Qualification Accredited

Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

MATHEMATICS

J560
For first teaching in 2015

J560/05 Summer 2018 series

Version 1

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. 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 can be downloaded from OCR.

Paper J560/05 series overview

This non-calculator paper is the second of the three papers taken by higher tier candidates for the GCSE (9-1) Mathematics specification.

Candidates were generally correctly entered at this tier and most were able to access at least some of the questions. There was an improvement from the previous year in answering types of questions that involved recall of skills and knowledge. It was noticeable that many candidates appeared better prepared for the paper this year and the numbers of very high scoring candidates has increased.

Candidates who did well on this paper generally did the following:

- Performed standard calculations following the required rubric
- Showed clear, concise and step by step methodology on multi-mark questions
- Had a strong skills and knowledge understanding of the specification content
- Applied knowledge and reasoning to questions set in a novel context.

Candidates who did less well on this paper generally did the following:

- Found it difficult to apply what they had learnt to unfamiliar situations
- Showed a more random approach in the working including trial and improvement on multi-mark questions
- Had a weaker skills and knowledge understanding of the specification including the recall of key terminology, formulae and routines.

Most successful topics/questions	*Least successful topics/questions*
• Calculate with fractions 2.01b • Reason with percentages 2.03b • Sample spaces and multiplication law of probability 11.2a and 11.02f • Index notation 3.01a • Decimals and fractions 2.02a	• Problem solving with cones and cylinders10.04a and 10.04b • Problems with reverse percentage 2.03c • Circle theorems 8.05g and 8.05h • Reasoning with brackets and algebra 6.01a and 6.01d • Manipulating surds 3.03b

On questions where candidates are asked to show a particular result, it is important to show systematic, step by step working with no omission of working to gain full marks.

On questions involving drawing of algebraic graphs, candidates should use a pencil to plot points and ensure that the points are joined with a smooth thin curve and not ruled line segments.

When giving geometric reasons for answers involving angles, it is important that candidates use the correct mathematical terminology as defined on the specification.

Question 1(a)

1 **(a)** Calculate.

$$\frac{3}{5}+\frac{5}{8}$$

Give your answer as a mixed number in its simplest form.

(a) .... **[3]**

This was very well answered by the majority of candidates. A few left their answers as an improper fraction while others showed a correct method in reaching $\frac{24}{40}+\frac{25}{40}$ but then made an arithmetic error in either adding the numerators or in giving a fraction out of 80. A very small minority could not recall the method for addition of fractions and gave answers such as $\frac{8}{13}$.

Question 1(b)

(b) Work out.

$$5\times10^{4}-1.6\times10^{3}$$

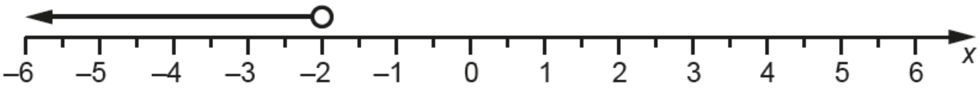
Give your answer in standard form.

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

For many this proved to be straightforward although this was less well answered than part (a). Almost all candidates used the method of converting both numbers to their actual values before attempting to subtract. There were errors seen in the subtraction and also some errors in the conversions. A few candidates, having calculated the correct answer, did not then convert it to standard form. Those that used the efficient method of adjusting one of the indices based on the place value of the numbers before subtracting almost always went on to give the correct answer.

Question 2

2 Gemma's solution to the inequality $3x + 1 > -5$ is shown on the number line.



Is Gemma's solution correct?
Explain your reasoning.

.... **[3]**

There were many different approaches to this question. Candidates were required to show the correct solution to the inequality before commenting on Gemma's solution in order to gain full marks and many used this approach successfully. Some gained partial credit by giving an incomplete answer such as the arrow is pointing the wrong way. Some struggled to solve the given inequality correctly and others thought that the circle on the arrow should be on a different value most commonly choosing -5.

Question 3(a)

3 Work out.

(a) $\begin{pmatrix} -3 \\ 2 \end{pmatrix} + \begin{pmatrix} 5 \\ 7 \end{pmatrix}$

(a) $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$ **[1]**

This was well answered although there were occasional arithmetic errors.

Question 3(b)

(b) $\begin{pmatrix}3\\4\end{pmatrix} - 2\begin{pmatrix}1\\-3\end{pmatrix}$

(b) $\begin{pmatrix} \\ \end{pmatrix}$ **[2]**

This was less well answered than part (a) with many unable to process the directed number calculation correctly. Candidates could gain one mark by having one of the components in the answer correct. A very small number chose to incorrectly use a fraction line between the two components of the vector in both parts (a) and (b).

