OCR
RECOGNISING ACHIEVEMENT

Thursday 19 January 2012 – Afternoon

FSMQ Intermediate Level

6989 **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.
* 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.**
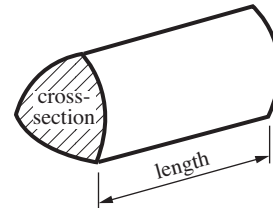
INFORMATION FOR CANDIDATES

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

OCR is an exempt Charity

Turn over

Formulae Sheet: 6989 Foundations of Advanced Mathematics

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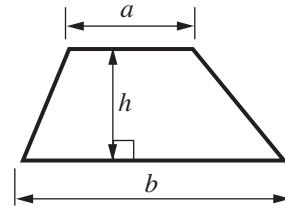
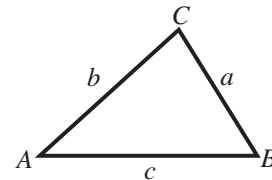**Volume of prism** = (area of cross-section) × length

In any triangle *ABC*

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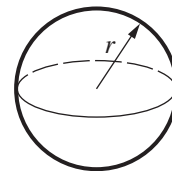
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$
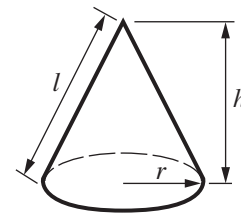
Area of triangle $= \frac{1}{2}ab \sin C$

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 $(-2)^3 = -8$

    B $\dfrac{(-40)}{(-5) \times (-2)} = -4$

    C $9 - 3 + 2 = 4$

    D $20 - 7 \times 2 = 6$

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

    A   There is only one prime number between 35 and 40.

    B   The square root of 20 is half the square root of 80.

    C   The highest common factor (HCF) of 60 and 132 is 4.

    D   The product of an odd number and an even number is always even.

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

    A $400 \, \text{mm}^2 = 40 \, \text{cm}^2$

    B $600 \, \text{g} = 0.6 \, \text{kg}$

    C $15 \, \text{m} \, \text{s}^{-1} = 54 \, \text{km} \, \text{h}^{-1}$

    D   80 centilitres $= 0.8$ litres

4   Three of the following statements are true and **one** is false. Which one is **false**?
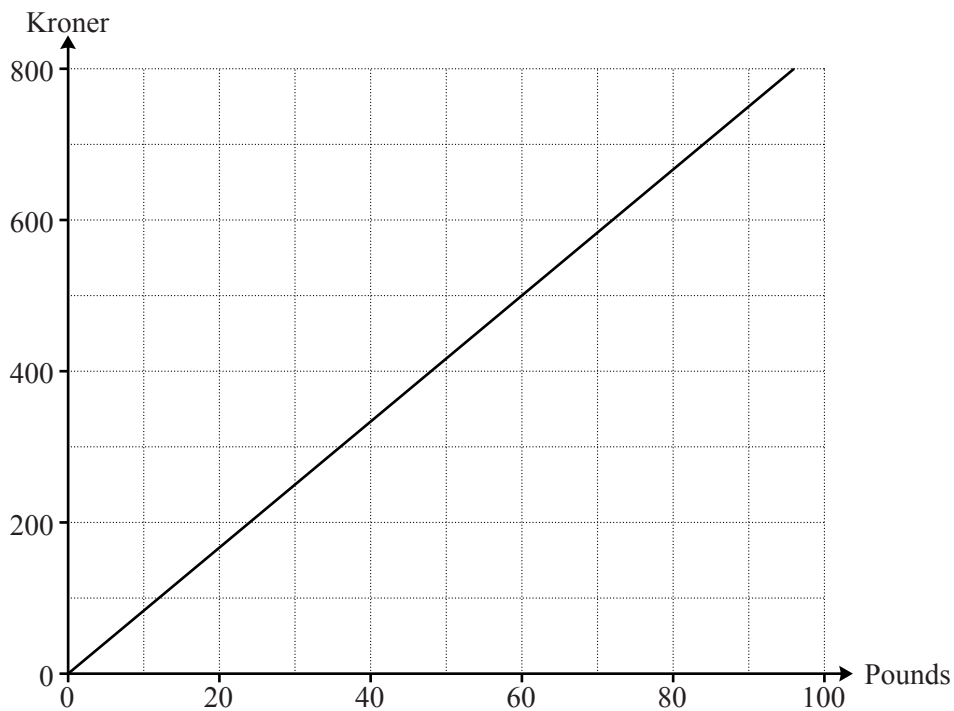
    A $\dfrac{964}{32.1} = 30$, correct to 1 significant figure.

