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Oxford Cambridge and RSA

GCSE (9–1)

Examiners' report

MATHEMATICS

J560

For first teaching in 2015

J560/04 November 2023 series

Version 1

ocr.org.uk/maths

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate responses is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from our secure Teach Cambridge site.

Paper 4 series overview

There were indications in this paper that candidates did not clearly read the demand of each question. For example, Question 2 (a) gave a clear lead to the expected response, which many ignored. In Question 7 they were asked for the integers which satisfied the inequality, yet many candidates gave an algebraic inequality as their response. In Question 13, in both parts, the candidates were asked for a single transformation and many gave a double transformation. In Question 18 they were asked to solve the equation using factorisation but many used the quadratic formula.

Many candidates struggled over the first half of this paper. In Question 1 many did not know how to calculate the percentage increase, often using the new price rather than the original price to calculate the percentage. In Question 3 many used percentages to express the proportions in a pie chart rather than degrees. In Question 4 they struggled to convert decimal hours to minutes. In Question 10 they made assumptions about the lengths of sides which were not correct.

There was a strong algebraic demand in this paper and candidates were required to know certain techniques soundly. This was not the case with some candidates. They were required to solve linear equations, linear inequalities and linear simultaneous equations. They were then expected to be able to factorise quadratic equations and to find the coefficients for a quadratic sequence. They were expected to apply the laws of indices and to simplify expressions with surds.

Some of the problems that emerged included converting time from decimal hours to minutes and understanding bearings, in particular finding missing angles using angles in parallel lines. Candidates also struggled to complete a proof using congruence of triangles. Many did not understand how to find the original frequency from a histogram.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• read each question carefully • gave their response to each question using the method or in the form requested • had sound algebraic techniques at this level • kept accuracy in their numerical calculations • knew how to find the information from a variety of diagrammatic representations • showed working in a clear and logical order.	• showed evidence of not having understood the demands of some questions • did not always give their responses in the form requested or using the method requested • algebraic techniques were not as sound • rounded or truncated partial figures which led to an inaccurate final result • did not know how to extract frequencies from diagrams such as pie charts and histograms • set out working in a haphazard way and some steps in the working were omitted.

Question 1

1 The price of a phone increases from £240 to £262.80.

Calculate the percentage increase in the price of the phone.

..... % **[3]**

Most responses subtracted the two prices to find the increase. However, some divided this figure by 262.80 rather than 240 to find the percentage. There were a few responses who left the answer as a decimal, usually 1.095, instead of picking the correct percentage from it.

Question 2 (a)

2 A prime number is a whole number that has exactly two factors.

(a) Explain why 1 is not a prime number.

.....

..... **[1]**

The initial statement about prime numbers was intended to be used as an introduction, and a hint to their response. However, many candidates ignored it and gave a wide variety of responses. A common approach was to say that 1 = 1 × 1. Others made a similar statement by saying that 1 only goes into itself, the other factor of 1 is itself, while some stated that 1 was in every times table.

The question contains important information.

The first line in the question gives a hint to answering this question, 'A prime number …….. has exactly two factors.' It is intended to give the candidates a prompt in giving their response which should address the 'exactly two factors' concept.

Question 2 (b)

(b) a and b are prime numbers.

Write down the **6** factors of a^2b.

(b) .... **[2]**

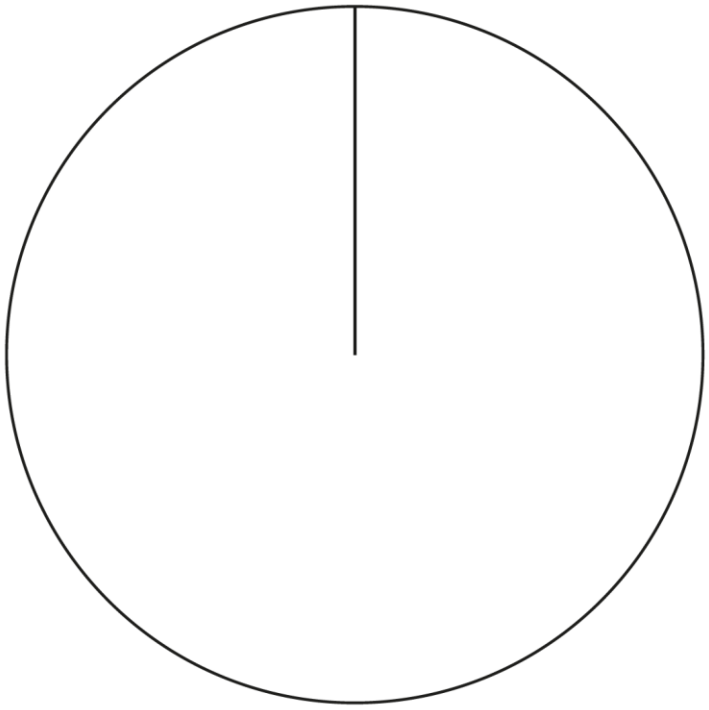
There were a very few candidates who answered this correctly. Most candidates have possibly not seen a question like this although quite a few did respond with 1, a and b as factors, therefore gaining some credit. Most candidates wrote down six integers as factors.

Question 3 (a)

3 (a) The table shows the results for a sports club's 'A' team.

Result	Frequency
Win	18
Draw	10
Lose	12
Total	40

Complete a labelled pie chart to show these results.

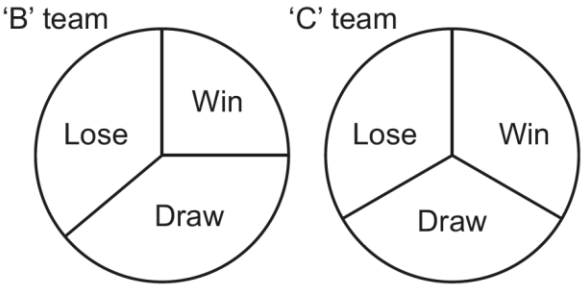


[4]

Many candidates found this question difficult. They would usually calculate the percentages correctly as 45%, 25% and 30%. However, they were unable to find the angles from these percentages. The one exception was 'Draw' which was 25% and some were able to work out that this was 90°. The best attempts realised that 9 × 40 = 360 so they found the angles by multiplying the frequencies by 9. Even then not all of these measured the three angles accurately.