Question 4

4 Here is the nutritional information for a 110 g serving of cereal.

Carbohydrates	99.4 g
Proteins	9.5 g
Fats	1.1 g

Emily says that more than 90% of this serving is carbohydrates.

Is she correct?
Explain your reasoning.

....

.... **[3]**

This was very well answered by candidates. The most common and successful approach was to show that 90% of 110 g was 99 g and then to compare this to the carbohydrate content of the cereal to show that Emily was correct. A number also chose to find 99.4 as a percentage of 110. This method was harder arithmetically and a number were unable to complete this accurately.

Question 5(a)

5 The table shows the relative frequencies of the results for a football team after a number of games.

Result of game	won	lost	drew
Relative frequency	0.2	0.45	

(a) Complete the table. **[2]**

Almost all candidates answered this correctly.

Question 5(b)

(b) The team lost 10 more games than they won.

How many games did the team play altogether?

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

This proved more difficult and required candidates to reason with the difference between 0.45 and 0.2.

Many candidates made a correct first step of finding the difference between won and lost to obtain 0.25. Fewer realised that this equated to 10 games. Those who did usually went on to score full marks.

Very few expressed the problem using algebra.

A common incorrect approach was to multiply the relative frequencies by the values of the trials leading to 8 won and 18 lost. This makes no reference to the number of games played and shows incorrect interpretation of relative frequencies.

Question 6

6 Jack sent 15% more text messages in March than in February.
Jack sent 460 text messages in March.

How many more texts did Jack send in March than in February?

.... **[4]**

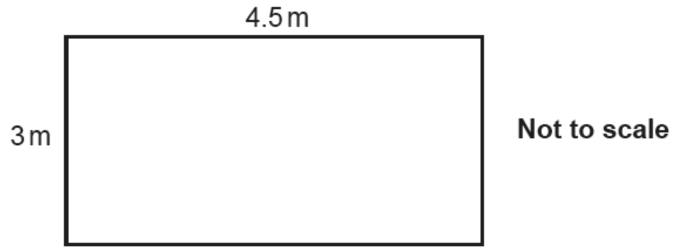
There was a large variation in responses to this question. A number of candidates interpreted the reverse aspect of the problem correctly and either reached the correct answer or an answer of 400 by forgetting to subtract this from 460. A number recognised that 460 was 115% but were then unable to divide by 115 or 1.15 correctly.

Many candidates did not interpret the question correctly and simply found 15% of 460 and gave a final answer of 69 or 391.

Some recognised 460 was 115% but then tried to multiply by 1.15.

Question 7

7 Here is the floor plan of a rectangular room.



Tim buys carpet tiles for this room.

Each tile is a square measuring 50 cm by 50 cm.
The tiles are only sold in packs of ten.
Each pack costs £20.
Tim pays for fitting at a rate of £7.50 per square metre, with any fraction of a square metre rounded up.

Work out the **total** cost of the tiles and fitting.

£ .... **[6]**

The higher ability candidates approached this well and showed a clear and concise method to obtain the correct solution. Those that worked methodically and organised their working logically tended to score well.

Most candidates were able to access some of the marks available, and those who calculated the number of tiles required for the length and width (6 × 9) tended to make fewer mistakes than those who calculated the area of the room and tried to divide it by the area of one tile. Candidates who converted the areas from m^2 into cm^2 commonly made errors and did not realise that $1\,m^2 = 10\,000\,cm^2$.

The part of the question concerned with fitting costs was not well done. Some multiplied by 14, but multiplying by 13.5 was more common with candidates not reading the fine detail in the question.

Other candidates obtained answers with costs over £10 000 and did not then consider that this answer was unreasonable in the context of the question.

Question 8(a)

8 Hannah wants to display all the possible outcomes when rolling two fair 6-sided dice.

(a) Give a reason why a tree diagram is not the best method to use.

.... **[1]**

This was generally answered well. The most common response was that there would be too many branches/possibilities. A few candidates did state that it was not possible to draw a probability tree with more than 2 or 3 branches.

Question 8(b)(i)

(b) **(i)** Draw a sample space to display all the possible outcomes. **[2]**

There were a variety of approaches to presenting the sample space including listing the elements and using a table. Some candidates gave the product while others only included the choices one way around – neither of these were credited full marks.