    B $\dfrac{1}{13} = 0.077$, correct to 3 decimal places.

    C $\sqrt{44} = 7$, correct to the nearest integer.

    D $28\,496 = 29\,000$, correct to the nearest thousand.

5 The chart below shows the exchange rate between pounds (£) and Danish kroner on a particular day.

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

A £60 is worth the same as 500 kroner.

B £20 is worth more than 200 kroner.

C 8000 kroner is worth less than £1000.

D The gradient of the line is the number of kroner equivalent to one pound.

6 Fernando manages a large hotel at a Spanish holiday resort. He has 800 guests and wants to find out how satisfied they are with his hotel. He decides to interview 80 guests who have been selected randomly.

Which **one** of the following will produce the required sample?

A The first 80 guests to arrive for breakfast one morning.

B There are 80 guests from London. Interview all of them.

C Interview the 80 guests who have been at the hotel for the longest period of time.

D Write the name of each guest on a piece of paper, put the 800 pieces of paper into a hat, mix them up and pick out 80 names.

7 Sophie is attempting to solve the equation $5(x + 2) - 4(3x - 1) = 42$.

Her working is shown in the four steps below, but her final answer is incorrect.

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

A $5x + 10 - 12x + 4 = 42$

B $-7x + 14 = 42$

C $-7x = 56$

D $x = 8$

8 Rachel is investigating the number of people who use her local bus stop. She records the number of passengers getting on each bus.

2 4 5 1 2 3 0 6 3 2 1 7 3 2 0 1 6 4 2 3 1 4

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

Number of people getting on a bus	Tally	Frequency
0		
1		
2		
3		
4		
5		
6		
7		

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

A   The number of buses in Rachel's investigation is 22.

B   The median is 2.5.

C   The mode is 2.

D   The range is 8.

9 You are given that $a = -2$, $b = 7$ and $c = -3$.

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

A $a - b - c = -6$

B $b(a + c) = -35$

C $ac^2 = 36$

D $\dfrac{b + 2}{c} - \dfrac{c + 1}{a} = -4$

10 Three of the following statements are true and **one** is false. Which one is **false**?
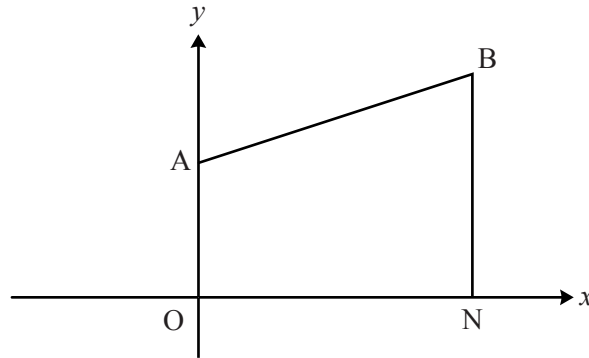
A $x(x + 2) + 1$ is equal to $(x + 1)^2$ for all values of x.

B In the expression $4x^3 - 5x^2 - 7x + 2$, the coefficient of x is 7.

C In the expression $4 + 7x - 2x^2$, the constant term is 4.

D The expression $x^2 + 9$ is a quadratic expression.

 Turn over

11 In the diagram below, O is the origin, N has coordinates $(4, 0)$, BN is perpendicular to the x-axis and the equation of AB is $2y = x + 6$.

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

A The coordinates of A are $(0, 3)$.

B The coordinates of B are $(4, 5)$.