Question 3 (b)

(b) Here are the results for the sports club's 'B' team and 'C' team.



The 'C' team manager says

The pie charts show that the 'C' team won more games than the 'B' team.

Referring to the pie charts, explain why the 'C' team manager may not be correct.

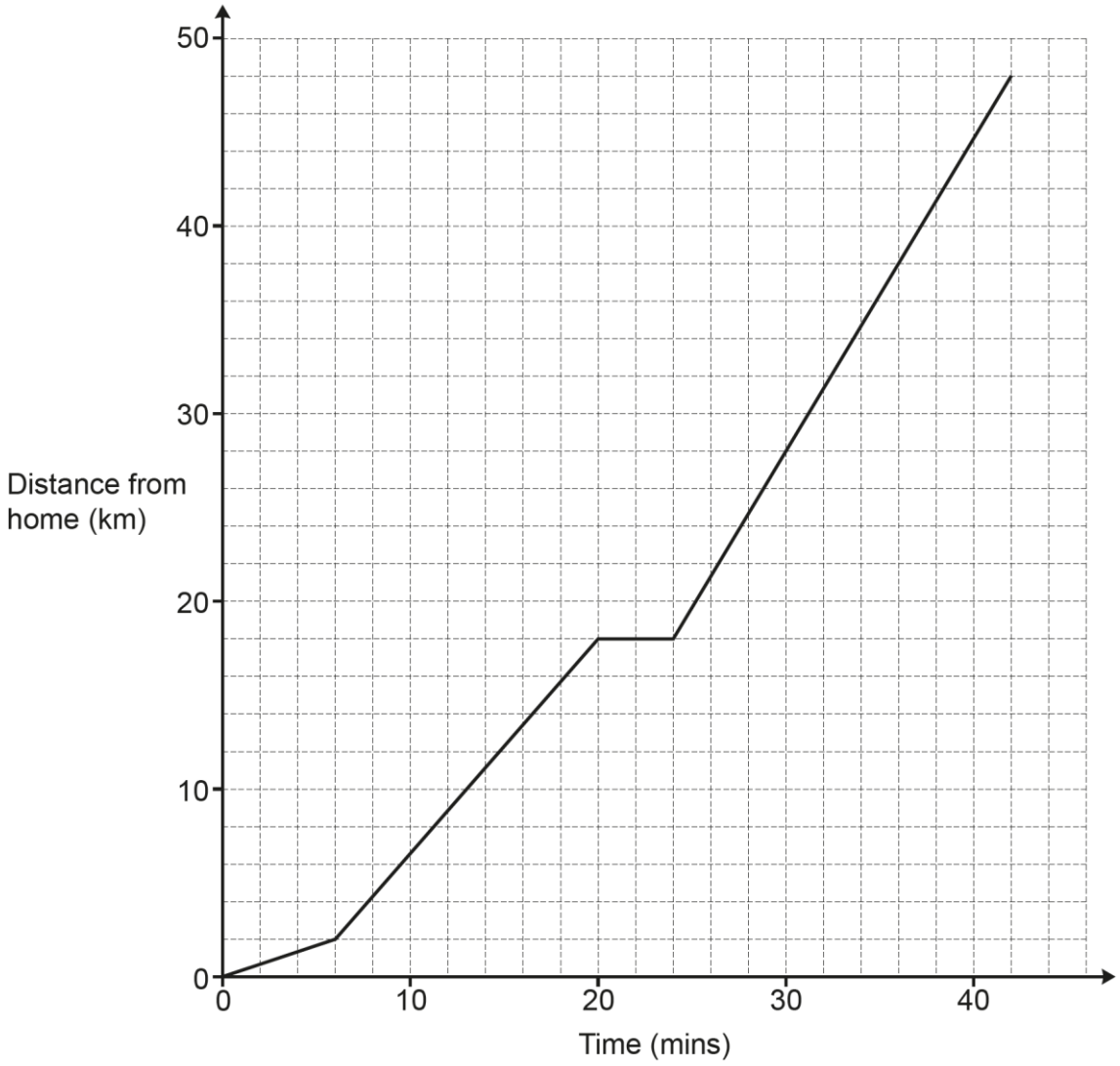
.....

..... **[1]**

The key response was to talk about the fact that the pie charts do not show how many matches have been played by both teams. Some candidates commented on the draws or losses, while others stated that the charts are not accurate, which may have been a comment about the lack of figures but it was not clear.

Question 4 (a)

4 The graph shows Taylor's journey from home to an airport.
During the journey Taylor stops for petrol.



(a) For how long did Taylor stop for petrol?

(a) ..... mins **[1]**

Almost every candidate answered this correctly by giving the answer 4. A few gave the answer 20.

Question 4 (b)

(b) Taylor drives the same route back home from the airport at an average speed of 45 km/h. Taylor leaves the airport at 22:00.

Work out the time when Taylor arrives home.

(b) ..... **[4]**

Most candidates started correctly by calculating 48 divided by 45. The answer is $1.0\dot{6}$, but many truncated this figure to 1.06 or rounded to 1.07. They should have taken the number on the calculator and multiplied by 60 to get 64 minutes. Many candidates used their inaccurate figures and so ended up giving the answer as 23:02, 23:03, 23:03.6, 23:05 or 23:06.

Question 5 (a)

5 **(a)** Write an expression for the weight, in grams, of an object weighing x kilograms.

(a) ..... g **[1]**

The question asked for an expression, but many candidates gave an equation often starting with x or w. The common incorrect expressions were either just 1000 or $\frac{x}{1000}$.

Question 5 (b)

(b) Write an expression for the area, in m^2, of a garden of area $y cm^2$.

