



Oxford Cambridge and RSA

Friday 12 January 2018 – Afternoon

FSMQ INTERMEDIATE LEVEL

6989/01 Foundations of Advanced Mathematics (MEI)



Candidates answer on the Answer Sheet.

OCR supplied materials:

- Answer Sheet (MS4)

Duration: 2 hours

Other materials required:

- Eraser
- Scientific calculator
- Soft pencil
- Ruler



INSTRUCTIONS TO CANDIDATES

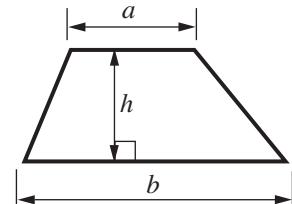
- Write your name clearly in capital letters, your centre number and candidate number on the Answer Sheet in the spaces provided unless this has already been done for you.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do **not** write in the bar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

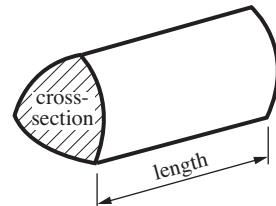
- Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
- This document consists of **28** pages. Any blank pages are indicated.

Formulae Sheet: 6989 Foundations of Advanced Mathematics

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



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

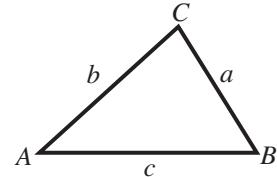


In any triangle ABC

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

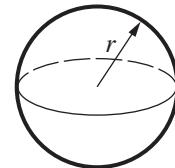
$$\text{Cosine rule} \quad a^2 = b^2 + c^2 - 2bc \cos A$$

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



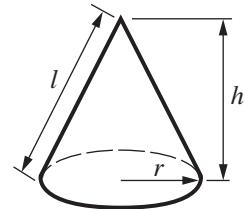
$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

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



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

$$\text{Curved surface area of cone} = \pi r l$$



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 79 is a prime number.
- B The cube of 3 is 27.
- C The cube root of 64 is 4.
- D The reciprocal of $\frac{1}{3}$ is 0.3.

2 Which **one** of the following has the **largest** value?

- A 72% of 200
- B One third of 426
- C 35 divided by $\frac{1}{4}$
- D $\sqrt{19500}$

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

- A $\frac{5+3\times7}{1+2\times3+6} = 2$
- B $(-2)\times(-3)+7 = 1$
- C $(-4)-(-5) = 1$
- D $(-3)^3 = -27$

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

A $\frac{2}{3} \times \frac{3}{4} = \frac{1}{2}$

B $\frac{2}{3} + \frac{3}{4} = \frac{5}{7}$

C $2\frac{5}{6} - 1\frac{1}{2} = 1\frac{1}{3}$

D $\frac{4}{7} \div \frac{9}{14} = \frac{8}{9}$

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

A $9^5 \div 3^2 = 3^3$

B $3^3 \div 3^5 = 3^{-2}$

C $4^3 \times 3^3 = 12^3$

D $5^3 + 5^2 = 150$

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

A $13\ 500\ 000 = 1.35 \times 10^7$

B $3 \times 10^4 + 4 \times 10^3 = 7 \times 10^7$

C $(5 \times 10^4) \times (4 \times 10^5) = 2 \times 10^{10}$

D $(6 \times 10^4) \div (1.2 \times 10^{-2}) = 5 \times 10^6$

7 A sum of money is split in the ratio 9:13. The larger share is £6500.

Which **one** of the following is the correct value for the sum of money that is split?

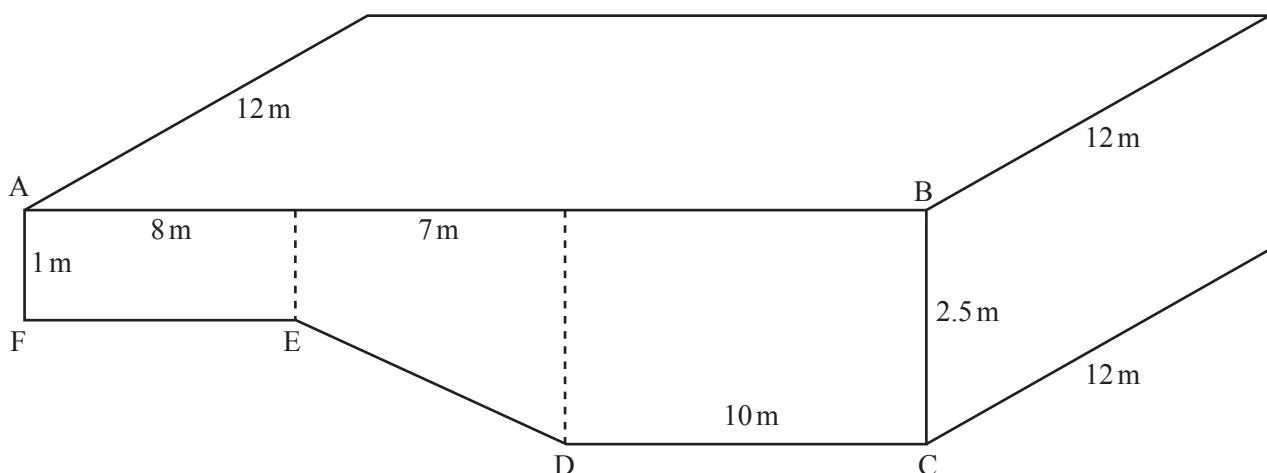
- A £11 000
- B £84 500
- C £9389 to the nearest pound
- D £15 889 to the nearest pound

8 Beth's lawn in her garden is rectangular in shape. The length is 7.5m, correct to 1 decimal place and the width is 4.7m, correct to 1 decimal place.

