

**GCSE (9–1)**

**Examiners' report**

# **MATHEMATICS**

**J560**

For first teaching in 2015

**J560/06 Summer 2022 series**

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## 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.

### Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our [website](#).

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## Paper 6 series overview

This is the third and final paper in the Higher tier of the GCSE (9-1) Mathematics specification.

The breadth of content examined, and the distribution of marks allocated to AO1, AO2 and AO3, are similar to J560/04 and J560/05.

Questions 6, 7, 8, 9 and 10 were also set on the Foundation tier paper J560/03.

Candidates seemed very well prepared and the marks achieved were generally higher than in previous series. The omission rates for whole questions and parts of questions were low for most candidates except for Question 16 (negative quadratic).

### Use of calculators

This is a calculator paper and so candidates are expected to use them to full advantage unless a question explicitly says not to. Candidates should be able to perform calculations with fractions, percentages, negative numbers and numbers in standard form, and be able to find cube roots. They should also be able to present the calculation using correct notation even if they key the calculator differently, e.g.  $18000 \times 0.7$  not  $18000 \times 70\%$  for the first stage of Question 9.

It is important that accuracy is maintained in multi-step problems. Some candidates wrote "Ans" when moving from one stage of a problem to the next. Although that may be the key they pressed on their calculator, it is not good notation and becomes confusing if used to represent more than one intermediate answer. In addition, there may be a mark for that "Ans" value but it cannot be awarded if not seen. Instead, candidates should be writing the first four or so digits, perhaps with dots to indicate use of a fuller value, such as 3.660...for the radius in Question 2.

There were several questions that stated "you must show your working" but that does **not** mean candidates need to show non-calculator arithmetic processing. So, " $\frac{3150}{12600} = 0.25$ , therefore 25%" was sufficient and expected for the second stage of Question 9, rather than breakdown methods or trials.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
<ul style="list-style-type: none"> <li>• attempted all questions</li> <li>• highlighted key words, phrases and values in the question</li> <li>• demonstrated good calculator skills. Questions 2, 3, 9, 10, 21</li> <li>• performed almost all standard techniques and processes accurately. Questions 2, 3, 6, 7, 9, 10, 15, 19 (a), 20, 21</li> <li>• usually interpreted and communicated mathematics accurately. In particular, information presented in words or diagrams was understood and correct notation was used when presenting a mathematical argument. Questions 3, 4, 5, 8, 9, 10, 11, 14, 15, 18, 20</li> <li>• showed all the stages in their working in questions worth more than 2 marks. Questions 2, 3, 4, 9, 10, 11, 12, 20, 21.</li> </ul>	<ul style="list-style-type: none"> <li>• did not correctly use formulae given on the Formulae Sheet. Questions 2, 10, 21</li> <li>• did not always use a calculator; instead they often used inefficient non-calculator methods leading to arithmetic errors. Questions 9, 11, 12</li> <li>• rounded values too soon while working through a method leading to a lack of accuracy in final answers. Questions 2, 11, 21</li> <li>• made errors in performing low-grade processes. Questions 2, 6 (a), 9, 10</li> <li>• misinterpreted questions and information or did not follow instructions. Questions 2, 4, 10, 15, 17, 19 (b), 20</li> <li>• demonstrated poor presentation of multi-step tasks. Questions 2, 4, 9, 10, 11, 21.</li> </ul>

**Question 1 (a)**

**1** A student rolls two fair four-sided dice each numbered 1, 2, 3 and 4. They add the two scores together.

**(a)** Complete the sample space diagram to show the possible outcomes from the dice.

		Second dice			
		1	2	3	4
First dice	Total				
	1	2			
	2				
	3				
	4				8

**[2]**

The whole of the first question provided a very positive experience for candidates and it was rare for full marks not to be given. The only error seen in completing the table was an occasional arithmetic slip.

**Question 1 (b)**

**(b)** Find the probability that the student gets an even total.

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

Almost all candidates gave the correct answer of  $\frac{8}{16}$  or its simplified fraction, decimal or percentage equivalent.

**Question 1 (c)**

**(c)** Find the probability that the student gets the same score on each dice.

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

This part of the question was slightly less successfully answered than part (b).  $\frac{14}{16}$  was the most common incorrect answer.

## Question 2

- 2 The circumference of a circle is 23 cm.

Show that the area of the circle is  $42.1 \text{ cm}^2$ , correct to **3** significant figures.

**[4]**

Candidates were expected to start with the circumference and work towards the area. A correct answer to an accuracy greater than 3 significant figures is required to demonstrate the given answer fully.

The Formulae Sheet included those for the circumference and area of a circle and so very few candidates used incorrect formulae.

Those candidates who found the diameter first often introduced an accuracy error due to premature rounding, whereas those who found the radius in one step from  $2\pi r = 23$  did not have this problem.

With full accuracy in the radius and the use of the  $\pi$ -button or 3.142, candidates should have reached an answer of 42.09... . With premature rounding, the candidate usually obtained 42.08... or 42.11... and therefore only scored 3 marks.

Presentation of working was often not as clear as it could have been, with jottings and calculations linked by arrows or the values being substituted into the formulae not being explicitly shown.

## Question 3

- 3 Light from the Sun travels 1 kilometre in  $3.3 \times 10^{-6}$  seconds.  
The distance from the Sun to the Earth is  $1.5 \times 10^8$  kilometres.

How long does it take light to travel from the Sun to the Earth?

Give your answer in minutes and seconds.

..... minutes ..... seconds **[4]**

Many candidates scored 3 or 4 marks or, alternatively, misinterpreted the question and scored 0 marks. By far the most common misinterpretation was thinking they needed to use 'speed = distance/time' and dividing rather than recognising the need to multiply. Those candidates who multiplied usually obtained the correct intermediate answer of 495. Candidates who changed the values to ordinary form often introduced an error in place value while those who remained in standard form made accurate use of their calculator.

