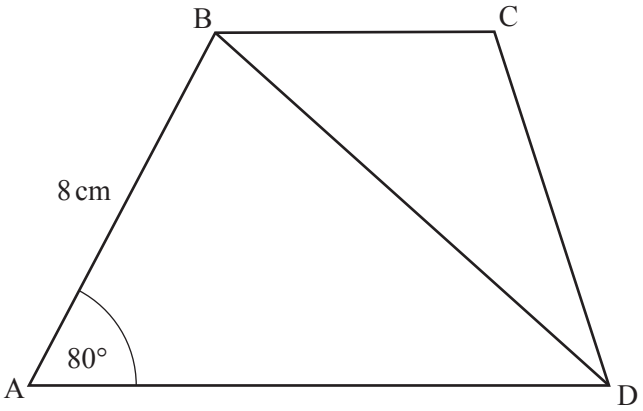
C



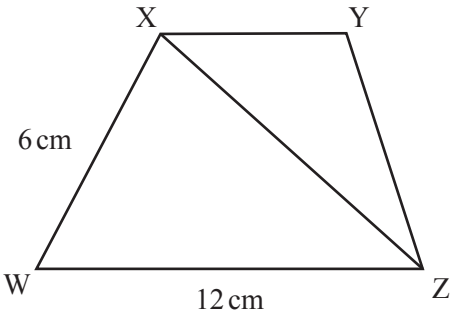
D



34 Quadrilaterals ABCD and WXYZ shown below are similar.



Not to scale



Not to scale

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

A The angle XWZ is 80°.

B The length AD is 16 cm.

C The ratio BD : XZ = 3 : 4.

D The area of quadrilateral WXYZ is $\frac{9}{16}$ of the area of quadrilateral ABCD.

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

A The line $y = 2x - 8$ crosses the x-axis at $x = 4$.

B The gradient of the line $3x - 4y + 5 = 0$ is 3.

C The line $y = 6$ does not cross the x-axis.

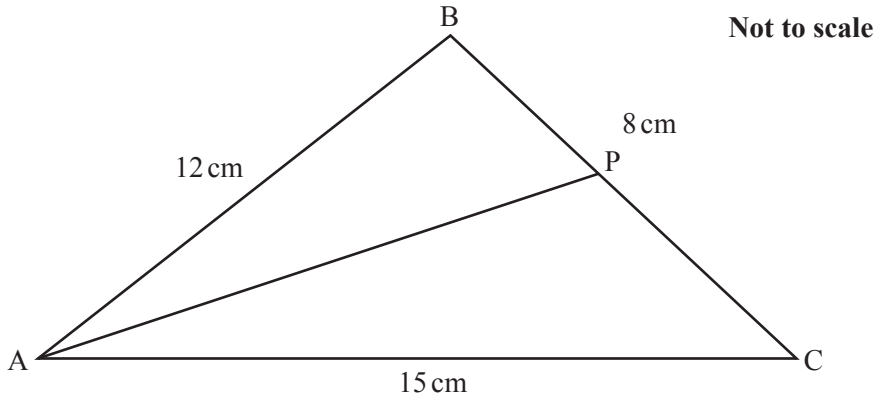
D The line $x = -\frac{15}{2}$ is parallel to the y-axis.

36 Triangle ABC is shown below.

AB = 12 cm, BC = 8 cm and AC = 15 cm.

P is a point on the line BC.

The line PA bisects the angle BAC so that angle BAP = angle PAC.



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

A $\cos \text{BCA} = \left(\frac{8^2 + 15^2 - 12^2}{2 \times 8 \times 15}\right)$