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

- A The perimeter is no greater than 24.6m.
- B The area is greater than 34.6m^2 .
- C The length of a diagonal is definitely greater than 8.8m.
- D The length is at least 2.7m greater than the width.

9 The shape and dimensions of a swimming pool are shown in the diagram.



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

- A The line DE slopes at 12° to the horizontal, correct to the nearest degree.
- B The length of DE is 7.16 m, correct to 2 decimal places.
- C When full of water, the swimming pool contains less than 750 m^3 .
- D The area of the cross-section ABCDEF is 43.75 m^2 .

10 Of the four quadratic equations below, only one has integer roots.

Which **one** is the equation with integer roots?

A $x^2 + 13x + 42 = 0$

B $x^2 - 200 = 0$

C $4x^2 - 4x + 1 = 0$

D $x^2 - 3x - 8 = 0$

11 A form tutor records the number of GCSEs gained by each member of her tutor group. She summarises the results in the table below to show how many students have gained each number of GCSEs.

Number of GCSEs	0	1	2	3	4	5	6	7	8	9	10
Frequency	2	1	0	5	6	9	4	0	2	1	1

Which **one** of the following is the **most appropriate** diagram to use to show these frequencies?

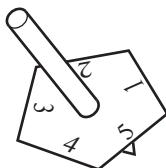
A Pie chart

B Cumulative frequency graph

C Histogram

D Vertical line graph

12 Fred and George each have a fair 5-sided spinner as shown in the diagram.



Fred and George spin their spinners. The numbers on the sides ending in contact with the table are noted.

Which **one** of the following is the **probability** that the two numbers are the same?

A $\frac{2}{5}$

B $\frac{1}{25}$

C $\frac{1}{10}$

D $\frac{1}{5}$

13 10 fruit flies are put into a closed box. The growth of the population of flies in the box can be modelled by the formula $P = 5 \times 2^n$ where P is the size of the population after n days.

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

A After two days, $P = 20$.

B When $n = 3$, $P = 40$.

C After four days, $P = 60$.

D When $n = 10$, $P = 5120$.

14 A company owns a chain of 30 shops. The following table shows the numbers of employees of these shops.

Number of employees	11–15	16–20	21–25	26–30
Frequency	5	12	9	4

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

A The range could be as great as 19.

B An estimate of the mean number of employees is 20.

C The median could be as great as 20.

D If a shop is chosen at random the probability that it employs 20 or fewer people is 0.43, correct to 2 decimal places.

15 It is required to rearrange the formula $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ to make f the subject.

Students come up with four different answers, but only one of them is correct.

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

A $f = \frac{u+v}{2}$

B $f = u+v$

C $f = \frac{uv}{u+v}$

D $f = \frac{u+v}{uv}$

16 Tom is attempting to solve the following simultaneous equations.

$$\begin{array}{l} 3x + 4y = 5 \quad \text{(i)} \\ 4x - 5y = 7 \quad \text{(ii)} \end{array}$$

His attempt is shown in the four steps below but the answer is incorrect.

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

- A** Multiply (i) by 4 giving $12x + 16y = 20$ (iii)
- B** Multiply (ii) by 3 giving $12x - 15y = 21$ (iv)
- C** Subtract (iv) from (iii) giving $y = -1$
- D** Substitute into (i) giving $x = 3$

17 Of the four equations given below, three equations have a solution that is not an integer and one has a solution that is an integer.

Which **one** of the following has a solution that is an integer?

- A** $4x + 5 = 3 - 2x$
- B** $2(x + 2) = 3 - 5(x + 3)$
- C** $3(x + 1) + 2(2x + 1) = 12$
- D** $\frac{1}{2}(3 - 2x) = 1 + \frac{1}{3}(x - 2)$

18 Which **one** of the following is the correct simplification of $\frac{2-x}{5} - \frac{1-2x}{3}$?

A $\frac{1-3x}{2}$

B $\frac{1+7x}{15}$

C $\frac{1+3x}{15}$

D $\frac{1+x}{15}$

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

A The solution of the inequality $3x+1 < 2-x$ is $x < \frac{1}{4}$.

B The solution of the inequality $3(2x+5) - 7 > 9$ is $x < \frac{1}{6}$.

C The solution of the inequality $3(x+4) - 2(x+1) > 20$ is $x > 10$.

D The solution of the inequality $\frac{2x}{5} > \frac{1-x}{4}$ is $x > \frac{5}{13}$.

20 One of the following quadratic expressions cannot be factorised in the form $(x - 1)(x + a)$ where a is a whole number (positive or negative).

Which **one** **cannot** be factorised in this way?

A $x^2 - x - 2$

B $x^2 - 3x + 2$

C $x^2 + 3x - 4$

D $x^2 - 6x + 5$

21 A cookery book gives the following instructions for cooking a turkey.

Cook for 16 minutes per 500 grams plus 20 minutes

T is the cooking time in minutes.

M is the mass of the turkey in kilograms.

