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RECOGNISING ACHIEVEMENT

FREE-STANDING MATHEMATICS QUALIFICATION
INTERMEDIATE LEVEL

Foundations of Advanced Mathematics (MEI) 6989

Candidates answer on the answer sheet.

OCR supplied materials:
- Answer sheet (MS4)

Other materials required:
- Eraser
- Scientific calculator
- Soft pencil
- Ruler

Friday 10 June 2011
Morning

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.

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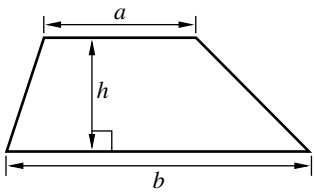
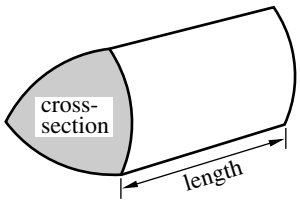
Formulae Sheet: 6989 Foundations of Advanced Mathematics

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



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

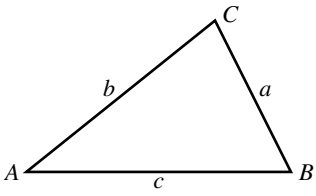


In any triangle ABC

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

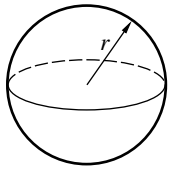
Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

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



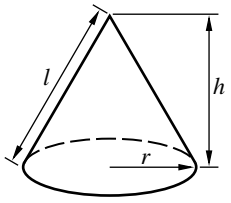
Volume of sphere $= \frac{4}{3}\pi r^3$

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

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

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

A The LCM (lowest common multiple) of 20 and 30 is 60.

B $\dfrac{2\times 4+3}{2\times 4-3}=2.2$

C $\sqrt{0.25^2-0.15^2}=0.2$

D 13 is a factor of 2011.

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

A $(-2)^3\times(-3)^2=72$

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

C $16^2\div 8^2=2^2$

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

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

A Half of $\frac{3}{4}$ is $\frac{3}{8}$.

B $\frac{3}{5}\times\frac{10}{33}=\frac{2}{11}$

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

D $\dfrac{1}{3^2}+\dfrac{1}{4^2}=\dfrac{1}{5^2}$

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4 Carlos recorded the number of people in each car passing his house in an hour.

Here are his results.

Number of people	1	2	3	4	5
Frequency	19	10	8	2	1

Which **one** of the following is the **most appropriate** diagram to use to display the data?

A Vertical line graph

B Cumulative frequency chart

C Pie chart

D Histogram

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

A $(2.1 \times 10^3) + (2.1 \times 10^4) = 2.31 \times 10^4$

B $(1.7 \times 10^6) - (2.8 \times 10^6) = 1.1 \times 10^6$

C $(2.6 \times 10^4) \times (4.5 \times 10^5) = 1.17 \times 10^{10}$

D $\dfrac{7.6 \times 10^4}{3.8 \times 10^{-2}} = 2 \times 10^6$

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

A 32% is equivalent to $\frac{8}{25}$.

B When expressed as a decimal, $\frac{1}{41}$ recurs.

C 1 in 10 000 is equivalent to 0.001%.

D 120% is equivalent to 1.2.

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7 The length of a rectangular room is 5.1 m, correct to 1 decimal place, and the width is 4.0 m, correct to 1 decimal place.

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

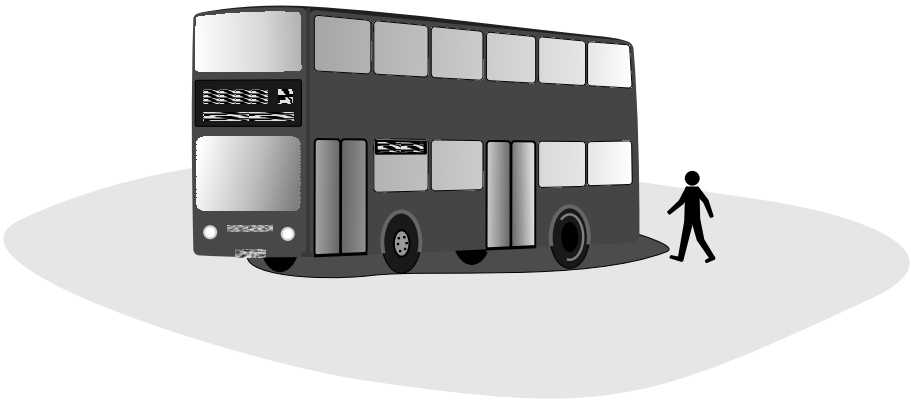
A The greatest possible difference between the length of the room and the width is 1.1 m.

B The perimeter is no greater than 18.4 m.

C The area is greater than 19.9 m^2.

D The area is less than 20.9 m^2.

8 Here is a drawing of a bus.



Which **one** of the following is the **most reasonable** estimate of the height of this bus?

A 2 m

B 4 m

C 7 m

D 10 m

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9 In a town there are 40 factories. The following table shows the numbers of employees of these factories.

