

Tuesday 20 June 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



INSTRUCTIONS TO CANDIDATES

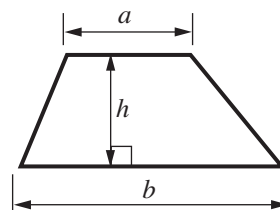
- Write your name clearly in capital letters, your centre number and candidate number on the Answer Sheet in the spaces provided unless this has already been done for you.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- There are **forty** questions in this paper. Attempt as many questions as possible. For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.
- **Read very carefully the instructions on the Answer Sheet.**

INFORMATION FOR CANDIDATES

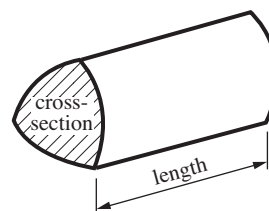
- Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
- This document consists of **24** pages. Any blank pages are indicated.

Formulae Sheet: 6989 Foundations of Advanced Mathematics

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



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

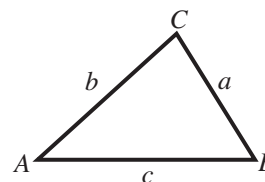


In any triangle ABC

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

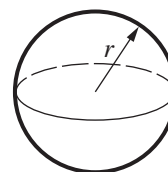
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

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



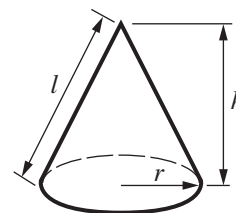
Volume of sphere $= \frac{4}{3}\pi r^3$

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

- A The highest common factor (HCF) of 60 and 144 is 12.
- B The lowest common multiple (LCM) of 6 and 20 is 60.
- C The difference between $2\frac{5}{6}$ and $1\frac{1}{2}$ is $1\frac{1}{3}$.
- D 43 is a factor of 2017.

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

- A $(-2) - (-3) = 1$
- B $(-2) \times (-3) = 6$
- C $2 + 3 \times 4 - 1 = 19$
- D $\frac{9 + 2 \times 3}{3 + 4 - 2} = 3$

3 I find three opened bags of sugar (of the same size) in my cupboard. $\frac{1}{3}$ of the first bag has been used, $\frac{1}{2}$ of the second bag has been used and $\frac{3}{4}$ of the third bag has been used.

Which **one** of the following is the **total** quantity of sugar remaining?

- A $1\frac{5}{12}$ bags
- B $2\frac{5}{12}$ bags
- C $1\frac{7}{12}$ bags
- D $1\frac{4}{9}$ bags

- 4 A sum of money is to be split in the ratio 5 : 7 : 8. The largest portion is £3000.

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

- A The smallest portion is £2000.
- B The difference between the smallest portion and the middle portion is greater than the difference between the middle portion and the largest portion.
- C Each portion is less than 50% of the total sum of money.
- D The total sum of money is £7500.

- 5 A company offers a pay rise to all its employees. It offers a choice of an increase of 5% or an extra annual payment of £1000.

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

- A If John's salary is £15 000 per year then he would be better off accepting the sum of £1000.
- B If Paul's salary is £22 000 per year then he would be better off accepting the percentage increase.
- C If Jane's salary is £25 000 per year then it makes no difference which choice she makes.
- D Debbie's salary is currently £45 000. She chooses to accept £1000. This represents an increase of 2.22% correct to 2 decimal places.

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

- A 75% is equivalent to $\frac{3}{4}$.
- B 0.65 is equivalent to $\frac{13}{20}$.
- C $0.7 < \frac{5}{7} < 0.8$
- D $\sqrt{30} = 5.47$, correct to 2 decimal places.

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

A $2^3 \times 2^{-3} = 0$

B $2^4 = 4^2$

C $2^3 \times 3^3 = 6^3$

D $2^3 \div 2^{-4} = 2^7$

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

A $x^2 - x - 2 = (x - 2)(x + 1)$

B $x^2 + 6x + 5 = (x + 2)(x + 3)$

C $x^2 + 5x - 6 = (x + 6)(x - 1)$

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

9 Adam, Bob, Chloe and Layia are four lecturers in a college.

Three of the following statements are possible and **one** is unlikely. Which one is **unlikely**?

A Adam is 1.8 m tall.

B Bob can run at 20 m s^{-1} .

C Chloe's car uses 1 litre of petrol for every 10 km.

D Layia weighs 82 kg.

- 10 The number 1034.6347 is to be written correct to 3 significant figures.

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

- A 103
- B 1030
- C 1035
- D 1034.635

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

- A 90 km h^{-1} is just over 56 mph.
- B $90 \text{ km h}^{-1} = 25 \text{ m s}^{-1}$
- C 1 pint is approximately 1.76 litres.
- D 1 kg is approximately 2.2 lb.

- 12 Which **one** of the following is the **correct** solution of the equation $x^2 - 7x + 6 = 0$?

- A $x = 1$ or 6
- B $x = \frac{7 \pm \sqrt{73}}{2}$
- C $x = 3$ or 4
- D $x = \frac{-7 \pm \sqrt{73}}{2}$

- 13 A train company determines the time taken for a journey by the formula

$$T = 10 + 4s + \frac{m}{2}$$

where T is the total time in minutes to complete a journey of m kilometres with s stops.

