Qualification Accredited

Oxford Cambridge and RSA

GCSE (9–1)

Examiners' report

MATHEMATICS

J560

For first teaching in 2015

J560/04 November 2022 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 answers 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 OCR.

Paper 4 series overview

There were very few scripts seen in this series so a summary will only be true for this small sample and may not reflect general performance and practice. As in previous series there were examples of candidates not fully answering the questions and many not giving their answer in the form required or giving the requested data item; a good example of this is Question 2 where the lowest common multiple was often given and not the next year. There were examples of premature rounding or truncating which would have led to an inaccurate answer, this was especially true of Question 12.

There were many good attempts at the problem-solving questions. Most candidates made positive starts to these questions but were not always able to complete them.

There were two questions involving different construction techniques and scale drawing and most candidates struggled to answer both questions, with many unable to bisect an angle or a side. The questions on statistics and probability were also examples of where candidates struggled. Many did not know what relative frequency was in Question 4. Few candidates were able to draw the cumulative frequency graph and calculate the cumulative frequencies in Question 15. In Question 21 (a) many could not correctly work out the frequency densities for the histogram.

Much of the algebra was reserved for the second part of the paper and aimed at the higher grades. Question 13, on direct proportion, was tackled as inverse proportion by some candidates. Few candidates were able to find the gradient of a perpendicular line and write the equation of that line in Question 17. Question 18 on sequences was a little unusual but there were many good attempts. The final question required the use of substitution, which many candidates were not confident of using.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• answered each question carefully and fully • applied the correct methods to each question • kept the numerical accuracy in calculations • showed working in a clear and logical order.	• did not use all the information in the question or answer the question fully • used methods in the wrong context • lost accuracy by rounding or truncating too early • showed working randomly which made it difficult to follow.

Question 1 (a)

1 **(a)** Write 65 400 in standard form.

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

This was well answered, the common error was not to write the first number as a number between 1 and 10, for example, 654×10^2.

Question 1 (b)

(b) Write 8.2×10^{-4} as an ordinary number.

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

Candidates often answered this correctly, sometimes one zero was omitted giving an answer of 0.0082.

Question 2

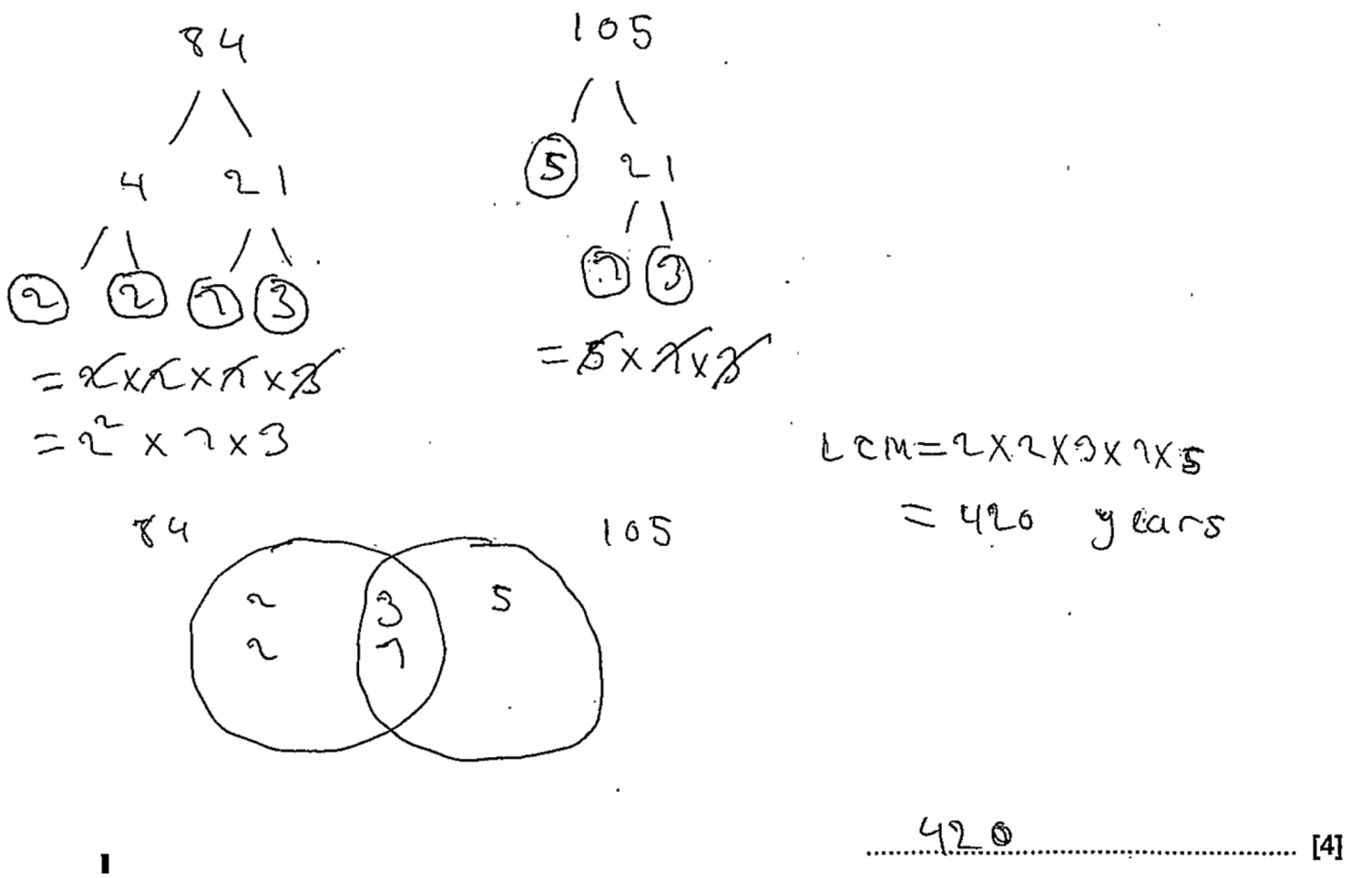
2 In 2019, comet A and comet B were both seen from Earth.
Comet A is seen from Earth every 84 years.
Comet B is seen from Earth every 105 years.

