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OCR
Oxford Cambridge and RSA

GCSE (9–1)

Examiners' report

MATHEMATICS

J560

For first teaching in 2015

J560/04 Summer 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 and highlight good performance and where performance could be improved. A selection of candidate answers is also provided. The reports will also explain aspects that 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

This paper required a reasonable competence in algebra as some questions needed an expression or equation to be set up to find the solution to a problem. While most candidates were able to do this, many candidates were then not able to manipulate these expressions and equations without making errors. In particular, showing the order of operations with brackets and expanding those brackets were common steps where errors were made.

In geometry, candidates needed to know how to find sides, angles and the area of right-angled triangles. Many struggled with this. They were given the opportunity to find an angle and a side of a right-angled triangle, but many tried to use the cosine rule to find the angle. In finding the area of a right-angled triangle, some tried to use $\frac{1}{2}ab\sin C$ where an angle had not been given. Another topic area that many found difficult was the angle properties of circles. Many candidates knew the properties, but they were unable to apply these to the two problems.

Number and ratio work was quite sound, though many were unable to calculate relatively simple sums on their calculator. Multiple calculations were spoilt by early rounding/truncation of results. In using percentages, candidates need to know how to produce the multiplier for a percentage increase or decrease.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• used a calculator to work out formulae without error • used brackets to show priority of operations • had a sound knowledge of angle properties in parallel lines and circles • when using percentages, knew how to convert a percentage increase or decrease to a multiplier • were able to factorise quadratic functions and to 'complete the square' on a quadratic function.	• made errors in calculations and truncated intermediate results • did not use brackets and worked out operations in the wrong order • were uncertain of some terms, such as 'alternate angles' or did not have a sound understanding of the 'alternate segment theorem' • were uncertain in their use of percentages • were not able to factorise quadratic functions or to 'complete the square' on a quadratic function.

Question 1

1 Work out.

$$\sqrt[3]{\frac{19.5^4 - 18^2}{1.45}}$$

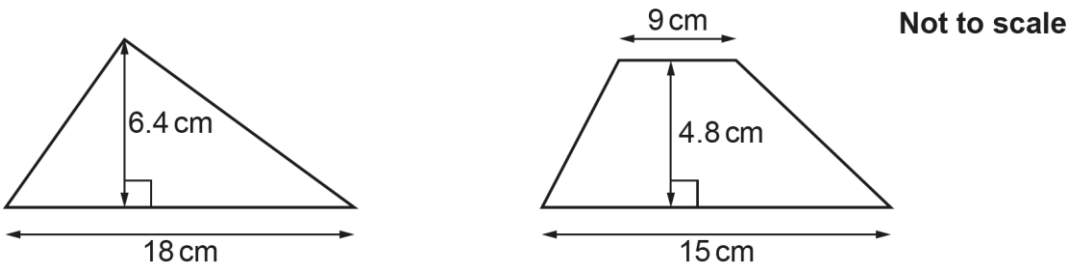
Write your answer correct to **4** significant figures.

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

This question was answered well, though some candidates did not write their final answer to 4 significant figures. Some showed no working at all and just wrote down an answer (working was not required to be shown but is good practice). The most common error was to read the cube root as 3 × square root, so arriving at an incorrect answer of 946.3.

Question 2

2 The diagram shows a triangle and a trapezium.



Show that they have the same area. **[3]**

Most were able to work out the area of the trapezium correctly as 57.6. However, many were not able to work out the area of the triangle. Some forgot the '$\frac{1}{2}\times$' and just calculated base × perpendicular height (as was also an issue in question 18(a) later on), while others tried to use ½*ab*sin *C*, but were unable to find *C*.

Question 3

3 Four numbers are written, in ascending order, as algebraic expressions.

a $a+b$ $a+2b$ $3a-b$

The mean of these four numbers is 27.
The range of these four numbers is 24.

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

$a =$ .....