Converting 495 seconds into minutes and seconds caused a variety of problems with the answer 8 minutes 25 seconds arising from  $495 \div 60 = 8.25$  minutes being a common error. A few candidates thought that they had found a time of 8 hours 15 seconds or 8 hours 15 minutes, leading to answers such as 480 mins 15 seconds, 495 minutes or occasionally 482 mins 5 secs.

Like a few other questions on the paper, this was one where a choice of answers was common. Candidates who were unsure of whether to initially multiply or divide the values often wrote both calculations without indicating which one should be marked.



## Assessment for learning



Candidates should not leave a choice of answer or method. If an answer is given, then the method leading to that answer is the one that will be marked. If no answer is given, then the poorer method will usually be marked.

### Question 4

4 You are given that

$$\frac{10a^k \times a^8}{ma^5} = \frac{2a^7}{5}$$

where  $k$  and  $m$  are integers.

Find the value of  $k$  and the value of  $m$ .

$k = \dots\dots\dots$  and  $m = \dots\dots\dots$  [4]

This question was not answered well and exposed widespread weakness in handling algebraic expressions containing fractions. Occasionally, elegant algebra leading to a quick solution was seen. Candidates were a little more successful in finding index  $k$  than constant  $m$ .

Hardly any candidates realised they could separate out the  $a$  terms and the constants on both sides. A common misconception was to treat the numerators and denominators separately, leading to  $k + 8 = 7$ ,  $k = -1$  from the numerators alone; and the denominators were then compared giving  $m = 5$ .

Another common error was when cross-multiplying by 5 with  $5(10a^k \times a^8)$  becoming  $50a^k \times 5a^8$ , eventually leading to  $m = 125$ .

Work was often not well presented; it was difficult to follow the process candidates were attempting and often they did not give a final answer. Sometimes there was a correct use of an index rule in the middle of a lot of wrong work. To ensure consistency in marking, the scheme marked the indices and constants separately, with 2 marks for each. A productive use of an index rule needed to be applied to the starting expression, with the remaining indices also being correct.

Exemplar 1

$$\frac{10a^k \times a^8}{ma^5} = \frac{2a^7}{5}$$

$$\begin{aligned} x + 8 - 5 &= 7 \\ x + 8 &= 12 \\ x &= 4 \end{aligned}$$

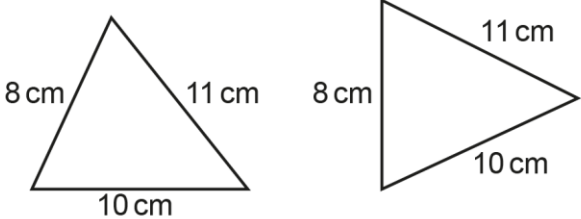
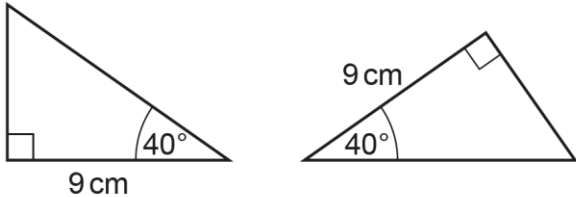
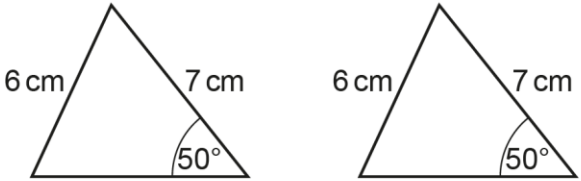
$$k = \overset{4}{\cancel{10}} \dots \dots \dots \text{ and } m = \overset{25}{\cancel{25}} \dots \dots \dots [4]$$

The candidate ignores the constants and focuses on applying the laws of indices to the given four indices. Ideally, they should have shown  $\frac{10}{m} = \frac{2}{5}$  too, but there was no requirement to show working and so full marks are still given for the correct answers.

### Question 5

5 In each row of the table there are two triangles.

State whether the two triangles are congruent or not.  
If they are congruent state a reason from SSS, SAS, ASA or RHS.

Triangles	Congruent (yes/no)	Reason (SSS/SAS/ASA/RHS)
<p style="text-align: center;"><b>Not to scale</b></p> 		
<p style="text-align: center;"><b>Not to scale</b></p> 		
<p style="text-align: center;"><b>Not to scale</b></p> 		

[3]

For the first pair of triangles, most candidates correctly answered “yes” and gave “SSS” as the reason.

Only about half of candidates answered “yes” with the correct reason of “ASA” for the second pair of triangles. “No” was quite frequent and “RHS” was also a common incorrect reason.

Only the more able candidates correctly answered “no” for the third pair of triangles.

Question 6 (a)

6 The mass of a stone is 680g.  
The density of the stone is 1.6g/cm<sup>3</sup>.

(a) Work out the volume of the stone.

(a) ..... cm<sup>3</sup> [2]

The majority of candidates knew and applied the density formula correctly. The usual error was to calculate mass × density, leading to an answer of 1088 cm<sup>3</sup>.

Question 6 (b)

(b) Write 1.6g/cm<sup>3</sup> in kg/m<sup>3</sup>.

(b) ..... kg/m<sup>3</sup> [1]

Few candidates gave the correct answer. Answers of 0.0016 and 0.000 001 6 were both more common than the correct answer of 1600 kg/m<sup>3</sup>.

Question 7 (a)

7 (a) Multiply out and simplify.

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

(a) ..... [2]

The vast majority of candidates scored full marks, with most others expanding correctly but making an error in the simplification.

Question 7 (b)

(b) Factorise.

$$x^2 - 25$$

(b) ..... [1]

The vast majority of candidates factorised correctly.

## Question 8 (a)

- 8** 1600 fish are released into a new lake which has no fish.  
The number of fish is expected to increase by 5% each year.

- (a)** The table shows the expected number of fish in the lake at the end of 1 year and at the end of 2 years.

Complete the table.

Round your answers to the nearest integer.