Question 8(b)(ii)

(ii) Show that the probability of the scores on the two dice adding to 11 is $\frac{1}{18}$.

.... **[2]**

Most candidates answered this part correctly, giving the answer $\frac{2}{36} = \frac{1}{18}$. A few wrote the two options (6, 5) and (5, 6) down but were then unsure how to answer the question. Only a small number used $2\left(\frac{1}{6} \times \frac{1}{6}\right)$ as a method.

Question 9(a)

9 (a) Complete the table for $y = x^3 - 3x$.

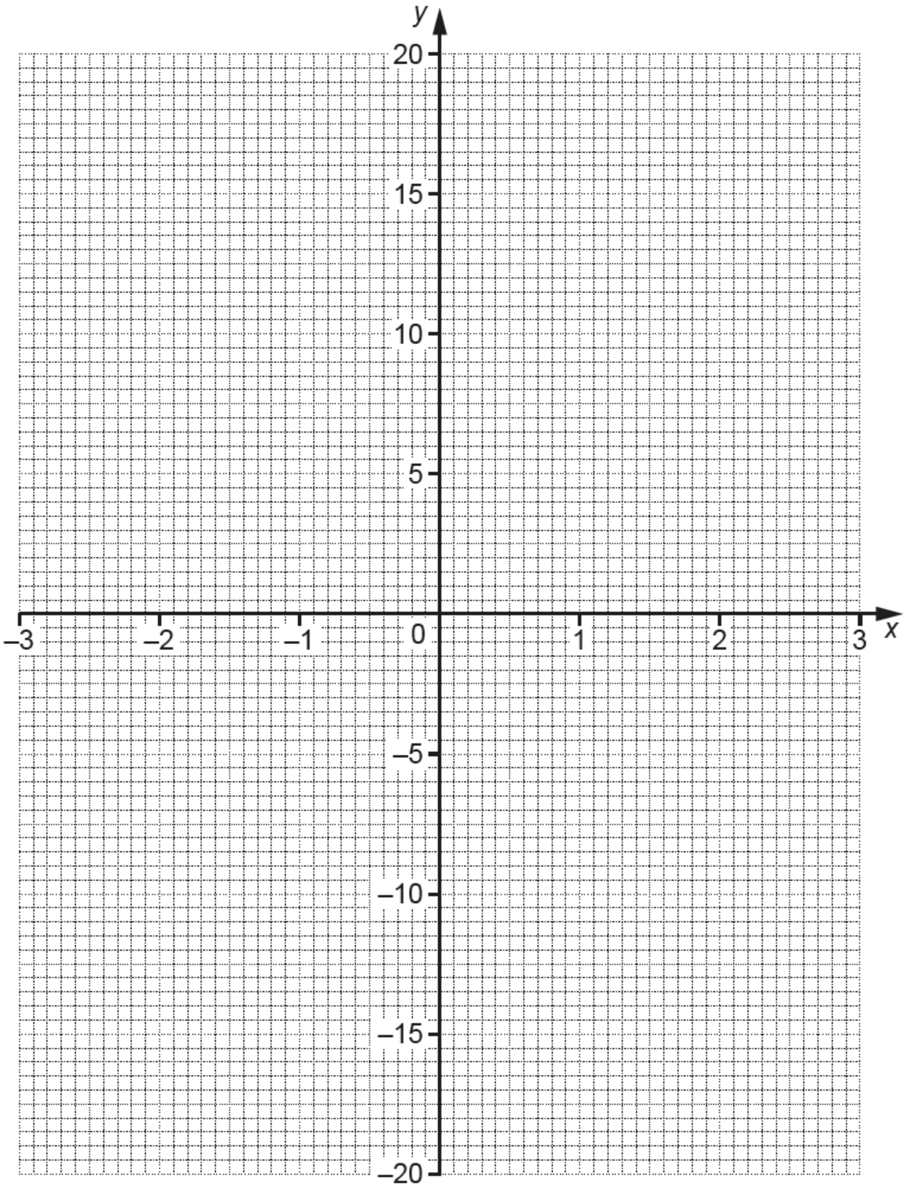
x	-3	-2	-1	0	1	2	3
y	-18	-2		0	-2	2	18

[1]

The majority of candidates answered this part correctly, but there were some common errors with answers of 4, -4 and -2 often seen.

Question 9(b)

(b) Draw the graph of $y = x^3 - 3x$ for $-3 \leqslant x \leqslant 3$.