Number of employees	1 – 10	11 – 20	21 – 30	31 – 40	41 – 50
Frequency	2	7	13	12	6

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

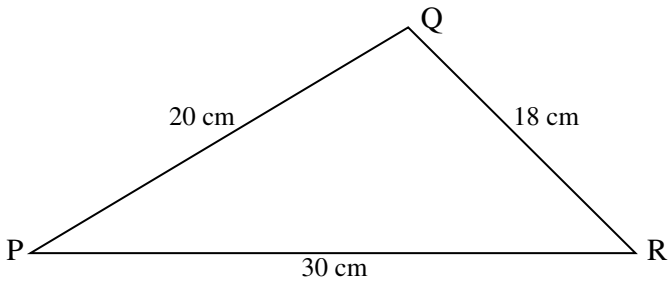
A A reasonable estimate of the mean number of employees is 28.75.

B A reasonable estimate of the median number of employees is 25.5.

C The range could be as great as 49.

D If a factory is selected at random, then the probability that it employs 10 people or fewer is 0.05.

10 In the triangle PQR, PR = 30 cm, RQ = 18 cm and QP = 20 cm.



Not to scale

Which **one** of the following is the **correct** value for the angle at Q, correct to the nearest degree?

A 104° **B** 76° **C** 119° **D** 61°

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11 In a tutor group of 40 students:

- The ratio of boys to girls is 3 : 1
- The ratio of left-handed students to right-handed students is 1 : 4
- 4 girls are left-handed.

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

A The number of boys is 30.

B The number of left-handed students is 8.

C The number of right-handed boys is 24.

D The ratio of right-handed boys to left-handed boys is 13 : 2.

12 In a sale, men's suits are being sold at a discount of 20%.

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

A A suit that was originally priced at £120 is now being offered for £100.

B '20% off' means that you pay $\frac{4}{5}$ of the price.

C A suit that is now selling for £144 was originally £180.

D Abdul saves £40 by buying a suit in the sale. The original price of the suit was £200.

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13 Three vectors are given by $\mathbf{a} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$, $\mathbf{b} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$, $\mathbf{c} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$.

You are given that $\mathbf{a} + k\mathbf{b} = \mathbf{c}$.

Which **one** of the following is the **correct** value for k?

A 1

B 2

C −1

D −2

14 On February 2nd, 2009 there was a heavy snow fall and many trains and buses did not run. It was reported that on one mobile phone network, between 0800 and 0805 on that morning, there were half a million text messages. The company reported that this was 50% up on a 'normal day'.

Which **one** of the following gives the **approximate number** of text messages sent through that network on a normal day in that period?

A 250 000 **B** 200 000 **C** 333 000 **D** 1 million

15 Abbie and Beth each throw a normal unbiased die, numbered 1 to 6.

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

A $\frac{1}{2}$ **B** $\frac{1}{6}$ **C** $\frac{1}{12}$ **D** $\frac{1}{36}$

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

A The line $\frac{x}{4} + \frac{y}{7} = 1$ passes through the point $(4, 7)$.

B The gradient of the line $7x - 4y = 5$ is $\frac{7}{4}$.

C The line $7x - 4y = 5$ cuts the y-axis at the point $\left(0, -\frac{5}{4}\right)$.

D The line through the two points $(1, 2)$ and $(-5, 7)$ has equation $5x + 6y = 17$.

17 A recent news item claimed that there were 71 road signs on a $\frac{1}{2}$ mile (880 yards) stretch of road.

Three of the following statements are consistent with this claim and **one** is not. Which one is **not**?

A On average there is 1 sign every 12.4 yards.

B On average there are about 8 signs per 100 yards.

C On average there are about 57 signs per kilometre.

D Travelling at 30 mph, a driver passes more than 1 sign per second on average.

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18 Which **one** of the following quadratic equations has **no** real solution?

A $x^2 - 2x - 1 = 0$

B $x^2 - 2x = 0$

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

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

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

A $x^2 + x^2 + x^2 = 3x^2$

B $\dfrac{x^2 \times x^4}{x^3} = x^3$

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

D $\left(2x^2y^3\right)^4 = 8x^8y^{12}$

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20 In this question, $a = 3$, $b = -4$, $c = 2$.

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

A $4b^2 = 64$

B $abc = -24$

C $ab + bc + ca = -26$

D $\dfrac{a-b}{a-c} = 7$

21 The spread of a virus through a population in a town can be modelled by the formula $P = \frac{1}{2} \times 2^n$ where P is the number of infected people on day n.

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

A On day 1 there is 1 infected person.

B On day 2 there are 2 infected people.

C On day 4 there are 4 infected people.

D On day 10 there are 512 infected people.

22 Four students try to rearrange the formula $s = vt - \frac{1}{2}at^2$ so that a is the subject. Only one of them is correct.

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

A $a = \dfrac{2(s-v)}{t}$

B $a = \dfrac{2s - vt}{t^2}$

C $a = \dfrac{2(vt - s)}{t^2}$

D $a = \dfrac{v}{t} - 2\dfrac{s}{t^2}$

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23 Which **one** of the following is the **correct** solution of the inequality $\frac{3x}{4} > \frac{1-x}{3}$?

A $x > \frac{2}{5}$

B $x > \frac{4}{13}$

C $x > \frac{1}{2}$

D $x > \frac{4}{5}$

24 A microwave cookery book gives the following instructions for cooking a joint of lamb.

Cook for 9 minutes per 500 grams plus 2 minutes.