(b) ..... m^2 **[1]**

As in part (a) there were some equations and very few correct expressions. The common errors seen were $\frac{10\,000}{y}$, $\frac{y}{100}$, $100y$ and m^2y.

Question 6

6 2 kg of carrots and 5 kg of potatoes cost £6.36.
3 kg of carrots and 2 kg of potatoes cost £5.25.

Find the cost of 1 kg of carrots and the cost of 1 kg of potatoes.
You must show your working.

1 kg of carrots cost £ .....

1 kg of potatoes cost £ .....
[5]

The expected method of writing two linear simultaneous equations and solving them was the most common method. This often led to the correct responses. We did see a method based on matrices which is not in the National Curriculum so does need to be clearly and correctly shown in order to be accepted. A few candidates used a trial and improvement method, which is also not in the National Curriculum and this method will only be rewarded if the correct responses are obtained. A few attempts at solving simultaneous equations did lead to arithmetic errors but evidence of the correct method was rewarded.

Question 7

7 Find all the possible integer values that satisfy the inequality $-10 < 3x + 2 \leqslant 8$.

$x =$ ..... **[3]**

Most candidates struggled to answer this question, not spotting what was required even though questions of this type have been set previously. Many treated the inequality as one unit which made the problem more difficult. The best attempts split the single inequality into two inequalities $-10 < 3x + 2$ and $3x + 2 \leq 8$, then they solved each one separately. Some of those who solved these inequalities omitted 0 as a solution.

Assessment for learning

These inequalities are best solved by writing as two separate inequalities first and solving them separately.

Exemplar 1

$-10 < 3x+2$ $\quad 3x+2 \leqslant 8$

$-12 < 3x$ $\quad 3x \leqslant 6$

$x \leqslant 2$

$-4 < x$

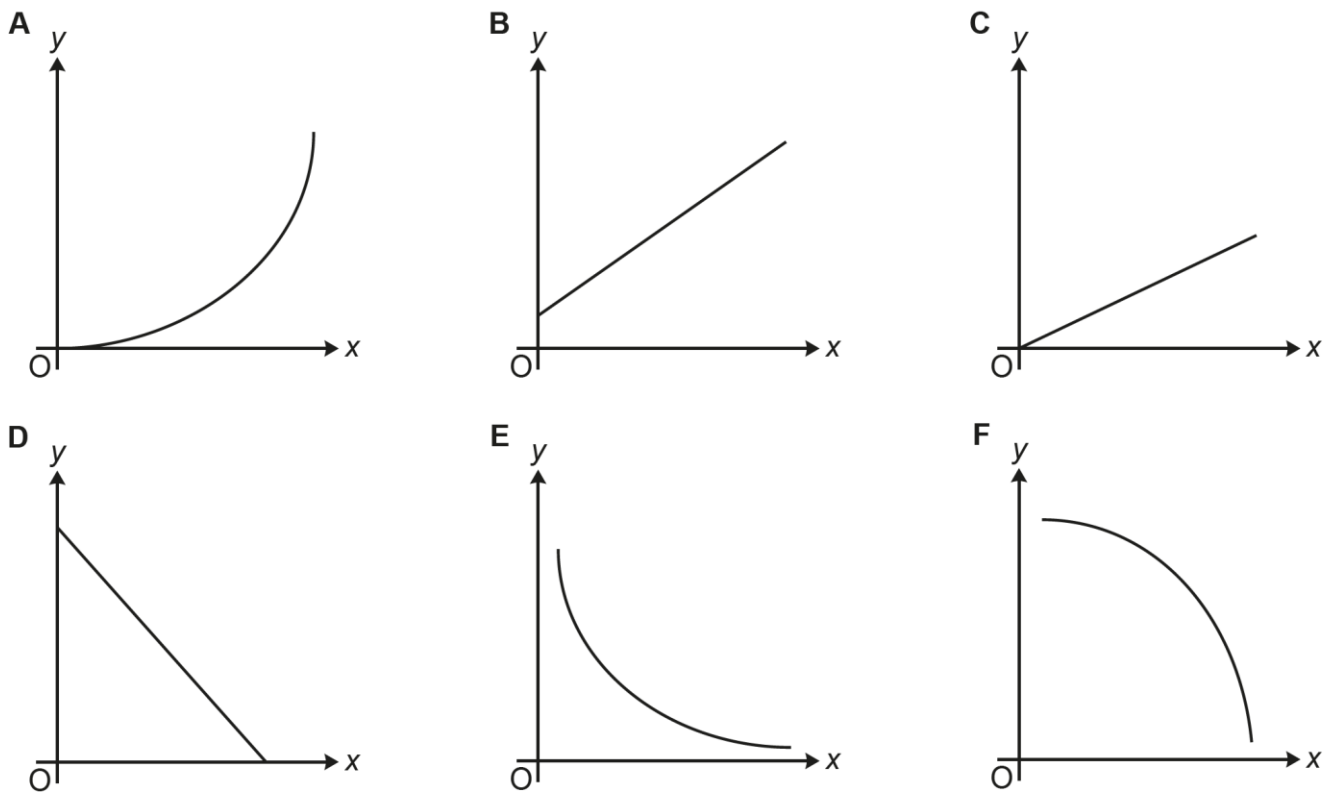
$-4 < x \leqslant 2$

$x =$ $-4 < x \leqslant 2$ **[3]**

The inequality can be solved as one statement or, as here, it can be split into two statements and solved separately. In this response the candidate needs to check the question demand to see that they need to find the integers that satisfy both of these inequalities.

Question 8 (a)

8 Here are sketches of six graphs, labelled **A** to **F**.



Write the letter of the graph that represents the following relationships.

(a) y is directly proportional to x.

(a) ..... **[1]**

There were many correct responses. The common incorrect responses were D and E.

Question 8 (b)

(b) y is inversely proportional to x.

(b) ..... **[1]**

There were many correct responses. The common incorrect responses were D and F.