Find the next year when both comets will be seen from Earth.

.... **[4]**

The most successful responses either wrote down the years after 2019 without error or they found the lowest common multiple (LCM) as 420 by prime factor decomposition. A few candidates forgot to add the 420 to 2019 to gain the final answer mark.

Exemplar 1



This exemplar shows a clear use of Venn diagrams, where the intersection provides the highest common factor (HCF), and the union provides the LCM. The candidate has not fully answered the question that has been asked so scored 3 marks.

Assessment for learning

Venn diagrams are an excellent tool for tackling problems involving lowest common multiple (LCM) and highest common factor (HCF).

A suggested exam technique for multi-step questions is to highlight the essential information in the question to make sure the question is fully answered.

Question 3

3 An examination has three papers.
Paper 1 is marked out of 60.
Paper 2 is marked out of 40.
Paper 3 is marked out of 100.
The three marks are added together to form the total mark out of 200.

A student scored 65% on Paper 1 and 70% on Paper 2.

Find the mark they need to get on Paper 3 to achieve 64% of the total marks.
You must show your working.

.... **[5]**

Most candidates found the marks on Paper 1 and Paper 2 as 39 and 28. Some did not find the total needed out of 200 which was 128, but if they did then the answer of 61 was frequently given.

Question 4 (a)

4 A phone manufacturer records the faults that are reported.
Last week, in a batch of 96 phones, 6 were reported as faulty.

(a) Write down the relative frequency of faulty phones in this batch.

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

Some candidates did not know what the relative frequency was and omitted this question. Others incorrectly wrote an answer of 96 – 6 as 90 or as a ratio 16 : 1. The correct response was seen in all of its equivalent forms. Answers in percentages had to have the percentage symbol.

Question 4 (b)

(b) In 2020, the manufacturer sold a total of 12 321 phones.

Work out how many of these phones the manufacturer should expect to be reported as faulty.

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

There were several blank responses, though many did do the correct working. A few did not round the answer to an integer so were credited with 1 mark. The most common error was to divide 12 321 by 96.

Question 5

5 B is 12 km due east of A.
C is south-east of A and on a bearing of 225° from B.

Complete the diagram to show the positions of A, B and C.
Show clearly the values of all three angles in triangle ABC.

Scale: 1 cm represents 2 km

[4]

Most candidates drew AB to the correct scale east of A. A few drew B west of A. Point C should have been on an exact south-east bearing so that the angle BAC was exactly 45°, mostly it was around 60°. The bearing from B to C was more often accurate. Very few candidates completed the diagram by marking the points and the angles.