T is the cooking time in minutes.

M is the mass of the joint of meat in kilograms.

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

A $T = \frac{M+2}{18}$

B $T = 18M + 2$

C $T = \frac{500M}{9} + 2$

D $T = 18(M + 2)$

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25 Only **one** of the following quadratic expressions can be factorised in the form $(x + 1)(x + a)$ where a is a whole number. Which one **can** be factorised in this way?

A $x^2 + 4x + 3$

B $x^2 - 4x + 3$

C $x^2 + 3x + 4$

D $x^2 + 3x - 4$

26 Dasras is attempting to solve the following simultaneous equations.

$$3x - 4y = 5 \qquad \text{(i)}$$
$$2x + 5y = 1 \qquad \text{(ii)}$$

His attempt is shown in the following 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 5 giving $15x - 20y = 25$ (iii)
Multiply (ii) by 4 giving $8x + 20y = 4$ (iv)

B Subtract (iv) from (iii) giving $7x = 21$

C Divide by 7 giving $x = 3$

D Substitute into (i) to give $9 - 4y = 5$ and hence $y = 1$

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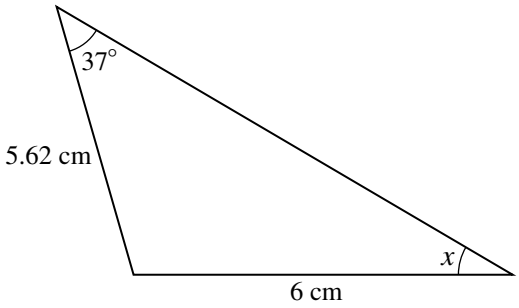
27 Which **one** of the following is the **correct** value for x in the diagram?



Not to scale

A 37.0°, correct to 1 decimal place.

B 43.1°, correct to 1 decimal place.

C 34.3°, correct to 1 decimal place.

D 40.0°, correct to 1 decimal place.

28 In the following formula, y is to be evaluated using a given value for x.

$$y = \frac{x^2 - 5}{x}$$

Which **one** of the following set of instructions will give the **correct** value for y?

A Square x, subtract 5 and divide the result by x.

B Square x, subtract 25 and divide the result by x.

C Square x and subtract the result of dividing 5 by x.

D Subtract 5 from x, square the result and then divide by x.

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29 Which **one** of the following equations has a solution which is **not** an integer?

A $5x + 2 = 14 - x$

B $3x + 2 = 2(x + 7)$

C $3(2x - 1) = 11 - 2(3x - 1)$

D $2(x - 2) + 3(2 - x) = 5$

30 Which **one** of the following is a **correct** simplification of $\frac{2x+3}{4} - \frac{1-3x}{5}$?

A $\frac{11(2x+1)}{20}$

B $\frac{11-2x}{20}$

C $\frac{13x-1}{20}$

D $\frac{2-x}{20}$

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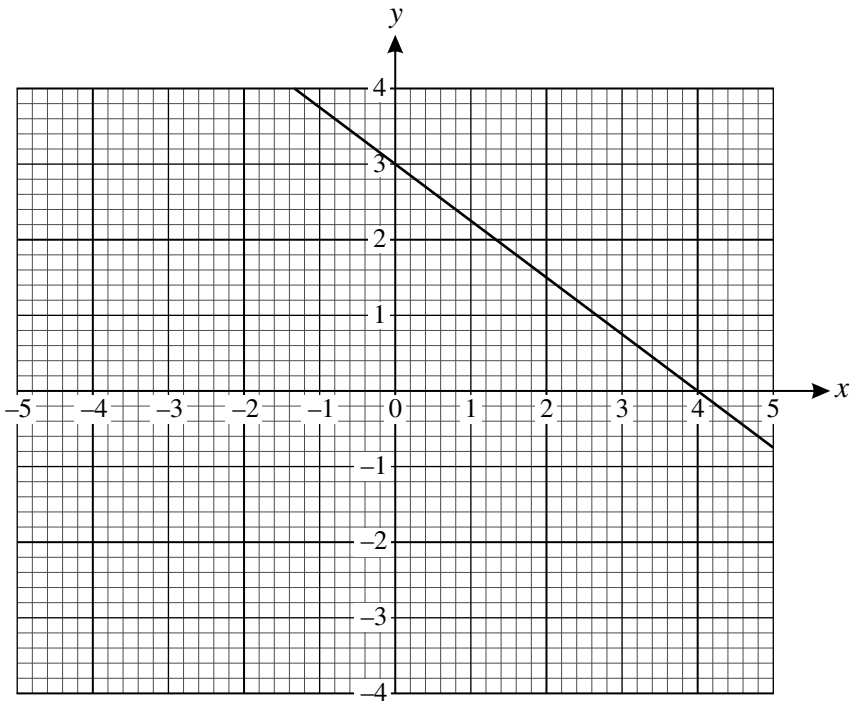
31 John has drawn the graph of an equation on the grid as shown below.



He wishes to find where this line meets the line whose equation is $2y = 5x - 7$.

You are advised that to answer this question you should draw the graph of the line $2y = 5x - 7$ *on the grid above.*

Which **one** of the following points is the point of intersection of the two lines?