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

A $T = 16M + 20$

B $T = 8M + 20$

C $T = 32M + 20$

D $T = 2(16M + 20)$

22 The following formula is to be used to evaluate y for different values of x .

$$y = \frac{(x+2)^2}{3}$$

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

- A When $x = 7, y = 27$.
- B When $x = -5, y = 3$.
- C y is always a whole number.
- D To find y you add 2 to x , square the result and then divide by 3.

23 Three vectors are given by $\mathbf{a} = 2\mathbf{i} + 3\mathbf{j}$, $\mathbf{b} = -3\mathbf{i} + \mathbf{j}$, $\mathbf{c} = -4\mathbf{i} + 5\mathbf{j}$.

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

- A $\mathbf{a} + \mathbf{b} + \mathbf{c} = -5\mathbf{i} - \mathbf{j}$
- B $2\mathbf{a} = 4\mathbf{i} + 6\mathbf{j}$
- C $\mathbf{c} - 2\mathbf{b} = \mathbf{a}$
- D $\mathbf{b} + \mathbf{c} - 2\mathbf{a} = -11\mathbf{i}$

24 Abigail and Mia visited a coffee shop recently with friends.
Abigail bought 3 coffees and 2 cakes, which cost £10.20.
Mia bought 4 coffees and 4 cakes, which cost £16.00.
Let x pence be the cost of a coffee and y pence be the cost of a cake.

Which **one** of the following is the **correct** pair of simultaneous equations for x and y ?