Question 6 (a)

6 **(a)** A solid block of wood is a cuboid which measures 3 cm by 4 cm by 5 cm.
Its density is 0.65 g/cm^3.

Work out the mass of the block of wood.

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

Most candidates found the volume of the cuboid but then divided 0.65 by 60 or the other way round.

Question 6 (b)

(b) Here are two areas.

State which area is greater.
Show how you decide.

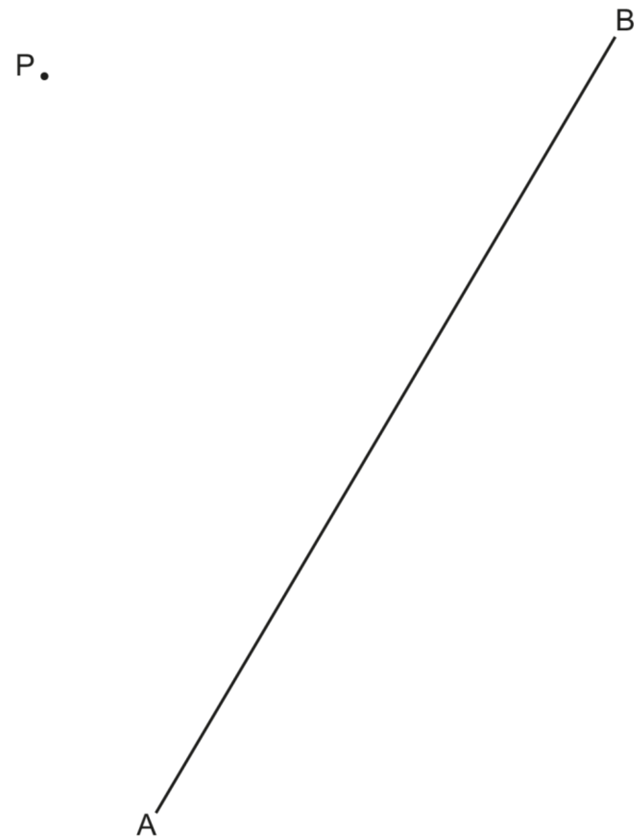
Area .... is greater because ....

.... **[2]**

Many candidates treated the units as length, so the use of 1000 was prevalent. The most successful responses converted both numbers to cm^2.

Question 7 (a)

7 **(a)** Construct the perpendicular from the point P to the line AB.

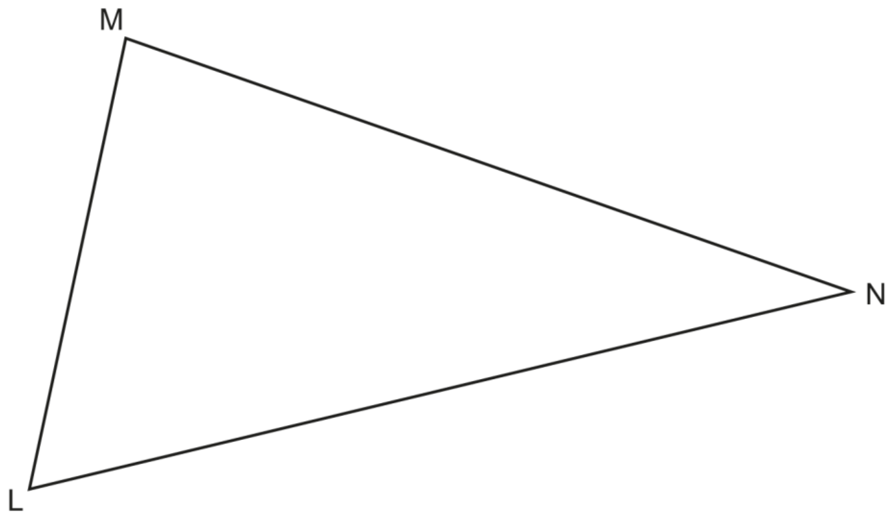


[2]

Not many candidates knew how to construct this bisector though a few drew an accurate one using a protractor and ruler.

Question 7 (b)

(b) The diagram shows a field LMN.



A tree is to be planted in the field so that it is

- the same distance from the fences MN and ML

and

- the same distance from corner M as from corner N.