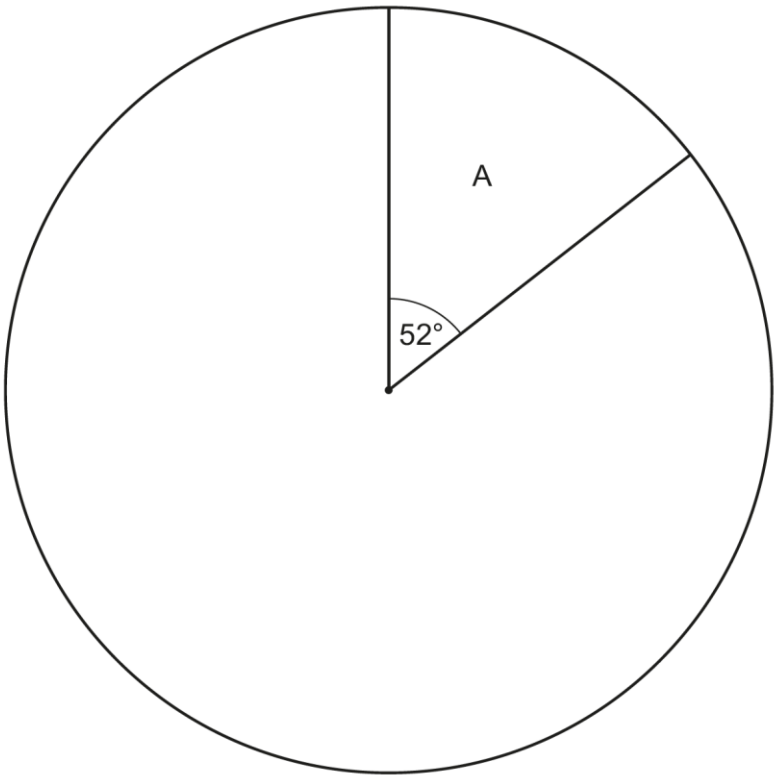
$b =$ ..... **[5]**

Those who attempted this using trials were always unsuccessful. The most successful method was to write down the two linear equations and to solve them algebraically. When writing the equations, the first one was often seen as $a + a + b + a + 2b + 3a – b \div 4 = 27$, which often ended up as $6a + 2b = 27$ (where the '÷ 4' had been forgotten) or $6a - 2b = 108$ (where there is a sign error). Many were unable to solve these equations algebraically. While most candidates multiplied or divided correctly, when adding or subtracting then they would make an error, usually in the *b*s. For example, they might subtract the *a*s and the numbers, but add the *b*s.

Question 4 (a) (i)

4 A school is deciding on a charity to support.
Each student at the school votes for one of four charities, A, B, C or D.
The results are to be shown in a pie chart.

This pie chart shows the sector for charity A.
Twice as many students voted for charity C than charity B.
Twice as many students voted for charity D than charity C.



(a) (i) Show that the sector for charity B will have an angle of 44°. **[2]**

The most common acceptable methods were 52 + 44 + 2 × 44 + 4 × 44 = 360 (or a variant of this one), or 308 ÷ 7 = 44. Some found 308 and then stopped. A few candidates gave no response at all.

Question 4 (a) (ii)

(ii) Complete the pie chart. **[3]**

Most completed this part successfully. A few were inaccurate in measuring the angles and some did not label the sectors.

Question 4 (b)

(b) 39 students voted for charity A.

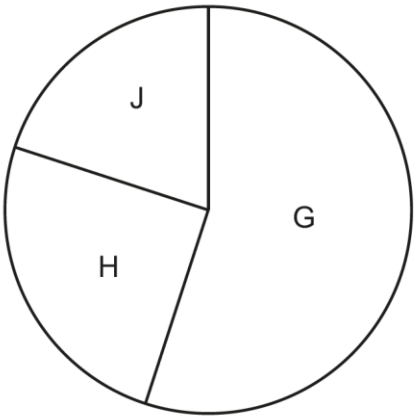
Calculate the total number of students at the school.

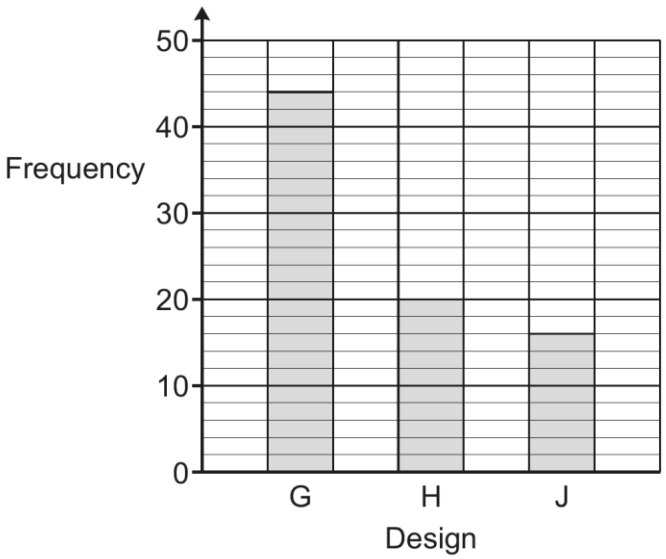
(b) ..... **[2]**

Many struggled with this part. Some calculated 52 ÷ 39 to get 1.33… and then would often multiply by 360 to arrive at 480. Some who correctly attempted 360 ÷ 1.333… gave an inaccurate answer (it is always best to keep the full decimal on the calculator and not to truncate midway through a calculation). A more efficient method was 39 ÷ 52 and then to multiply by 360.

Question 4 (c) (i)

(c) The school asks 80 of the students to choose a new logo from three designs G, H and J.
The same results are shown in a pie chart and in a bar chart.





(i) Give one **advantage** of using the pie chart rather than the bar chart.

.....