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

- A The time allowed for a stop is 4 minutes.
- B A journey of 80 kilometres with 2 stops will take less than 1 hour.
- C If a journey of 200 kilometres is timed to take less than 2 hours there can be no more than 2 stops.
- D A journey time of 300 minutes with 4 stops is allowed for a journey of 137 km.

- 14 Becci is playing a number game. She asks Erin to do the following:

Choose any whole number.

Add 1 to it.

Square the result.

Divide this result by 2.

Add 1.

Now tell me your answer.

Becci calls this answer y .

Which **one** of the following expressions can be used to find Erin's correct starting number?

- A $\sqrt{2(y-1)} - 1$
- B $\frac{(y+1)^2}{2} + 1$
- C $\sqrt{2(y+1)} + 1$
- D $\frac{\sqrt{(y-1)}}{2} - 1$

- 15 Lily is solving the inequality $2(x-1) > 1-3x$.

Kian is solving the inequality $\frac{y}{2} - 2(y-2) > \frac{1}{2}$.

Lily says that the solution to her inequality is $x > \frac{5}{3}$.

Kian says that the solution to his inequality is $y < \frac{7}{3}$.

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

- A Lily is right and Kian is wrong.
- B Both Lily and Kian are right.
- C Lily is wrong and Kian is right.
- D Both Lily and Kian are wrong.

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

- A $\frac{10x-13}{12}$
- B $\frac{2x-13}{12}$
- C $\frac{3x-4}{12}$
- D $\frac{x-4}{12}$

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

- A The formula $A = kr^2$ means that the value of A can be found by squaring r and multiplying by k .
- B The formula $d = a + b^2$ means that the value of d can be found by adding b to a and squaring the result.
- C If $V = a^2b$ when $a = 4$ and $b = 5$ then $V = 80$.
- D If $y = (x - 7)^2$ then y is never negative.

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

- A $3.3 \times 10^4 + 7.1 \times 10^4 = 1.04 \times 10^5$
- B $4.31 \times 10^5 + 2.33 \times 10^6 = 2.761 \times 10^6$
- C $2.5 \times 10^3 \times 4.2 \times 10^2 = 1.05 \times 10^6$
- D $2.6 \times 10^5 \div 6.5 \times 10^{-2} = 4 \times 10^2$

19 The formula $s = ut + \frac{1}{2}at^2$ is to be rearranged so that a is the subject.

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

- A $a = \frac{2(s - ut)}{t^2}$
- B $a = \frac{s}{ut} - \frac{1}{2}t^2$
- C $a = \frac{2s - ut}{t^2}$
- D $a = \frac{\sqrt{2s - 2ut}}{t}$

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

- A The solution of the equation $2x - 3 = 5$ is $x = 4$.
- B The solution of the equation $10 - 3x = 2x$ is $x = 2$.
- C The solution of the equation $3(2x + 1) - 2 = 11$ is $x = 2$.
- D The solution of the equation $2(3 - x) - x = x - 4$ is $x = 2\frac{1}{2}$.

21 Which **one** of the following is the **correct** solution of the following simultaneous equations?

$$\begin{aligned}2x + 5y &= 12 \\ 7x - y &= 5\end{aligned}$$

- A $x = 1$ and $y = 2$
- B $x = 6$ and $y = 0$
- C $x = 0$ and $y = -5$
- D $x = \frac{239}{231}$ and $y = \frac{74}{33}$

22 Ava has a number of box files which she wants to store in a row on a shelf.
Each box file is 6 cm thick, correct to the nearest cm.
The shelf is 70 cm long, correct to the nearest cm.

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

- A The length of the shelf is no more than 705 mm.
- B The thickness of one box file is at least 55 mm.
- C 11 box files will definitely fit onto the shelf.
- D It is possible that 12 box files will fit onto the shelf.

- 23 In a coffee shop, Jacob buys 2 coffees and a cake and pays £5.50.
In the same shop Paula buys 3 coffees and 2 cakes and pays £7.80.
All coffees are the same price and all cakes are the same price.
Let x be the price in pence of a coffee and y be the price in pence of a cake.

Which **one** of the following simultaneous equations **correctly** represents this information?

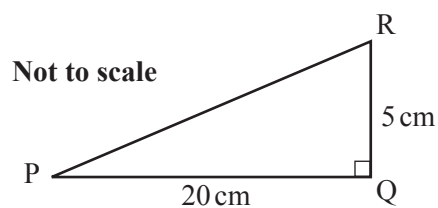
A $2x + y = 550, 3x + 2y = 780$

B $2x + y = 5.50, 3x + 2y = 7.80$

C $\frac{x}{2} + y = 550, \frac{x}{3} + \frac{y}{2} = 780$

D $\frac{x}{2} + y = 5.50, \frac{x}{3} + \frac{y}{2} = 7.80$

- 24 In the diagram, $PQ = 20$ cm, $QR = 5$ cm and the angle $PQR = 90^\circ$.



Which **one** of the following is the **correct** size of angle PRQ , correct to the nearest 0.1° ?