Show, by construction, whether this can be done or cannot be done.

This .... be done. **[5]**

Most candidates knew that they had to bisect an angle and a side, but they could not work out which ones. Many attempts bisected two sides and two angles, often not the correct ones. It was common to see both angles M and N bisected with only the bisector of N being accurate.

Question 8

8 A bag contains 35 balls.
Each ball is either red or green.
The ratio of red balls to green balls is 3 : 2.

Work out the smallest number of balls of each colour that have to be added to the bag so that the ratio of red balls to green balls becomes 7 : 3.
You must show your working.

Number of red balls added to the bag = ...

Number of green balls added to the bag = ... **[5]**

Many candidates found the contents of the bag correctly as 21 red and 14 green. Some continued incorrectly with the same ratio throughout their work, instead of looking for multiples of 3, 7 or 10. Multiples of 3 above 14 would have given 15 green balls very quickly, leading to the correct answer. It was common to see 49 and 21 as the total number of red and green balls giving answers of 28 and 7.

Exemplar 2

r g
3 : 2

21 : 14

4×7= 28 : 7 = 35

r g
49 : 21 = 70

70 ÷ 10 = 7

7×7 = 49
7×3 = 21

Number of red balls added to the bag = 28

Number of green balls added to the bag = 7 **[5]**

This candidate quickly reached the contents of the bag, 21 red and 14 green. They correctly took the ratio 7 : 3 and multiplied by 7 to give a possible solution for the final contents, 49 and 21. The solution of 28 extra red and 7 extra green is not the smallest number to be added though. They needed to have explored the possible solutions by multiplying 7 : 3 by 6 and 5 to find the solution to fully answer this question.

Check the demand of the question before writing down your answer.

Many candidates gave a solution of 28 red balls and 7 green balls, but this solution did not fully answer the question which asked for the smallest number of balls to be added.

Question 9 (a)

9 Here are two pieces of work.

For each one, describe the error in the method and give the correct answer.

(a)

Question:

Rearrange $y = 3x + 17$ to make x the subject.

Solution:

$y = 3x + 17$

$y + 17 = 3x$

$x = \dfrac{y + 17}{3}$

Error is ....

Correct answer .... **[2]**

Many candidates identified the error, but they did not give the 'correct answer'. Some omitted the 'x =' and some did not correct the addition of 17.

Question 9 (b)

(b)

Question:

Rearrange $A = 4x^2$ to make x the subject, where $x > 0$.

Solution:

$A = 4x^2$

$\sqrt{A} = \sqrt{4x^2}$

$\sqrt{A} = 4x$

$x = \dfrac{\sqrt{A}}{4}$

Error is ....

Correct answer .... **[2]**

Many candidates did not identify the error in the third line. The most common mistake was to suggest that division by 4 was necessary in the second line. Some candidates could not produce the 'correct answer', some produced $x = \dfrac{A}{4}$ while others did not have x as the subject and gave $4x = \sqrt{A}$.

Question 10

10 You may use these kinematics formulae to answer this question.

$v = u + at$

$s = ut + \frac{1}{2}at^2$

A particle has an initial velocity of 3 m/s.
After 20 seconds the particle has a velocity of 11 m/s.

Work out the distance the particle has travelled after 20 seconds.

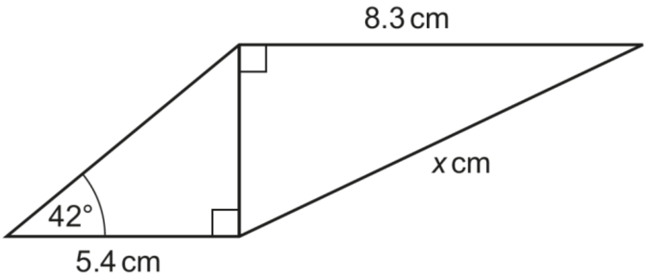
.... m **[4]**

This question was found to be difficult for the majority. Many candidates did not know what the variables represented. They did not realise that they had to find the value of *a*. Some used either 3 or 11 – 3 or 8 as the value of *a*. Even with an incorrect value for *a*, some demonstrated that they could use the second formula correctly.

Question 11

11 The diagram shows two right-angled triangles that are joined together.

All measurements are given accurate to 2 significant figures.