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

Many stated that it was easy to read or easier to see which one has the most votes, which are both also true of the bar chart. We were really looking for comments about proportions here.

Question 4 (c) (ii)

(ii) Give one **disadvantage** of using the pie chart rather than the bar chart.

.....

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

This was answered better than the previous part. Most candidates stated that the pie chart did not show the actual frequencies.

Question 5

5 The same dog food is sold in three different sized packs.
The diagram shows the price of each pack.

Which pack is the best value for money?
Show how you decide.

The ..... pack because .....

.....

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

The most common comparison was to divide the price by the number of grams, hence 1.1, 1.08 and 1.078 or similar were seen with the correct answer. Some rounded 1.078 to 1.08, but that meant they could not distinguish between the two largest packs. Those who calculated the cost of 1 gram or 1 kilogram often picked the one with the largest number and hence gave the incorrect answer. There were also many other ways to compare the packs and we saw a wide variety of methods.

Question 6

6 A regular polygon has n sides.
The interior angle of the polygon is 15 times its exterior angle.

Find the value of n.

$n =$ ..... **[4]**

Many found this difficult. A large number attempted it as if the interior angle and the exterior angle sum to 360° and not 180°, therefore giving an answer of 16 rather than 32. Some correctly found the exterior angle of 11.25° and the interior angle of 168.75° but did not know how to use these to find the number of sides. Some thought the formula to find the interior angle of a regular polygon was $180(n - 2)$. Few seemed to know the formula $360 \div n$.

Question 7

7 Write the following in order of size, smallest first.

$0.2 \quad 2^{-2} \quad 2 \times 10^{-2}$

Show how you decide.

..... , ... , ... **[3]**
smallest

This was well answered. A few wrote 2^{-2} before 0.2 in the order. A minority wrote some values as decimals and some as fractions, which made the comparison difficult for themselves.

Question 8

8 The price of a television is increased by 35%.
In a sale, the new price of the television is decreased by r%.

The overall percentage increase in the price of the television is 16.1%.

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

$r =$ ..... **[5]**

The best methods attempted to find the difference between the given percentages and turn that into the percentage, such as $\frac{135 - 116.1}{135}$ and then multiplying by 100 (or similar) or doing the straight division $\frac{1.161}{1.35}$ and then subtracting from 1 and multiplying by 100 (or similar). Those who used the raw numbers 35 and 16.1 struggled to gain any credit at all. Some candidates used a starting amount, which was often a successful strategy.

Question 9

9 Sasha and Taylor each have a stamp collection.

They organise their stamp collections according to where the stamps come from: United Kingdom (UK), European Union (EU), Other.

The table shows the number of stamps in each collection and the ratio UK : EU : Other.

	Number of stamps	**Ratio UK : EU : Other**
Sasha's collection	1638	9 : 3 : 2
Taylor's collection	660	8 : 1 : 2

When they put the two stamp collections together, Sasha and Taylor claim that at least $\frac{2}{3}$ of all the stamps come from the UK.

Are they correct?
Show how you decide.

They are ..... because .....

.....

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

The most successful candidates found the number of UK stamps in both collections and added these together. They then found ⅔ of the overall total and showed that there were more UK stamps than required. Some added together the ratios (to get 17 : 4 : 4) and made their argument using this information, which was not correct.

Question 10

10 Here is a question and an incorrect solution.

Question:
You are given
$y \propto x$ and $y = 9$ when $x = 2$.

Find a formula linking x and y.

Solution:
$y \propto x$ so $y = x + c$
Substituting $y = 9$ and $x = 2$ gives
$9 = 2 + c$
$c = 7$
So, $y = x + 7$

Describe the error made and write out a correct solution.

The error is .....

.....

A correct solution is .....

.....

.....

.....

.....

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

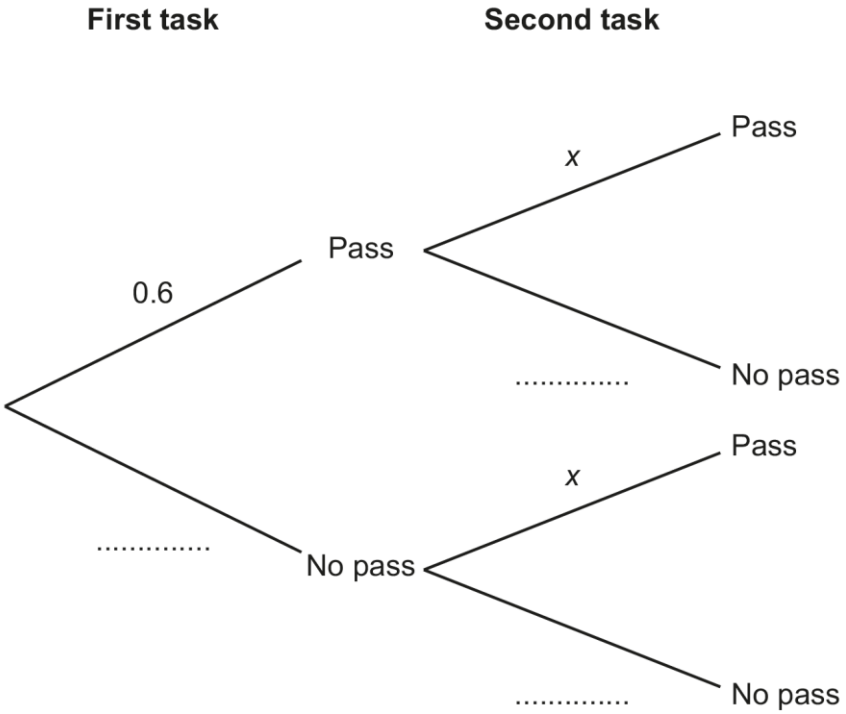
Many candidates correctly described the error, but many did not give the correct equation, some leaving it as '$y = kx$ and $k = 4.5$'. Some thought the question involved inverse proportion and gave an equation such as $y = \frac{18}{x}$.