A 75.5°

B 14.0°

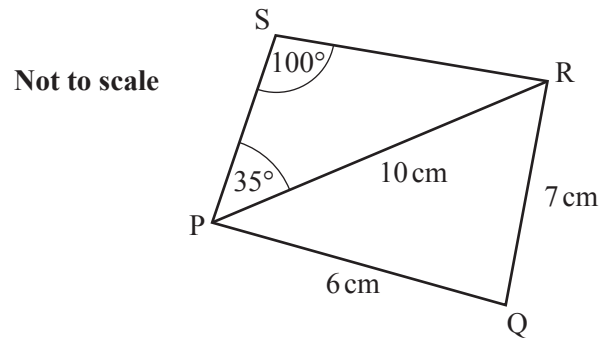
C 76.0°

D 14.5°

25 Three of the following expressions may be simplified to $x + 1$ and one does not. Which **one** does **not**?

- A $3(x+4) - (2x+11)$
- B $5x-2 + (3-4x)$
- C $x(x+2) - (x^2+x-1)$
- D $(5-x) - 2(3-x)$

26 Two students are given a quadrilateral PQRS with sides and angles as shown in the diagram. The diagonal PR is also given.



They make assertions about the quadrilateral as follows:

- Charlie says that angle PRQ is 36.2° , correct to 1 decimal place.
- Dawn says that side SR has length 17.2 cm, correct to 1 decimal place.

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

- A Both Charlie and Dawn are correct.
- B Charlie is correct and Dawn is incorrect.
- C Charlie is incorrect and Dawn is correct.
- D Both Charlie and Dawn are incorrect.

- 27 Aswan tosses two fair coins.

Which **one** of the following is the **correct** probability of obtaining one head and one tail?

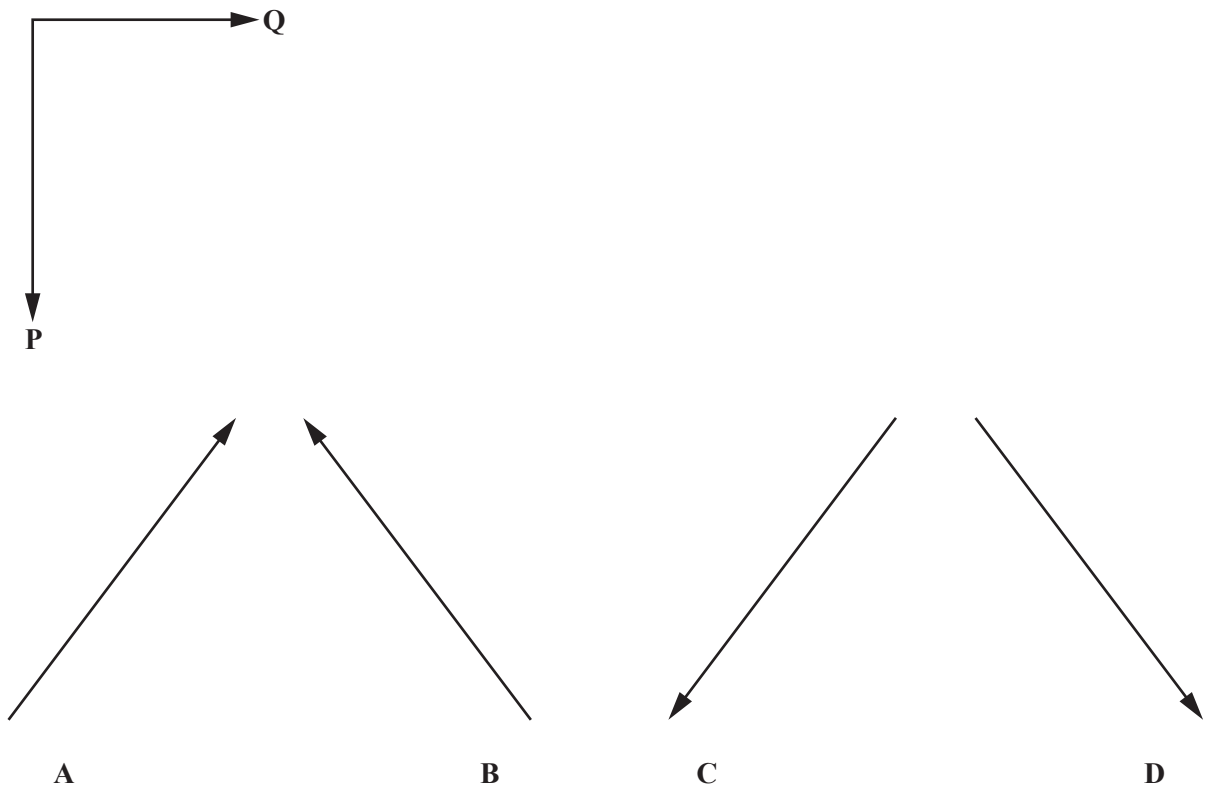
A $\frac{1}{2}$

B $\frac{1}{3}$

C $\frac{1}{4}$

D 1

- 28 Two forces **P** and **Q** have directions at right angles to each other, as shown in the diagram.



Which **one** of **A**, **B**, **C** and **D** correctly represents the resultant force of **P** and **Q**?