A $\frac{x}{3} + \frac{y}{2} = 1020$, $\frac{x}{4} + \frac{y}{4} = 1600$

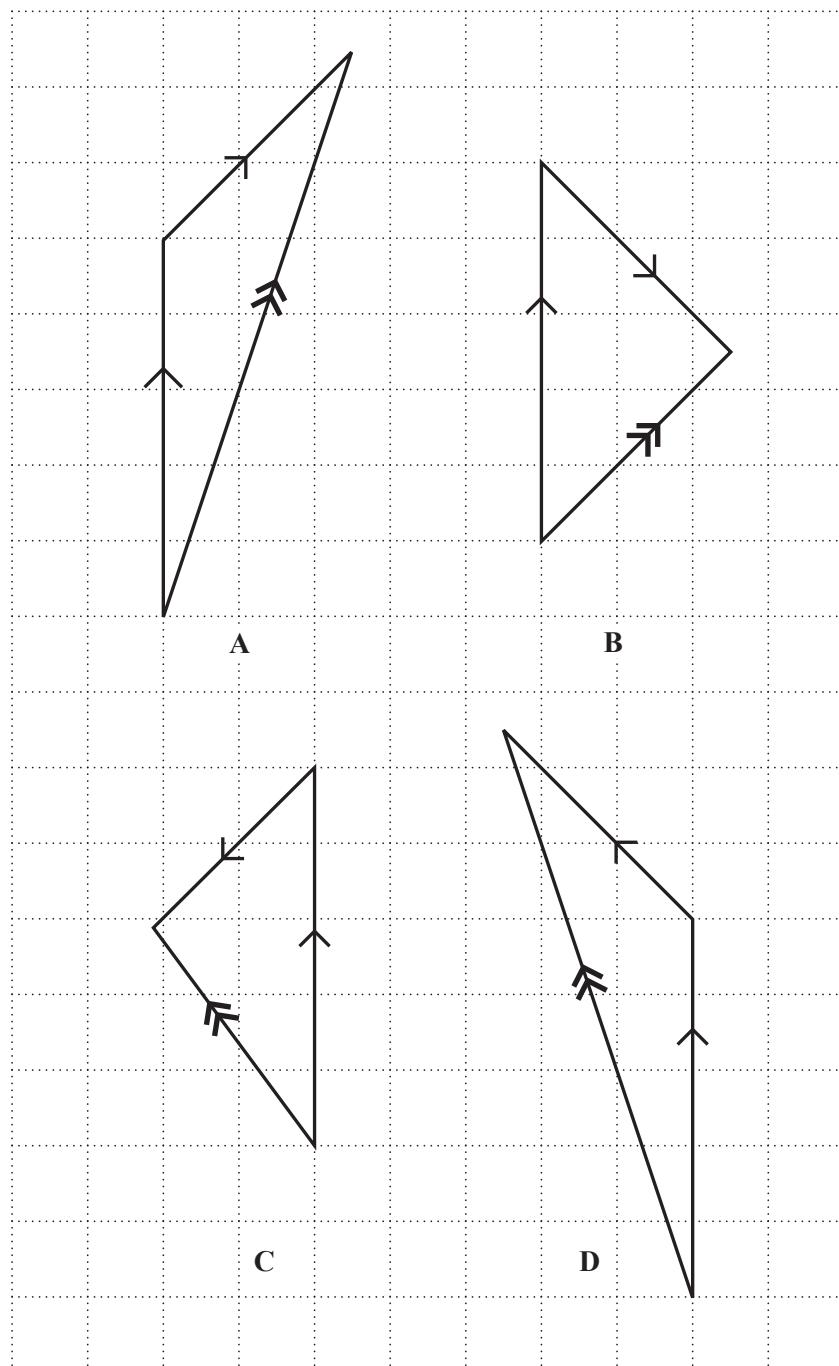
B $3x + 2y = 1020$, $4x + y = 1600$

C $3x + 2y = 1020$, $x + y = 6400$

D $3x + 2y = 1020$, $x + y = 400$

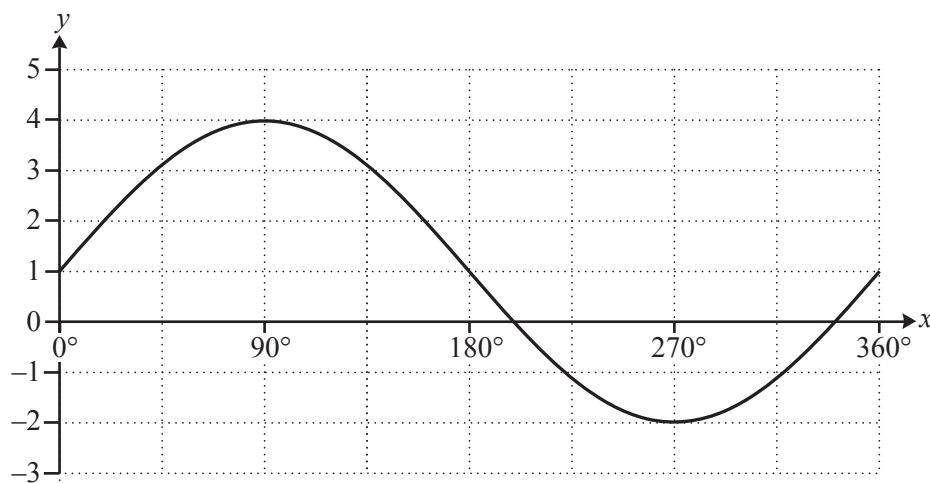
25 Charlie and Daryl are steering due north in a small motor boat in an estuary. The boat travels at 5 km h^{-1} through the water, but there is a current flowing **from** the northeast at 3 km h^{-1} .

In which **one** of the following diagrams does the line with the double arrow represent the direction and speed in which the boat is travelling?

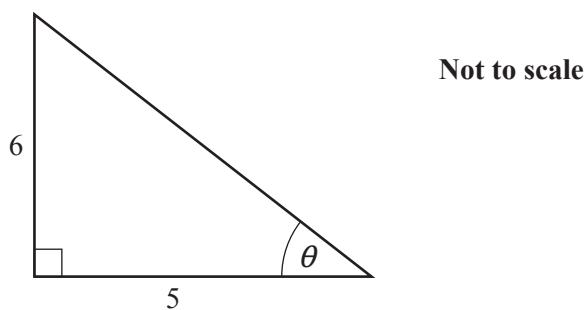


26 Three of the following statements are true and **one** is false. Which one is **false**?

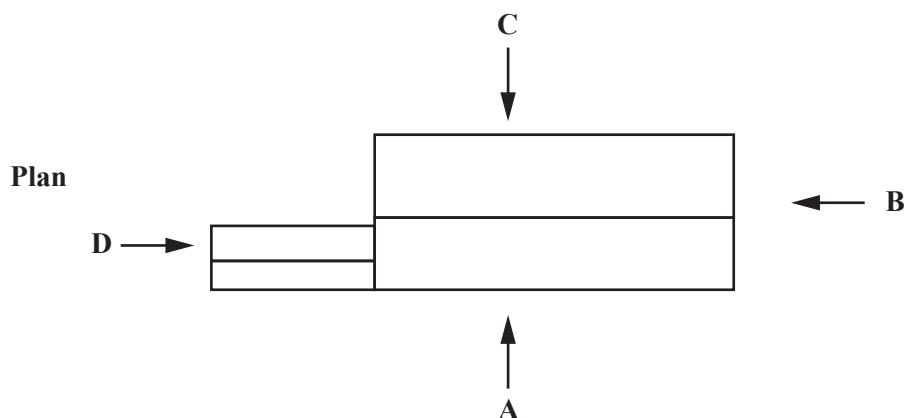
- A $\sin 37^\circ = \cos 53^\circ$
- B $\tan 56^\circ = \tan 236^\circ$
- C This is part of the curve $y = 1 + 3 \cos x$.



- D In this triangle, $\theta = 50.2^\circ$, correct to 1 decimal place.



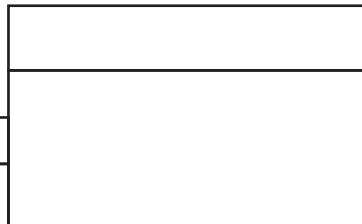
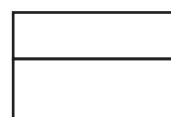
27 The diagram shows the plan of a rectangular house with a rectangular extension.



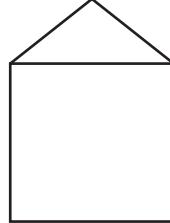
Three of the following elevations are correct and **one** is incorrect.

Which one of the elevations A, B, C, D is **incorrect**?

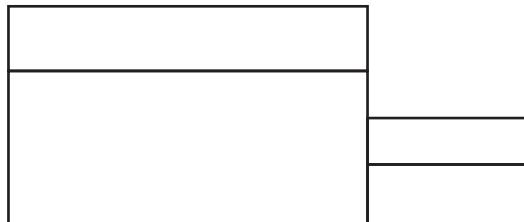
A This is the elevation from A.



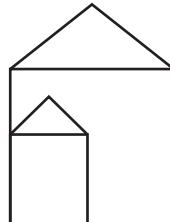
B This is the elevation from B.



