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OCR
Oxford Cambridge and RSA

GCSE (9–1)

Examiners' report

MATHEMATICS

J560

For first teaching in 2015

J560/05 November 2024 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, highlight good performance and where performance could be improved. A selection of candidate responses are 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 OCR.

Paper 5 series overview

There was a small entry for the November resit paper with many more candidates taking the Foundation tier rather than the Higher tier. The marks ranged from 6 to 95 with most candidates able to access the paper.

Presentation of work was generally good, but a small number of candidates are still using random approaches in their layout of their working to some of the unstructured problem-solving questions. This is evident in Question 5 and 11 where a more structured approach would have benefitted candidates when obtaining method marks.

The questions that were generally very well answered were in the first half of the paper, for example Question 3 (a) on percentages, Question 4 on forming an expression, Question 7 on proportion, Question 9 on solving equations and Question 10 on straight lines.

The questions that candidates found most challenging included Question 15 on problems involving circles, Question 16 on inequalities and regions, Question 17 on cumulative frequency, Question 19 on geometric reasoning with angles in circles, Question 21 (b) on index equations and Question 22 on algebraic proof.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• had a good breadth of knowledge across the curriculum • had secure arithmetic procedures when calculating with fractions, decimals, percentages, measures and surds • showed concise well-structured working to multi-step unstructured problems • drew curves as appropriate to the nature of the function or statistics required when drawing graphs • recalled facts and used mathematical language appropriate to the problem.	• did not showcase a depth of curricular knowledge • used random unstructured working on multi-mark questions • were less secure with their arithmetic when performing calculations involving fractions, decimals, percentages and measures.

Question 1

1 Work out.

$$1\frac{5}{6} - \frac{2}{3} \div \frac{3}{4}$$

..... **[4]**

A number of candidates answered this well. The most common error was to carry out the calculation in the wrong order, subtracting $\frac{2}{3}$ from $1\frac{5}{6}$ first before dividing by $\frac{3}{4}$. A few candidates approached the problem in the correct order but made arithmetic mistakes when dividing by $\frac{3}{4}$ and when subtracting the answer from $1\frac{5}{6}$. A few candidates attempted to convert fractions into decimals.

Assessment for learning

When working with calculations involving fractions, candidates should not write a fraction with a decimal in the numerator or denominator.

Question 2 (a)

2 **(a)** Work out the size of an exterior angle of a regular hexagon.

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

Those candidates that recognised the exterior sum of a polygon was 360° were usually successful in this part. For many candidates there were a number of misconceptions, however. These included interior angle sum of a polygon = 360, interior angle + exterior angle = 360. Some candidates attempted to find the interior angle first using $\frac{180(6-2)}{6}$ and then subtracting from 180°, this was a less successful approach.

Question 2 (b)

(b) Use your answer to part **(a)** to write down the size of an interior angle of a regular hexagon.

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

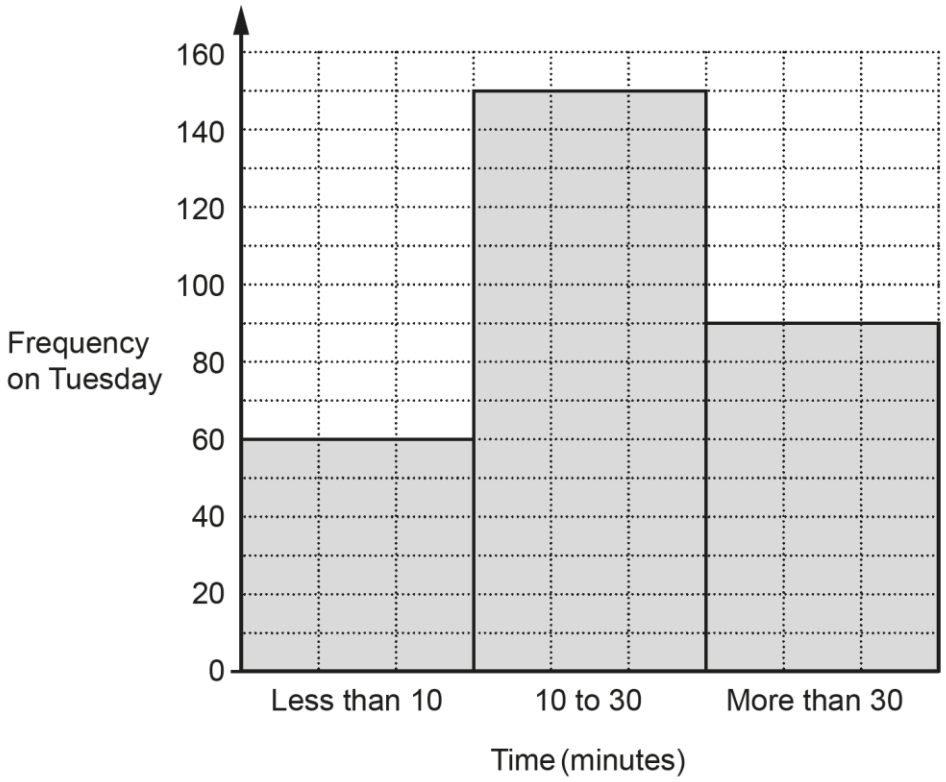
More candidates were successful in this part. Examiners allowed a follow through from the previous answer. A number did 360 minus their answer and some gave an interior angle sum of the polygon rather than the size of one individual angle.