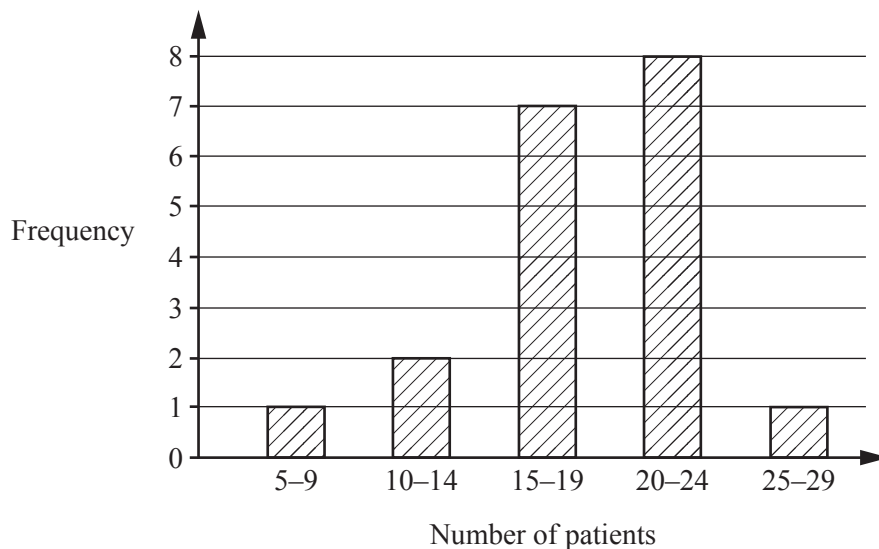
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- 29 A doctor records the number of patients she sees each day over a period of 20 days.

13 22 10 21 24 22 19 17 16 21
28 12 24 8 14 16 17 21 20 19

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

Interval	Frequency
5 – 9	1
10 – 14	4
15 – 19	6
20 – 24	8
25 – 29	1



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

- A The doctor's frequency table is correct.
- B The doctor's bar chart is correct.
- C From the original data, the range of patients seen per day is 20.
- D From the original data, the mean number of patients seen per day is 18.2.

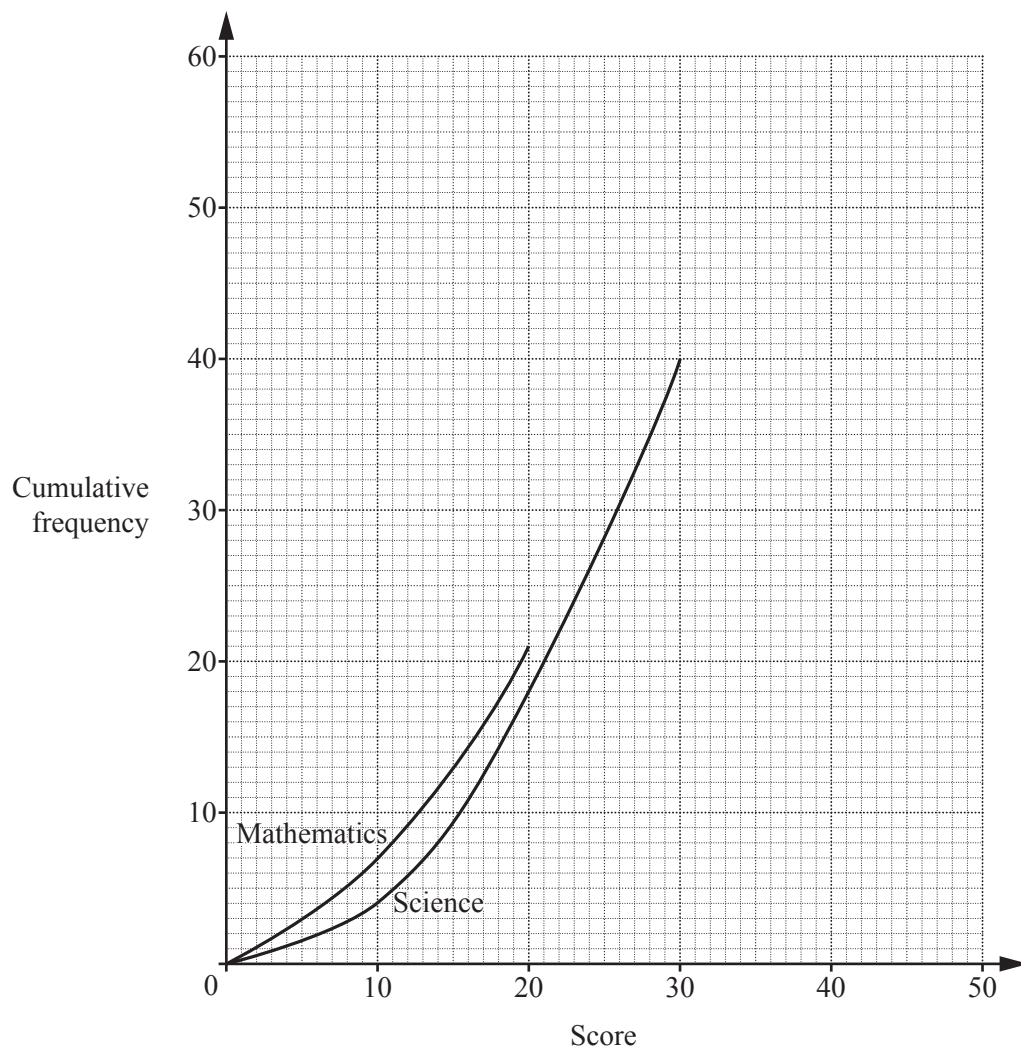
- 30 Rabi is analysing the marks scored by students in a Mathematics exam and in a Science exam. He constructs a frequency table for each. (No student scored 0 in either exam.)