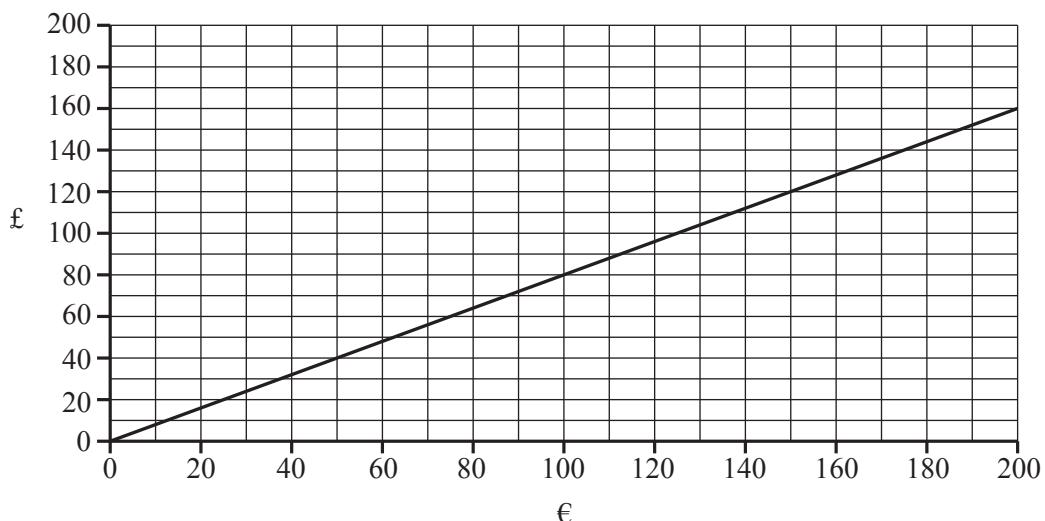
C This is the elevation from C.



D This is the elevation from D.



28 The graph below represents the conversion between euros and pounds on one day.



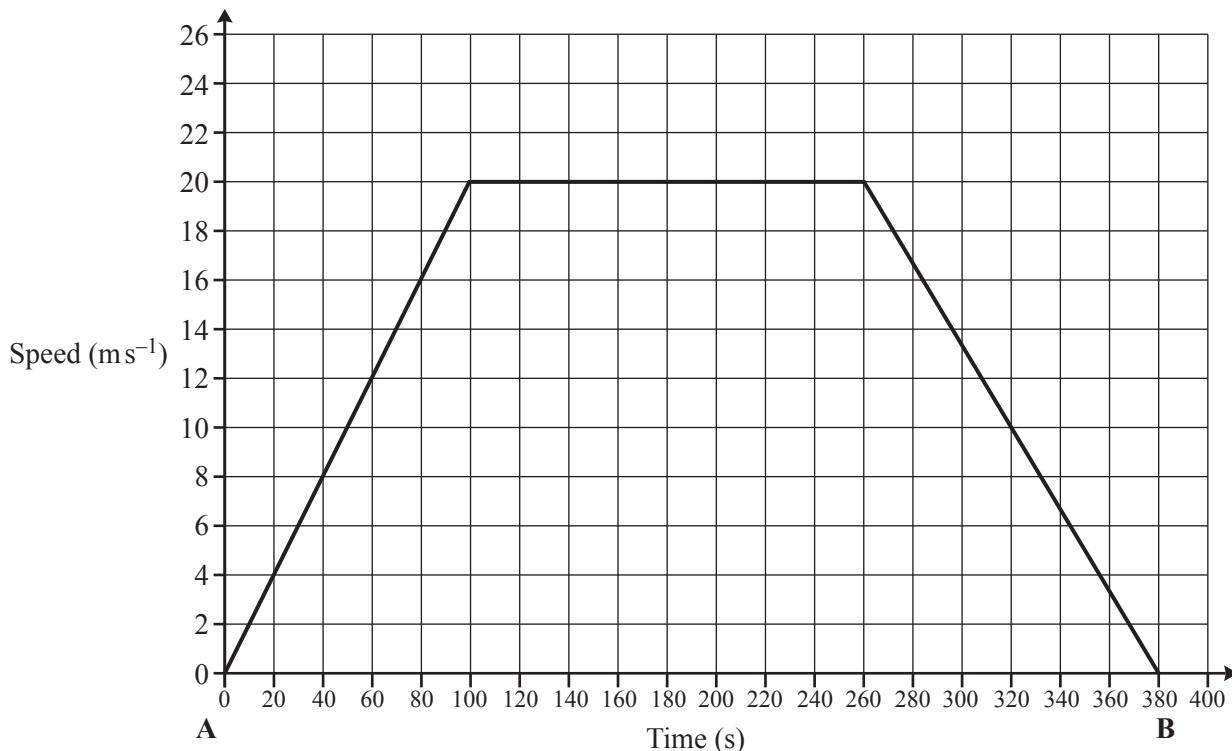
Three of the following statements are true and **one** is false. Which one is **false**?

- A £80 is roughly equivalent to €100.
- B €40 is roughly equivalent to £30.
- C €1 is worth less than £0.90.
- D On a later occasion I exchanged £50 for €55. The conversion graph for this exchange rate would be less steep than that drawn above.