C The gradient of the line AB is 1.

D The area of the trapezium OABN is 16 units^2.

12 Keaton is investigating the probability of snow falling in his garden in December.
He has collected data for the last 20 years and finds that snow has fallen on 31 of the 620 December days.

Keaton assumes that snowy days occur independently of one another.

On the basis of these data, three of the following statements about next December are true and **one** is false. Which one is **false**?

A The probability that snow will not fall on 15 December is 0.95.

B The probability that snow will fall on both of the first two Saturdays of December is less than 0.01.

C The probability that snow will fall on the first day of December but not the last is 0.0475.

D Snow will fall on exactly one day in December.

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

    A $(4x^2)^3 = 64x^6$

    B $\dfrac{16x^{12}}{2x^4} = 8x^8$

    C $2x^5 \times 3x^{-1} \times 4x = 24x^4$

    D $7x^{-2} = \dfrac{7}{x^2}$

14 Anna, Bridie and Charlie share lottery winnings of £90 000 in the ratio 8:7:5.

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

    A   Anna gets two fifths of the winnings.

    B   Bridie gets less than one third of the winnings.

    C   Charlie gets 25% of the winnings.

    D   Bridie gets £9000 more than Charlie.

15 Which **one** of the following statements is most likely to be **true**?

    A   A car is between 4 and 6 metres in length.

    B   A box of 6 eggs from a supermarket has a mass of about 1.5 kg.

    C   A bottle of lemonade contains about 10 litres.

    D   In a year London has between 200 and 400 hours of sunshine.

16 A rectangular mat is 120 centimetres long and 80 centimetres wide, both correct to the nearest centimetre.

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

    A   The length of the mat is less than 120.5 centimetres.

    B   The minimum possible width of the mat is 79.5 centimetres.

    C   The area of the mat is less than 9700.25 square centimetres.

    D   The minimum possible perimeter of the mat is 399.5 centimetres.

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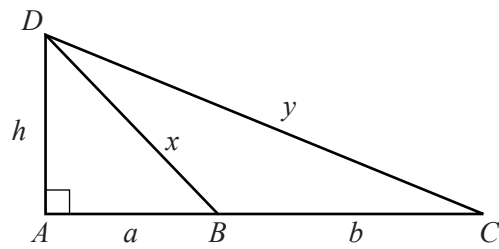
Three of the following statements are true and **one** is false. Which one is **false**?

A $\tan ADB = \dfrac{a}{h}$

B The area of triangle BCD is $\frac{1}{2}bh$.

C $h = \sqrt{y^2 - a^2 - b^2}$

D $\dfrac{x}{\sin BCD} = \dfrac{y}{\sin CBD}$

18 When the expressions in **A**, **B**, **C** and **D** are factorised, three of them have a factor in common.

Which **one** does **not** have this common factor?

A $x^2 + 2x - 15$

B $x^2 - 9$

C $x^2 - x - 6$

D $x^2 + 2x - 3$

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

A $\quad 0.000\,009\,7 = 9.7 \times 10^{-6}$

B $\quad 3 \times 10^{-3} + 4 \times 10^{-4} = 3.4 \times 10^{-3}$

C $\quad (5 \times 10^8) \times (8 \times 10^5) = 4 \times 10^{14}$

D $\quad (2 \times 10^3) \div (4 \times 10^{-2}) = 5 \times 10^6$

20 Joshua and Luke have each worked out their answers to these four questions from an exercise on fractions.

(i) $\quad 1\frac{7}{8} + 3\frac{2}{3}$ **(ii)** $\quad 8\frac{3}{10} - 2\frac{3}{4}$ **(iii)** $\quad \frac{5}{9}$ of 10 **(iv)** $\quad 15 \div 2\frac{3}{4}$

- Joshua claims that all four answers lie between 5 and 6.
- Luke claims that when the answers are expressed as decimals exactly two of the four answers will terminate.