Marks scored out of 50	1 – 10	11 – 20	21 – 30	31 – 40	41 – 50
Frequency for Mathematics	7	14	16	10	3
Frequency for Science	4	14	22	16	4

In order to carry out the analysis, Rabi is wants to construct a cumulative frequency table and draw a cumulative frequency curve for each subject.

In order to answer this question you are advised to complete the cumulative frequency tables and the cumulative frequency curves.

Marks scored out of 50	– 10	– 20	– 30	– 40	– 50
Cumulative frequency for Mathematics	7	21			
Cumulative frequency for Science	4	18	40		



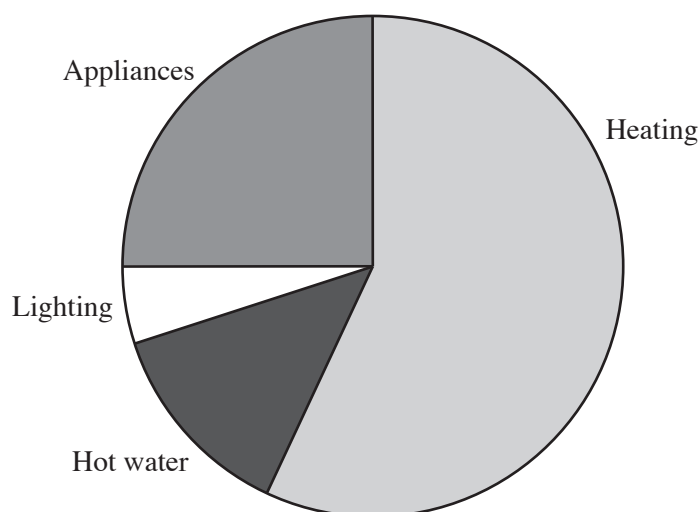
Three of the following statements are true and **one** is false. Which one is **false**?

- A There are more Science results than Mathematics results recorded.
- B 3 students scored more than 80% in Mathematics.
- C The interquartile range for the Science results is approximately 14.
- D The median score in both exams is the same.

- 31 Tia wants to analyse the use of energy in houses in England. She finds the following data on a website.

Heating	60%
Hot water	15%
Lighting	6%
Appliances	19%

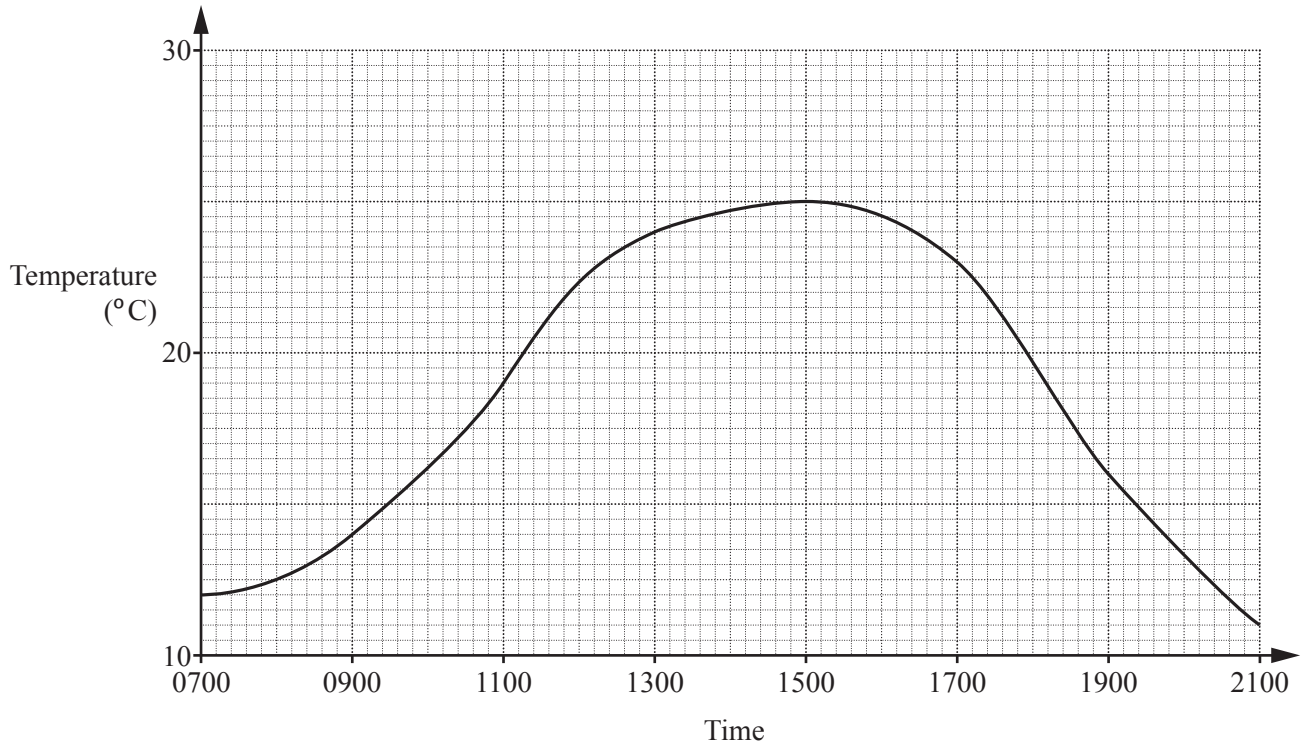
She draws the following pie chart to show this information.