A $\left(2, 1\frac{1}{2}\right)$

B $\left(1\frac{1}{2}, 2\right)$

C (1.75, 1.7)

D (3, 0.75)

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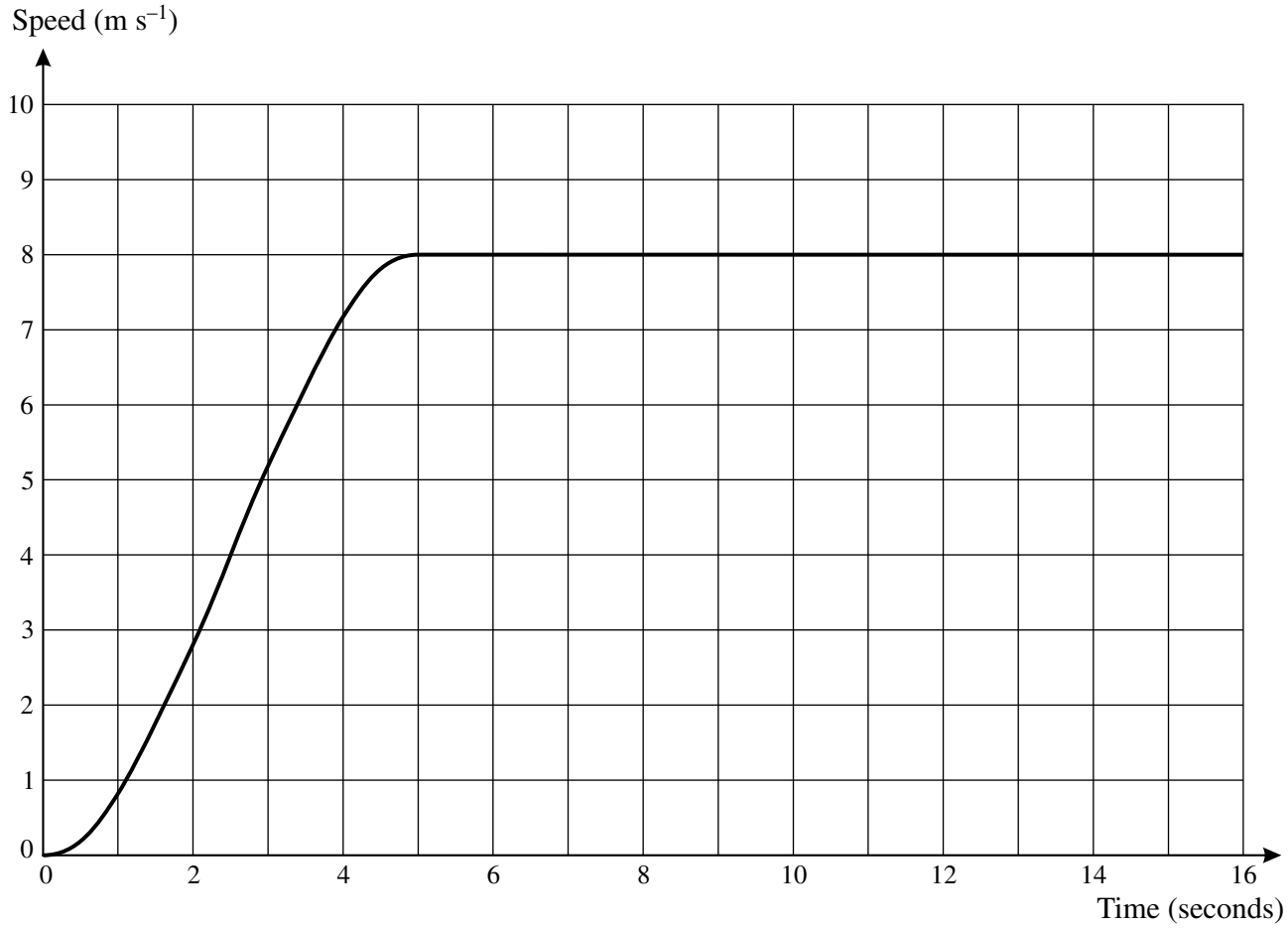
32 In a group of 10 students there are 6 males and 4 females. Two students are chosen at random.

Which **one** of the following is the **correct** probability that one male and one female are chosen?

A $\frac{4}{15}$ **B** $\frac{8}{15}$ **C** $\frac{6}{25}$ **D** $\frac{12}{25}$

33 Paul recently took part in a 100 m race. His speed during the race is shown in the graph below.



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

A His greatest acceleration was approximately 2.4 m s^{-2}.

B During acceleration to the maximum speed he travelled approximately 20 metres.

C His constant speed 5 seconds after starting the race was 24 km h^{-1}.

D Paul crosses the finishing line after approximately 15 seconds.