Misconception

A number of candidates are not secure in recalling interior and exterior angle facts, e.g. common errors included exterior + interior = 360, interior angle sum = 360. Some did not recognise a hexagon has six sides.

Question 3 (a)

3 The graph shows the time, in minutes, taken by some pupils to travel to school on **Tuesday**.



(a) Find the percentage of these pupils that took more than 30 minutes to travel to school.

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

Many candidates answered this well. The most common errors were to obtain a correct fraction $\frac{90}{300}$ and then incorrectly convert it to a percentage or misread the scale on the bars when obtaining the fraction. Some thought the bar chart was a histogram and attempted area calculations of the bars to work out the frequencies. A few used 160 as the total time instead of 90 + 150 + 60.

Question 3 (b)

(b) On **Tuesday** the number of pupils taking 10 to 30 minutes to travel to school was 25% less than on Monday.

Find the number of pupils taking 10 to 30 minutes to travel to school on **Monday**.

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

Candidates that recognised 75% was equivalent to 150, the height of the bar for 10 – 30 minutes, usually went on to calculate the correct answer. Many candidates attempted calculations involving 25% of 150 and were unsuccessful.

Question 4

4 An electrician charges £30 per visit plus £22 per hour.

Write an expression for the cost, in £, charged by the electrician for one visit lasting n hours.

£ ..... **[2]**

This was generally very well answered. Candidates should note that in expressions, units such as pound signs should not be included. A few candidates gave an answer of $30 + 22^n$ misinterpreting the rate per hour.

Question 5

5 Anika has a shelf 79.6 cm long.
She has many books, each of width 3.4 cm.
Anika puts two paperweights, each of width 5 cm, and the maximum possible number of books on the shelf.

Work out the amount of space on the shelf that is left over.
You must show your working.

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

Many candidates showed a systematic approach to the problem, they reached the correct answer and showed required working. A number made arithmetic errors in an otherwise correct method, particularly for those using repeated addition or subtraction approaches rather than a formal division of (79.6 – 10) ÷ 3.4.

Some candidates did not include the width of the two paperweights in the calculation for the number of books but they received some credit from correct work done with the width 3.4 cm in these cases. A few did not use the given values in the question but instead used estimates such as 80 and 3 for the calculation, this approach limited marks they could score as the question requires accurate calculations involving decimals. For some a random approach to the working prevented credit for method particularly when multiple conflicting attempts were shown.

Assessment for learning

Estimation approaches can be useful as a check on whether answers are sensible, it should not be used to replace calculations unless the demand of the question specifically uses the command word 'estimate'.

Question 6

6 Jack has ten cards numbered 11 to 20.
He picks a card at random.

Jack says,

In these ten cards, there are two multiples of 5 and five even numbers.
Therefore, the probability that I pick a card that is a multiple of 5 or an even number is $\frac{2}{10}+\frac{5}{10}=\frac{7}{10}$.

Describe the error in Jack's method and give the correct answer.

The error is .....

.....

The correct answer is ..... **[2]**

Those candidates that recognised that 20 was both a multiple of 5 and an even number were able to articulate this in their reasoning and usually went on to give a correct answer. Many candidates focused their response on the operations with the fractions and not that the events overlapped, e.g. the fractions should have been multiplied and not added was a common incorrect reason.

Question 7 (a)

7 Felix makes craft figures at a constant rate.
He can make 5 craft figures in 40 minutes.

(a) Find the number of craft figures Felix can make in 4 hours.

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

This was answered well by candidates. A few multiplied 5 by 60 after 240 ÷ 4 rather than 240 ÷ 40.

Question 7 (b)

(b) Darcie makes craft figures 10% quicker than Felix.

Work out how long Darcie takes to make 15 craft figures.

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

This was well answered by candidates. A few misinterpreted 'quicker' as taking 10% longer rather than taking 10% less time.

Question 8

8 Here is a question and an incorrect answer.

Question:

Expand the brackets and simplify fully.

$3(a + 2b) + a$

Answer:

$a4 + 6 \times b$

Explain why the answer is **not** correct.

.....

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

Candidates often did not focus on the demand of the question which was to explain how the given answer was incorrect. Those that explained the incorrect algebraic notation for both terms scored two marks. Other candidates stated that the answer is $4a + 6b$ but did not explain why the given answer had errors. Those candidates were given partial credit for giving the answer $4a + 6b$.

Question 9

9 Solve.

$3x + 12 = 9 - 7x$

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

Most candidates answered this well. Those that made errors were usually in the signs when dealing with inverse operations, collecting terms in x and the numbers on each side of the equation.

Question 10 (a)

10 A straight line has equation $y = 4x + 9$.

(a) Write down the gradient of the line.

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

This was well answered. A few candidates gave the answer 9.

Question 10 (b)

(b) Casey says the graph of $y = 4x + 9$ passes through the point (3, 23).

Is Casey correct?
Show how you decide.

..... because .....

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

This was answered well by a number of candidates. The most common approach was to substitute $x = 3$ into $y = 4x + 9$ and show that $y = 21$ and not 23. A number of candidates omitted this part.

Question 11 (a)

11 A bag only contains green, red, blue and yellow discs.

Orla carries out an experiment.
She picks one disc at a time from the bag, records its colour and then returns the disc to the bag.
When she has finished the experiment, Orla works out the relative frequency of each colour.
Some of her results are shown in the table.