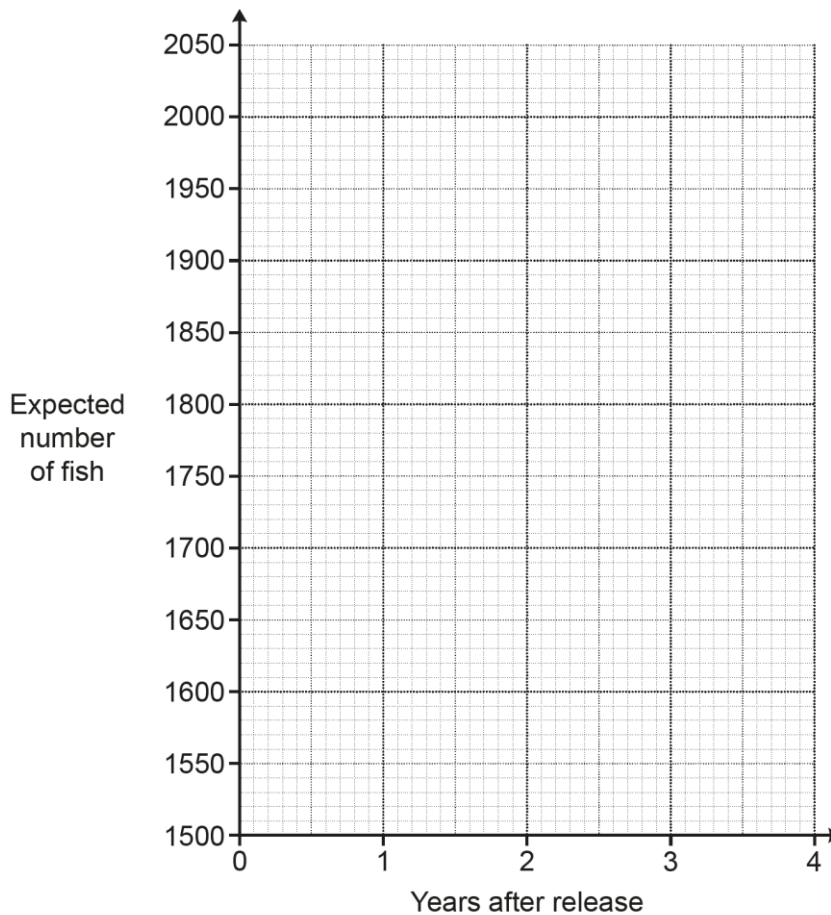
Years after release	0	1	2	3	4
Expected number of fish	1600	1680	1764		

**[3]**

The vast majority of candidates found the correct two integer values. A few candidates gave decimal answers, scoring 2 marks.

### Question 8 (b)

(b) Use the table to draw a suitable graph to show the expected number of fish in the lake.



[3]

Almost all candidates plotted their points accurately, scoring 2 marks. However, many candidates either drew a line of best fit or merely joined their first and last points with a straight line.

### Question 8 (c)

(c) A maximum of 2000 fish can live in the lake.

What effect would you expect this to have on the shape of your graph after 4 years?

.....

.....

..... [2]

Most candidates gave descriptions that scored 1 mark. For 2 marks, candidates needed to refer to the three facts: (i) the graph initially continues to increase and (ii) will then remain constant (iii) at 2000 fish. Some leeway was given in the precise words and phrasing used if the meaning was clear. A few candidates described what was physically happening to the fish in the lake rather than the shape of the graph.

### Question 9

- 9 A garage is trying to sell a car.  
The price of the car is normally £18 000.  
In a sale, the price of the car is reduced by 30%.  
As a special offer, the sale price is then reduced by  $r\%$ .  
The special offer price is £9450.

Find the value of  $r$ .  
You must show your working.

$r = \dots\dots\dots [5]$

Many candidates used lengthy non-calculator methods for percentages. At times it seemed as though they were unaware of more efficient methods. The instruction “you must show your working” on a calculator paper means candidates should write  $18000 \times 0.7$  and  $\frac{3150}{12600}$  but can use their calculator to obtain the answers. It made little difference in this question as the numbers were set up to work out nicely.

Many correct answers were seen with many others earning part marks for partially correct methods.

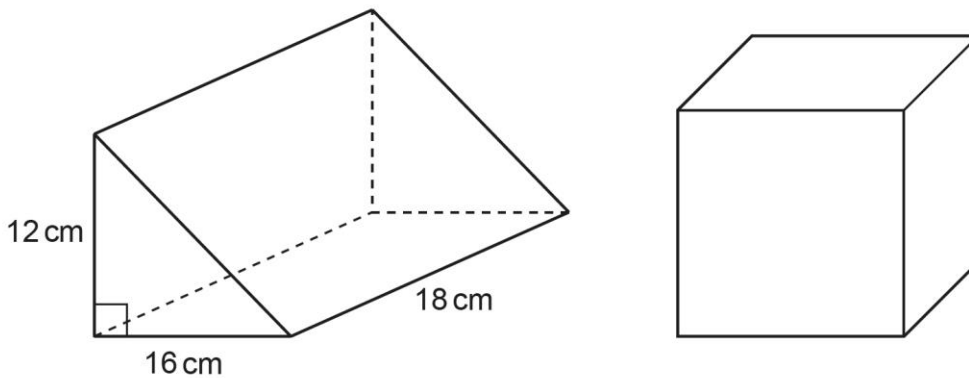
Most candidates were able to score B2 for calculating the sale price of £12600 irrespective of method or manner of working out. A few did make errors in doing this but were able to follow on correctly with their wrong value.

Having reached £12600, it was fairly common to see this ignored and instead £9450 was found as 52.5% of the original £18000. This was either given as their answer or, more often, 30% was subtracted and 22.5% was given. Others found £3150 as a percentage of £18000 leading to the common error of 17.5%.

A small minority used an algebraic approach and were usually successful in their attempts.

### Question 10

- 10 The diagram shows a triangular prism and a cube.  
The ends of the prism are right-angled triangles with base 16 cm and height 12 cm.  
The prism is 18 cm long.



The volume of the prism is equal to the volume of the cube.