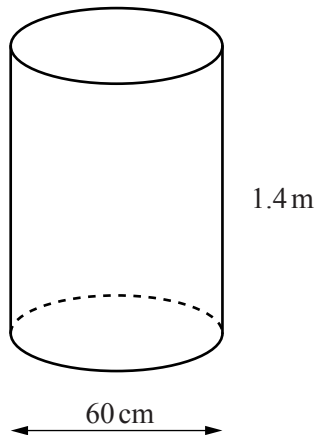Which **one** of the following statements is **true**?

A Joshua and Luke are both correct.

B Joshua is correct and Luke is incorrect.

C Joshua is incorrect and Luke is correct.

D Joshua and Luke are both incorrect.

21 A cylindrical open-topped tank, with its base horizontal, collects rain water. The tank has a diameter of 60 cm and a height of 1.4 m.

1.4 m

60 cm

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

A The ratio of the diameter to the height is 3:7.

B The external curved surface area of the tank is approximately $2.64\,\text{m}^2$.

C The capacity of the tank exceeds 400 litres.

D The volume of water in the tank is directly proportional to the depth of water.

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

A A 30% discount is a smaller reduction than $\frac{1}{3}$ off the price.

B A pair of trainers costs £80 including VAT at 20%. The amount of VAT included in the price is £16.

C The angles of a pie chart are in the ratio 7:5:4:2. The smallest sector has an angle of 40°.

D A probability of $\frac{1}{7}$ is less than a probability of 0.15.

23   Which **one** of the following is the **correct** solution of the equation $3x^2 - 15x = 8$?

A $\dfrac{15 \pm \sqrt{321}}{6}$ **B** $\dfrac{-15 \pm \sqrt{321}}{6}$ **C** $\dfrac{15 \pm \sqrt{129}}{6}$ **D** $\dfrac{-15 \pm \sqrt{129}}{6}$

24   Three vectors are given by $\mathbf{x} = \begin{pmatrix} -4 \\ 0 \end{pmatrix}$, $\mathbf{y} = \begin{pmatrix} 7 \\ 3 \end{pmatrix}$ and $\mathbf{z} = \begin{pmatrix} 1 \\ -5 \end{pmatrix}$.

Which **one** of the following is **equal** to $3\mathbf{x} - \mathbf{y} + 4\mathbf{z}$?

A $\begin{pmatrix} -15 \\ -23 \end{pmatrix}$ **B** $\begin{pmatrix} -15 \\ -20 \end{pmatrix}$ **C** $\begin{pmatrix} -15 \\ -17 \end{pmatrix}$ **D** $\begin{pmatrix} -15 \\ -8 \end{pmatrix}$

25 This question is about the gradient of the curve $y = \dfrac{60}{x}$.

In order to complete this question you are advised to draw the graph of $y = \dfrac{60}{x}$,

from x = 1 to x = 6, on the grid below.
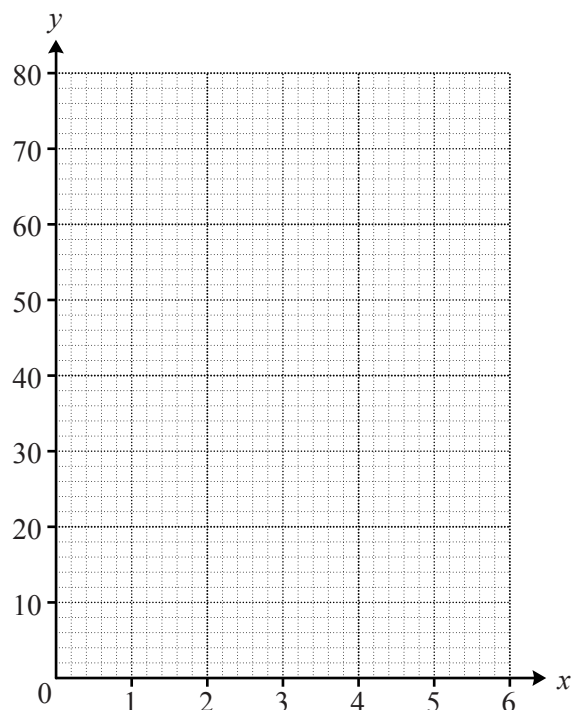
Which **one** of the following is the **best** estimate of the gradient of the curve $y = \dfrac{60}{x}$ when $x = 3.5$?