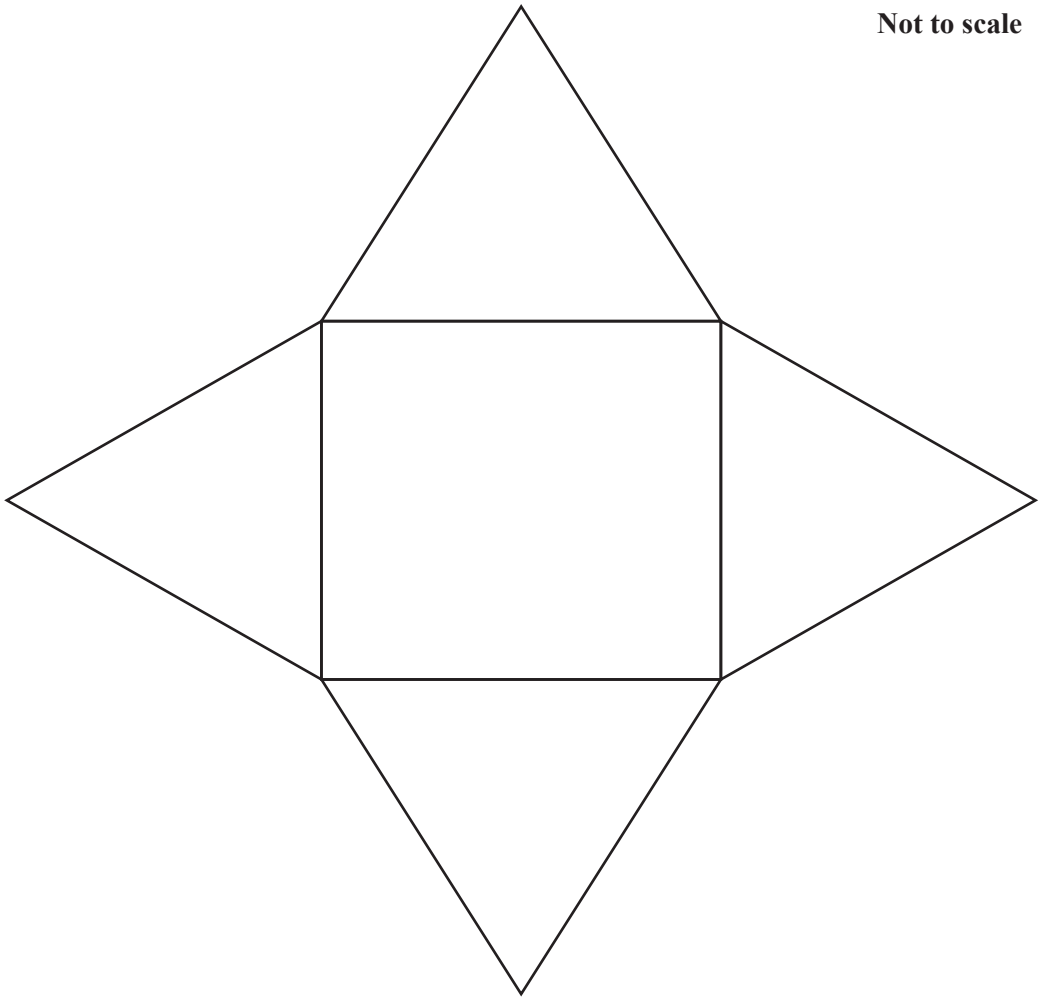
B BP = PC = 4 cm

C $\text{angle BPA} = 180° - \left(\text{angle PBA} + \frac{\text{angle BAC}}{2}\right)$

D $\text{area of triangle ABC} = \frac{1}{2} \times 15 \times 8 \times \sin \text{ACB}$

37 The net of a square-based pyramid is shown below. The area of the base is $36\,\text{cm}^2$. The four triangles in the net are equilateral.

Not to scale



Which **one** of the following is the **exact** total surface area of the pyramid?

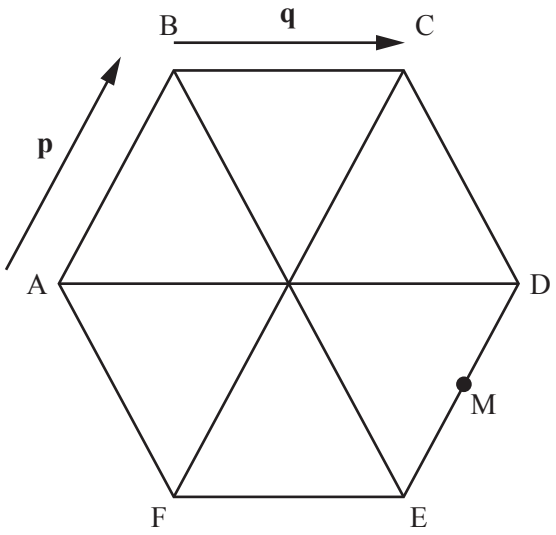
A $36(1+\sqrt{3})\,\text{cm}^2$

B $12(3+\sqrt{3})\,\text{cm}^2$

C $18(1+2\sqrt{3})\,\text{cm}^2$

D $6(3+2\sqrt{3})\,\text{cm}^2$

38 ABCDEF is a regular hexagon, where $\overrightarrow{AB} = \mathbf{p}$ and $\overrightarrow{BC} = \mathbf{q}$. M is the midpoint of DE.