Not to scale

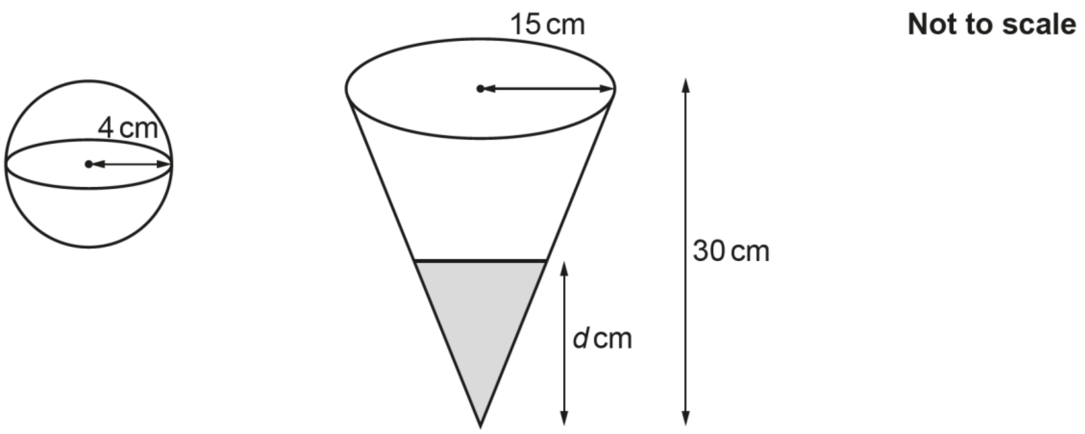
Work out the value of *x*.
Give your answer correct to an appropriate degree of accuracy.
You must show your working.

$x =$ .... **[6]**

Incorrect use of trigonometry, usually involving cosine, was widely seen. Some candidates attempted to use Pythagoras' theorem with 42 and 5.4 and many candidates were not comfortable using tan. Once a value had been found for the height of the first triangle, most used Pythagoras' theorem in the second triangle. Some did not give their answer correct to two significant figures.

Question 12

12 The diagram shows a sphere and a cone.



The sphere has radius 4 cm.
The cone has radius 15 cm and height 30 cm.

The sphere is completely filled with water.
The same amount of water is poured into the cone.

Work out the depth, d cm, of the water in the cone.
You must show your working.

[The volume V of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.

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

$d =$ .... **[6]**

The common response was to start by calculating the volume of the sphere and the volume of the cone. After that most did not know how to work out the scale factor of length. Only a few were able to progress using this method. Alternatively, some realised that the radius of the cone of height d is $\frac{d}{2}$ and so they were able to form an equation and solve it.

Exemplar 3

$4 : 15$

$8 : 30$

$\cancel{V \text{ of } S = \frac{16}{3} \times \pi \times r^3}$

$\cancel{= \frac{3\pi}{3} \times \pi \times 4^3 \times h}$

$\cancel{V \text{ of } C = \frac{1}{3}}$

$V \text{ of } S = \frac{4}{3} \times \pi \times r^3 = \frac{4}{3} \times \pi \times 4^3 = 268$

$V \text{ of } C = \frac{1}{3} \times \pi \times r^2 \times h = \frac{1}{3} \times \pi \times 15^2 \times 30 = 7068.6$

$\cancel{7068.8 - 268 =}$ $\frac{268}{7068.6} \times 100$

$= 3.8$

$d =$ ~~38~~ 3.8 **[6]**

In this exemplar the volume of the sphere and the volume of the cone were correctly worked out. The candidate took a step further by dividing the volumes, but incorrectly converted to a percentage. Instead of multiplying by 100, they needed to find the cube root to give the scale factor for length. This could then be multiplied by the height to give the correct answer.

The two volumes have been rounded but these figures would still give an accurate final answer. Candidates should be encouraged to avoid rounding mid-way through calculations as this impacts the accuracy of the final answer.

Question 13

13 y is directly proportional to $\sqrt{x}$.
$y = 1$ when $x = 16$.

Find a formula for y in terms of x.

.... **[3]**

Many were not able to form an equation with a constant of proportionality, k, and use the information to find the value of k. Some did not realise that the final answer was the formula.

Question 14 (a)

14 An estimate for the number of seals on an island is given by the formula

$P = 5200 \times 1.02^t$

where P is the number of seals t years after the start of year 2015.

(a) Write down the annual percentage increase in the number of seals on the island.