A   −5   **B**   −0.5   **C**   0.5   **D**   5

26 Here is a pair of simultaneous equations.

$$2x - y = 14$$
$$4x + 5y = 7$$

Which **one** of the following **correctly** describes their solution?

A   Both x and y are positive.

B x is positive but y is not.

C y is positive but x is not.

D   Neither x nor y is positive.

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

A $y = 3x - 4$ can be rearranged to give $x = \dfrac{y+4}{3}$.

B $\dfrac{a}{c} = \dfrac{h}{k}$ can be rearranged to give $c = \dfrac{ka}{h}$.

C $E = \dfrac{1}{2}mv^2$ can be rearranged to give $v = \pm\sqrt{\dfrac{2E}{m}}$.

D $x = \dfrac{\sqrt{y+9}}{4}$ can be rearranged to give $y = 4x^2 - 9$.

28 You are given the vectors $\mathbf{a} = \mathbf{i} + \mathbf{j}$, $\mathbf{b} = -4\mathbf{i} + 3\mathbf{j}$ and $\mathbf{c} = -8\mathbf{i} + 6\mathbf{j}$.

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

A The vector $\mathbf{a}$ is a unit vector.

B The vectors $\mathbf{b}$ and $\mathbf{c}$ have the same direction.

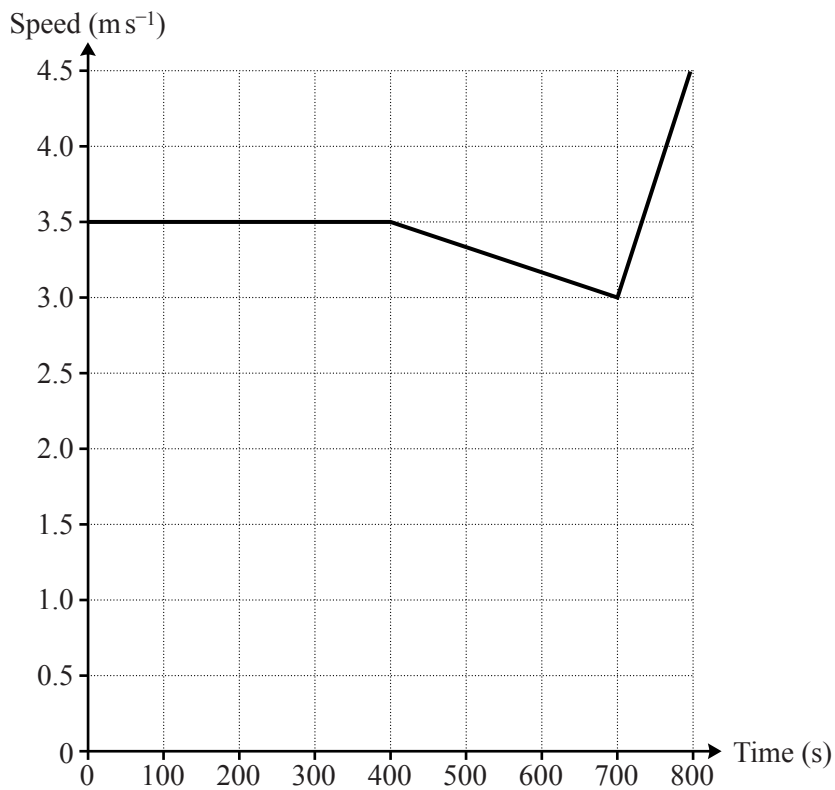**C** The angle between vectors $\mathbf{c}$ and $\mathbf{i}$ is approximately $143.1°$.

D $4\mathbf{a} + \mathbf{b} = 7\mathbf{j}$

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

    A   The solution of $2y + 11 < 5$ is $y < -3$.