Colour	Green	Red
Relative frequency	0.35	0.25

The relative frequency of the yellow discs was three times the relative frequency of the blue discs.

In total, there are 2000 discs in the bag.

(a) Use this information to find an estimate for the **total** number of green and yellow discs that are in the bag.
You must show your working.

(a) ..... **[5]**

Candidates that were successful in this part, worked systematically and showed each step of their working. There were two approaches used. Some worked with the probabilities and found the probability of yellow and blue first and then added the probability of yellow and green before working out the expected number of green and yellow. Others worked out the expected number of green and red and then subtracted from 2000 and used ratio to find the numbers of blue and yellow before adding green and yellow together.

Candidates need to show each step as they will not receive credit if arithmetic mistakes are made within the method, e.g. probability of yellow and blue = 0.5 with no method will not receive any credit but (1 – 0.25 – 0.35) = 0.5 will receive some credit for the method shown despite the arithmetic error.

Question 11 (b)

(b) Explain why your estimate may **not** be reliable.

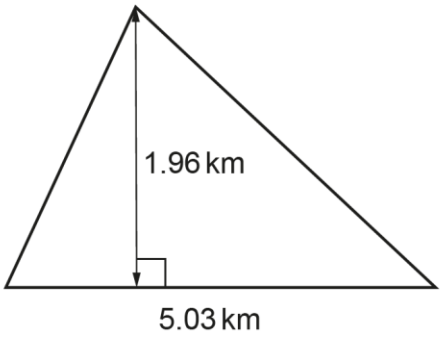
.....

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

Candidates found this part challenging and did not focus on how the reliability of any experiment depends on the number of trials. Responses included rounding values, not recording correctly and picking the same counter more than once.

Question 12

12 A housing estate is built on a triangular piece of land.



Not to scale

There are 3951 people living on the estate.

Work out an **estimate** of the population density of the estate in people per km^2.

..... people per km^2 **[4]**

A number of candidates answered this correctly using values rounded to one significant figure. In questions that ask for an estimation in the demand, candidates should round the given values to one significant figure before attempting any calculation. A number of candidates worked with the given values in the question making the calculation much more difficult and not answering the demand.

Other made errors in calculating the triangular area and did base × height rather than base × height ÷ 2.

A few converted units from km to metres which was unnecessary and led to errors.

Question 13

13 Write $\frac{4}{11}$ as a recurring decimal.

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

Many candidates were able to convert $\frac{4}{11}$ to a decimal number of 0.36..... , but fewer were able to record their answer using the correct recurring notation $0.\dot{3}\dot{6}$ Some candidates gave answers of $0.4\dot{1}$ without any working.

Question 14 (a)

14 The expected value of a painting, £P, is given by the formula

$$P = 2500 \times 1.2^n$$

where n is the number of years after it was bought and $0 \leqslant n \leqslant 4$.

(a) Write down the value of the painting when it was bought.

(a) £ ..... **[1]**

Many gave the correct answer. Some gave 3000 from 2500 × 1.2

Question 14 (b)

(b) Write down the annual percentage increase in the expected value of the painting.

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

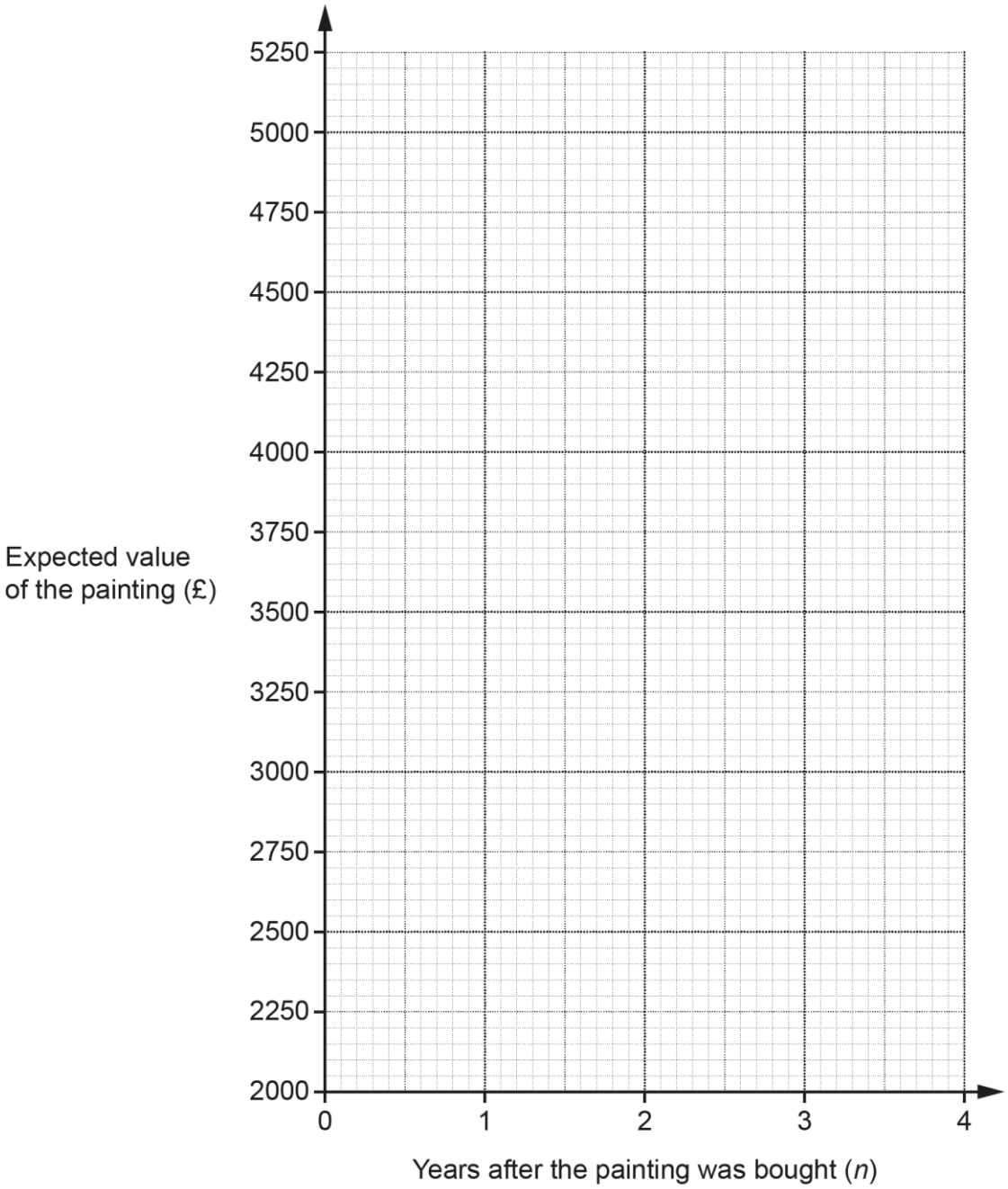
A number of candidates gave the correct answer. Some gave 1.2, 101.2 or 25 as the answer.