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

Many answers were given such as 2, 2.1, 1.02, 102, 1.04 and 5200.

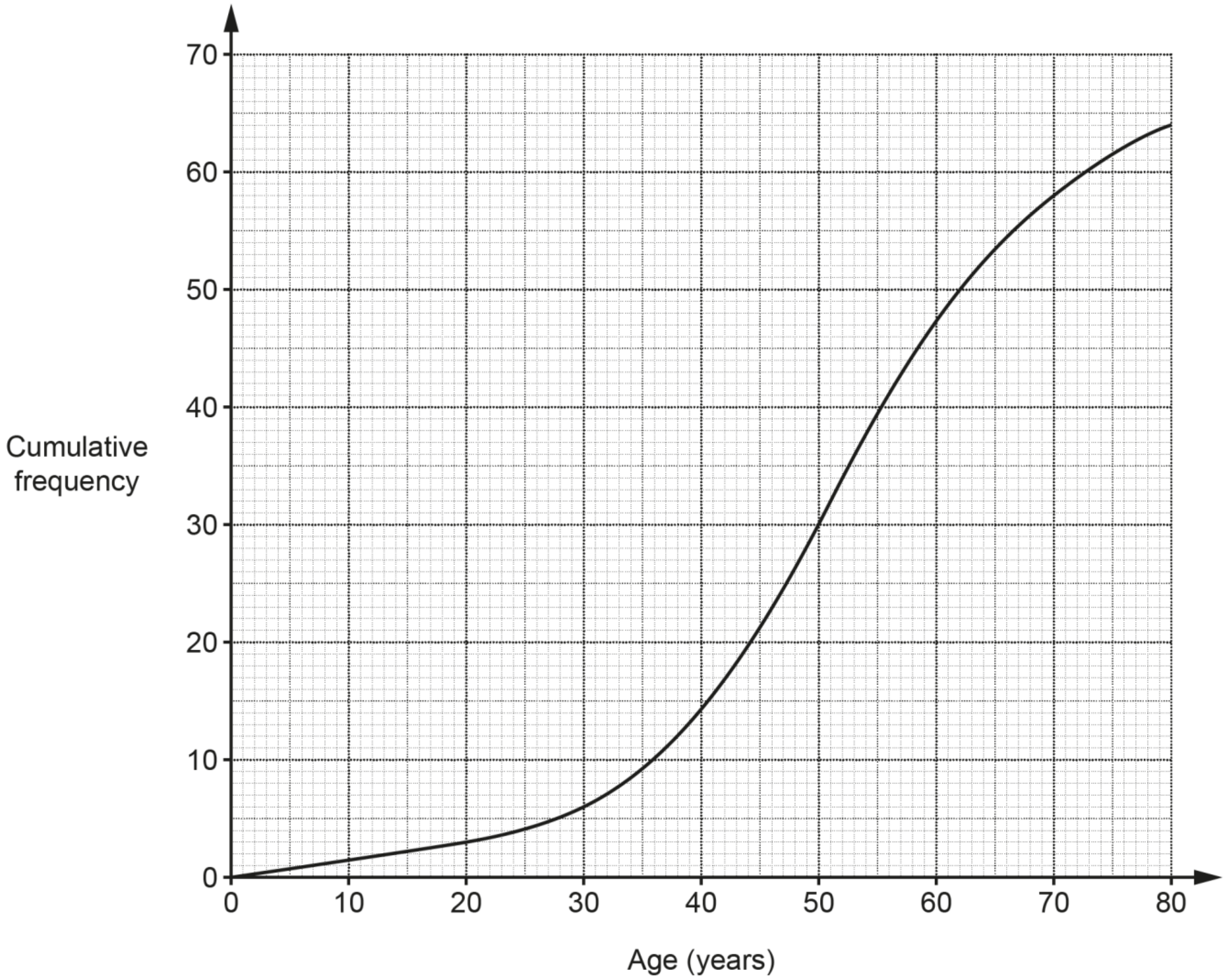
Question 14 (b)

(b) Use the formula to show that there may have been about 4700 seals on the island at the start of year 2010. **[2]**

Many correct responses were seen and there were a variety of ways to use the formula to show that 4700 seals were on the island at the start of year 2010. The common error was to attempt to show this without using the formula, such as 5200×0.98^5.