Find the **surface area of the cube**.  
You must show your working.

..... cm<sup>2</sup> [6]

The solution essentially involved three stages: volume of the prism; dimension of the cube; surface area of the cube. Each stage scored 2 marks. The distinct stages meant that the candidates' working was generally easier to follow than other high-value questions on the paper.

Some good, confident, work was seen from many candidates, and almost half scored full marks.

The formula for the volume of a prism was given on the Formulae Sheet. Most candidates found the volume 1728 cm<sup>3</sup> and included their working. Other candidates multiplied the three dimensions but did not divide by 2; thus, they had found the volume of a cuboid. Such candidates were limited to a maximum of 2 marks.

Most candidates knew they had to find the cube root of their volume to find the dimension of the cube. A few candidates did not use the cube root function and resorted to trials to find the dimension of 12 cm. A small number of candidates divided their volume by 3 even if writing a cube root expression.

It was then not uncommon for candidates to find the area of one face of the cube and forget to multiply by 6, therefore leaving an answer of 144 cm<sup>2</sup>.

Another error seen a few times was finding the surface area of the triangular prism, often correctly done, then saying this was the surface area of the cuboid and giving this as the final answer or dividing by 6 to give the area of one face. Candidates need to read questions more carefully.



### Question 11

**11** Amir, Beth and Charlie work in a cafe.  
 Customers give spare change as tips.  
 At the end of each week, Amir, Beth and Charlie share the total amount of tips between them in the ratio matching the number of hours they worked that week.

This week:

- Amir's share of the tips was £25.40.
- Beth worked twice as many hours as Amir.
- Charlie worked 5 more hours than Amir.
- The total hours worked by Amir, Beth and Charlie was 85 hours.

Calculate the total amount of tips received this week.  
 You must show your working.

£ ..... [6]

While many candidates gave the correct final answer, a few were not given full marks due to lack of working. There were several possible methods that could be used to reach the final answer. Candidates needed to show a minimum of M1M1 or M2 to enable full marks. This was typically met by showing (i) an algebraic equation such as  $a + 2a + a + 5 = 85$  or a trial and correct evaluation of  $a + 2a + a + 5$ , together with a tips per hour or tips per 5 hours calculation implied by 1.27 or 6.35, or (ii) a more concise but clear approach using ratios. Insufficient working included just the values 20, 31.75, 107.95 with no supporting method.

Generally, solutions were not presented in a logical manner with unstructured working being 'scattered' across the page. Many solutions started in the middle of the answer space and, on running out of space, continued above the initial working.

Some candidates used a trial and improvement method for the hours, with no totals indicated. Those using an algebraic approach often created a suitable equation, but many did not solve accurately:  $a + 2a + a + 5 = 85$  becoming  $3a = 80$  was a common incorrect simplification. Another common error was the expression for Charlie, often written as '2a + 5' or '5a', the latter simplifying the problem and therefore losing access to the majority of the marks.

Some candidates could access the problem but showed little supporting work. Having spotted the correct value for a, these candidates would often continue with just a list of totals for each person and no indication of the key divisions and multiplications being made.

Some candidates used the ratio of the hours (1 : 2 : 1.25) to calculate the final amount in a much shorter method, such as  $25.4 \times 4.25$ .

Exemplar 2

$$a + 2a + a + 5 = 85$$

$$4a + 5 = 85$$

$$4a = 85 - 5$$

$$4a = 80$$

$$a = 20$$

Amir = 20 hr  
 Beth = 40 hr  
 Charlie = 25 hr

$$20 : 40 : 25$$

$$4 : 8 : 5$$

$$4 + 8 + 5 = 17$$

$$\frac{x}{17} \times 4 = 25.4$$

$$x \times 4 = 431.8$$

$$x = \frac{431.8}{4}$$

$$x = 107.95$$

£ ..... 107.95 ..... [6]

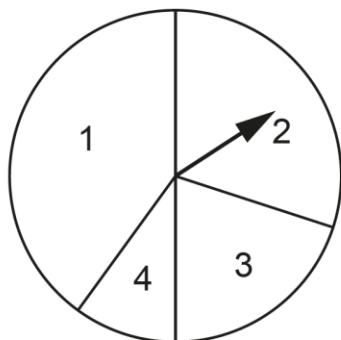
We can assume that the candidate is using  $a$  to represent the number of hours worked by Amir. They then have algebraic expressions  $2a$  and  $a + 5$  for the hours worked by Beth and Charlie (B1 for either of these). The algebraic terms are summed, equated to 85 (M1) and solved to reach  $a = 20$  (A1) and hence the hours worked by each person.

There are various approaches available from here. This candidate uses a ratio method, first simplifying  $20 : 40 : 25$  to  $4 : 8 : 5$ . They then set up an equation for Amir's share of the tips:  $\frac{4}{17}$  of the total tips ( $x$ ) which is given as £25.40 in the question (equivalent to M2). They then solve the equation to reach the total tips of £107.95.

The candidate has shown sufficient working (M1M1 or M2) for full marks. The presentation of the work is also clear.

### Question 12

12 A student has a spinner with sectors numbered 1, 2, 3 and 4.



The table shows the probability of each score.

Score	1	2	3	4
Probability	0.4	0.3	0.2	0.1

The student spins the spinner twice.

Calculate the probability that the student gets the same score on each spin.

..... [4]

Just over half of candidates scored full marks. There was an equal divide between those that drew a tree diagram before answering and those that did not.

The most common error was to double each probability and often then find the product of those values. A few candidates gave answers greater than 1 showing a lack of understanding of probability.

Some candidates, having reached the correct answer of 0.3, thought they needed to divide by 4, and so spoiled their method and answer.

A few candidates ignored the context and given probabilities, and merely repeated their solution to Question 1 parts (a) and (c).

## Question 13

- 13 A car registration plate has two letters, a number from 10–99 and three letters.  
For example:

**AB56 CDE**

The letters I and O are not used, leaving 24 possible letters.