Question 11 (a)

11 A student attempts two tasks.
The result of each task is either "Pass" or "No pass".

The probability of the student passing the first task is 0.6.
The probability of the student passing the second task is x.

(a) Complete the tree diagram.



[2]

In the first task almost everyone answered 0.4. In the second task some candidates put $1 - x$, but others had y or 0.4. There were a few who initially put $1 - x$, but then replaced it with a decimal, usually 0.4, 0.6 or their answer to part (c).

Question 11 (b)

(b) Write down the mathematical assumption that has been made about the two tasks.

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

We saw a large variety of answers. Some were correct about statistical independence. Incorrect answers included that there were only two outcomes or that the probabilities were the same for both tasks.

Question 11 (c)

(c) The probability of the student passing just one of these two tasks is 0.528.

Work out the value of x.

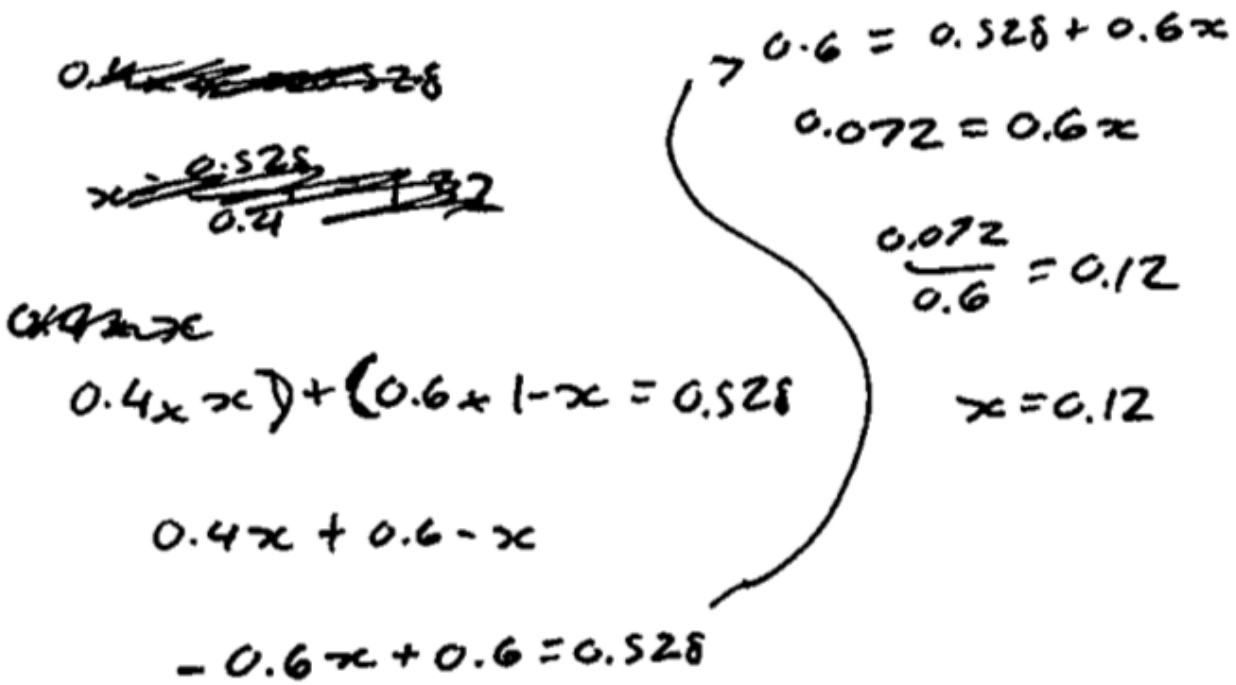
(c) $x =$ ..... **[4]**

Many answers involved the use of just one branch, so common responses were $0.4x = 0.528$ or $0.6x = 0.528$, leading to answers of 1.32 or 0.88. Others solved the equation $0.6(1 – x) = 0.528$, which led to an answer of 0.12. The most common error was not to use or expand brackets, so we often saw things such as $0.6 \times 1 – x$ 'simplified' to $0.6 – x$.