Question 15 (a)

15 The cumulative frequency graph shows the distribution of the ages of the members of a **tennis** club.



(a) The table summarises the ages of the members of a **cycling** club.

Age (a years)	$0 < a \leqslant 20$	$20 < a \leqslant 30$	$30 < a \leqslant 40$	$40 < a \leqslant 50$	$50 < a \leqslant 70$	$70 < a \leqslant 80$
Frequency	8	14	8	12	17	5

On the graph above, draw the cumulative frequency graph of the ages of the members of the **cycling** club. **[5]**

Most candidates did not work out the cumulative frequencies and produced a frequency graph. Some did calculate the cumulative frequencies, but they tended to plot them against the group mid-values.

Question 15 (b)

(b) Find out which club has younger members on average.
Give evidence to support your decision.

.... because ....

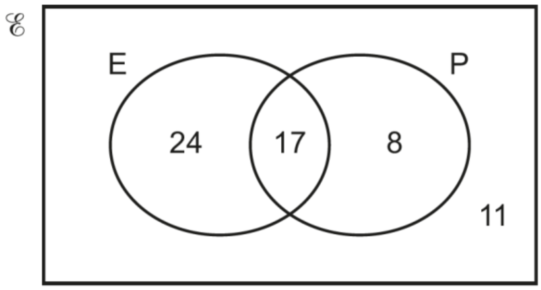
.... **[2]**

Most candidates interpreted the graph correctly and chose the cycling club. Many struggled to give evidence to support their decision. The words 'on average' in the question were meant to encourage the use of the graph to find the medians. The use of the shape of the graphs and comparison of frequencies were also both accepted.

Question 16

16 A salesroom sells various types of car.
Some cars are electric (E), some are petrol (P), some are both and some are neither.

The Venn diagram below shows the salesroom's stock of cars.



A petrol car is picked at random.

Find the probability that the car is also electric.

.... **[2]**

Candidates usually gave the correct numerator, but the denominator was often 49 or 60 so typical incorrect answers were $\frac{17}{49}$ or $\frac{17}{60}$. The other common incorrect answer was the probability of getting an electric car, $\frac{41}{60}$.

Question 17

17 Find the equation of the line through (4, 5) that is perpendicular to $y = 2x - 3$.

.... **[3]**

Most candidates did not know how to find the gradient of a line that is perpendicular to a given line, using $m_1 \times m_2 = -1$. Some used the point (4, 5) to find the gradient and usually gave $\frac{5}{4}$. Other common gradients seen were 4 and 8.

More candidates knew to use the point (4, 5) to find the value of '*c*'. There were a few diagrams drawn to try to find the value of the constant.

Question 18 (a) (i)

18 **(a)** The next term in a Fibonacci sequence is found by adding together the two previous terms.

(i) The first and second terms of a particular Fibonacci sequence are *x* and *y*.

Show that the fourth term of the sequence can be written as $x + 2y$. **[2]**

The candidates who were confident with algebra answered this part correctly. Others used numbers to show the formula works. A few gave the third term as $x + y$ but simply wrote $x + 2y$ for the fourth term without showing where it came from.

In 'Show that…' questions, candidates must have no omissions or incorrect work shown.

OCR support

A poster detailing the different command words and what they mean.

Question 18 (a) (ii)

(ii) The fourth term of the same Fibonacci sequence is 7.
The seventh term of the sequence is 31.

Work out the value of *x* and the value of *y*.
You must show your working.

(a)(ii) $x =$ ....

$y =$ .... **[6]**

Those candidates who produced correct expressions usually went on to find the correct answers. The method of trials usually required a systematic approach with many trials to find the answer, the algebraic method proved much shorter.

Question 18 (b)

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

$1 \qquad \sqrt{3} \qquad 3 \qquad 3\sqrt{3}$

Write an expression for the *n*th term.

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

Most candidates could not work out what type of sequence this was, some treated it as an arithmetic sequence while others changed the terms to decimals. They needed to identify the common ratio as $\sqrt{3}$ to have any chance of writing down the expression.

Question 18 (c)

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

-1 5 13 23

The nth term is $n^2 + bn + c$.

Find the value of b and the value of c.

(c) $b =$ ....

$c =$ .... **[3]**

Many looked at the differences which was not necessary as the first term had been given as n^2. The first step should have been to subtract the n^2 values from those given or, the longer method, to produce a pair of simultaneous equations from the terms given.