Question 14 (c)

(c) The table shows the expected value of the painting n years after it was bought.

Years after the painting is bought (n)	1	2	3	4
Expected value of the painting (£)	3000	3600	4320	5184

On the page opposite, draw a suitable graph to show the expected value of the painting n years after it was bought, where $0 \leqslant n \leqslant 4$.



[3]

Many were able to plot four correct points from 1 year to 4 years, but most did not plot a point at (0, 2500). The points were often joined by a curve but some incorrectly used straight lines or did not join their points.

Question 14 (d)

(d) An art collector correctly works out 2500×1.2^{10} as 15479.

They say,

The expected value of the painting 10 years after it was bought is £15479.

What assumption has the art collector made.

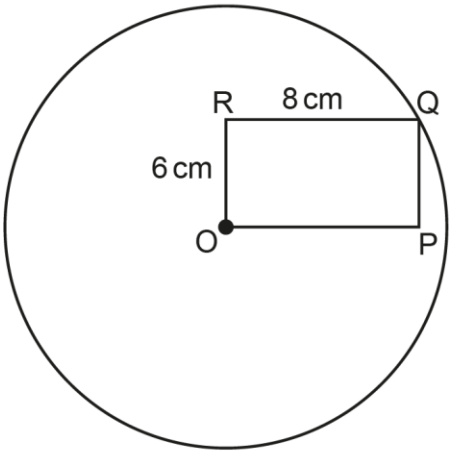
.....

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

Correct responses referred to the percentage rate of increase remaining constant for the period. Some stated the formula stayed the same. Incorrect responses referred to the annual value increasing rather than the percentage increase staying the same.

Question 15 (a)

15 (a) The diagram shows a rectangle, OPQR, and a circle, centre O, which passes through Q.
OR = 6 cm and RQ = 8 cm.



Not to scale

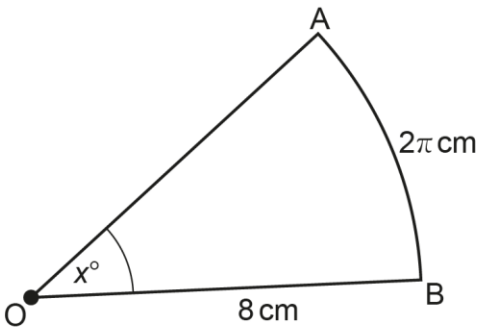
Find the circumference of the circle.
Give your answer in terms of π.

(a) ..... cm **[4]**

A few candidates answered this part well, finding the radius first using Pythagoras' and then calculating the circumference in terms of π. A small number attempted an evaluation using a value of π which was not required in the demand. A few candidates did not attempt to find the radius and attempted area calculations with 6cm and 8cm. There were some candidates that omitted this part.

Question 15 (b)

(b) AOB is a sector of a circle, centre O and radius 8 cm.
Angle AOB = $x°$.
The arc, AB, has length 2π cm.