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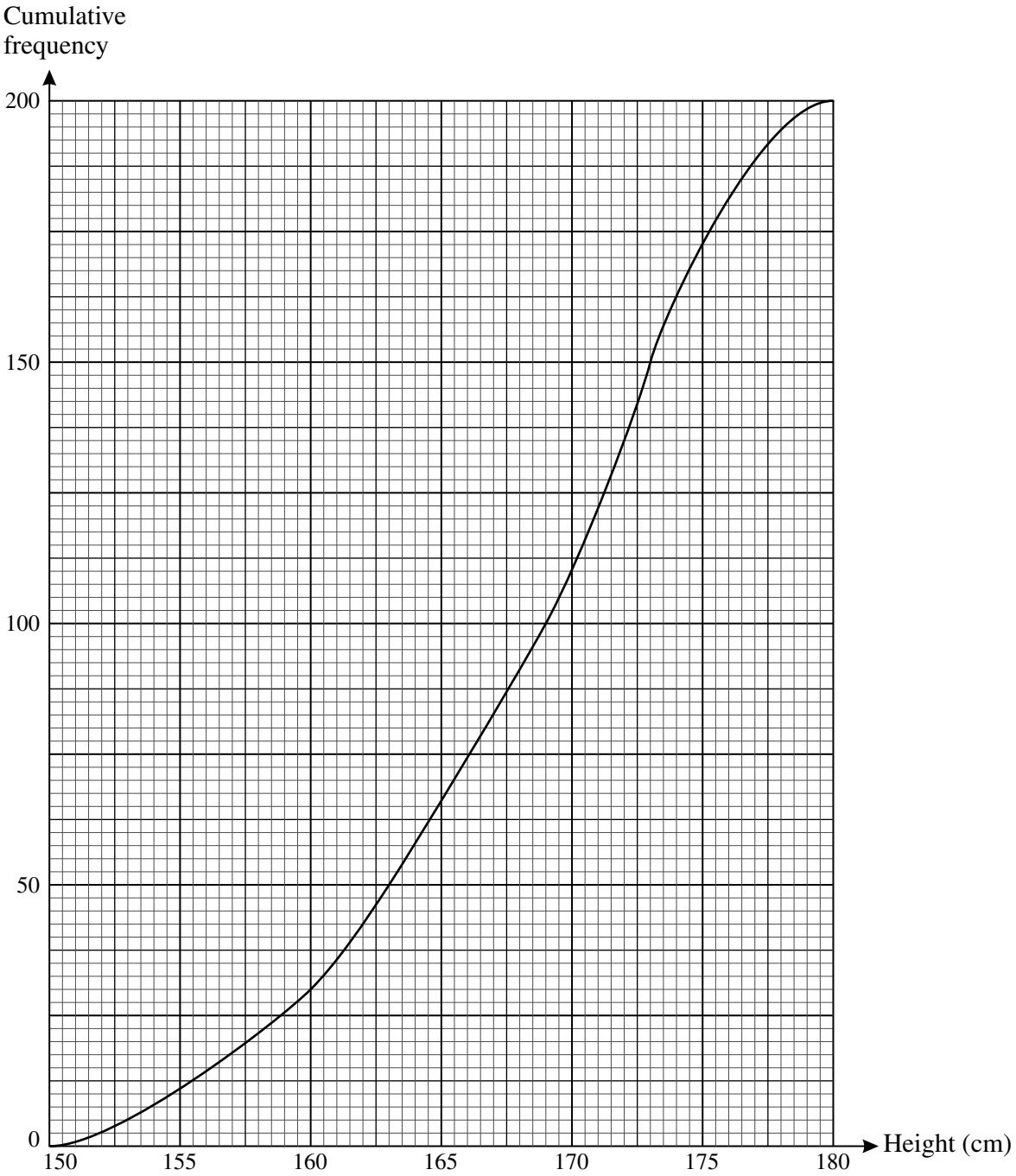
34 The cumulative frequency curve summarises the heights of students in a college.



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

A The heights of 200 students are summarised on the graph.

B The median height is about 169 cm.

C The interquartile range is about 10 cm.

D The students all go to a theme park where the minimum height allowed on one of the rides is 160 cm. Approximately 15% of the students will be able to go on the ride.

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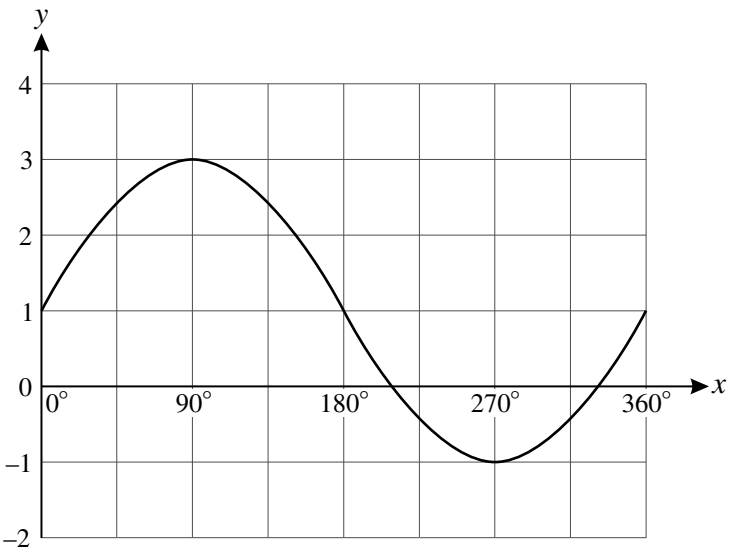
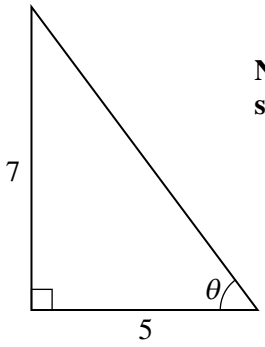
35 Three of the following statements are true and **one** is false. Which one is **false**?