Assessment for learning

Expressions such as '0.6' multiplied by '$1 – x$' should be written $0.6(1 – x)$ using brackets to preserve the priority of operations, so that the subtraction is done before the multiplication. To write this without brackets must be $0.6 – 0.6x$.

Exemplar 1

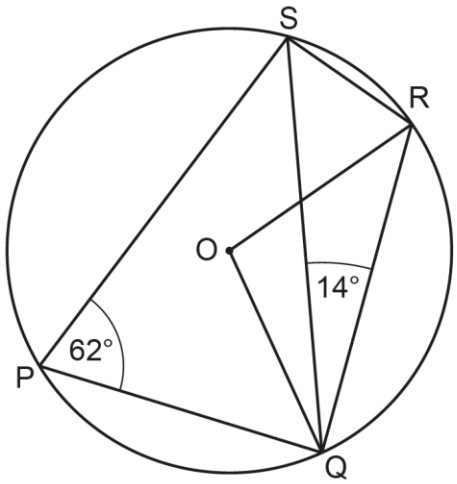


(c) $x =$ .....0.12..... [4]

The first line should be $0.4 \times x + 0.6 \times (1 - x) = 0.528$. The second line would then become $0.4x + 0.6 - 0.6x = 0.528$, which leads to the correct answer of 0.36.

Question 12 (a)

12 (a) P, Q, R and S are points on the circumference of a circle, centre O.
Angle SQR = 14° and angle SPQ = 62°.



Not to scale

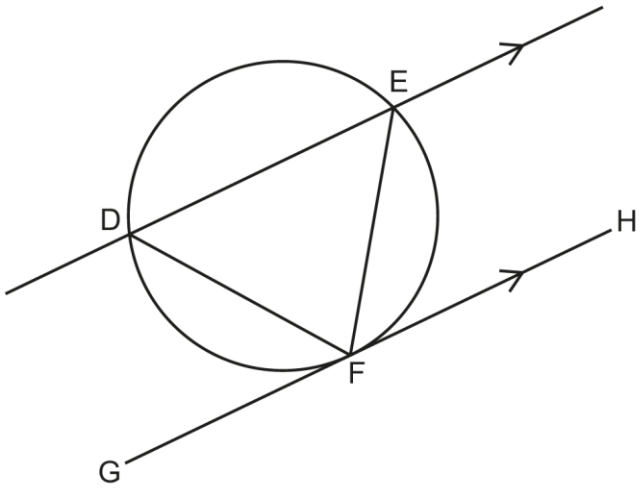
Find the size of angle ROQ.

(a) Angle ROQ = ...° **[3]**

On the diagram, we often saw the angle SRQ written as 118° and the angle RSQ as 48° correctly, but with some other angles incorrectly calculated. Only a few candidates were able to calculate the correct answer. Most did not answer or showed a few incorrect angles, highlighting that the angle properties of lines within a circle continues to be a topic that candidates struggle with.

Question 12 (b)

(b) D, E and F are points on the circumference of a circle.



Not to scale

Line GH is a tangent to the circle at F.
Line DE is parallel to line GH.

Complete these statements to prove that triangle DEF is isosceles.
Give reasons for your statements.
You may not need all of the lines.

Angle ..... = Angle ..... because .....

.....

Angle ..... = Angle ..... because .....

.....

Angle ..... = Angle ..... because .....

.....

Angle ..... = Angle ..... because .....

.....

Angle ..... = Angle ..... because .....

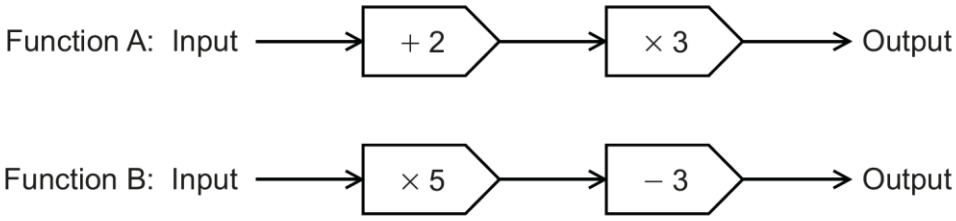
.....

Triangle DEF is isosceles because ..... **[3]**

Candidates have often found proof questions to be a challenge and this one was no exception. A few did give the full and correct proof. Some were able to equate two angles with the correct property (such as angle DEF = angle EFH because they are alternate angles) even if they couldn't construct the full proof.

Question 13 (a)

13 Function A and function B are shown below.



(a) The **output** of function B is x.