Not to scale

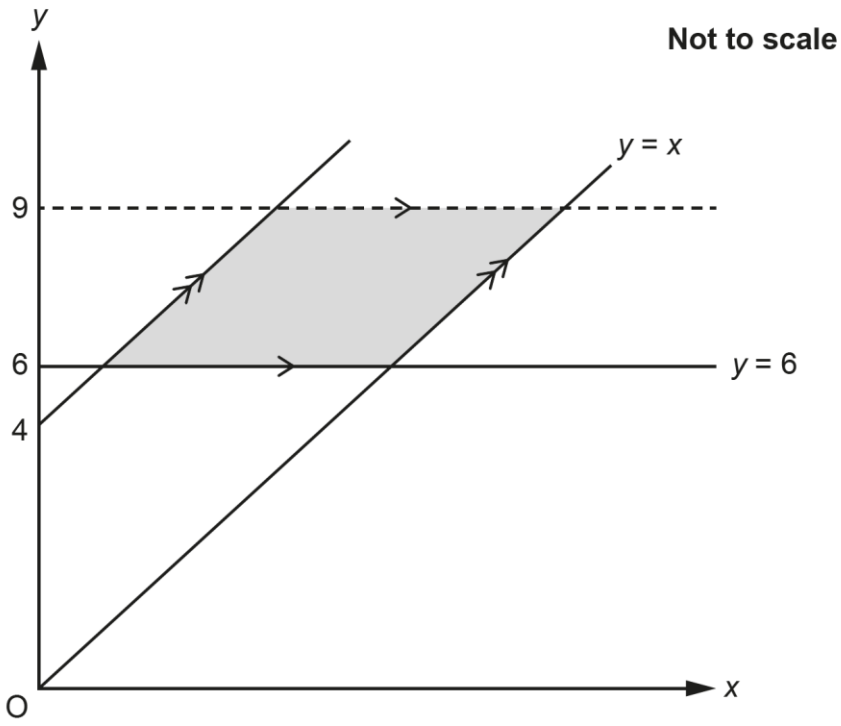
Find the area of the sector.
Give your answer in terms of π.

(b) ..... cm^2 **[4]**

A small number of candidates were successful and gave a correct response. Most candidates found this part more challenging than part (a) and many struggled to find the fraction of the circle represented by the sector or the angle *x*. Some showed understanding however of how to find the area of the sector for their angle *x*.

Question 16 (a)

16 In the diagram below, the shaded region is a parallelogram.
The parallelogram can be identified by four inequalities.
Two of the inequalities are $y \geqslant 6$ and $y \geqslant x$.



(a) Write down the other **two** inequalities that identify the parallelogram.

(a) .....

.....

[3]

A small number of candidates fully answered this part correctly. Some candidates found the equations for both boundary lines but were unable to write the correct inequality to describe the region. Candidates were more successful in giving $y < 9$ than $y \leq x + 4$. Many struggled to find the equation of the boundary line $y = x + 4$ using the parallel line property with $y = x$ and having y – intercept 4.

Question 16 (b)

(b) Work out the area of the parallelogram.
You must show your working.

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

This part was omitted by many candidates. A small number attempting this were successful and others earned method marks by annotating the diagram with correct values for the length and/or the perpendicular height of the parallelogram. Some wrote coordinates of vertices and received partial credit. A misconception for some was to write 3 as the slant height of the parallelogram.

Question 17 (a)

17 A farmer grows pumpkins.
The farmer records the masses, m kilograms, of 80 of their pumpkins.
The table shows the results.

Mass (m kg)	$0 < m \leqslant 5$	$5 < m \leqslant 10$	$10 < m \leqslant 15$	$15 < m \leqslant 20$	$20 < m \leqslant 25$
Frequency	10	22	28	14	6

(a) Complete the cumulative frequency table.

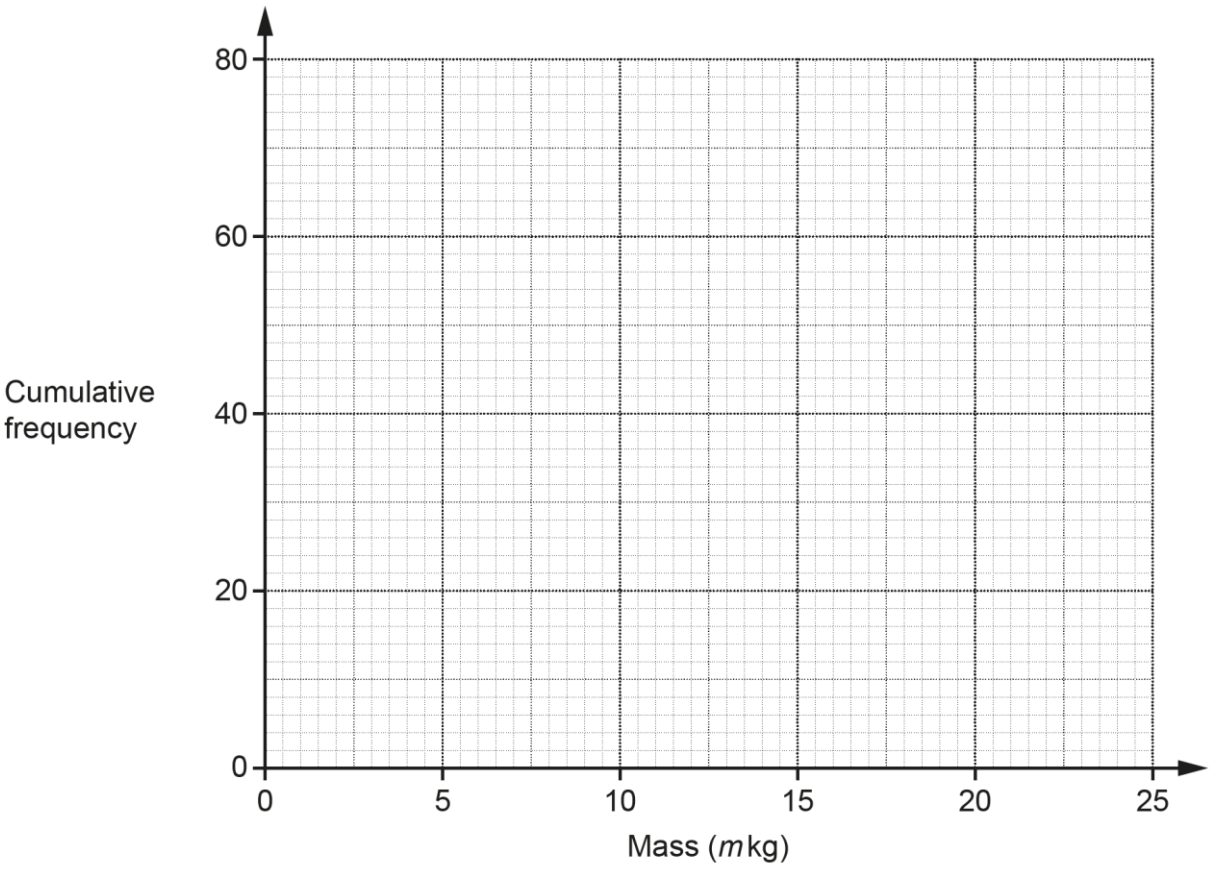
Mass (m kg)	$m \leqslant 5$	$m \leqslant 10$	$m \leqslant 15$	$m \leqslant 20$	$m \leqslant 25$
Cumulative frequency	10	32			