29 Which **one** of the following might reasonably have a mass of 400 g?

- A A box of half a dozen eggs
- B A pencil
- C 5 litres of milk in a plastic container
- D A large cat

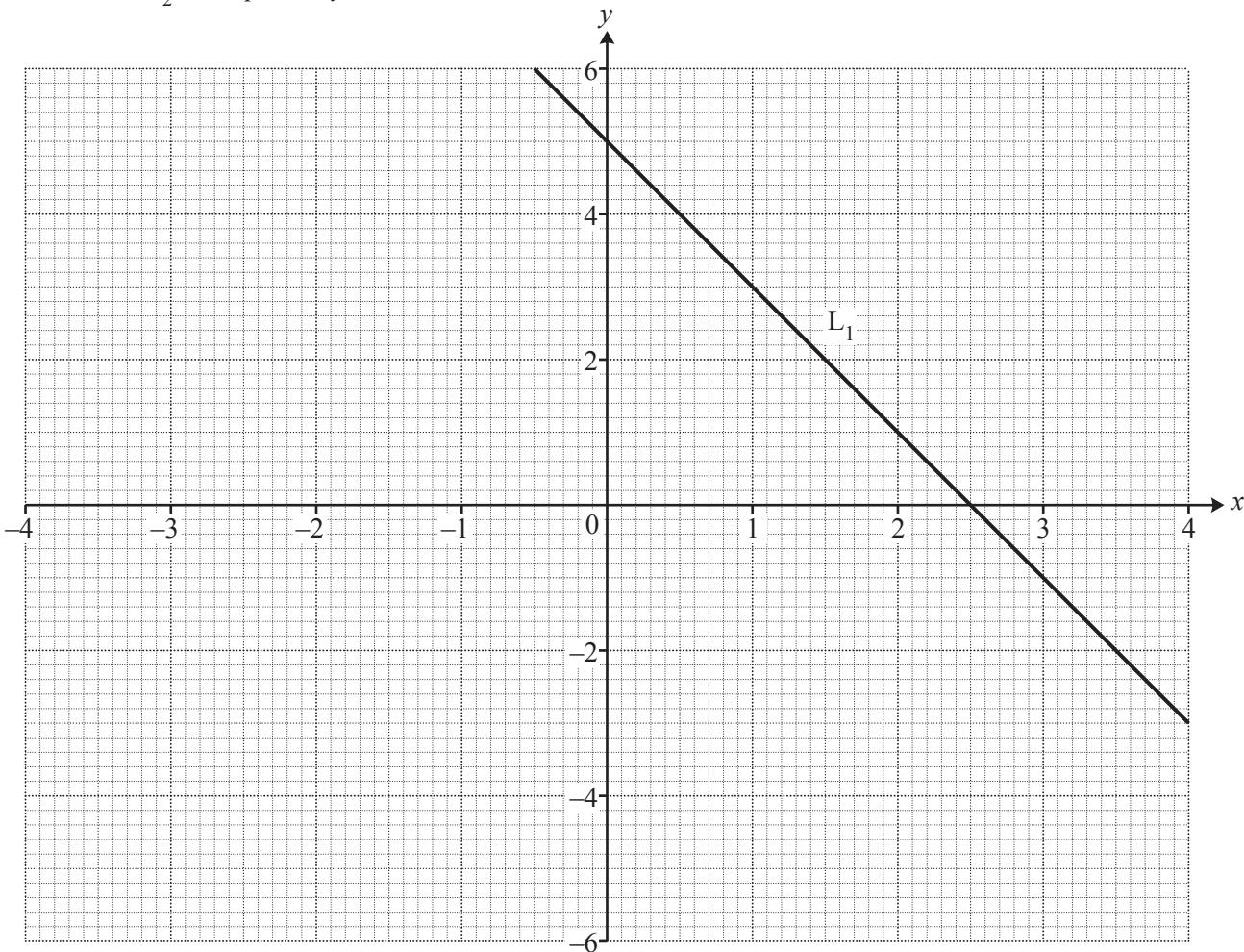
30 A train travels from station A to station B. It accelerates uniformly from rest at A to a speed of 20ms^{-1} which it maintains for 160 seconds before decelerating uniformly to rest at station B. This motion is shown in the graph below.



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

- A The acceleration of the train in the first 100 seconds is 0.2 m s^{-2} .
- B The train decelerates at a greater rate than it accelerates.
- C $20\text{ms}^{-1} = 72\text{kmh}^{-1}$.
- D The distance between the stations is 5400 metres.

31 The line L_1 below is a graph of the equation $y = 5 - 2x$.
 The line L_2 has equation $y = 3x - 5$.



To answer this question you are advised to plot the graph of the line L_2 on the grid above.

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

- A The graph of L_1 above shows that the solution of the equation $5 - 2x = 0$ is $x = 2.5$.
- B The gradient of the line L_1 is 2.
- C Lines L_1 and L_2 meet at the point with coordinates $(2, 1)$.
- D The y intercept of L_2 is -5 .

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

- A $6(x - 2) + x = 7x - 12$
- B $2x^2 + 4xy = 2x(x + 2y)$
- C $(x + y)(2x - y) = 2x^2 - y^2$
- D $(x + 1)(x - 1) = x^2 - 1$

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

- A The mass of a banana is measured in milligrams.
- B The density of a metal is measured in grams per cubic centimetre.
- C The speed of a sprint runner is measured in metres per second.
- D The distance from London to York is measured in kilometres.

34 Four sequences are as follows.

- A is a linear sequence with the first three terms 3, 7, 11.
- B is a quadratic sequence with the first three terms 3, 7, 13.
- C is an exponential sequence with the first three terms 3, 6, 12.
- D is a linear sequence with the first three terms 3, 1.5, 0.