Three of the following statements about Tia's pie chart are **true** and one is false. Which one is **false**?

- A Tia has drawn the sector for Appliances too large.
- B The correct angle of the sector for Heating is 10 times as large as the correct angle for the sector for Lighting.
- C The correct angle by calculation for the Hot water sector is 24° .
- D The correct angle by calculation for the Heating sector is 216° .

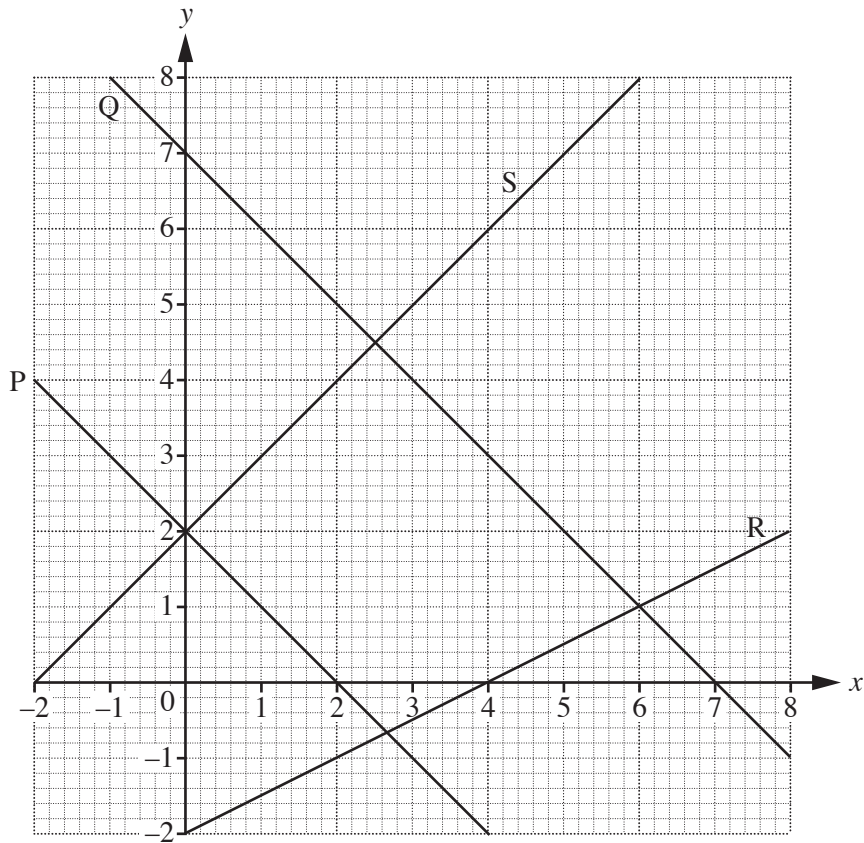
32 The following graph shows the temperature, in degrees C, in a garden one day in the summer.



At which **time** does the temperature appear to be rising **most** rapidly?

- A 0930
- B 1130
- C 1530
- D 1830

33 Parts of four lines, P, Q, R and S are shown on the diagram.



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

- A The equation of line P is $x + y = 2$.
- B The line Q passes through the point $(9, -2)$.
- C The gradient of the line R is $-\frac{1}{2}$.
- D Both the x and y co-ordinates of the point of intersection of R and S are negative.

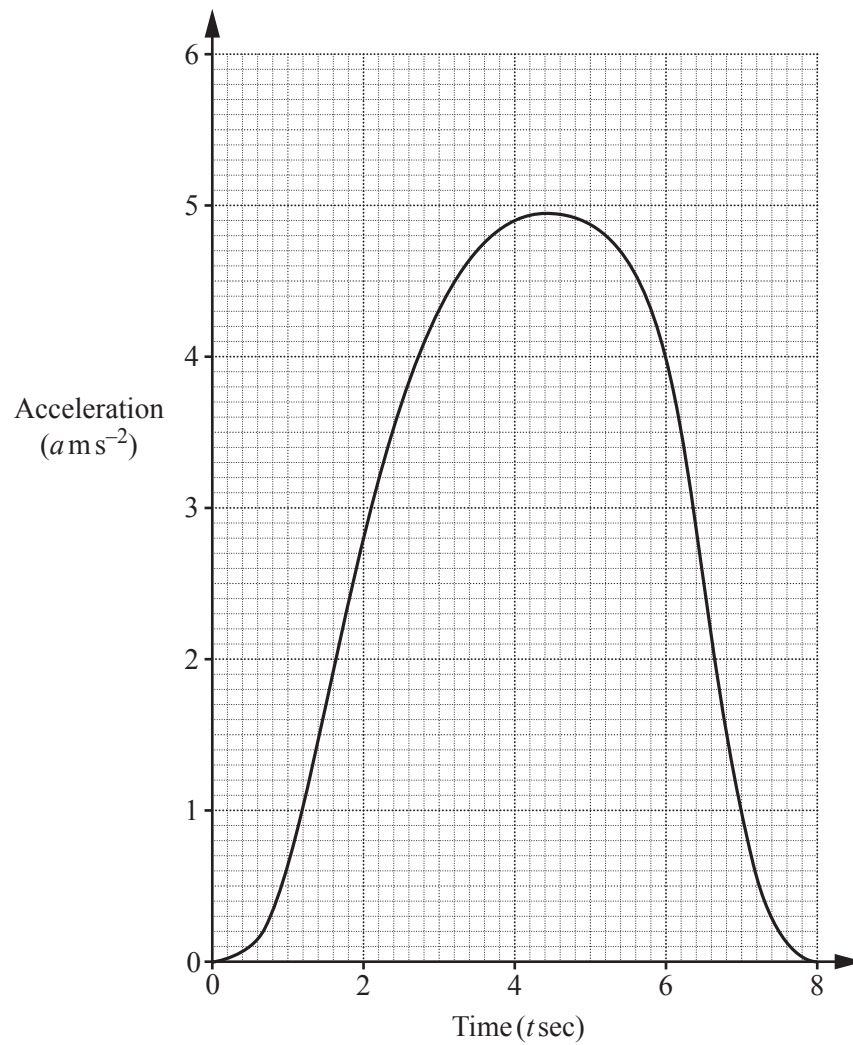
34 Three vectors are given as $\mathbf{a} = 3\mathbf{i} + 4\mathbf{j}$, $\mathbf{b} = -\mathbf{i} + 2\mathbf{j}$, $\mathbf{c} = p\mathbf{i} + q\mathbf{j}$ where p and q are whole numbers.