A This is part of the curve $y = 1 + 2\sin x$.

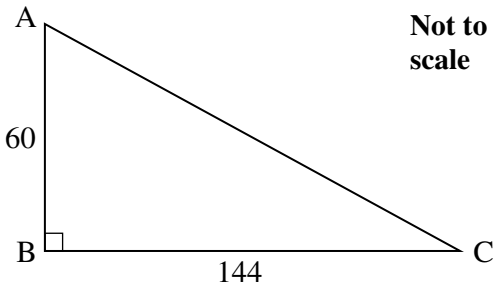


B In this triangle $\theta = 54.5°$, correct to 1 decimal place.



Not to scale

C In this triangle, AC = 156.



Not to scale

D $\cos 170° = \cos 10°$

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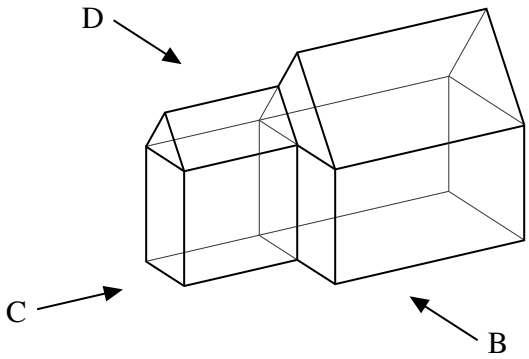
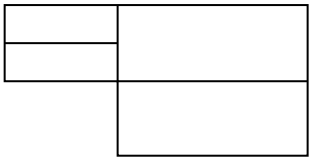
36 The diagram illustrates a house which has an extension on one side.

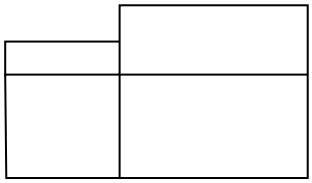


Three of the following diagrams are correct and **one** is incorrect. Which one is **incorrect**?

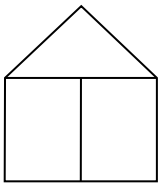
A This is the plan.



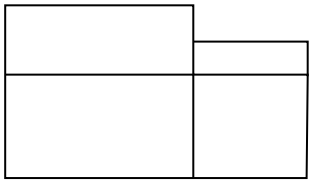
B This is the side view from B.



C This is the side view from C.



D This is the side view from D.



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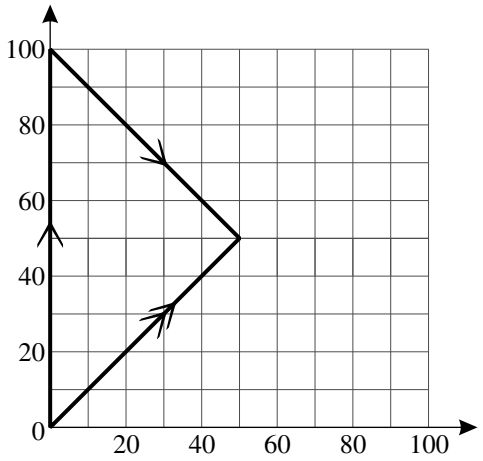
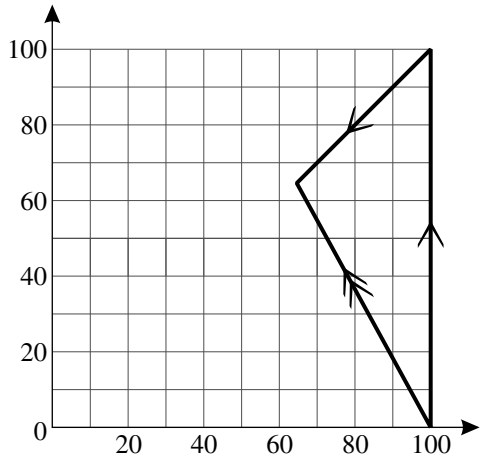
37 Peter is flying a light aircraft and is heading due north at 100 km per hour. The wind is from the northeast at 50 km per hour.

Which **one** of the following represents the direction and speed in which Peter travels?