    B   The solution of $y \leqslant 4(y - 3)$ is $y \geqslant 4$.

    C   The solution of $4 - \dfrac{y}{2} \geqslant 0$ is $y \geqslant 8$.

    D   The solution of $y + 1 - (2y + 3) < 0$ is $y > -2$.

30 This graph shows the speed of a runner when taking part in a race.

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

    A   The runner travels at constant speed for more than 6 minutes.

    B   8 minutes after the start of the race the runner is decelerating.

    C   During the final minute of the race the runner is accelerating at $0.015 \, \mathrm{m\,s^{-2}}$.

    D   The distance of the race is $2.5 \, \mathrm{km}$.

31 Three of the following statements are true and **one** is false. Which one is **false**?
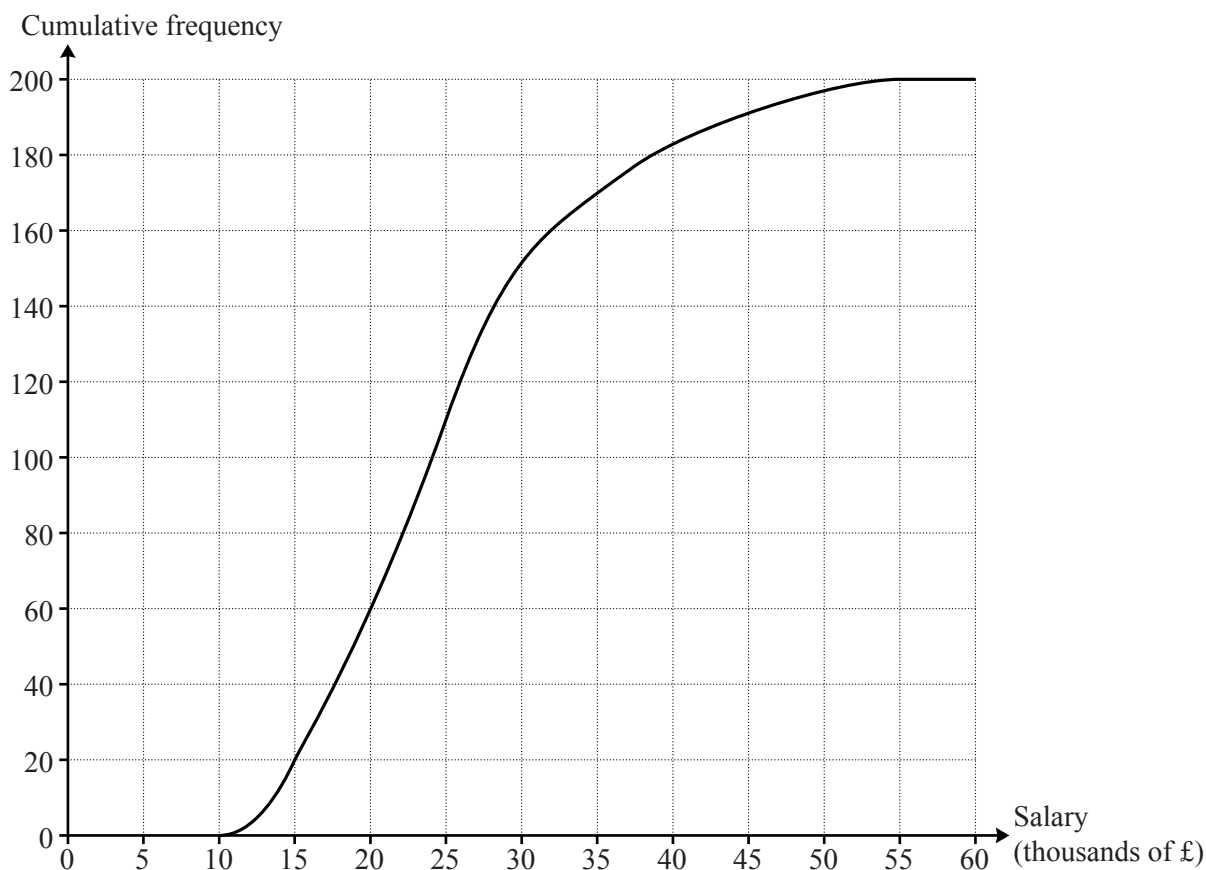
    A $(3x - y)(4x + 7y) = 12x^2 + 17xy - 7y^2$