[3]

There were quite a few errors in the plotting of points due to candidates incorrectly reading the vertical scale.

Drawing the curve was also variable with many often not drawing their curve through the plotted points within the permitted 1 mm accuracy of the plot.

A few produced feathering on their curve and some incorrectly joined all points with a ruler.

Candidates need to pay careful attention to the quality of their curves and interpreting scales.

Question 9(c)

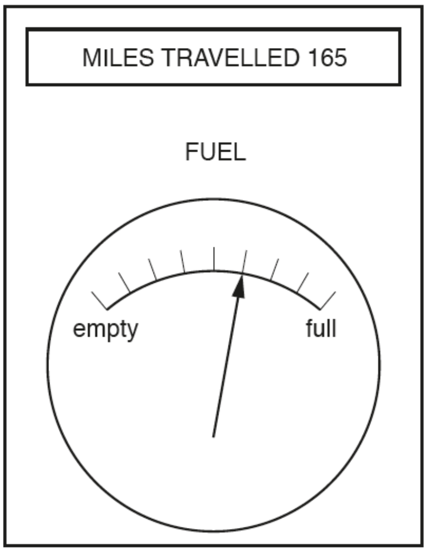
(c) Use your graph to solve $x^3 - 3x = 10$.

(c) $x =$ .... **[1]**

Most candidates obtained an answer for this part within the tolerance permitted.

Question 10(a)

10 Ifsaw noticed this information on her car's dashboard at the end of her journey.
She started her journey with a full tank of fuel and her miles travelled set to zero.



(a) Work out how far Ifsaw's car can travel on a full tank of fuel.

(a) .... miles **[3]**

There was a mixed response to this question. A number of candidates correctly identified 165 miles with $\frac{3}{8}$ of the capacity of the tank and then divided by and multiplied by 8 correctly. Others tried this approach and made arithmetic errors but because they showed the full method were able to earn two method marks. A common error was to misread the scale as $\frac{4}{9}$ which was incorrect or to treat the 165 miles as $\frac{5}{8}$ resulting in an answer of 264 miles for which partial credit was given.

Question 10(b)

(b) What assumption have you made when answering part **(a)**?

....

.... **[1]**

The strongest answers referred to the assumption that the conditions for the rest of the journey were the same as conditions for the first part or the rate of fuel consumption was constant. Some answers were vague and did not go far enough to suggest that the fuel economy was assumed to be the same throughout the journey.

Exemplar 1

33 × 8 = ~~1452~~ 764

(b) What assumption have you made when answering part **(a)**?

that she drove at a constant speed

.... **[1]**

Answers often referred to constant speed and this was accepted as an indication that fuel economy stays constant.

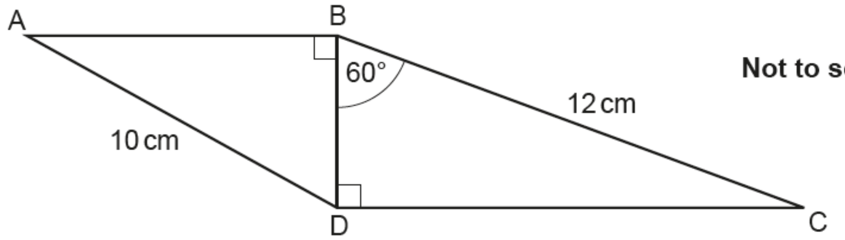
Exemplar 2

~~Four~~ find out how many notches their are and find out what 1 notch is and ~~to~~ **[1]** times it by how many they're.

This type of response missed the point of the question and described the method used in part (a) rather than the assumption made.

Question 11

11 The diagram shows two right-angled triangles ABD and BCD, sharing a common side BD.
AD = 10 cm, BC = 12 cm and angle DBC = 60°.



Not to scale

Work out the length of AB.

.... cm **[6]**

Candidates who were able to find BD correctly almost always went on to score full marks. Most attempted to use trigonometry to find BD although a few recognised triangle BCD as half of an equilateral triangle and just wrote BD = 6.

Candidates who used basic trigonometry rather than attempting combinations of sine and cosine rules were more successful. A few did unnecessary extra work and calculated DC first.

The main issues for candidates included confusing the values of cos 60 and sin 60 and dividing 12 by 0.5 rather than multiplying.

A number of candidates assumed both triangles had the same angles and tried to use scale factors.

Question 12

12 Carol says that $64^{-\frac{1}{2}} = \frac{1}{32}$.

Explain her error and give the correct value of $64^{-\frac{1}{2}}$ in the form $\frac{p}{q}$.