[1]

There were a variety of responses and a number of candidates omitted this part. Candidates that understood the term cumulative frequency were generally successful apart from a few with arithmetic errors. Others wrote the frequency values or added pairs of frequencies or treated the frequency values as a sequence and tried to continue the pattern.

Question 17 (b)

(b) Draw the cumulative frequency graph to represent these results.



[3]

Those candidates with a correct table in part (a) often gave a correct graph. A common misconception however was to draw a cumulative bar graph which is incorrect. Other candidates were given credit for plotting points from their table in the correct position on the graph.

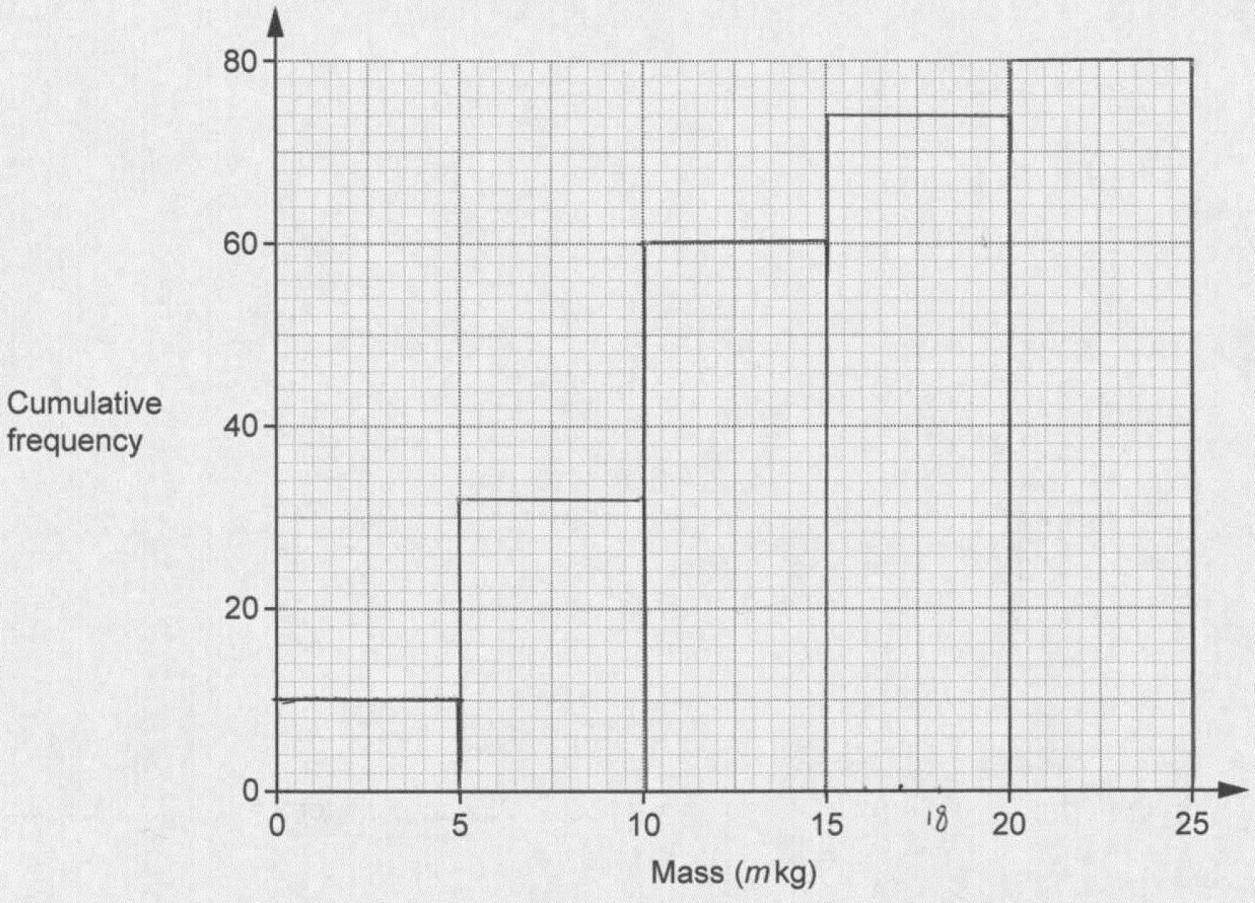
Exemplar 1

(a) Complete the cumulative frequency table.