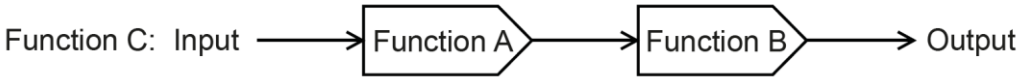
Write an algebraic expression, in terms of x, for the inverse of function B.

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

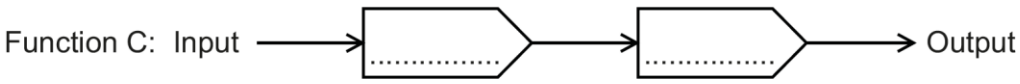
There were many correct answers. The common error was to write the two operations in the wrong order, so giving an answer of $\frac{x}{5} + 3$. Other candidates wrote their answer as $x + 3 \div 5$ (which has the correct operations, but mathematically the incorrect order), or wrote the regular function taking the input as x and so giving $5x - 3$.

Question 13 (b)

(b) Function C is shown below as a composite function.



Complete the diagram below using two arithmetic operations to show function C as a single function.

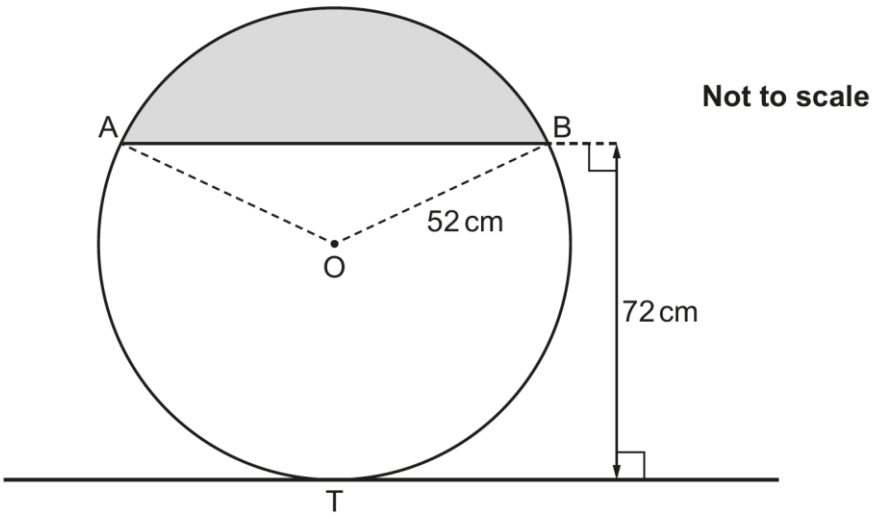


[4]

There were a number of correct answers. Others gained credit by working out $3(x + 2)$ or $5 \times 3(x + 2)$. There were also several candidates who made sign errors in their calculations and wrote $5 \times 3(x + 2) - 3 = 15x - 27$.

Question 14

14 The diagram shows a circle, centre O and radius 52 cm.



AB is a chord of the circle.
The line through T is a tangent to the circle.

The chord is parallel to the tangent.
The perpendicular distance between the chord and the tangent is 72 cm.

Calculate the area of the shaded segment.
You must show your working.

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

The key to solving this problem was to realise that the area of the triangle OAB was required and hence the perpendicular height of this triangle was also required. The most common error was to attempt to find the shaded area by either treating it as a triangle with base AB and height 32 cm, or as a semicircle (usually with a radius of 32 cm). Many were unable to find the angle AOB and did not realise the triangle was isosceles, so it could be divided into two identical right-angled triangles that would make the calculations easier.

Question 15 (a)

15 (a) Solve by factorisation.

$3x^2 + 10x - 8 = 0$

(a) $x =$ ..... or $x =$ ..... **[3]**

The common errors included either not writing the two factors in full (such as leaving them as $3x(x + 4) - 2(x + 4)$) or incorrect factorisations such as $(3x - 4)(x + 2)$ or $(3x + 4)(x - 2)$. Despite the request in the question, there were many who used the quadratic formula.

Question 15 (b)

(b) Write $x^2 + 8x + 11$ in the form $(x + a)^2 - b$.

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

This was answered much better than similar questions in the past. Many gave the brackets correctly as $(x + 4)^2$, but there were sometimes errors with the value of b. Some wrote $(x + 8)^2 - 11$.

Question 15 (c) (i)

(c) (i) Write down the coordinates of the turning point of the graph $y = (x-3)^2 + 8$.

(c)(i) (..... , ...) **[2]**

This was well answered. The most common error was one or both numbers being written as negative.

Question 15 (c) (ii)

(ii) Describe the **single** transformation which maps the graph of $y = x^2$ onto the graph of $y = (x-3)^2 + 8$.

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

Very few answered this part correctly. Most guessed rotation or enlargement. The link with part (c)(i) often didn't seem to be recognised.