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

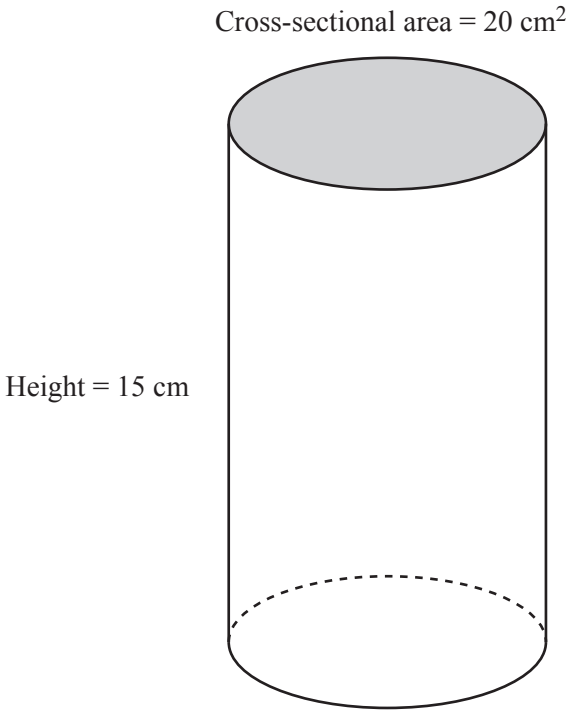
A $\overrightarrow{EB} = 2(\mathbf{p} - \mathbf{q})$

B $\overrightarrow{DA} = -2\mathbf{q}$

C $\overrightarrow{BM} = \frac{1}{2}(4\mathbf{q} - 3\mathbf{p})$

D $\overrightarrow{FM} = \frac{1}{2}(\mathbf{p} - 2\mathbf{q})$

39 The solid circular cylinder shown below has a cross-sectional area of $20\,cm^2$ and a height of 15 cm.



Which **one** of the following is the **correct** surface area of the cylinder correct to two significant figures?

A $640\,cm^2$

B $280\,cm^2$

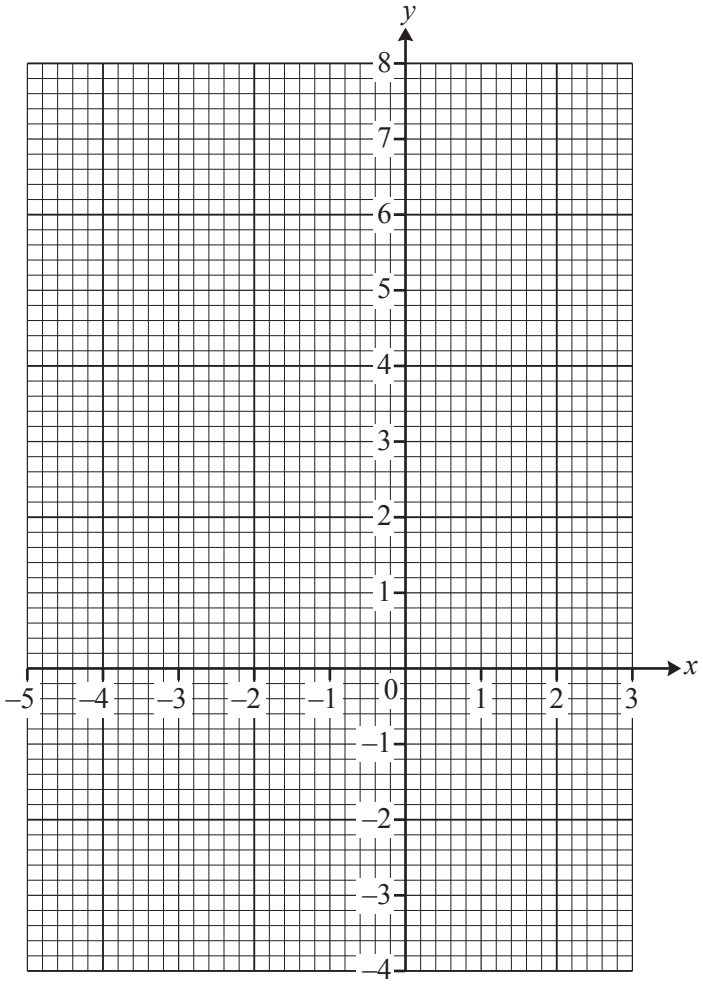
C $160\,cm^2$

D $340\,cm^2$

40 The incomplete table below shows some of the points lying on the curve of the graph of $y = 6 - 2x - x^2$.

x	–4	–3	–2	–1	0	1	2
y	–2	3			6		–2

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



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

A The equation $6 - 2x - x^2 = 0$ has 2 roots.

B The gradient of the curve is positive when $x = 0$.

C The maximum value of the curve occurs when $x = -1$.

D The area enclosed by the curve and the x-axis is between 22 and 28 square units.

END OF QUESTION PAPER