Mass (*m* kg)	$m \leqslant 5$	$m \leqslant 10$	$m \leqslant 15$	$m \leqslant 20$	$m \leqslant 25$
Cumulative frequency	10	32	60	74	80

[1]

(b) Draw the cumulative frequency graph to represent these results.



[3]

This example shows a common misconception for those candidates that completed the cumulative frequency table correctly in part (a). The graph has been drawn with bars rather than points plotted at the upper bound of the intervals and then joined with a smooth curve. Candidates received no credit from drawing bars on a cumulative frequency graph

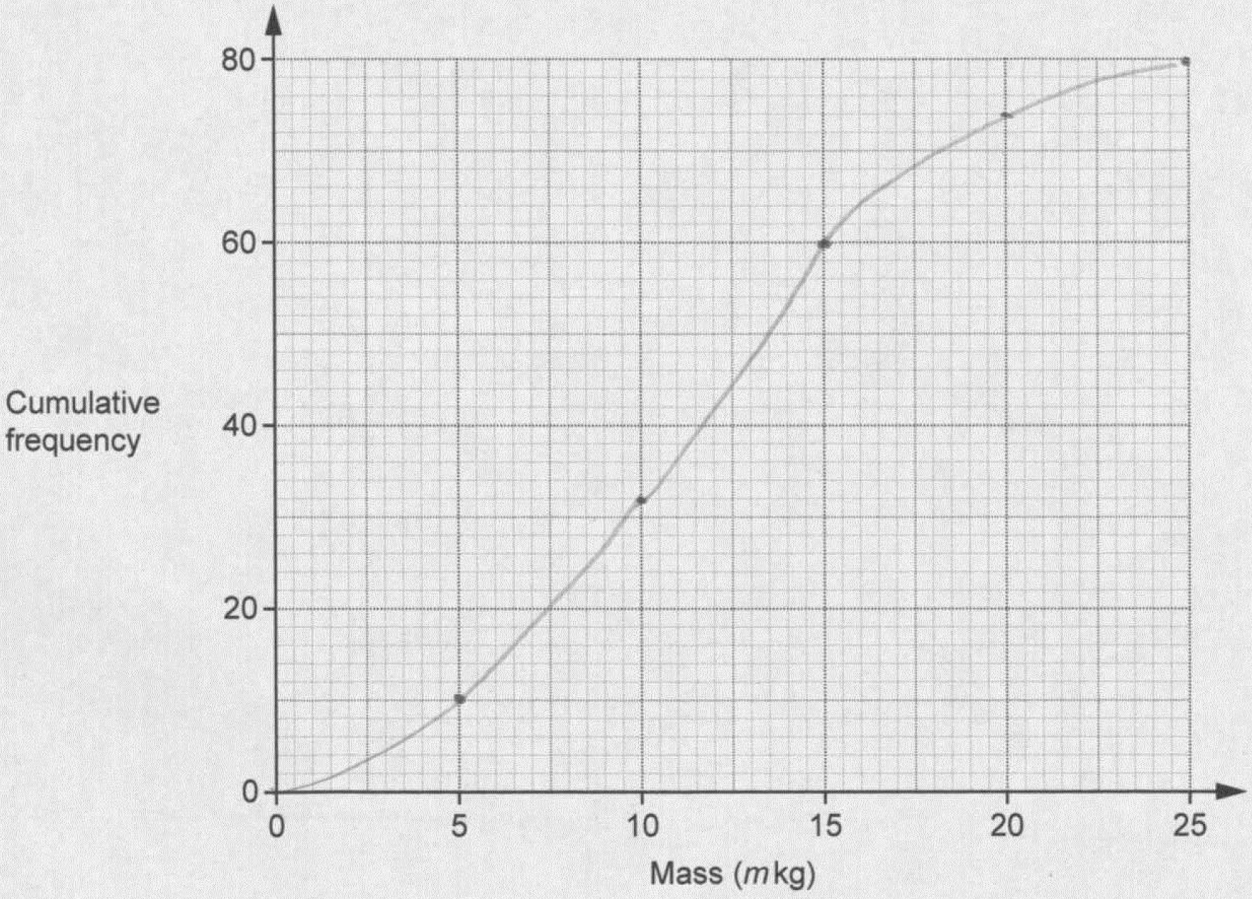
Exemplar 2

(a) Complete the cumulative frequency table.

Mass (m kg)	$m \leqslant 5$	$m \leqslant 10$	$m \leqslant 15$	$m \leqslant 20$	$m \leqslant 25$
Cumulative frequency	10	32	60	74	80

[1]

(b) Draw the cumulative frequency graph to represent these results.



[3]

This example shows a correct approach to the graph using correctly plotted points joined with a smooth curve.

