Qualification Accredited

OCR
Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

MATHEMATICS

J560
For first teaching in 2015

J560/04 Summer 2019 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper 4 series overview

This is the first of three papers taken by Higher tier candidates for the GCSE (9-1) Mathematics specification.

The candidates appear to have done better on this paper than in previous series. There is an improvement in the responses to the problem solving questions, showing that more candidates are selecting appropriate methods to solve these problems.

There are certain topics that are essential such as numeracy, setting up and solving equations, solving quadratic equations, substituting into formulae, angle properties of shapes and parallel lines, finding the area and perimeter of common shapes and reading information from graphs, tables and diagrams.

Candidates will improve further if they can answer the questions as stated in the demand. For example, Q1 requires the answer correct to 3 significant figures, Q2 gives the two numbers in different units, Q3 has a subtle difference between the two parts, Q5 needs to be read carefully, Q7 requires the perimeter and not the area, Q10 wants the interest to the nearest penny, Q16 is on inverse proportion and not direct proportion and Q19 requested that it was solved algebraically to 2 decimal places. Each of these questions were not read correctly by some of the candidates.

Read the question carefully

Important words in the question demand could be highlighted so that they are not missed or ignored.

In using calculators many candidates continue to truncate their intermediate answers or even their final answers to an inappropriate degree of accuracy.

Use of calculators

Keep intermediate results to more accuracy than you need and round your final answer either to the accuracy requested or to a reasonable level of accuracy. Do not truncate values.

In this paper there were very few direct algebra questions and that is because there was quite a lot of algebra expected in the problem solving questions. The questions which were answered the best/worst are listed below.

Most successful topic/question	*Least successful topic/question*
• use of calculators (Q1) • ratio (Q2) • application of linear equations (Q5) • transformations (Q8)	• properties of parallel lines (Q9) • quadratic sequences (Q12b) • histograms (Q13b) • vectors (Q15) • indices (Q17)

The topics of vectors and histograms appear in the least successful topics regularly. Candidates do not appear to be confident using vector algebra and they still struggle to work out the frequencies in histograms.

On this Higher tier paper it was surprising that many candidates struggled over topics which are also on Foundation tier such as using a calculator, ratio, angle properties of parallel lines, lowest

common multiple, compound interest and circumference of a circle. Some candidates also struggled to round numbers to the required degree of accuracy, particularly using significant figures.

In selecting a method to attempt the problem solving questions, there is always a better method than trial and improvement which is no longer in the specification. Each problem solving question does have at least one intended method to solve it.

Finally, in questions with multiple solutions, it is sensible to check that the written solution satisfies the original information, in other words go back to the question and check the solution works.

Question 1

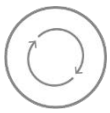
1 Calculate.

$$\sqrt[3]{\frac{210}{10^2+5^2}}$$

Give your answer correct to 3 significant figures.

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

This question required candidates to divide 210 by 125, find the cube root and then round the answer correct to 3 significant figures. The most common error was to misunderstand the cube root notation and divide 210 by 125 to reach 1.68 and then to find the square root and multiply that answer by 3 to get to 3.888444… and hence 3.89. Some candidates did not round their answer as required by the question or they rounded to 3 decimal places instead.

	**AfL**	Use a pen or highlighter to identify that the final answer must be given correct to three significant figures.

Question 2

2 The ratio 50 grams to 1 kilogram can be written in the form 1 : *n*.

Find the value of *n*.

n = ... **[2]**

The units must be standardised so the first step should be to write the unsimplified ratio as 50 : 1000 and then cancellation follows on from there. The answer is 20 and not 1 : 20 though that was condoned. Units in the answer were not condoned. Some candidates thought that there were 100 g in a kilogram.

Question 3 (a)

3 **(a)** Anne, Barry and Colin share a prize in the ratio 3 : 4 : 5.
Colin gives $\frac{1}{3}$ of his share to a charity.

What fraction of the whole prize does Colin give to the charity?

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

The first step is to find the total number of shares, 12, and then work out Colin's share, $\frac{5}{12}$. The required fraction is then $\frac{5}{12} \times \frac{1}{3}$. Many candidates found one third of 5 but wrote it as an incorrect truncated decimal, 1.6, rather than 1.6666…; if this was then placed as a fraction over 12 they would have gained M2.

Question 3 (b)

(b) Delia, Edwin and Freya share some money in the ratio 5 : 7 : 8.
Freya's share is £1600.

How much money did they share?