Question 9 (a)

9 Here are two pieces of work.
Each shows a question and an incorrect solution.

For each part, describe the error made and write out a correct solution.

(a)

Question:
Factorise. $x^2 + x - 20$

Solution:
$(x + 4)(x - 5)$

The error is .....

.....

A correct solution is ..... **[2]**

The most common reason given was that the brackets lead to $-x$ rather than $+x$ and many gave the correct pair of brackets. The most common error was from those who thought the 4 and 5 should be 1 and 20 giving $(x + 1)(x – 20)$ as their solution. There were a few who did not describe the error, but they just wrote out the incorrect line without comment.

Question 9 (b)

(b)

Question:
Solve. $4x + 5 = x + 2$

Solution:
$4x + 5 = x + 2$
$3x + 5 = 2$
$3x = 5 - 2$
$3x = 3$
$x = 1$

The error is .....

.....

A correct solution is .....

.....

.....

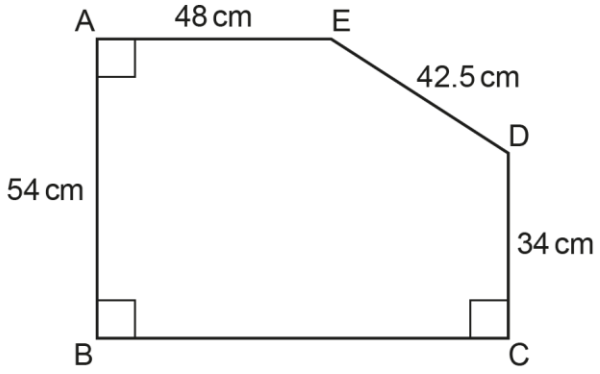
.....

..... **[2]**

Most described the error and the correction as we had expected. The main error was that some thought in line 2 that $4x - x$ should have been $x - 4x$ giving $-3x$. As in part (a) a few just gave the line where the error was without comment.

Question 10

10 The diagram shows a pentagon ABCDE.



Not to scale

Find the area of the pentagon.
You must show your working.

..... cm^2 **[6]**

The key piece of information that candidates needed to find was the perpendicular length from point E to line CD produced by using Pythagoras' theorem which many were able to deduce. The pentagon can be divided into many different shapes, so we did see quite a variety of approaches. The most common was to make a rectangle using vertices BAE, another rectangle using DC and a right-angled triangle using ED as the hypotenuse. There were some candidates with the correct method, but they made a calculation error in one of the areas.

Question 11

11 Riley and Sam are conducting surveys.
They are both given the same list of 12 463 people from which to select their sample.

Riley selects every 56th person.
Sam selects every 64th person.
They both start counting from the first name in the list.

Work out how many people will be selected to be in both surveys.
You must show your working.

..... **[5]**

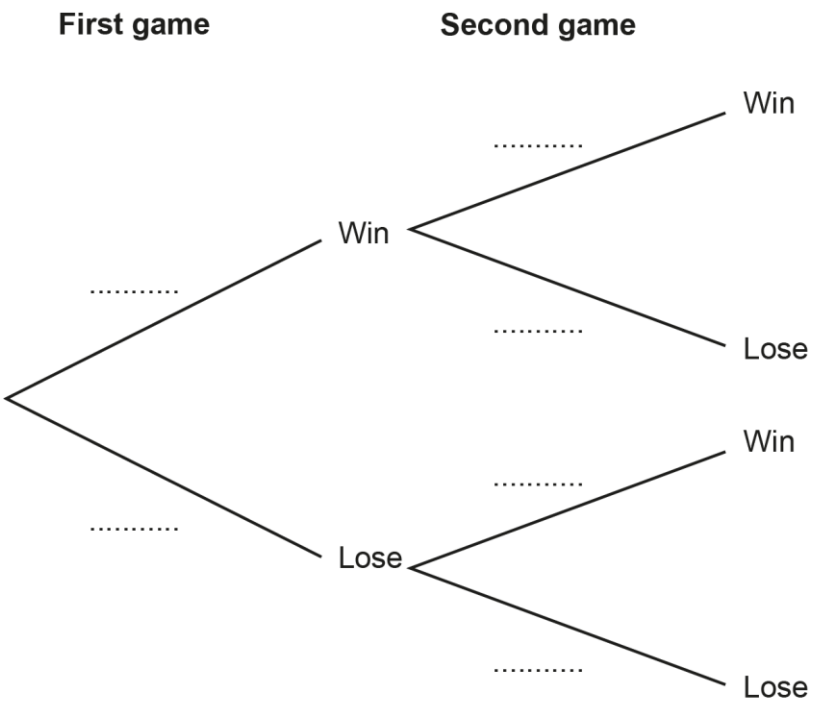
Many candidates found this difficult, but some did find a method to solve the problem. There were two successful methods used. The most common was to find the lowest common multiple of 448 and to divide 12 463 by 448, or the other method, which does work in this context, is to divide 12 463 by 56 and 64 separately and to subtract the results. Many candidates did attempt the second method, but they added the results or they left them alone as the answers.

Question 12 (a)

12 In a computer game the player can either win or lose.
A student thinks the ratio of the probability of winning to the probability of losing is 2 : 3.

The student plays two games.

(a) Use the information to complete the tree diagram.



[3]

Most candidates found $\frac{2}{5}$ and $\frac{3}{5}$ but some only put these probabilities on the first branch, with many going on to put $\frac{1}{3}$ and $\frac{2}{3}$ or $\frac{1}{4}$ and $\frac{3}{4}$ on the second branches. Despite this being a probability tree, some candidates wrote integers in the spaces.

Question 12 (b)

(b) Find the probability that the student wins at least one of the two games.

(b) ..... **[3]**

Most candidates did write down one correct product, but many only wrote down the two products that lead to the probability of exactly one win when they were asked for the probability at least one win. Most did multiply the two probabilities on successive branches and add together the alternatives, although some multiplied all the probabilities together.