....

....

....

.... **[3]**

Candidates generally showed a good understanding of indices and answered this question well. Most were able to give the correct answer of $\frac{1}{8}$ although not all were able to explain the error clearly. Both Carol's error and the correct step were needed for the full 3 marks. Some candidates still thought that the answer should be negative or misinterpreted the index element $\frac{1}{2}$ as something other than a square root.

Question 13(a)

13 (a) Write $\frac{5}{12}$ as a recurring decimal.

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

This was generally well answered and examiners reported good use of symbolism in recording the answer with many using the correct recurring notation.

A few attempted the division of 5 by 12 but made arithmetic errors. Some attempted 12 divided by 5.

Question 13(b)

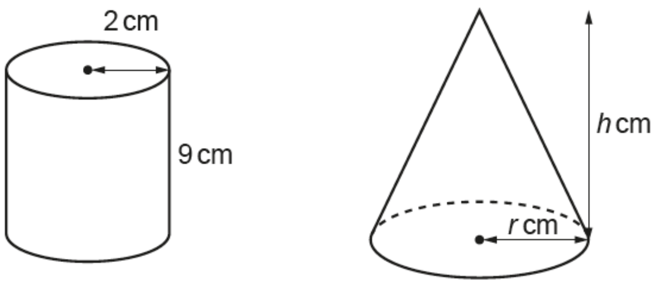
(b) Convert $0.\dot{7}\dot{6}$ to a fraction.

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

This was very well answered. Many candidates appreciated that the resulting fraction should be given as a fraction with 99 as the denominator. Most showed correct methodology before obtaining the correct fraction.

Question 14

14 The diagram shows a cylinder and a cone.



The cylinder has radius 2 cm and height 9 cm.
The cone has radius r cm and height h cm.

The ratio $r : h$ is 1 : 4.
The volume of the cone is **equal to** the volume of the cylinder.

Work out the value of $\boldsymbol{r}$.

[The volume V of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

.... **[5]**

There were a number of correct answers given by candidates showing step by step reasoning.

Recalling the formula for volume of a cylinder was a source of error for a number of candidates.

Of those using the correct formula many obtained a correct volume of 36π. Some substituted a numerical approximation for π to 2 or 3 decimal places which significantly increased the difficulty for the next steps and usually they made no further progress.

Of those obtaining the correct volume for the cylinder of 36π, a large proportion also reached $r^2h = 108$ after setting up an equation with the volume of the cone.

Some candidates made an error in dealing with the fraction in the cone formula arriving at $12 = r^2h$.

Those who obtained $108 = r^2h$ either used the ratio 1 : 4 to work out $9 \times 12 = 108$ so $r = 3$ and $h = 12$, or s substituted $h = 4r$ to obtain the correct answer.

Question 15

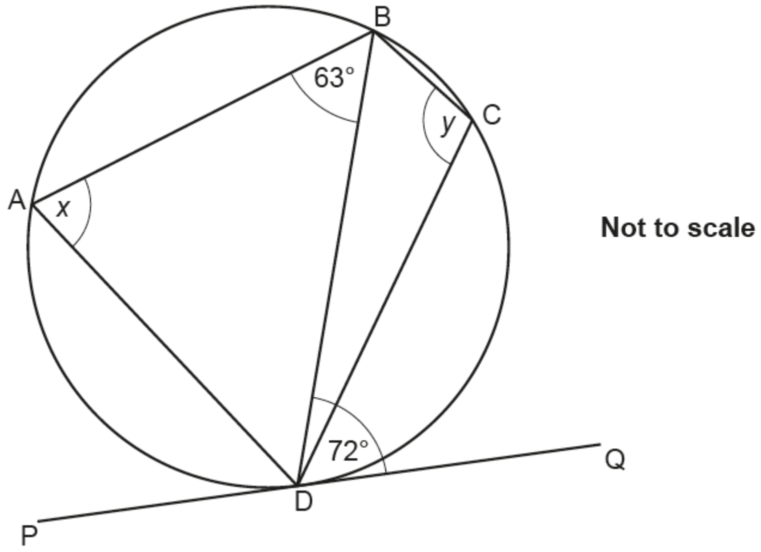
15 n is a positive integer.