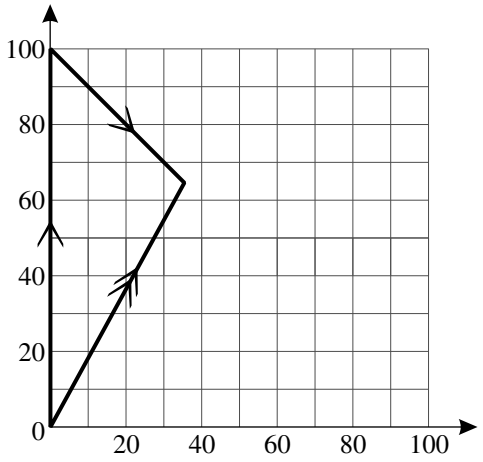
A



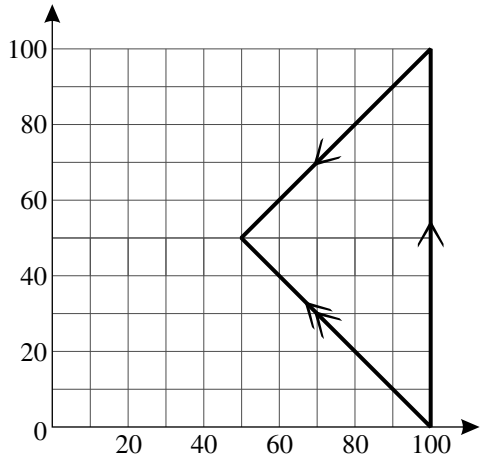
B



C



D



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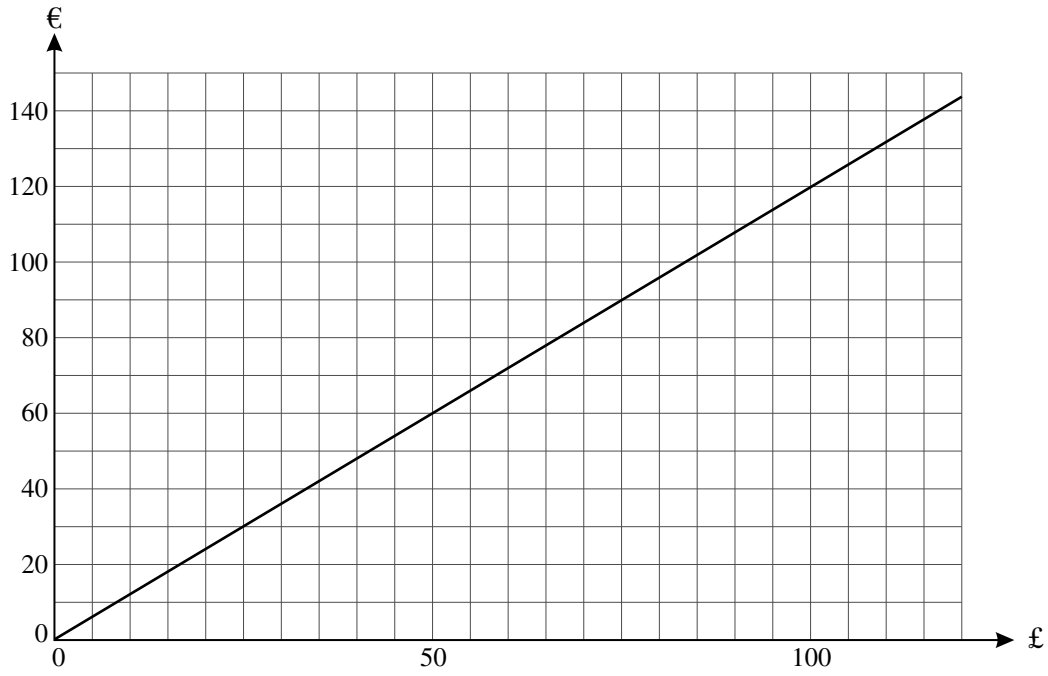
38 The graph below represents the conversion between pounds and euros one day.



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

A £1 is worth less than €1.50.

B €50 is roughly equivalent to £42.

C £60 is roughly equivalent to €70.

D On a later occasion I paid £77.10 for €100. The conversion graph for this exchange rate would be less steep than that drawn above.

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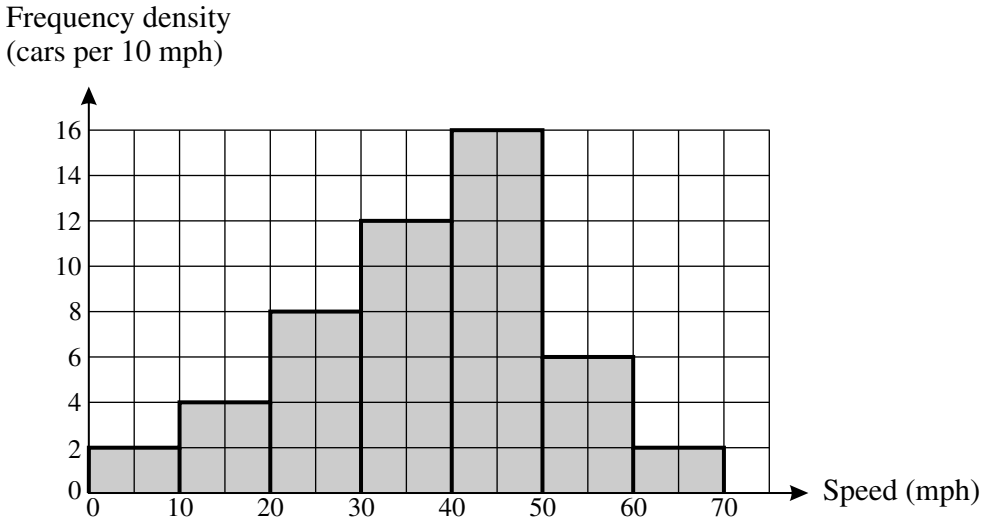
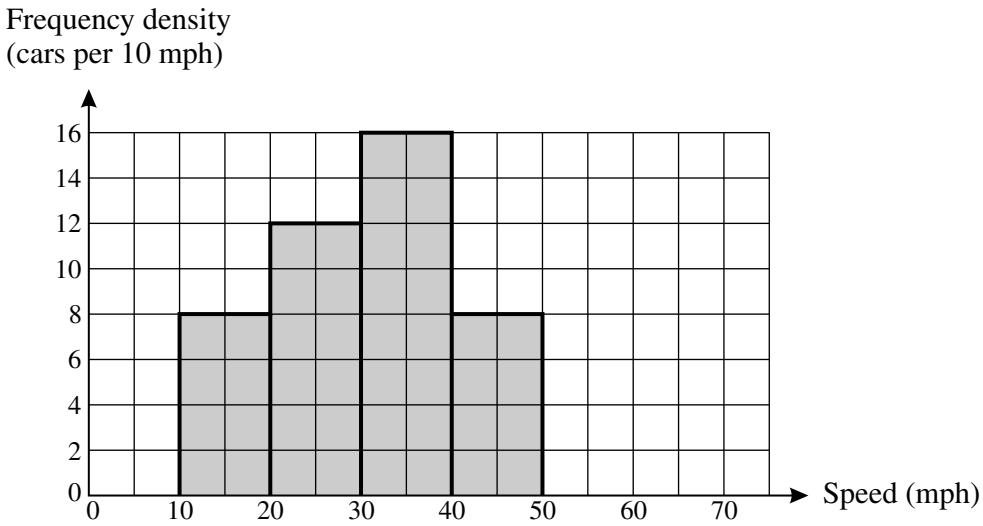
39 On two stretches of road a council record the speeds of cars over a period of two hours. The results are shown in the histograms below.