Question 12 (c)

(c) The student now thinks the ratio of the probability of winning to the probability of losing has changed to 2 : 5.

Explain the effect this change will have on your answer to part **(b)**.

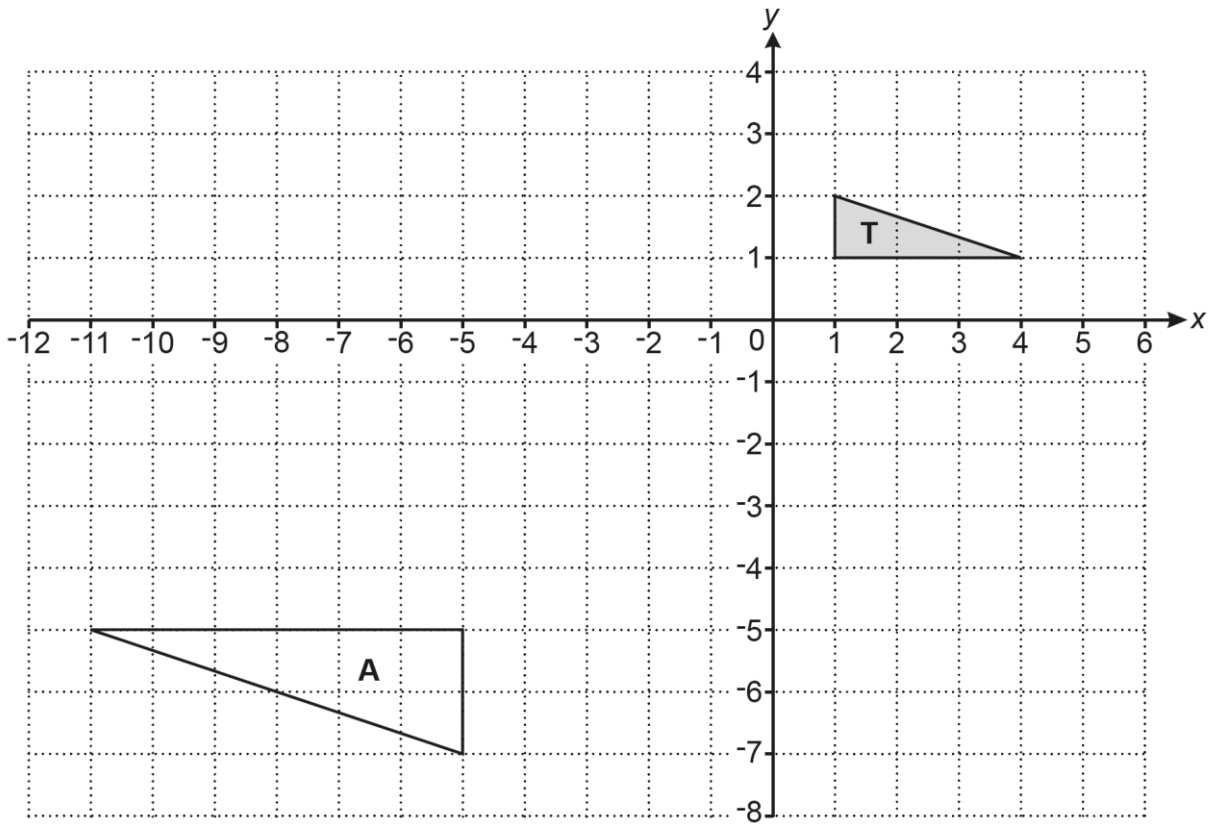
.....

..... **[1]**

The question asks for the effect on the answer to part (b), but many candidates discussed how many games they are likely to win and some started to do calculations. Some thought that there would be a greater chance of winning. Still there were many correct responses to this question.

Question 13 (a)

13 Triangle **T** and triangle **A** are drawn on the coordinate grid.



(a) Describe fully the **single** transformation that maps triangle **T** onto triangle **A**.

.....

..... **[3]**

Despite the clear question demand for a single transformation, most candidates gave a double transformation usually involving an enlargement and a rotation. Some gave the response of a single enlargement and would often give the correct centre, but the scale factor was the most difficult property to work out.

Question 13 (b)

(b) Describe fully the **single** transformation that is equivalent to:

- a rotation of 90° clockwise about centre (0,0), followed by
- a reflection in the *y*-axis.

You may use the grid above to help you.