Prove that $13n + 3 + (3n - 5)(2n + 3)$ is a multiple of 6. **[4]**

This question tested whether candidates were able to formally prove a statement algebraically. Many were able to expand the brackets correctly although a number made errors such as $3n \times 2n = 6n$ or $3 \times 3n = 6n$. A number were able to simplify the expression correctly to $6n^2 + 12n - 12$ but then were unable to complete the proof with a correct factorisation or correct division by 6 followed a correct conclusion.

Question 16(a)

16 A, B, C and D are points on the circumference of a circle.



PQ is a tangent to the circle at D.
Angle BDQ = 72° and angle ABD = 63°.

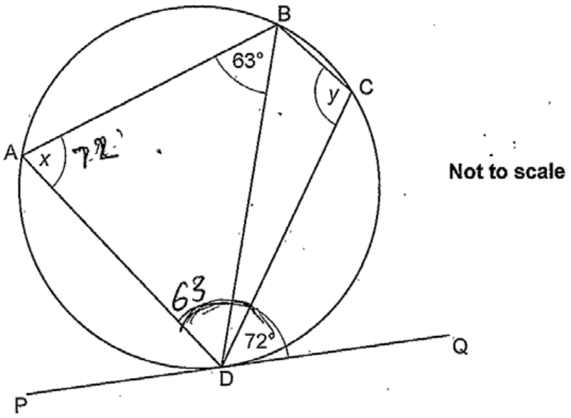
(a) Work out angle *x*.
Give a reason for your answer.

Angle *x* = ...° because ....

.... **[2]**

This question was not well answered. Many candidates could not obtain the value for *x*, with 54° being a common incorrect answer. The use of correct language in giving reasons was weak and candidates who obtained the correct value of *x* often gave reasons such as angle in same segment, or alternate angles.

Exemplar 3



PQ is a tangent to the circle at D.
Angle BDQ = 72° and angle ABD = 63°.

(a) Work out angle x.
Give a reason for your answer.

Angle x = 72 ° because the angles opposite are equal. **[2]**

Correct value for x but incorrect terminology in the reason.

Exemplar 4

Angle x = 72 ° because alternate segment theorem **[2]**

Correct value for x and correct reason.

Question 16(b)

(b) Work out angle *y*.
Give a reason for your answer.

Angle *y* = ...° because ....

.... **[2]**

A few more candidates were successful in this part in recognising the circle property and giving a correct answer or following through correctly from their incorrect value in part (a). The property of cyclic quadrilaterals was recognised by many but fewer were able to articulate a reason using the correct terminology. Answers such as opposite angles of a cyclic quadrilateral are equal or opposite angles of a quadrilateral add to 180 were common.

Exemplar 5

$$\begin{array}{r} 180 \\ -\ 72 \\ \hline 108 \end{array}$$

Angle *y* = 108° because opposite angles in a quadrilatral in a circle add up to 180° **[2]**

Correct value for *y* but the term cyclic quadrilateral was essential within this reason.

Exemplar 6

Angle *y* = 108° because angles opposite in a cyclic quadrilateral add to 180° **[2]**

Correct value for *y* and correct reason with correct terminology.

Question 17

17 $(x+a)(x+3)(2x+1) = bx^3 + cx^2 + dx - 12$

Find the value of *a*, *b*, *c* and *d*.

$a =$ ....

$b =$ ....

$c =$ ....

$d =$ .... **[4]**

This question was a good discriminator with many of the lower ability candidates missing it out or showing no working. A complete correct solution was quite rare. Many candidates demonstrated that they could expand the brackets correctly but then had difficulty in the reasoning required to interpret the required values needed for the answer.

A number of candidates multiplied out one pair of brackets successfully to gain partial credit but then struggled with the third bracket. Many found the value of *b* correctly but did not go on to find the other values. For those using the method of comparing coefficients in the identity to obtain the value of *a*, follow through marks were available for the values of *c* and *d* although these marks were only occasionally credited.

Question 18(a)

18 **(a)** A straight line passes through the point (0, 6) and is perpendicular to $y = 4x - 5$.

Find the equation of this line, giving your answer in the form $y = mx + c$.

(a) .... **[3]**

There were mixed answers to this part. The most common incorrect answer seen was $y = 4x + 6$ which gained partial credit for an equation of the form $y = kx + 6$.

Most candidates struggled to recall the gradient properties of perpendicular lines. Those that recognised that the required gradient was $-\frac{1}{4}$ generally went on to score full marks.

Question 18(b)

(b) Work out the coordinates of the intersection of the graphs of $y = 4x - 5$ and $y = x^2 - 17$.

(b) (.......................... , ...)