Question 17 (c)

(c) Write down the upper quartile of the mass of the 80 pumpkins.

(c) ..... kg **[1]**

Some candidates were successful, but many omitted this part.

Question 17 (d)

(d) The farmer picks a pumpkin at random.

Find an estimate for the probability that the pumpkin has a mass greater than 18 kg.

(d) ..... **[2]**

Examiners gave credit for candidates that used their curve to obtain the answer to this part provided a line or curve had been drawn and not a bar graph.

Question 18

18 Solve.

$$\frac{x^2-5}{x-4}=4x$$

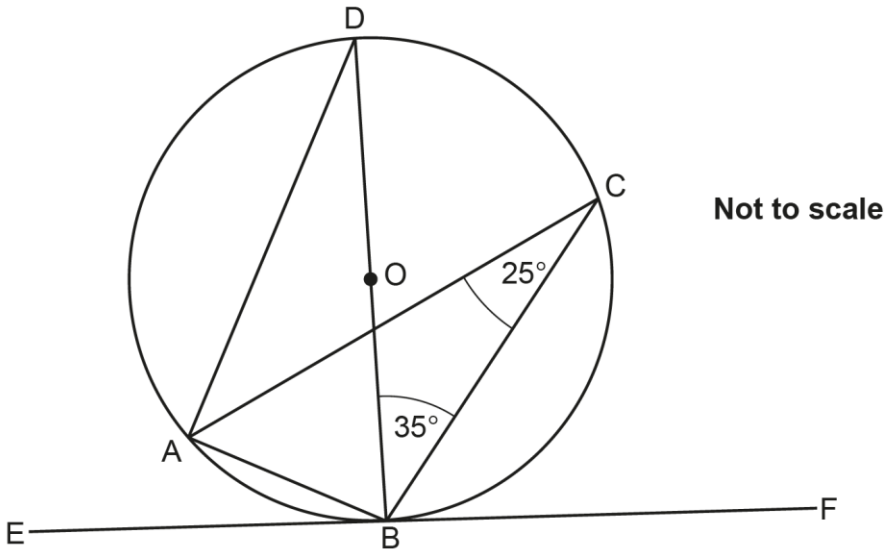
You must show your working.

x = ... or x = ... **[6]**

Many candidates removed the denominator $x - 4$ from the fraction as the first step and often used brackets when doing this. A number made errors when expanding the bracket, e.g. $4x(x-4) = 4x^2 - 16$. A small number attempted to incorrectly factorise $x^2 - 5$ to $(x - 5)(x + 5)$. Those that did manipulate the algebra correctly to 3-term quadratic sometimes went on to give the correct solutions. The preferred method was to factorise the quadratic equation although a few used the formula. Those that factorised sometimes made sign errors. Examiners awarded method marks for those that used a correct method to solve their 3-term quadratic equation.

Question 19 (a)

19 A, B, C and D are points on the circumference of a circle, centre O.
BD is a diameter of the circle.
EBF is a tangent to the circle.



(a) Give a reason why angle BAD = 90°.

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

Very few candidates used the correct terminology in their reason. Common incorrect reasons were, it is a right-angle, it is a right-angled triangle, or it is on the diameter.

Question 19 (b)

(b) Write down **one** other angle that is 90°.
Give a reason for your answer.

Angle ..... because .....

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

Some candidates could identify another 90-degree angle although angle ABC was a common error.

Most did not give a complete explanation using the correct terminology in their reason. Reasons sometimes included the word tangent or radius, but not both. Some candidates incorrectly stated that angle ABC was 90-degrees, stating that it was an angle in a semicircle.

Question 19 (c)

(c) Write down the value of angle CAD.

(c) ..... ° **[1]**

A few candidates answered this part correctly. The most common answers were 25, 45, 60 and 90. A common misconception is that the lines AD and BC are parallel.

Question 19 (d)

(d) Write down the value of angle EBA.

(d) ..... ° **[1]**

A few candidates answered this part correctly. A common misconception is that angle CAD is equal to angle EBA.

Question 20

20 Simplify.

$\sqrt{160} \div \sqrt{2}$

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

Most candidates attempted this question, and many were successful in completing the first step in obtaining $\sqrt{80}$. Candidates that were less successful attempted to simply $\sqrt{160}$ and did not consider the division by $\sqrt{2}$.

Question 21 (a)

21 (a) Work out.

$$\left(\frac{1}{8}\right)^{\frac{1}{3}}$$

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

Many candidates attempted to answer this part, and a few were successful. Common incorrect answers were $\frac{1}{24}$, 24, $\sqrt[3]{8}$ and 2^{-3}.

Question 21 (b)

(b) $2^x \times 4^y = 16$

Show that $y = 2 - \frac{x}{2}$. **[4]**

Candidates who recognised that all the terms could be written in terms of base 2 often achieved full credit. Many unsuccessful candidates attempted to substitute values or $y = 2 - \frac{x}{2}$ into the original equation.

Question 22

22 A sequence has nth term $2n^2 + 1$.

Prove algebraically that the sum of any two consecutive terms in this sequence is always a multiple of 4. **[6]**

The few candidates who recognised that the $(n + 1)^{th}$ term was $2(n + 1)^2 + 1$ generally achieved full credit. The majority of candidates attempted to substitute numbers into the nth term. This method did not achieve credit as the question demand asks for a proof.

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