Which **one** of the following pair of values for p and q give $\mathbf{a} + \mathbf{b} + \mathbf{c} = \mathbf{0}$?

- A $p = -2, q = -6$
- B $p = 2, q = 6$
- C $p = 4, q = 2$
- D $p = -4, q = -2$

- 35 A car accelerates from rest.

The graph below gives the acceleration ($a \text{ m s}^{-2}$) for the first 8 seconds in the interval $0 \leq t \leq 8$.



The area under an acceleration-time graph gives the increase in velocity over the interval of time.

Which **one** of the following is an **approximate** value for the velocity when $t = 8$?

- A 4.9 m s^{-1}
- B 22 m s^{-1}
- C 39.2 m s^{-1}
- D 44 m s^{-1}

- 36 Dominic records the number of text messages he receives per day over a period of 90 days. He displays the results in the table as shown.

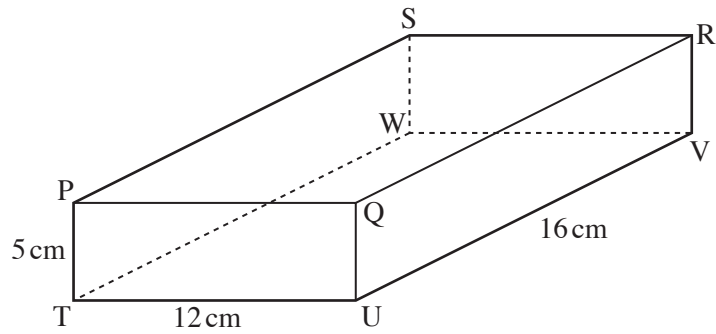
Number of text messages	Number of days
0	1
1	0
2	0
3	2
4	7
5	8
6	13
7	17
8	23
9	15
10	4
11 or more	0

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

- A The range is 10.
- B The mean number of texts is 7.
- C The median number of texts is 7.
- D If a day is chosen at random then the probability that Dominic received fewer than 3 texts on that day is $\frac{3}{11}$.

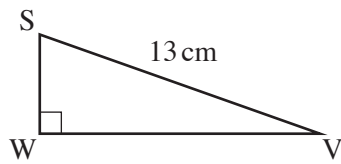
37 Ahmed is making sketches of parts of a cuboid.

The cuboid PQRSTUVW is shown below where $PT = 5\text{ cm}$, $TU = 12\text{ cm}$ and $UV = 16\text{ cm}$.

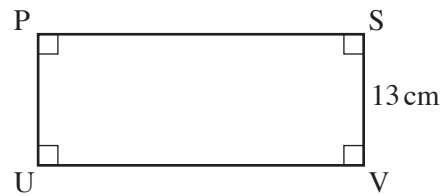


The four sketches that Ahmed makes are shown below, labelled **A**, **B**, **C** and **D**. Three of the sketches, which are not to scale, contain correct information but one contains an error.

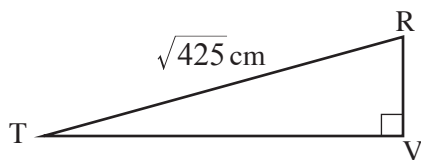
Which **one** contains an error?