    B $(5x + y)^2 = 25x^2 + y^2$

    C $10x^3y^3 - 6x^5y^2 = 2x^3y^2(5y - 3x^2)$

    D $4x(x + 3) - 3x(x - 2) = x^2 + 18x$

32 Ramandeep owns a business with 200 employees. She draws this cumulative frequency curve for the salaries of her employees.

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

    A   The median is approximately £24 000.

    B   The interquartile range is approximately £6000.

    C   More than a quarter of the employees have a salary below £20 000.

    D   Approximately 5% of the employees have a salary above £45 000.

33 ABCDEF is a triangular prism where ABC is an isosceles triangle.
AB = AC = 10 cm, BC = 12 cm and AD = 15 cm. M is the midpoint of EF.
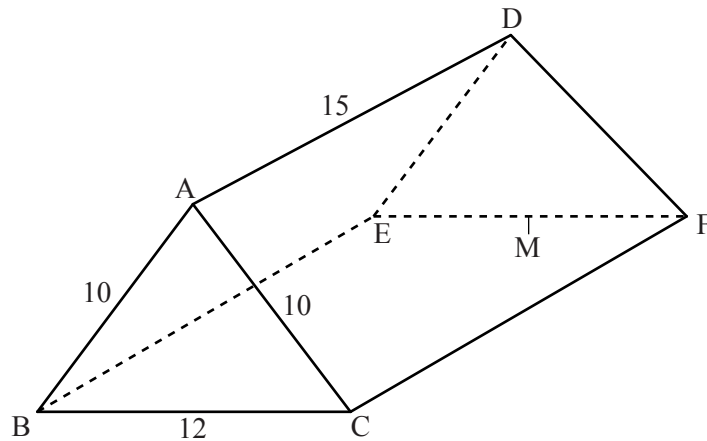
Three of the following statements are true and **one** is false. Which one is **false**?

A Angle BAC = 73.7°, correct to 1 decimal place.

B AM = 17 cm.

C AE, AF, DB and DC are all equal.

D The volume of the prism is 1440 cm³.

34 The production time for an item is obtained by adding together the manufacturing time and the checking time. It takes m minutes to manufacture an item and s seconds to check an item. T is the total time in hours required to produce x thousand items.

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

A $T = \dfrac{x}{1000}\left(\dfrac{m}{60} + \dfrac{s}{3600}\right)$

B $T = 1000x\left(\dfrac{m}{60} + \dfrac{s}{3600}\right)$

C $T = \dfrac{x}{1000}(60m + 3600s)$

D $T = 1000x(60m + 3600s)$

35 This map shows an island drawn on a centimetre square grid. The scale is 1:50 000.
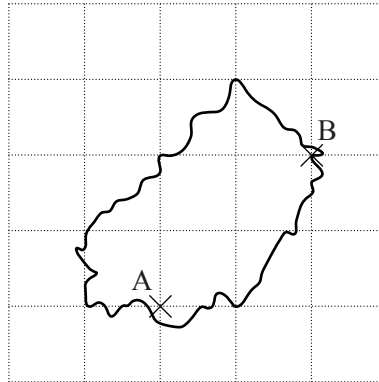
Three of the following statements are true and **one** is false. Which one is **false**?

A A length of 1 cm on the map corresponds to a length of 500 metres on the island.

B The actual distance between A and B is about 1.4 km.

C An area of $2\,cm^2$ on the map corresponds to an actual area of $100\,000\,cm^2$.

D On the map the area of the island is between 5 and $7\,cm^2$.