Show that there are approximately 720 million possible car registration plates of this form. **[4]**

Many candidates were able to make a reasonable attempt and some did achieve the correct answer of 716 636 160. By far the most common error was thinking that there were 89 possible numbers (from 99 – 10), not realising that this effectively counted the numbers from 11 to 90. Some did use 90, with very few showing the calculation of  $9 \times 10$ . Having reached 89 or 90 possible numbers, several used  $89 \times 89$  or  $90 \times 90$  in their calculations.

Another common error occurred when finding the number of letters at the beginning and the end. It was common to see calculations such as  $2 \times 24$  and  $3 \times 24$  or  $5 \times 24$ .

Only a small number made the error of using all 26 letters in their calculations but a few did treat the choice of letters as being without replacement and calculations such as  $24 \times 23 \times 90 \times 22$  etc. were seen.

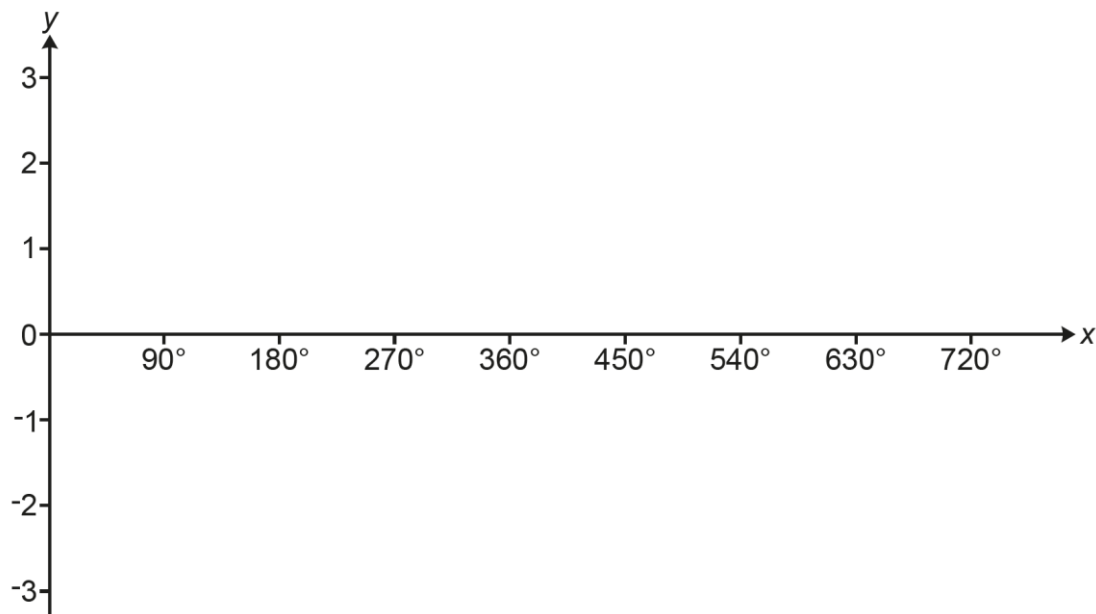
A small number of candidates attempted to work backwards, not realising that using the approximate value was never going to lead to a successful conclusion.

There were a few occasions of finding probabilities, with varying degrees of success. Those that realised the denominator gave an indication of the number of combinations were able to gain marks.

This was another question where a choice of answers was common, with many instances of multiple attempts at a calculation in an attempt to get a value of 720 million. All too often there was no indication of which combination of numbers to mark, and therefore marks were lost.

## Question 14

14 Sketch the graph of  $y = \cos x - 1$  for  $0^\circ \leq x \leq 720^\circ$ .



[3]

About half of the candidates started their sketch with a maximum on the  $y$ -axis and many proceeded to sketch the graph of  $y = \cos x$  with the maximum points correct at  $360^\circ$  and  $720^\circ$ . This scored 2 marks. Some candidates were able to apply the translation correctly and therefore had the maximum points at  $y = 0$  and minimum points at  $y = -2$ .

Other candidates either sketched the graph of  $y = \sin x$ ,  $y = -\sin x$  or a straight line.

The demand of the question was to “sketch” the graph. Candidates who only plotted points needed to draw the curve through the points.

## Question 15 (a)

- 15 80 cyclists take part in a race.  
A summary of their times is shown in the table.

Time ( $t$ minutes)	Frequency
$20 < t \leq 25$	5
$25 < t \leq 30$	15
$30 < t \leq 35$	24
$35 < t \leq 40$	25
$40 < t \leq 45$	7
$45 < t \leq 50$	4

- (a) Complete the cumulative frequency table.

Time ( $t$ minutes)	Cumulative frequency
$t \leq 25$	5
$t \leq 30$	
$t \leq 35$	
$t \leq 40$	
$t \leq 45$	
$t \leq 50$	

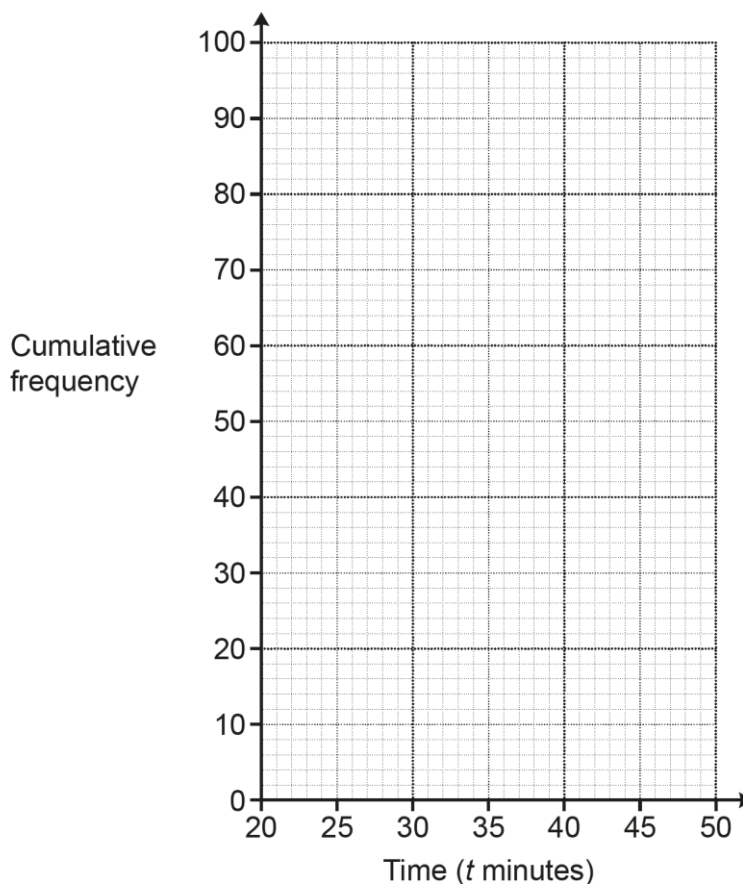
[2]