Road X



Road Y



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

A Two of the cars on Road X were recorded as travelling below 10 mph.

B The speed limit is 40 mph on both roads. The number of cars travelling below the speed limit on Road X was 10 fewer than the number of cars travelling below the speed limit on Road Y.

C The mean speed on Road Y is lower than that on Road X.

D The spread of speeds is greater on Road Y.

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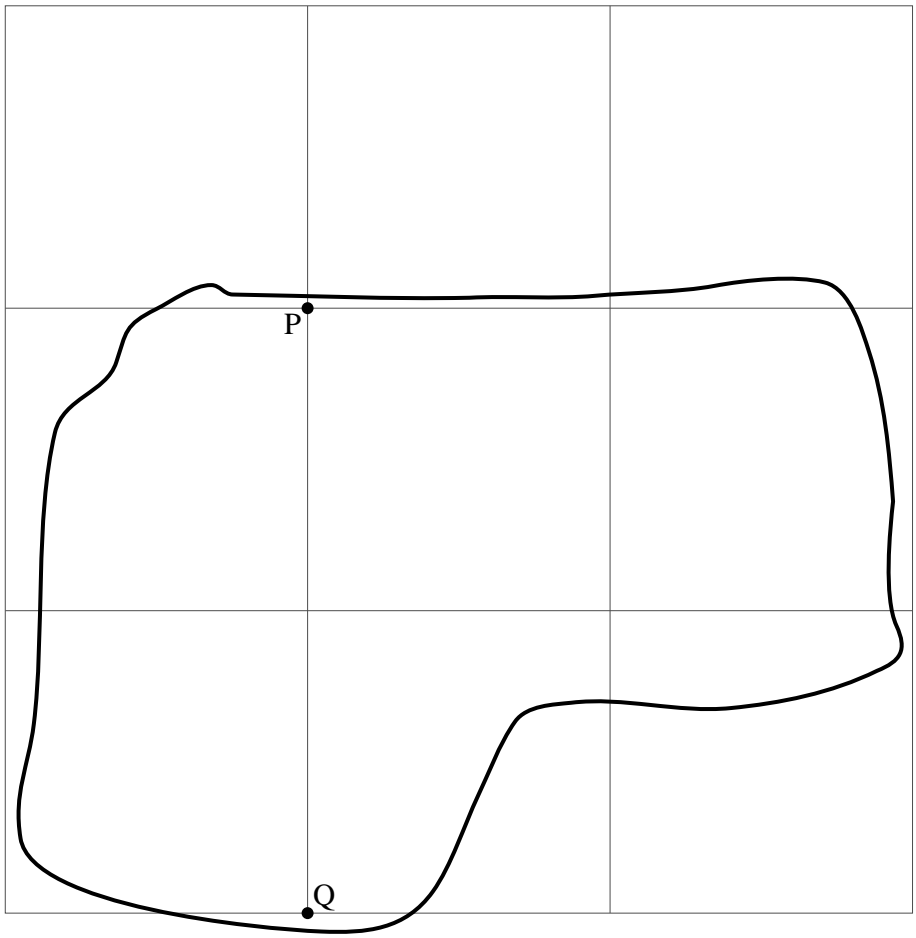
40 The diagram is part of a map showing a field.
It is drawn on a four centimetre square grid.
The scale is 1 : 25 000.



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

A The actual distance between P and Q is two kilometres.

B One square on the map represents 1 km^2.

C An area on the map of 1 cm^2 corresponds to an actual area of 625 000 m^2.

D An upper estimate of the area of the field is 5 km^2.

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