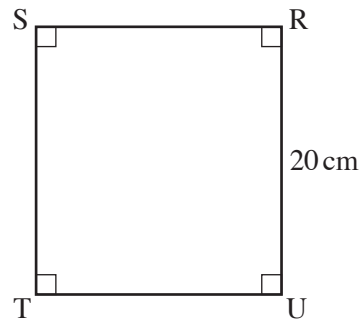
A



B

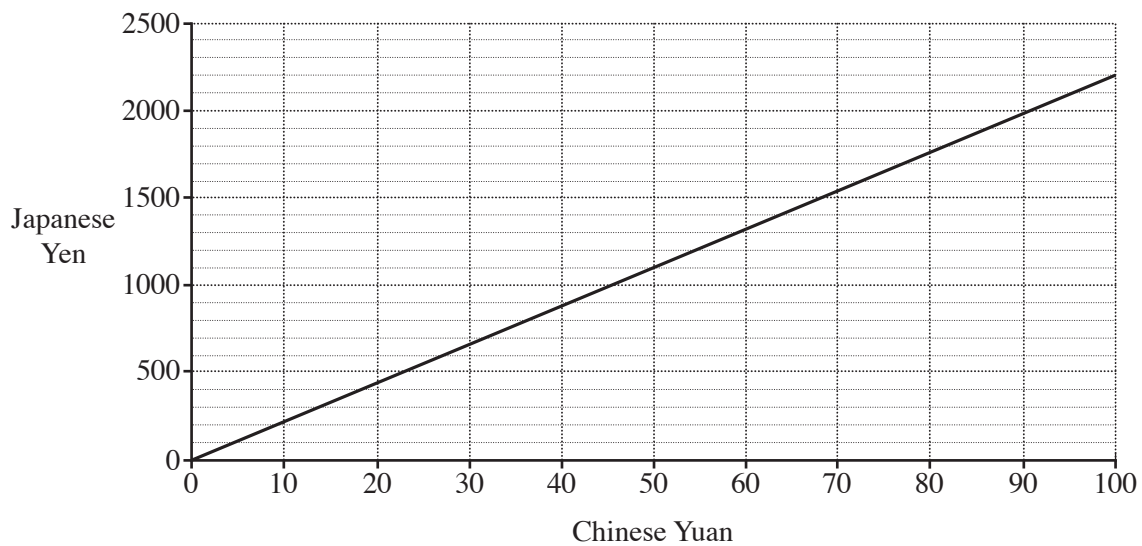


C



D

- 38 The graph below is used to convert between Japanese Yen and Chinese Yuan one day.



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

- A 1 Chinese Yuan is worth approximately 22 Japanese Yen.
- B 70 Chinese Yuan is worth more than 1600 Japanese Yen.
- C The gradient of the line is 22 Yen per Yuan.
- D 500 Japanese Yen is worth more than 20 Chinese Yuan.

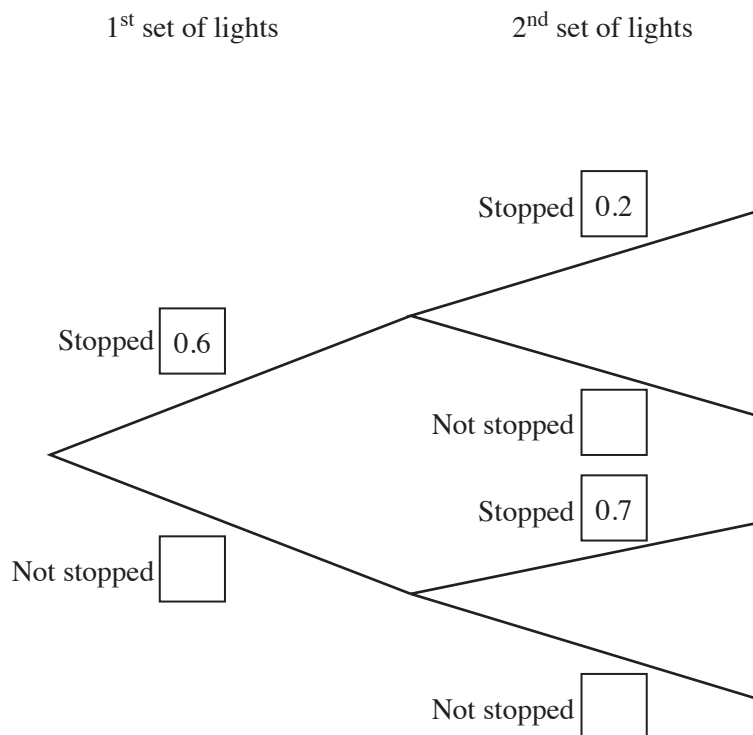
- 39 Alex and Toby are discussing work they are doing on samples of data.
 Alex is conducting an on-line survey asking for feedback from a conference. He has sent out 150 requests and has had 50 returned. He claims that this is a random sample.
 Toby has attended a union meeting. At the meeting were 20 employees of the company out of a total work force of 500. He claims that this is a random sample.

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

- A Both Alex and Toby are correct.
- B Both Alex and Toby are incorrect.
- C Alex is correct and Toby is incorrect.
- D Alex is incorrect and Toby is correct.

- 40 Paul is driving down a road where there are two sets of traffic lights. Having driven down this road many times in the past he knows that there is a probability of 0.6 that he will be stopped at the first set of lights. If he is stopped then the probability that he will be stopped at the second set of lights is 0.2. If he is not stopped by the first set of lights then the probability that he will be stopped by the second set of lights is 0.7.

In order to answer this question you are advised to complete the tree diagram below showing the probabilities.



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

- A The probability that Paul does not stop at either sets of lights is 0.12.
- B The probability that Paul stops at both sets of lights is 0.88.
- C The probability that Paul stops at the second set of lights is 0.4.
- D The probability that Paul stops at just one of the sets of lights is 0.76.

END OF QUESTION PAPER

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