The majority of candidates completed the cumulative frequency table correctly, with a few others having one arithmetic slip.

Some candidates had little idea on how to complete the table, with some repeating the frequencies, some dividing each  $t$  limit by 5 and a few attempting frequency densities.

### Question 15 (b)

(b) Draw the cumulative frequency graph to show the information.



[3]

Most candidates with correct values in part (a) usually plotted their points correctly. However, a significant proportion of these candidates did not join the points with a curve or straight-line segments.

Although there was some follow through permitted from part (a), most candidates who had struggled there either omitted this part, or they produced a bar chart or other incorrect plot.

Question 15 (c) (i)

(c) Reece makes two comments about the times taken to complete the race.

For each comment, decide if Reece is right or wrong and give a reason for your answer.

(i)  $\frac{3}{4}$  of the 80 cyclists took more than 30 minutes to complete the race.

Reece is ..... because .....  
.....  
..... [2]

The distribution of marks was quite uniform.

For full marks, candidates needed to answer “right” and reference the cumulative frequency of 20 cyclists completing in less than or equal to 30 minutes and link this to  $\frac{3}{4}$  of 80 being the remaining 60 cyclists taking more than 30 minutes. Equivalent statements were accepted.

Question 15 (c) (ii)

(ii) The longest time that any of the 80 cyclists took to complete the race must have been 50 minutes.

Reece is ..... because .....  
..... [1]

Most candidates incorrectly answered “right”. Even with “wrong”, the reason was often incorrect; “the graph may not show all the cyclists” being common.

Misconception

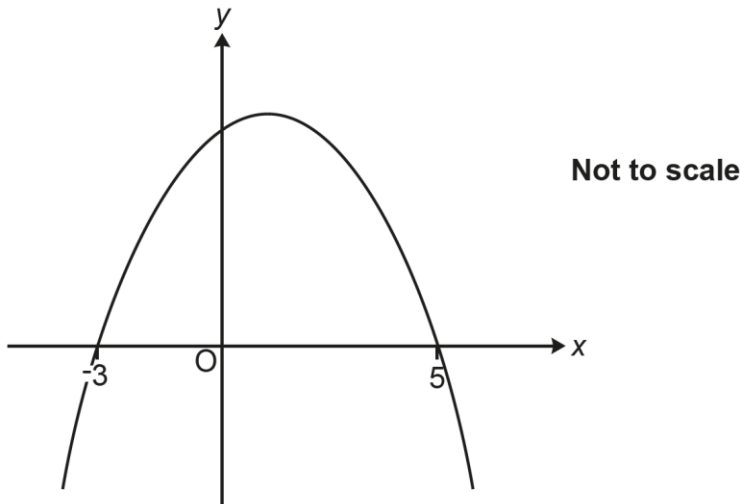


Many candidates did not have an understanding of what a cumulative frequency table, cumulative graph and the associated inequality notation actually represents.



Question 16 (a)

16 Frankie sketches this quadratic graph.



Frankie says

The  $y$ -intercept is 15.

(a) Show that what Frankie says could be correct.

[3]

Very few candidates were able to answer this question correctly as they did not recognise the graph as a negative quadratic. Those who realised that the roots came from the factors  $(x + 3)(x - 5)$  gained some credit, but far fewer coped correctly with the fact that the graph was 'upside-down' and knew that this meant the coefficient of  $x^2$  was negative. Very occasionally, candidates started from this perspective and used the known roots with  $y = -x^2 + bx + c$  to set up and solve simultaneous equations.

Many candidates mistakenly used  $(x - 3)(x + 5)$ . Those using  $(x + 3)(x - 5)$  often identified their intercept as -15. Similarly, just  $-3 \times 5$  was very common.

Work involving  $y = mx + c$ , sometimes involving tangents, or for completing the square to find the turning point, were often seen.

Misconception



A common misconception was that an "intercept" must be associated with a straight line.

### Question 16 (b)

(b) Explain why what Frankie says may **not** be correct.

.....

.....

.....

..... [2]

While only a few candidates could explain a 'multiplier' approach in words or symbols, some candidates did realise that the same roots could be obtained with a different negative  $x^2$  term. These candidates often started with an example in factorised form such as  $-2(x + 3)(x - 5)$ , which they expanded and then highlighted that the intercept was no longer 15.

### Question 17 (a)

17 Blake is asked to write 15 552 000 000 as a product of prime factors in index form.  
Blake writes

$$15552000000 = 2^7 \times 5^6 \times 6^5.$$

(a) Explain Blake's mistake.

.....

.....

..... [1]

Although most realised that the mistake was that 6 was not a prime number, many other candidates thought that index form referred to using standard index form numbers. There were also often comments that the numbers were in an inappropriate order – and these were re-sorted to  $6^5 \times 5^6 \times 2^7$  as the order of powers had been deemed essential. There were also a few candidates who decided that the correct form had actually been given and that there was no mistake.

Question 17 (b)

(b) Write 15552000000 as a product of prime factors in index form.

(b) ..... [2]

Some candidates efficiently changed  $6^5$  into  $2^5 \times 3^5$ , and were then usually successful in writing the correct final answer.