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

- A The next two terms of sequence A are 15, 19.
- B The next two terms of sequence B are 21, 29.
- C The next two terms of sequence C are 24, 48.
- D The next two terms of sequence D are $-1.5, -3$.

35 Flora draws a triangle ABC in which $AB = 6\text{cm}$, $CA = 5\text{cm}$ and the angle C is 60° . She claims that the angle $B = 46.2^\circ$, correct to 1 decimal place.

Josie draws a triangle DEF in which $DE = 6\text{cm}$, $EF = 8\text{cm}$ and $FD = 9\text{cm}$. She claims that angle E = 78.6° , correct to 1 decimal place.

Which **one** of the following is a **true** statement?

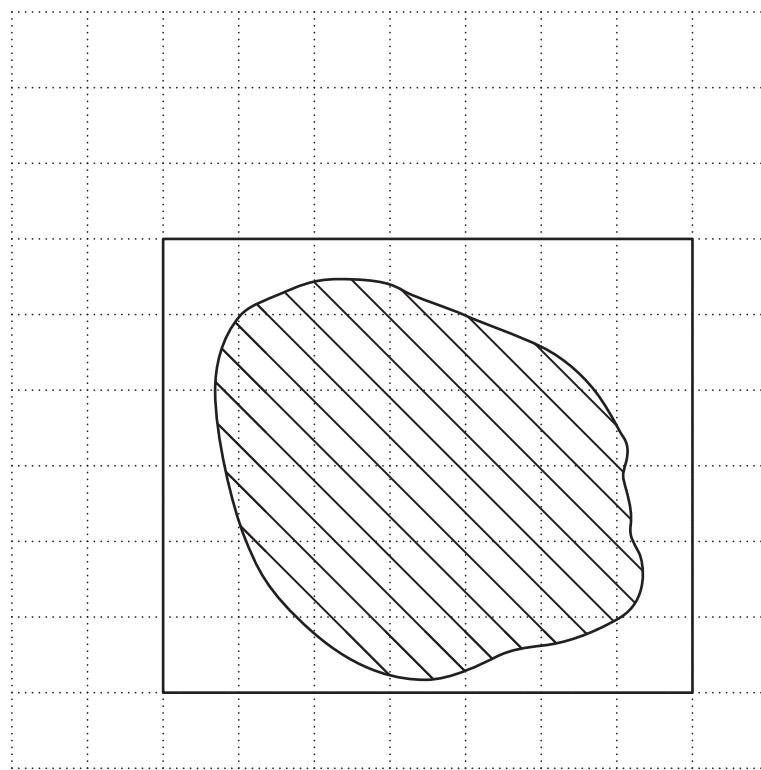
- A Flora is right and Josie is wrong.
- B Both Flora and Josie are right.
- C Flora is wrong and Josie is right.
- D Both Flora and Josie are wrong.

36 The number 4343.4976 is written below in four different ways.

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

- A Correct to 1 decimal place, it is 4343.5.
- B Correct to 3 significant figures, it is 434.
- C Correct to 1 significant figure, it is 4×10^3 .
- D Correct to the nearest 100, it is 4300.

37 The map below shows a lake. The rectangle round it is a fence. The map is drawn on a centimetre square grid and 1 centimetre represents 20 metres.

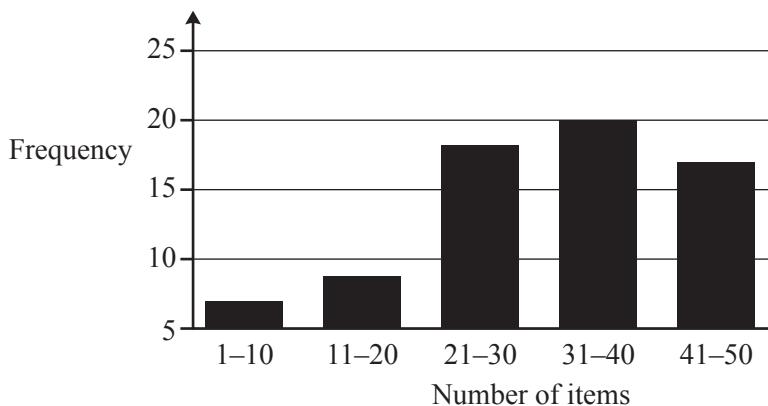


Three of the following statements are true and **one** is false. Which one is **false**?

- A The actual length of the fence is 520 m.
- B The surface area of the lake is between 8000 m^2 and $10\ 000 \text{ m}^2$.
- C The nearest the fence is to the lake is approximately 2 m.
- D The scale of the map is 1 : 200.

38 Morven investigates the number of items that people buy on a single visit to the local supermarket. She stands outside the exit door at midday one Saturday and asks the first 70 people who come out of the store how many items they have purchased.

She draws the following bar chart to show her summarised results.