(.......................... , ...) **[6]**

More able candidates used a standard algebraic approach and many answered this well. For some, having obtained a quadratic equation, the negative terms in the equation caused problems with factors.

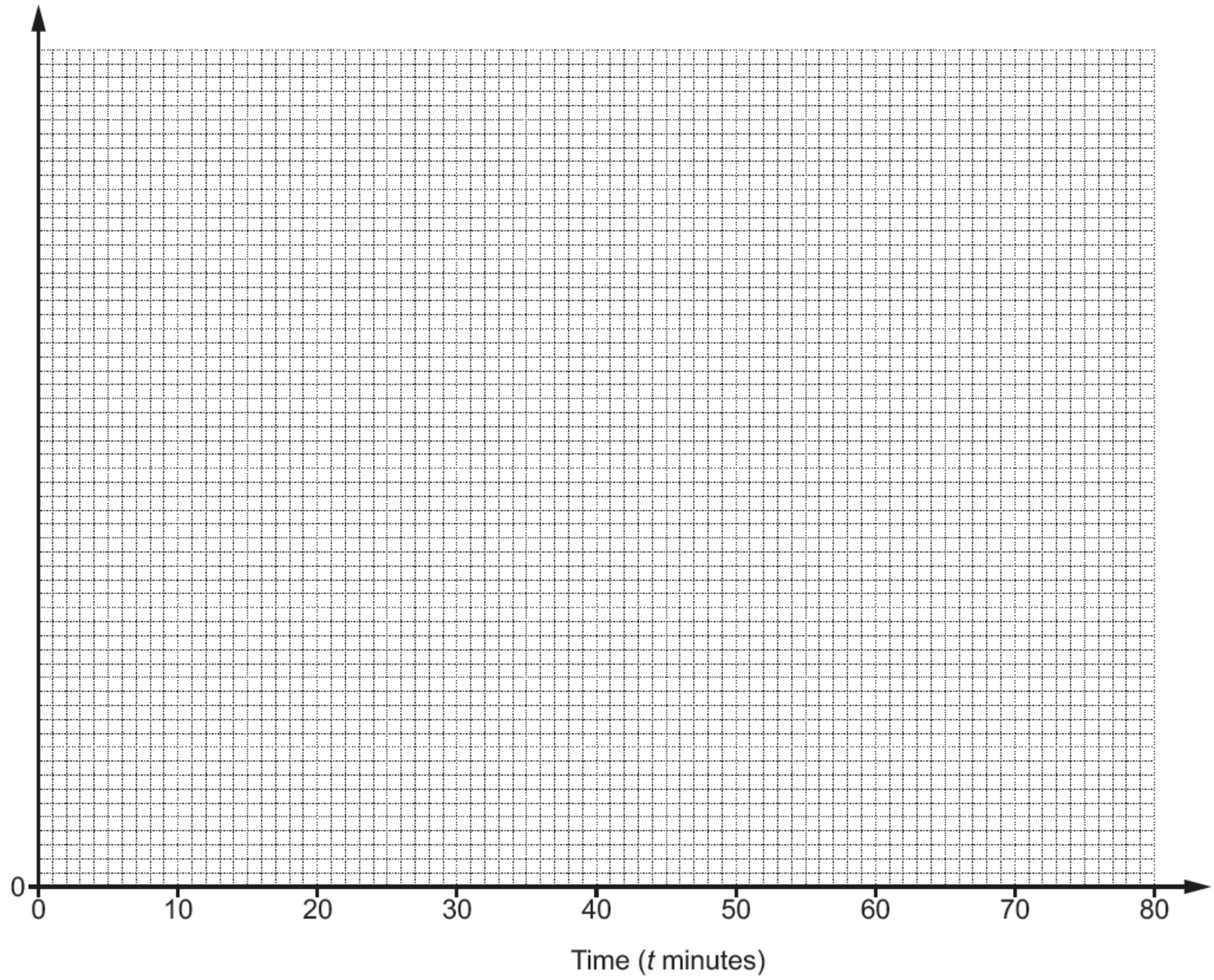
Some candidates tried to use the quadratic formula to solve their quadratic equation but this method was not as successful. It was common to see substitution of values of *x* into both equations with many drawing out two sets of tables of values. This trial and improvement approach sometimes led to one correct point usually (6, 19). The second coordinate was often then assumed to be the negative of the first. A few tried to draw or sketch the graphs and then read off the intercepts.