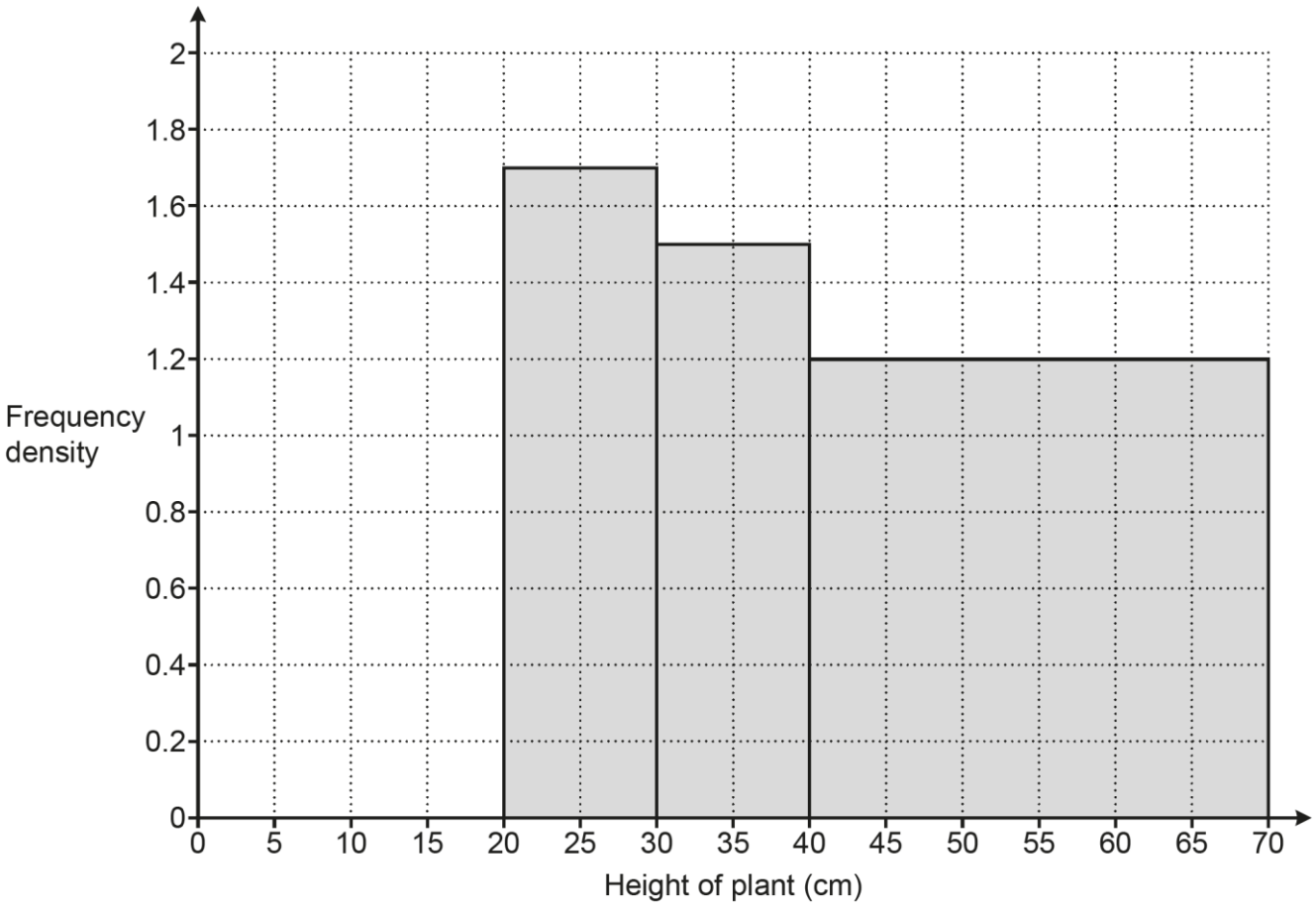
.....

..... **[3]**

Few candidates attempted this part of the question, despite similar questions having been set many times previously. The best solutions used triangle T and operated both transformations on it, then used that to help them find the equivalent single transformation. Again, many gave a double transformation despite the clear question demand.

Question 14

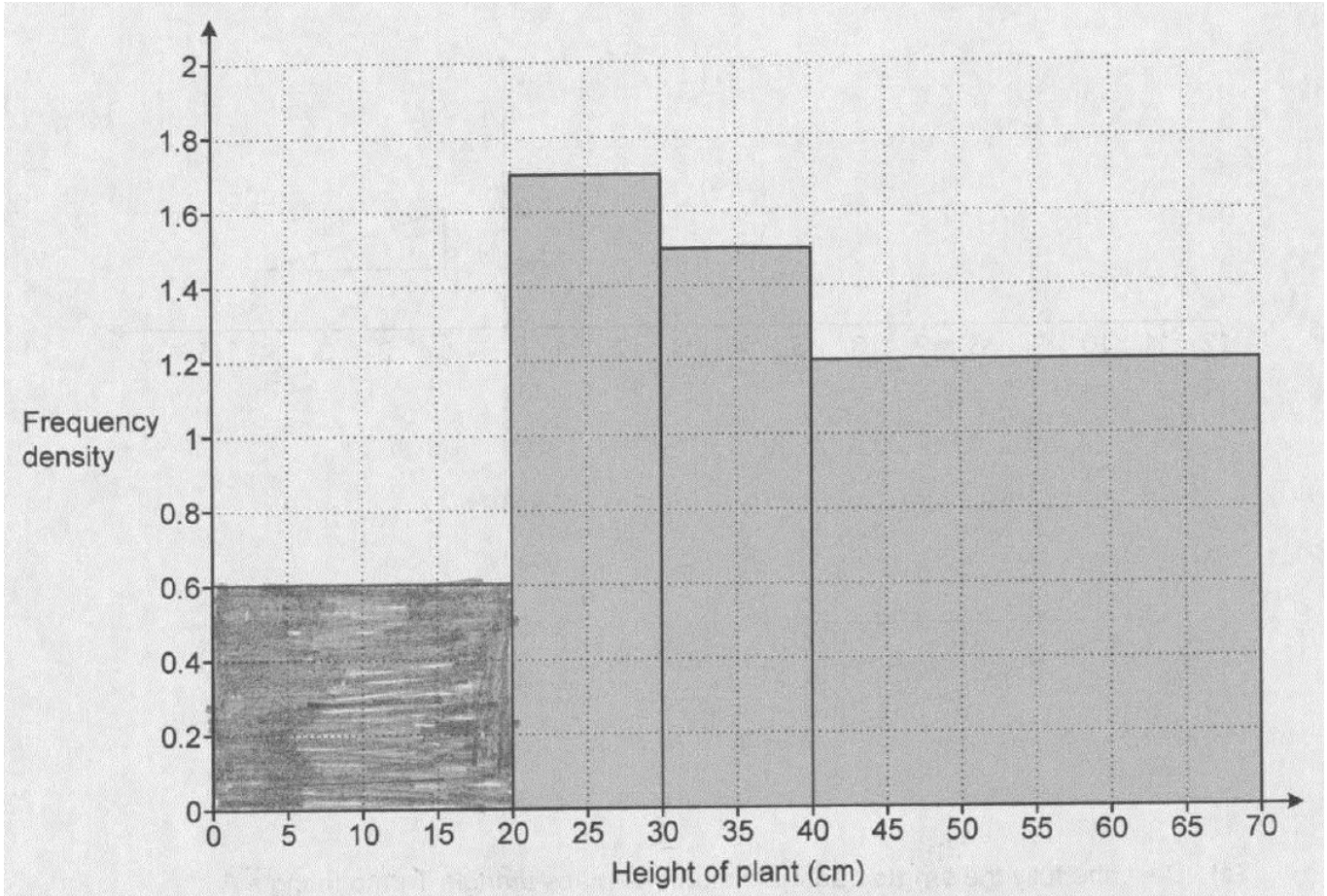
14 The histogram shows the heights of some plants out of a total of 80 plants.