(b) £ ..... **[2]**

In this question the candidates need to divide the 1600 by 8 to find the required multiplier, in this case 200. However, the common incorrect method was to add 5 + 7 + 8 to get 20 and then to divide 1600 by 20 to get 80. It is likely these candidates did not realise that the £1600 was Freya's share and treated it as the global sum.

	**AfL**	Highlighting the word 'Freya' might avoid some errors.

Question 4 (a)

4 A bus timetable shows the following information.

- A bus following route T leaves for the train station every 20 minutes.
- A bus following route A leaves for the airport every 18 minutes.
- A bus following route T and a bus following route A both leave at 8.37 am.

(a) When is the next time one of each bus is timetabled to leave at the same time?

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

A common method was to write down all the times of the buses up to the next occurrence. Using this approach, numerical mistakes were usually made and the correct answer was rarely seen. Those candidates that used the lowest common multiple approach were more successful. Some who found 180 minutes to be 3 hours then added on the 3 hours incorrectly and gave an answer of 12.37. The next occurrence of 14.37 was also seen as the answer.

Exemplar 1

$20 = 2^2 \times 5$

$18 = 2 \times 3^2$

$LCM = 2^2 \times 5 \times 3^2 = 180 \text{ mins} = 3 \text{ hours}$

$8.37 + 3 = 11.37 \text{ am}$

(a) 11.37am **[4]**

This exemplar shows the expected method using the lowest common multiple of 18 and 20.

Question 4 (b)

(b) Write down one assumption that was necessary to solve this problem.

.....

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

Any reasonable assumption, such as "Buses are assumed to leave on time", were accepted. Answers which were unlikely, such as "There is no traffic", were not accepted.

Question 5

5 Bennie is 7 years older than Ayesha.
Chloe is twice as old as Bennie.
The sum of their three ages is 57.

Work out the ages of Ayesha, Bennie and Chloe.

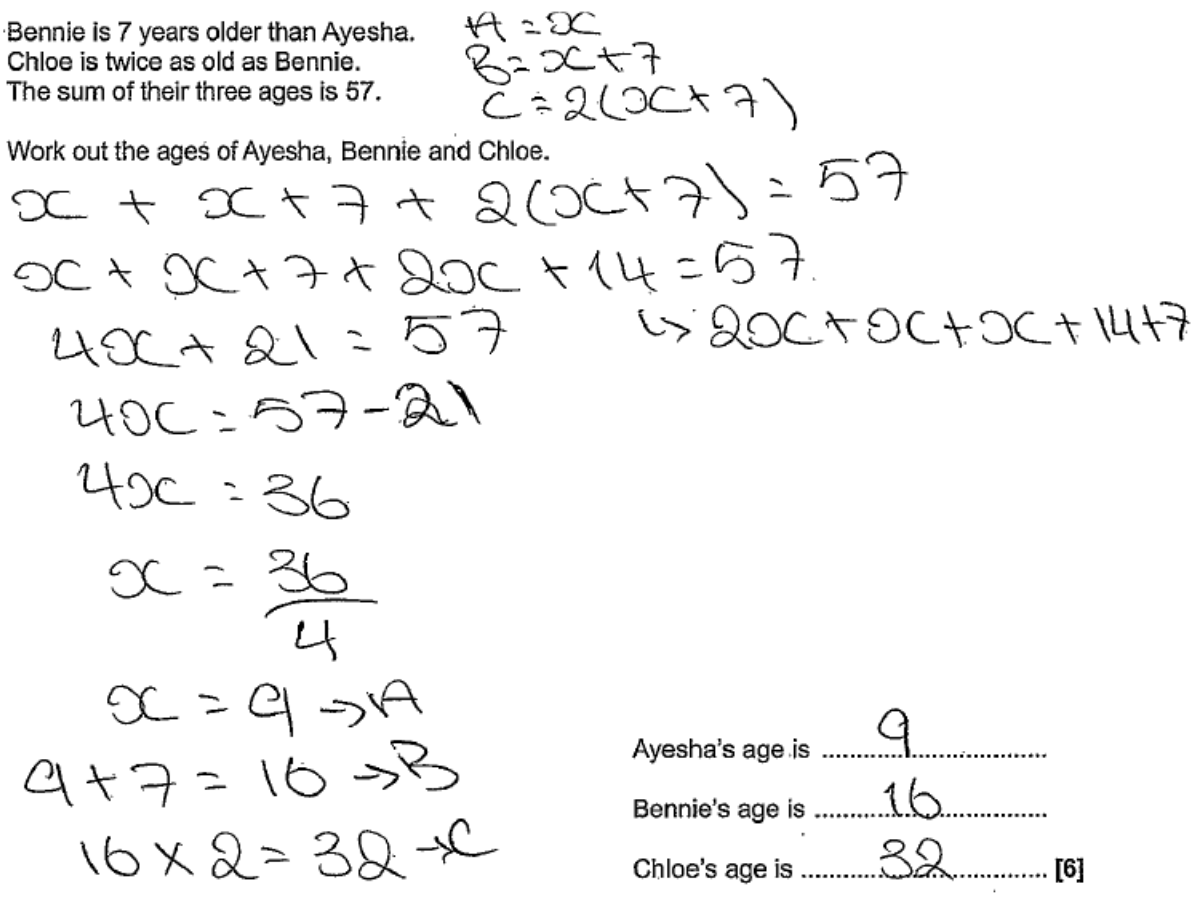
Ayesha's age is .....