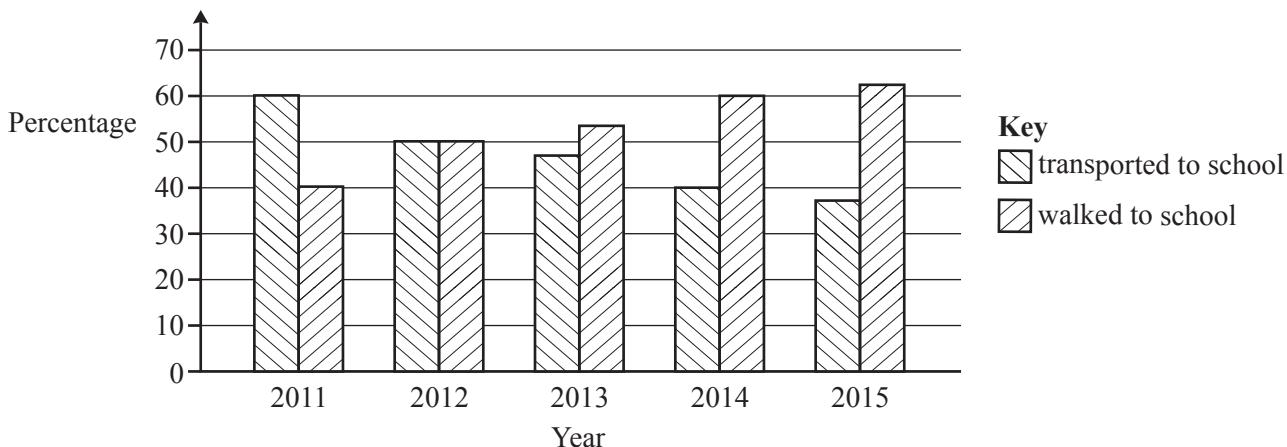


Three of the following statements are true and **one** is false. Which one is **false**?

- A The sample is not random.
- B The chart is misleading.
- C The modal group is 31–40.
- D The number of people in the 11–20 group is twice the number in the 1–10 group.

39 A local authority began to allocate students starting secondary school to their nearest school in order to reduce the cost of transport.

The bar chart below displays the percentage of students in the local authority walking and being transported to school for five years after the implementation of this policy.



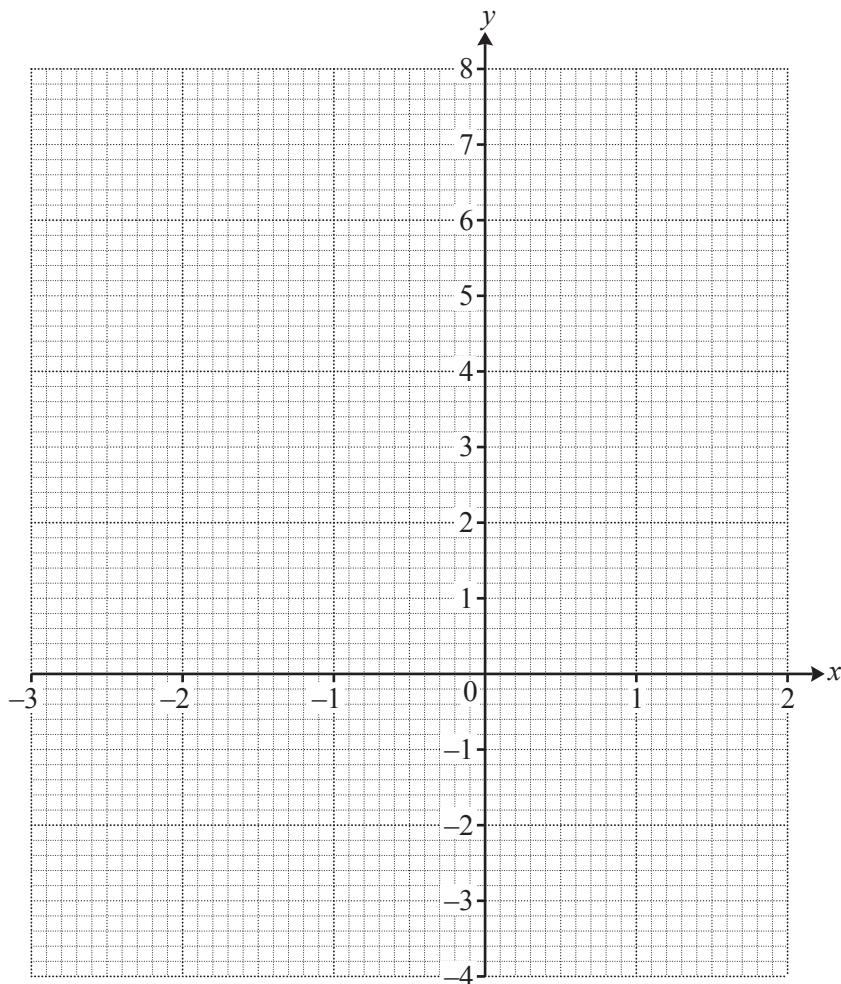
Three of the following statements are true and **one** is false. Which one is **false**?

- A Equal numbers of students walked to school and were transported to school in 2012.
- B The chart indicates that the percentage of students walking to school is increasing over time.
- C The chart indicates that all students in the local authority were included in the data.
- D The chart indicates that the cost in pounds of transporting students to school is decreasing over time.

40 The table below gives some values for the function $y = x^3 + 2x^2 - 3x - 2$.

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

To answer this question you are advised to complete the table and draw the graph on the grid below.



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

- A The point $(-3, -2)$ lies on the curve.
- B There are two points on the curve $y = x^3 + 2x^2 - 3x - 2$ at which the gradient is zero.
- C When $x = 0$ the gradient is positive.
- D The equation $x^3 + 2x^2 - 3x - 2 = 0$ has three roots, none of which are integers.

END OF QUESTION PAPER



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