Complete the histogram to show the plants with heights between 0 cm and 20 cm. **[5]**

Few candidates knew how to work out the frequency from a histogram. Those that did know usually made a very good attempt at this question with many correct responses seen. Some did find the missing frequency of 12 but they calculated the frequency density by dividing 20 by 12 instead of the other way round.

Exemplar 2



Complete the histogram to show the plants with heights between 0 cm and 20 cm. **[5]**

Frequency density = $\frac{\text{Frequency}}{10}$

1·7 x 10 = 17

1·5 x 10 = 15

1·2 x 30 = 36

total = 80

17 + 15 + 36 + b = 80

b = 12

Frequency = 12

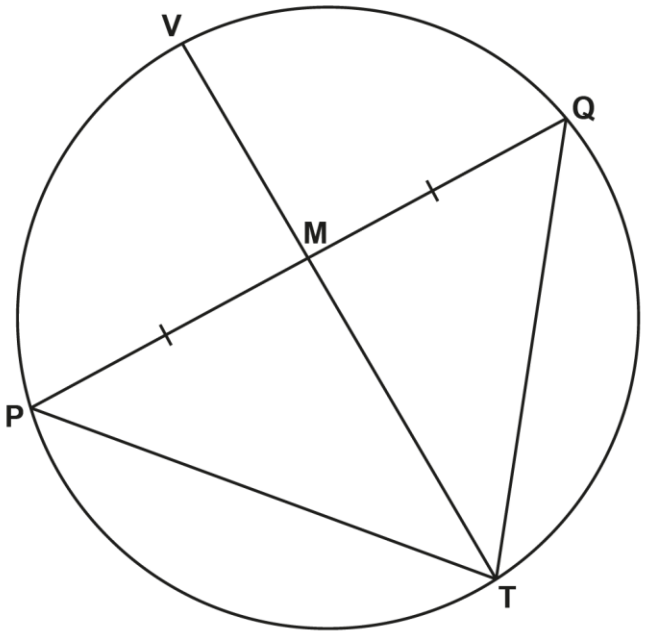
Class width = 20

Frequency density = $\frac{12}{20}$ = 0·6

The formula is not quite correct as it should be frequency density = $\frac{\text{frequency}}{\text{group width}}$. However, the formula was applied correctly here. The frequency had to be calculated before the candidate can find the missing frequency and then the height of the bar can to be calculated from the frequency.

Question 15

15 P, Q, T and V are points on the circumference of a circle.
TV is a diameter of the circle.
M is a point on PQ such that PM = MQ.



Not to scale

Complete these sentences to show that triangle TMP is congruent to triangle TMQ.

Side PM = side MQ because it is given to you.

Angle PMT = angle ..... because .....

.....

.....

Side MT is .....

Triangle TMP is congruent to triangle TMQ because .....

[3]

This was meant to be a partly completed proof. Only a few candidates realised they needed to refer to angle to angle QMT in the first part as most candidates put 90° instead and most did not know the reason why these two angles were equal. However, many used the correct term for side MT with 'common' or 'shared' being the most popular words. Also, many candidates realised it was SAS that was the reason for congruence. As there was a right angle some did give RHS instead.

Question 16 (a)

16 A biologist assumes the population, P, of birds on an island can be predicted using the formula

$P = 3800 \times 1.042^n$

where n is the number of years after the start of 2020.

(a) Write down the percentage increase per year that is used in the formula.

(a) ..... % **[1]**

Many candidates gave the correct response of 4.2 but some wrote 1.042 instead. This was the most common incorrect response.

Question 16 (b)

(b) Calculate the predicted population at the start of 2024.

(b) ..... **[2]**

This part was answered very well. The most common error was to calculate 3800×1.042^2 using $n = 2$.

Question 16 (c) (i)

(c) (i) Show that the number of birds is predicted to exceed 7000 during 2034. **[3]**

This was answered quite well although many candidates thought giving $3800 \times 1.042^{15} = 7043$….. was enough to show what the question demand required. However, this showed that it had reached 7000 by the end of 2034/start of 2035 but it does not show it happened during 2034 unless they show the population at the start of 2034 as well. Many candidates did get marks on this question.

Question 16 (c) (ii)

(ii) A researcher says that between 2022 and 2030 the percentage increase per year in the population will be 2.8%.

If the researcher is correct, explain how this new information will affect the answer in part **(c)(i)**.

.....

..... **[1]**

Many candidates did give an acceptable response. The common error was to suggest that the population will be greater than expected or the population would reach 7000 earlier than expected.

Question 17 (a)

17 (a) A sequence is defined by

$u_{n+1} = 3u_n + 7$ and $u_1 = -2$.

Work out the value of u_2 and the value of u_3.

(a) $u_2 =$ .....

$u_3 =$ .....

[2]

This question is aimed at the higher grades and there were only a few correct responses. The common errors were $u_2 = 2 \times -2 = -4$ with $u_3 = 3 \times -2 = -6$ and $u_2 = 3 + 7 = 10$ with $u_3 = 3 \times 10 + 7 = 37$ which did score follow through credit.

Question 17 (b)

(b) Here are the first four terms of a quadratic sequence.

-2 7 22 43

The sequence has the formula $x_n = an^2 + b$.

Find the value of a and the value of b.

(b) $a =$ .....

$b =$ .....

[3]

Most candidates did not attempt this part, but most of those who did were able to work out the second difference of 6 and from that, they calculated the value of a to be half of 6 which is 3. A few were able to work out the value of b.