Question 16 (a)

16 A lift can travel at a maximum speed of 9.83 m/s, correct to 3 significant figures.
The lift travels a distance of 174 m, correct to the nearest metre, between the ground floor and the top floor of a building.

(a) Use the above information to work out the shortest possible time for the lift to travel between the ground floor and the top floor.
You must show your working.

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

The vast majority of responses divided the distance by the speed. Some divided the other way round and some multiplied. Some knew to write down the bounds, but many of these chose one or two incorrect bounds to use in their calculation.

Question 16 (b)

(b) Explain why your answer to **part (a)** may not be possible to achieve.

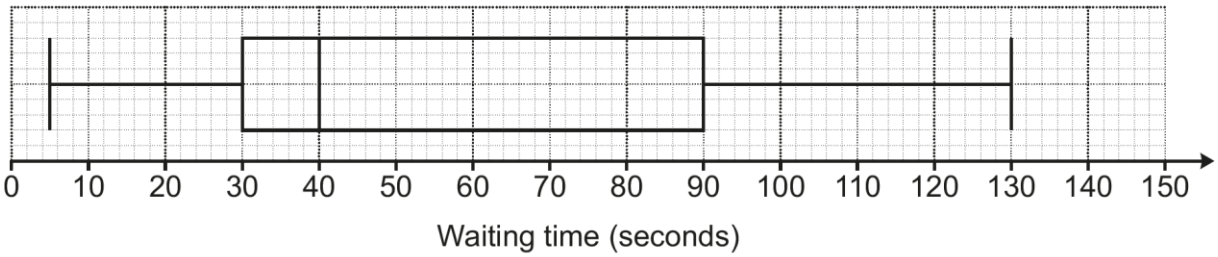
.....

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

We accepted any reasonable explanation. Usually it included any incident that would slow the lift down or anything about the lift that would slow it down such as loading or malfunction.

Question 17 (a)

17 The box plot shows the distribution of the waiting time of cars at a road junction.



(a) Write down the median waiting time.

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

There were many correct answers. The most common error was 60.

Question 17 (b)

(b) What percentage of the waiting times were less than 30 seconds?

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

There were fewer correct answers here than in part (a). The most common incorrect answer was 20.

Question 17 (c)

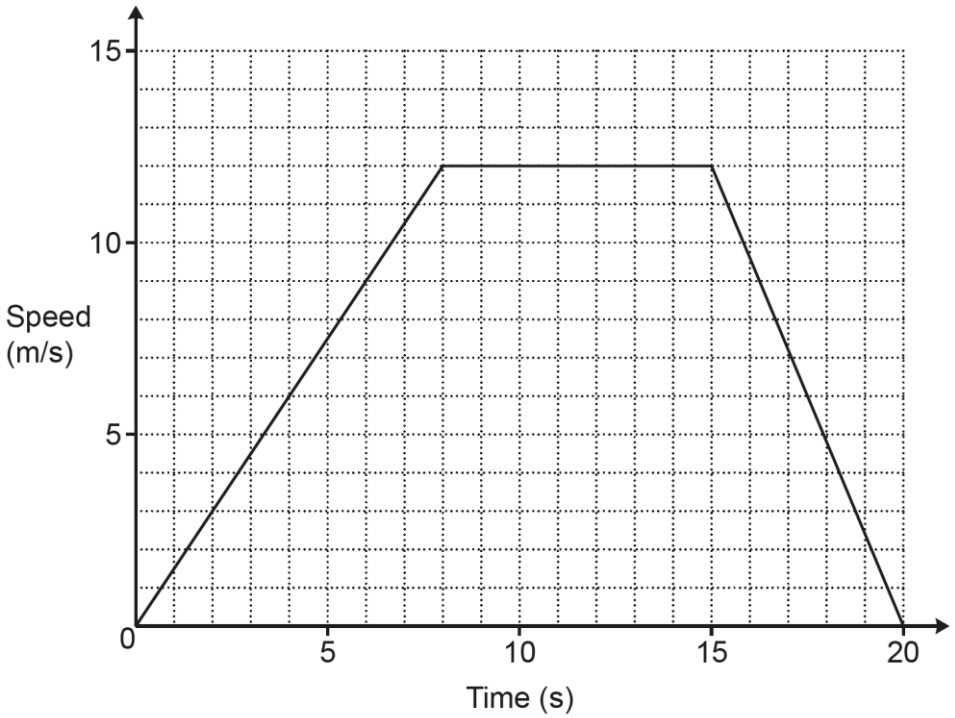
(c) Given that a randomly chosen car waited for more than 30 seconds, write down the probability that the car waited for more than 90 seconds.

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

Few candidates gave the correct answer, which should come from working such as $\frac{25}{75}$. The main error was to multiply their fractions together, so we saw $\frac{3}{4} \times \frac{1}{4} = \frac{3}{16}$.

Question 18 (a)

18 (a) The graph shows the speed of an object during the first 20 seconds of its motion.