Other candidates often adopted an inefficient approach by 're-starting' a full prime factor decomposition. This resulted in extensive working for the 2 marks available and a lack of space, which did not seem to be questioned. Some did reach  $3^5$  or  $2^{12}$  in their final answer, either of which scored 1 mark.

Those candidates that could not answer part (a) correctly would invariably not get very far in this part of the question. These candidates would attempt to make the correction that they had stated in part (a), e.g. trying to write an answer in standard index form or restating the given answer in a different order or different form such as  $128 \times 15625 \times 7776$ .

Exemplar 3

$$\begin{array}{l}
 3 \\
 3 \\
 3 \\
 3 \\
 3
 \end{array}
 \begin{array}{l}
 2 \\
 2 \\
 2 \\
 2 \\
 2
 \end{array}
 \left. \vphantom{\begin{array}{l} 3 \\ 3 \\ 3 \\ 3 \\ 3 \end{array}} \right\} = 6^5 = (2 \times 3)^5$$

$$\begin{aligned}
 & 2^7 \times 5^6 \times 2^5 \times 3^5 \\
 & = 2^{12} \times 5^6 \times 3^5
 \end{aligned}$$

(b) .....  $2^{12} \times 3^5 \times 5^6$  ..... [2]

In part (a), the candidate had correctly identified that 6 was not a prime number. They efficiently take the given  $2^7 \times 5^6 \times 6^5$  and re-write  $6^5$  as  $(2 \times 3)^5$  and then as  $2^5 \times 3^5$ . Finally, they simplify  $2^7 \times 2^5$ .

**Question 17 (c)**

(c) You are given that  $140\,000 = 2^5 \times 5^4 \times 7$ .

Find the highest common factor (HCF) of 15 552 000 000 and 140 000.

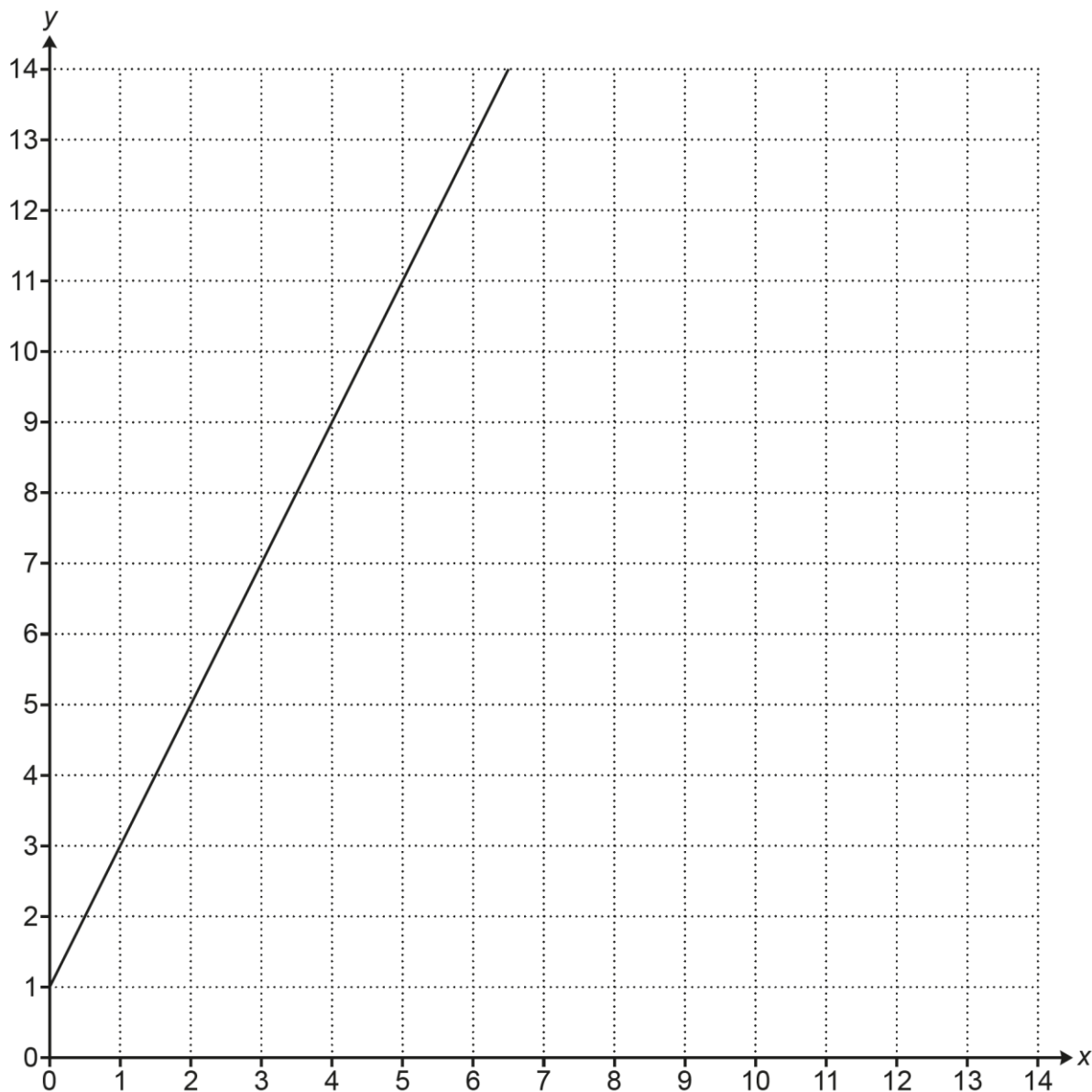
(c) ..... [2]

Many candidates did not appear familiar with finding the HCF with numbers in index form. Attempts at finding the LCM or random selections of values chosen from the 2 sets of factors were often seen.

A small number of candidates used a Venn diagram approach. More common was simply listing factors and identifying common terms. There were occasional inaccurate evaluations of identified HCFs and omission of zeros but it was rare to award the method mark in this part.