Question 18

18 Solve this quadratic equation by factorisation.

$2x^2 - 6x - 24 = 5x - 3$

$x =$ ..... or $x =$ ..... **[4]**

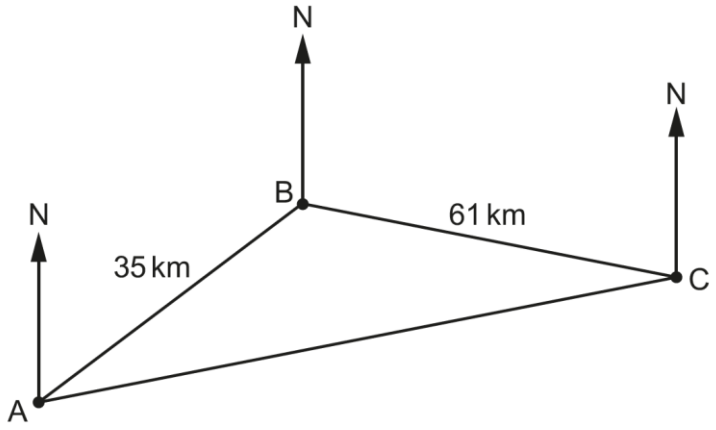
Many candidates attempted this question, but they needed to rearrange it first to combine all the terms on one side which many did not do correctly. Some of those who managed to do this correctly then used the 'quadratic formula' to solve it, despite the demand of the question which asks for the method of factorisation to be used. Some candidates attempted to factorise just the left-hand side of the equation, $2x^2 - 6x - 24$, which does not factorise.

The question states that a certain method must be used.

This question states that the method of factorisation must be used to solve the equation which means that this method must be used in order to get full marks.

Question 19

19 The diagram shows the positions of three towns A, B and C.



Not to scale

The bearing of town B from town A is 053°.
The bearing of town C from town B is 108°.
AB = 35 km and BC = 61 km.

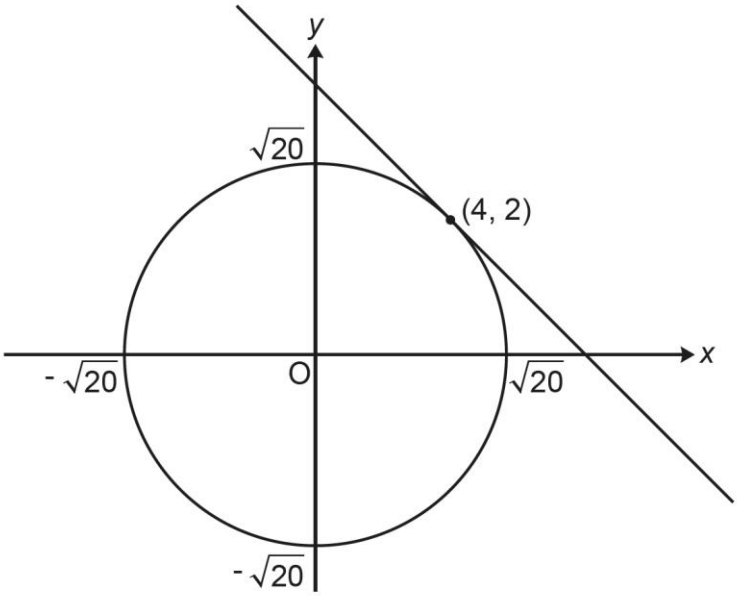
Calculate AC.
You must show your working.

AC = ... km **[5]**

The key to this question is finding angle ABC correctly. Most of those who did then went on to use the cosine rule to find AC. Some assumed that the anti-clockwise angle at B equals the clockwise angle at B, 108°, so they found angle ABC to be 144°. They then used the cosine rule correctly to gain some credit. A few assigned 53° to the angle BAC and so they used the sine rule to find angle ACB and then they solved the triangle.

Question 20 (a)

20 The diagram shows a circle, centre the origin, with the tangent to the circle at the point (4, 2).



(a) Write down the equation of the circle.

(a) ..... **[2]**

Many candidates wrote down the formula $x^2 + y^2 = r^2$ but most were not able to find the value of r^2. A few used r^2 as $\sqrt{20}$ and a few as 20.

Question 20 (b) (i)

(b) (i) Show that the tangent to the circle at the point (4, 2) has gradient -2. **[2]**

Few candidates attempted this part. Most were able to show the gradient of the radius from (0, 0) to (4, 2) is $\frac{2}{4}$ but they did not clearly show how to get from that to −2. They need to use or imply $m_1 \times m_2 = -1$ for perpendicular lines.

Question 20 (b) (ii)

(ii) Find the equation of the tangent to the circle at the point (4, 2).

(b)(ii) ..... **[2]**

Although candidates were told that the gradient was -2, we did not see many responses with the equation $y = -2x + c$. A few did work out from (4, 2) that $c = 10$.

Question 21

21 Solve.

$$x^{-\frac{1}{6}} = \frac{5x^{\frac{1}{3}}}{x^{\frac{3}{4}}}, \text{ where } x \neq 0$$

$x =$ ..... **[3]**

The candidates were required to know and apply the laws of indices to be able to answer this question and most of them could not do this. The best attempts used the law on the right-hand side to get $x^{\frac{1}{3}} \div x^{\frac{3}{4}} = x^{-\frac{5}{12}}$ and a few were able to obtain the correct answer from the use of one or more of these laws.

Question 22

22 You are given this identity.

$$\frac{2-3\sqrt{18}}{\sqrt{18}+4} = a\sqrt{2}+b$$

Find the value of a and the value of b.
You must show each step in your working.

$a =$ .....

$b =$ .....

[6]

A few candidates were able to complete this correctly showing all the working. This can be worked out on some calculators now, but the question demanded each step of working to be shown. Many candidates did not attempt it. Many candidates did not know that $\sqrt{18} = \sqrt{9 \times 2} = 3\sqrt{2}$ and many of them did not know how to rationalise the denominator by multiplying the numerator and denominator by $(\sqrt{18} - 4)$.

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