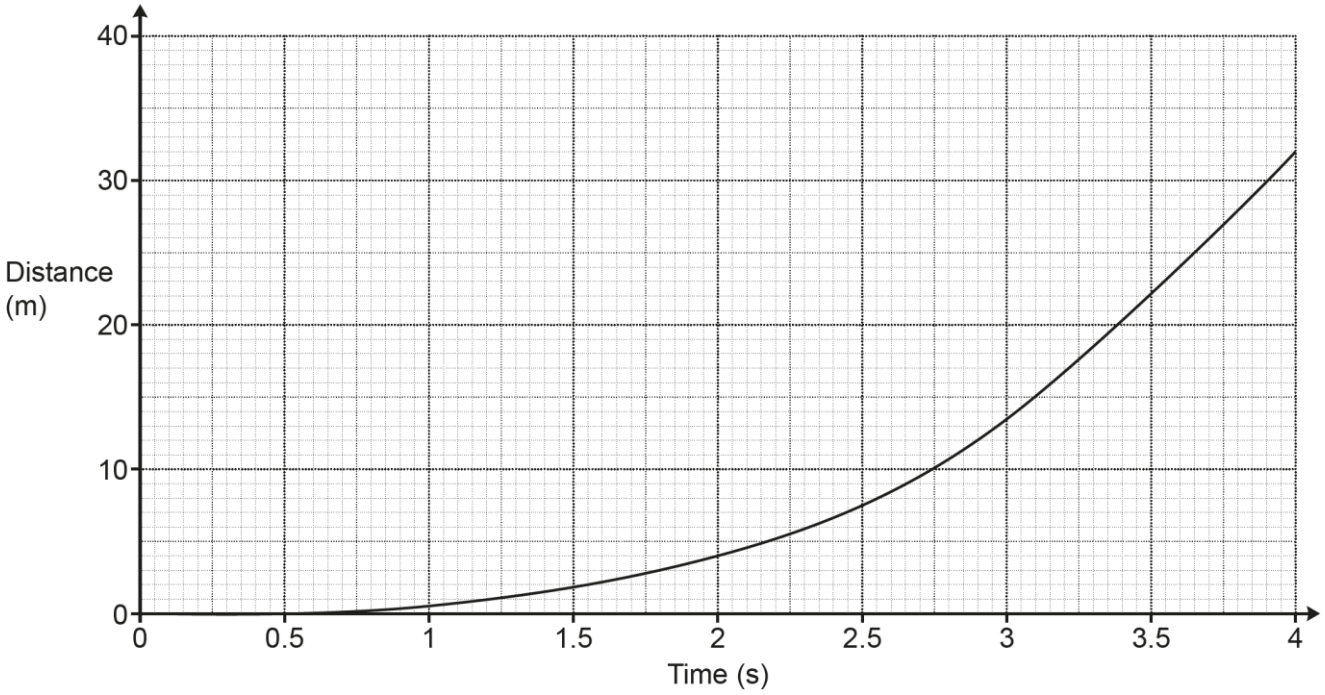
Calculate the distance travelled by the object during the 20 seconds.

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

Many candidates answered this correctly. The main problem seemed to be forgetting to include '$\frac{1}{2}\times$' in their formulae for the area of a triangle (as had also been seen in question 2 earlier on), so a common response was 96 + 84 + 60 = 240. Some misread the figures on the graph, for example 8 on the 'Time' axis was often considered to be 5.6.

Question 18 (b) (i)

(b) The graph shows the distance travelled by an object during the first 4 seconds of its motion.



(i) Work out the average speed of this object between 2 and 4 seconds.

(b)(i) ..... m/s **[2]**

This proved more difficult than expected. The difference in distance should have been calculated using 32 – 4 = 28, but many calculated 32 + 4 = 36 instead. This should then have been divided by 4 – 2 = 2, but many divided by just 4.

Question 18 (b) (ii)

(ii) Use the graph to estimate the speed of this object at 3 seconds.
You must show working to support your estimate.

(ii) ..... m/s **[3]**

This question expected candidates to draw a tangent, although we are aware of other correct methods and sometimes we did see those. Most of the candidates who drew a tangent went on to attempt 'rise divided by run', although some used the point (3, 13) so divided these to get 4.33… .

Question 18 (b) (iii)

(iii) What happens to the speed of this object during these 4 seconds of motion.
Explain how you know.

The speed .....

I know this because .....

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

Many candidates did explain this correctly, but a number said that the speed is increasing because the curve is going up, which wasn't enough for the mark.

Question 19

19 Show that $\frac{\sqrt{3}+2}{\sqrt{48}-6}$ can be written in the form $\frac{a+b\sqrt{3}}{6}$.

You must show each step in your working. **[5]**

Candidates often tried to use their calculator for this but found it to be little help. They needed to multiply the numerator and the denominator by the conjugate of the denominator and those that didn't do that were unable to make much progress with the question.

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