## Question 18

18 The graph of  $y = 2x + 1$  is drawn on this one centimetre grid.



The region **R** satisfies these inequalities.

$$\begin{aligned}y &\leq 2x + 1 \\y &\geq 5 \\x + y &\leq 13\end{aligned}$$

Show that the area of region **R** is  $12 \text{ cm}^2$ .

[6]

Many candidates drew the correct line for  $y = 5$ , with only a few instances of  $y = 4$ ,  $y = 6$  or  $x = 5$  being seen. Candidates had greater difficulty in drawing  $x + y = 13$  and the line was often either omitted or else interpreted as meaning the two lines  $x = 13$  and  $y = 13$ .

Candidates who drew the correct lines often proceeded to identify the correct region for R. Although it should have been straightforward to then find the area of the triangle through  $\frac{1}{2} \times \text{base} \times \text{height}$ , some candidates attempted  $\frac{1}{2}ab\sin C$ , often measuring  $a$ ,  $b$  and  $C$  and then fudging the values to obtain an answer of  $12 \text{ cm}^2$ . Such attempts scored 0 marks for the area unless absolutely accurate.

Candidates who did not draw  $x + y = 13$  correctly sometimes added the line  $y = 9$ , therefore creating a trapezium of area  $12 \text{ cm}^2$  for an incorrect region R bounded by  $y = 5$ ,  $y = 9$ ,  $y = 2x + 1$  and the  $y$ -axis. This is an example that scored 2 marks, because  $y = 5$  was correct and their region R was the correct side of  $y = 5$  but not the correct side of  $y = 2x + 1$ .

**Question 19 (a)**

**19 (a)** Write  $x^2 - 8x + 9$  in the form  $(x - a)^2 - b$ .

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

Many candidates had little problem with this question and scored full marks. Errors were sometimes made with directed numbers in the expansion of  $(x - 4)^2$ , leading to  $+25$ . Some did not realise the need to subtract 16 from the expression and simply had  $+9$  at the end.

Expressions involving  $(x^2 - 4x)^2$  and  $(x - 8)^2$  were often seen with the latter usually having a value of  $+9$  following the bracket, the values having been taken directly from the question.

Where candidates had an incorrect bracket, most were not able to follow through to find an appropriate constant and little in the way of method was presented.

**Question 19 (b)**

**(b)** Use your answer from part (a) to solve.

$$x^2 - 8x + 9 = 0$$

Give your answers in exact form.  
You must show your working.

**(b)**  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

Many candidates did not follow the instructions to use part (a). Candidates who used the quadratic formula scored 0 marks. In addition, many candidates gave their final answers as decimals even though the exact answers were also often seen somewhere in the working.

## Question 20

**20** Two pyramids, A and B, are mathematically similar.

Pyramid A has surface area  $12\text{ cm}^2$  and volume  $8\text{ cm}^3$ .

Pyramid B has surface area  $75\text{ cm}^2$ .

Work out the volume of pyramid B.

You must show your working.

.....  $\text{cm}^3$  [4]

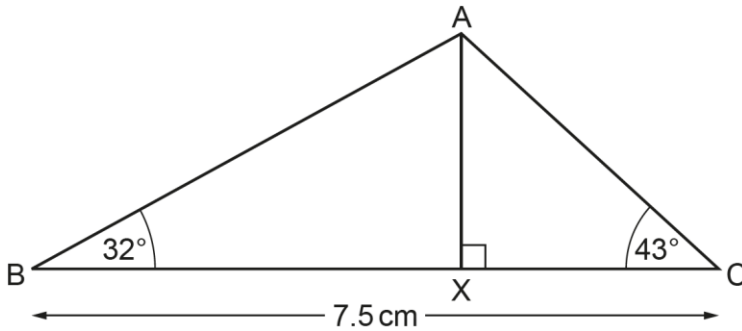
Some good solutions were seen from candidates who realised they needed to find the area scale factor, then the linear scale factor and then the volume scale factor. A few of these candidates gave this volume scale factor, 15.625, as their final answer and so only scored 3 marks. Some candidates set out their work in a table, which helped them to realise they were working initially with an area scale factor.

Many candidates multiplied the volume of pyramid A by the area scale factor of 6.25 to give an incorrect answer of  $50\text{ cm}^2$ . Other candidates reached the same answer via ratios with the value of the volume of pyramid A being  $\frac{2}{3}$  of the value of its area.

Some candidates thought 6.25 was a length scale factor and so used  $6.25^3$  as their volume scale factor.

### Question 21

- 21 The diagram shows triangle ABC.  
X lies on BC such that angle  $AXC = 90^\circ$ .



Not to scale

$BC = 7.5$  cm, angle  $ABC = 32^\circ$  and angle  $ACB = 43^\circ$ .

Work out length AX.  
You must show your working.

..... cm [6]

There were good responses for this question, showing a good understanding of trigonometry, with working that was easy to follow. Most opted to use the sine rule to find either AB or AC and followed this with simple trigonometry (or sometimes the sine rule with a  $90^\circ$  angle) to find AX.

Less efficient methods were seen. For example, having found AB (or AC), some calculated BX (or CX) and followed this with either Pythagoras or the cosine rule. Premature approximation at the various stages of these longer methods tended to lead to final answers that were slightly inaccurate.

A few candidates attempted far more complex methods which would work but were rarely successfully completed. For example, finding both AB and AC, then equating the area of the triangle using  $\frac{1}{2} \times AB \times AC \times \sin 105$  with  $\frac{1}{2} \times 7.5 \times AX$ ; or using  $BX : XC$  as  $x : 7.5 - x$ , then equating and solving  $x \tan 32 = (7.5 - x) \tan 43$  to find  $x$  then AX.

Common errors on this question included treating triangle ABC as if it were right-angled, or simply guessing at lengths for BX and XC, usually as 5 cm and 2.5 cm. Alternatively, some candidates only used angles, stopping at the point where they had found all the different angles but they did not work out BAC as  $105^\circ$ , which may have given them a method mark.



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