36 Clare, Dina, Edward, Freddie, Gary and Harriet are the six members of a group working on a project. They decide to choose a chairperson and a secretary for team meetings by putting the 6 names into a hat and drawing two out. The first name drawn will be the chairperson and the second name drawn will be the secretary.
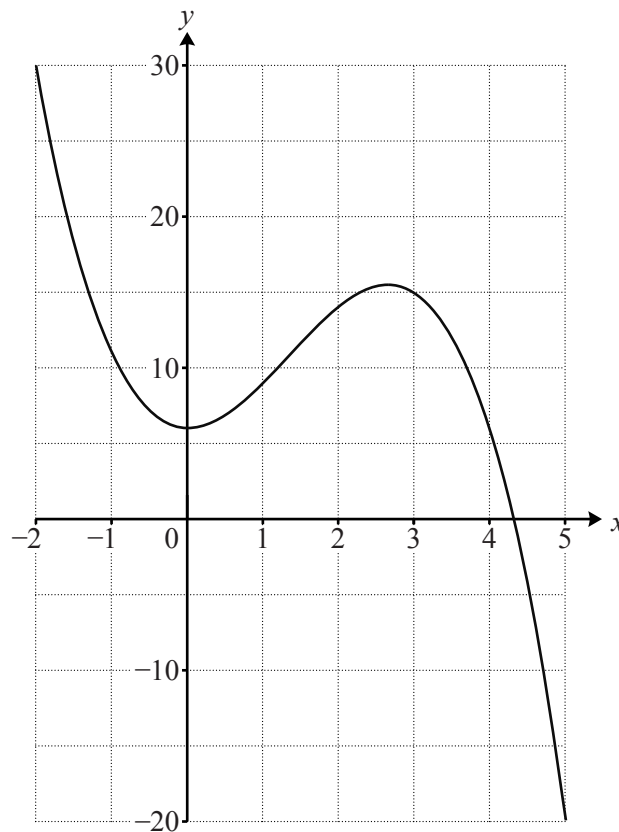
Three of the following statements are true and **one** is false. Which one is **false**?

A The probability that Freddie will be chairperson is $\frac{1}{6}$.

B The probability that Dina will be secretary is $\frac{1}{5}$.

C The probability that Clare will be chairperson and Gary will be secretary is $\frac{1}{30}$.

D The probability that Harriet will be neither chairperson or secretary is $\frac{2}{3}$.

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

   A $\cos 160° = \cos 200°$.

   B $\theta = 150°$ is a root of the equation $\sin\theta = 0.5$.

   C   For $0° < \theta < 45°$, $0 < \tan\theta < 1$.

   D   For $0° < \theta < 360°$, $\sin\theta$ and $\cos\theta$ always take different values.

38 The diagram shows part of the graph of $y = 6 + 4x^2 - x^3$.

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

   A   The least value of $6 + 4x^2 - x^3$ occurs at $x = 0$.

   B   The gradient of the curve $y = 6 + 4x^2 - x^3$ is negative at $x = 3.5$.

   C   The equation $6 + 4x^2 - x^3 = 0$ has exactly one positive root.

   D   The equation $6 + 4x^2 - x^3 = k$ has exactly one root if $k > 17$.

39 Amy and Andrew are studying algebraic fractions.

- Amy claims that $\dfrac{x-2}{3} - \dfrac{x}{5}$ can be simplified to $\dfrac{2x-10}{15}$.

- Andrew claims that $\dfrac{3x}{4} - \dfrac{5x-1}{8}$ can be simplified to $\dfrac{x-1}{8}$.

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

A   Amy and Andrew are both correct.

B   Amy is correct and Andrew is incorrect.

C   Amy is incorrect and Andrew is correct.

D   Amy and Andrew are both incorrect.

40 Teneisha has been given the first five terms of a quadratic sequence. She finds the first differences and the second differences as shown below.

Sequence   4   15   32   55   84   …   …

First difference   11   17   23   29   …   …

Second difference   6   6   6   …   …

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

A   The next number in the first difference row is 35.

B   The seventh term in the sequence is 160.

C   The 10th term of the sequence is an odd number.

D   The nth term in the sequence is given by $3n^2 - 2n + 3$.