Question 19

19 Describe the **single** transformation that maps the graph of $y = x^2$ onto the graph of $y = (x+3)^2 + 5$.

....

.... **[3]**

Very few knew how to interpret the equation as a transformation. A small number of candidates wrote 'translation' but the vector defining the translation was often wrong.

Question 20

20 Mrs Sweet has 8 different milk chocolates and 9 different plain chocolates.

Her daughter chooses one of the milk chocolates.
Her son then chooses one of the plain chocolates.
Mrs Sweet then chooses one of the remaining chocolates.

Work out how many different combinations of three chocolates they can choose.

.... **[3]**

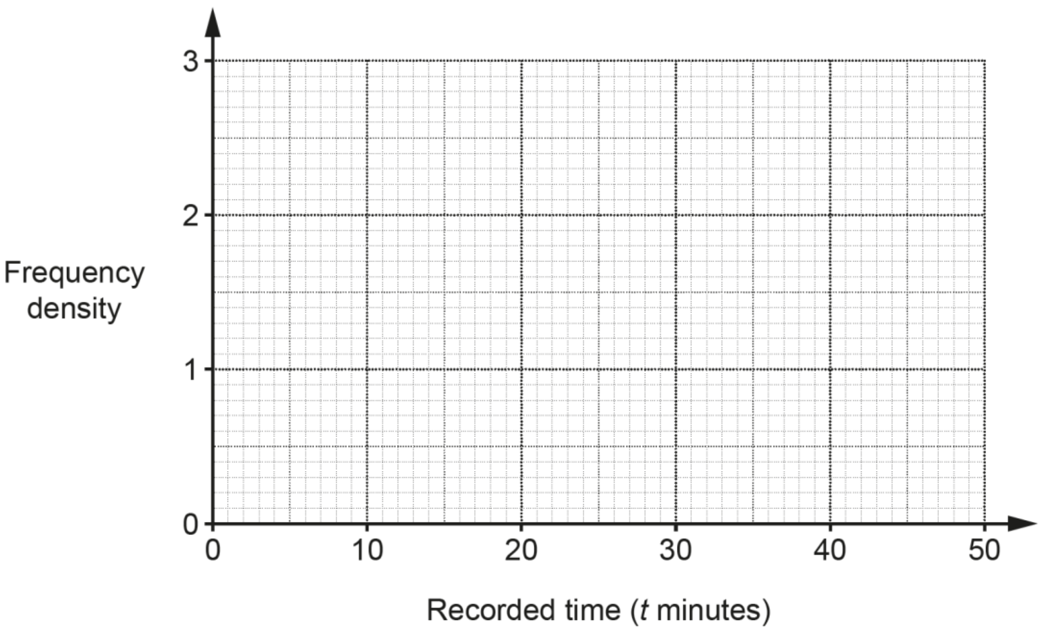
Many different methods were seen and few candidates answered this correctly. A few treated all the milk chocolates as the same and all the plain chocolates as the same, giving the answer 2 from $1 \times 1 \times 2$. A common error was to calculate $8 \times 9 \times 17$.

Question 21 (a)

21 60 people each try to solve a puzzle.
The table summarises their recorded times.

Recorded time (t minutes)	**Frequency**
$0 < t \leqslant 5$	12
$5 < t \leqslant 15$	19
$15 < t \leqslant 30$	18
$30 < t \leqslant 50$	11

(a) Draw a histogram to show this information.



[3]

There were some excellent answers, but some incorrect approaches too. Some candidates divided all the frequencies by 10. A few found the midpoint of each group and then calculated the mean. A few plotted a frequency curve.

Question 21 (b)

(b) Those people who failed to solve the puzzle within 50 minutes were given a recorded time of 50 minutes.

Nina uses mid-interval values to estimate the mean recorded time of the 60 people.

Explain why Nina's answer is likely to be an under-estimate for the mean of the actual time taken by the 60 people.

....

.... **[1]**

There were some good responses including a comment about the low total time due to so many not solving the puzzle. Some incorrectly stated that as it was an estimate, it cannot be correct.

Question 22

22 Solve algebraically.

$$x^2 + y^2 = 18$$
$$y = x - 6$$

$x =$ ....

$y =$ .... **[5]**

The main error was candidates not making the substitution, for either *x* or *y*, into the quadratic equation. Those candidates who did, almost always solved these equations correctly.

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