Question 19(a)

19 Ceri records the time taken, t minutes, to travel to school for a sample of 168 students at her Academy.

Time taken (t minutes)	**Frequency**
$0 < t \leqslant 10$	54
$10 < t \leqslant 20$	50
$20 < t \leqslant 40$	44
$40 < t \leqslant 80$	20

(a) Draw a histogram to represent this information.



[4]

Many candidates did not realise that the frequency density was required to draw the histogram and used the frequencies given in the table for the heights of the blocks gaining no credit. Those that did calculate frequency densities usually drew a correct diagram but often omitted to label the vertical axis 'frequency density' for the final mark. There were occasional arithmetic errors in the calculation of the frequency densities usually with the third and fourth intervals.

Question 19(b)

(b) Ceri says

The longest time that any of these students took to travel to school was 80 minutes.

Is she correct?
Give a reason for your answer.

....

.... **[1]**

A large number of candidates thought the highest value was 80 as that was included in the group, with a few suggesting that there could be some even higher values. There were a few answers that were vague and difficult to interpret. Of the candidates that correctly said no or Ceri may not be correct, the majority gave acceptable comments on the fact that the times were in intervals and no one knew the exact times.

Exemplar 7

no as she cannot be certain as its inbetween two times. **[1]**

This is an example of a sufficient explanation with the key part 'it is in between two times'.

Exemplar 8

Correct because that is the maximum of the biggest group **[1]**

This is an example of a common incorrect response.

Question 19(c)(i)

(c) Ceri also claims that 25% of all of the students at this Academy took more than 30 minutes to travel to school.

(i) Show how Ceri might have worked out her claim. **[2]**

A variety of attempts were seen for this part with some candidates not seeing how 25% could be achieved from their groups. The most successful approach was to use 20 and 44 ÷ 2 to reach 42 and then show that this was 25% of 168. Many wrote 20 + 22 = 44 and did not earn the method mark owing to a basic error. The calculation of $\frac{1}{4}$ or 25% of 168 to conclude was usually successful.

Question 19(c)(ii)

(ii) State one assumption that Ceri has made in making her claim.

....

.... **[1]**

The most common solutions for this part commented on the times being evenly distributed or that half of the group $20 < t \leq 40$ took longer than 30 minutes. A few candidates also gained credit for stating the assumption that the sample is representative of the school. Candidates getting this part wrong talked about how the data collected might not be accurate or that students might not always take the same amount of time or get stuck in traffic.

Exemplar 9

The $20 < t \leq 40$ group has an even split of students between 20-30 minutes and 30-40 minutes **[1]**

This correct response refers to an even split in the interval $20 < t \leq 40$.

Exemplar 10

that every student takes the same amount of time to travel each day. **[1]**

This candidate misses the connection to the previous part and does not describe the assumption.

Exemplar 11

That this sample is representative of the rest of the school. **[1]**

This correct response refers to the sample being representative of the rest of the school.

Question 20(a)(i)

20 In the following equation, n is an integer greater than 1.

$$(\sqrt{2})^n = k\sqrt{2}$$

(a) (i) Find k when $n = 7$.

(a)(i) $k =$ .... **[2]**

Fully correct answers were rarely seen and many candidates omitted this part. Many struggled to make any progress and for these candidates their work consisted of random calculations involving $\sqrt{2}$ and k. More methodical candidates attempted the product of seven roots, sometimes pairing to give three twos and others evaluating the product in order, but not always reaching $8\sqrt{2}$. Those candidates that reached $8\sqrt{2}$ or $2 \times 2 \times 2 \times \sqrt{2}$ were given partial credit. A common error was $2 \times 2 \times 2 = 6$

Question 20(a)(ii)

(ii) Find n when $k = 64$.

(ii) $n =$ .... **[2]**

This part was poorly answered, with many candidates doing little more than substitute $k = 64$ and working out $2^6 = 64$ giving an answer of 6 or 7.

A common error was to forget the remaining $\sqrt{2}$ and give an answer of 12.

Many candidates omitted this part.

Question 20(b)

(b) Show that $\frac{14}{3-\sqrt{2}}$ can be written in the form $a+b\sqrt{2}$. **[5]**

In this part, there were some very good responses. Most candidates knew that they needed to rationalise the denominator, although many had forgotten how to do this and multiplication of numerator and denominator by $\sqrt{2}$ or $3-\sqrt{2}$ were quite common.

Those candidates that used $3+\sqrt{2}$ were often successful in gaining full marks. Some made mistakes while attempting to multiply, particularly with the denominator.

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