Bennie's age is .....

Chloe's age is ..... **[6]**

Candidates are expected to use linear equations to solve this problem. Some clearly used trial and improvement but there was no credit for this method unless they found the correct answer. There are two reasons for this: the first is that the topic is no longer in the specification and the second is that this method is very difficult to follow.

Exemplar 2



This exemplar shows the expected method of using linear equations.

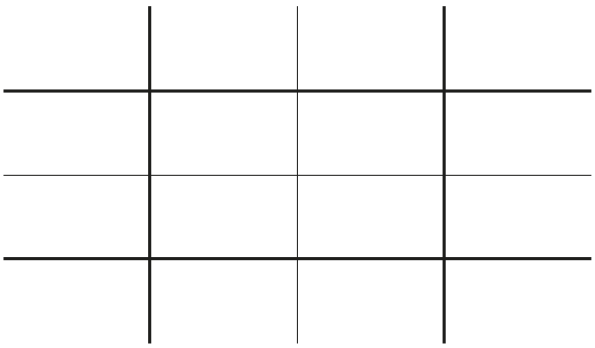
Question 6

6 120 students in Year 10 and Year 11 sit a test.

- 61 of the students are in Year 10.
- 83 of the students are right-handed.
- 20 of the students in Year 11 are left-handed.

One of the students in Year 10 and one of the students in Year 11 are chosen at random.

Which one is more likely to be left-handed?
Show your working. You may use the table if you wish.



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

This was a problem solving question so the mark scheme was biased towards finding the missing information. The empty table was given as a hint; those candidates who used it usually obtained the correct numbers and those who ignored it often made errors. It was quite common for the number of left-handed Y10 students to be omitted. Few candidates were able to compare the two fractions and it was not sufficient just to say one fraction is larger than the other one. The mark scheme gives a number of alternative methods but the simplest is to convert the two fractions into decimals. Percentages were accepted providing the correct notation was used.

	AfL	When percentages are used to compare fractions or decimals, the correct notation (%) must be used.

Exemplar 3

	right-handed	left-handed	total
Year 10	44	17	61
Year 11	39	20	59
Total	83	37	120

120 - 83 = 37 left-handed students

37 - 20 = 17 Y10 left-handed students

61 - 17 = 44 Y10 right-handed students

83 - 44 = 39 Y11 right handed students

39 + 20 = 59 Y11 students in total

Y10 chance of being left-handed:

$\frac{17}{61} = 0.279$

Y11 chance:

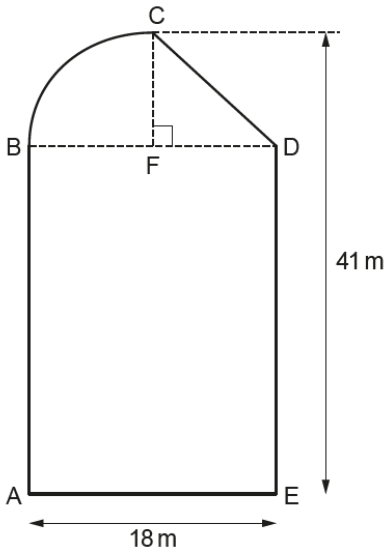
$\frac{20}{59} = 0.339$

The Year 11 student is more likely to be left-handed [6]

This exemplar shows the correct solution using the table to find the missing information.

Question 7

7 The diagram shows a shape ABCDE.
The shape is made from a rectangle, a right-angled triangle and a quarter of a circle.



Not to scale

F is the mid-point of BD.
AE = 18 m and the perpendicular distance from C to AE is 41 m.

Work out the **perimeter** of the shape ABCDE.

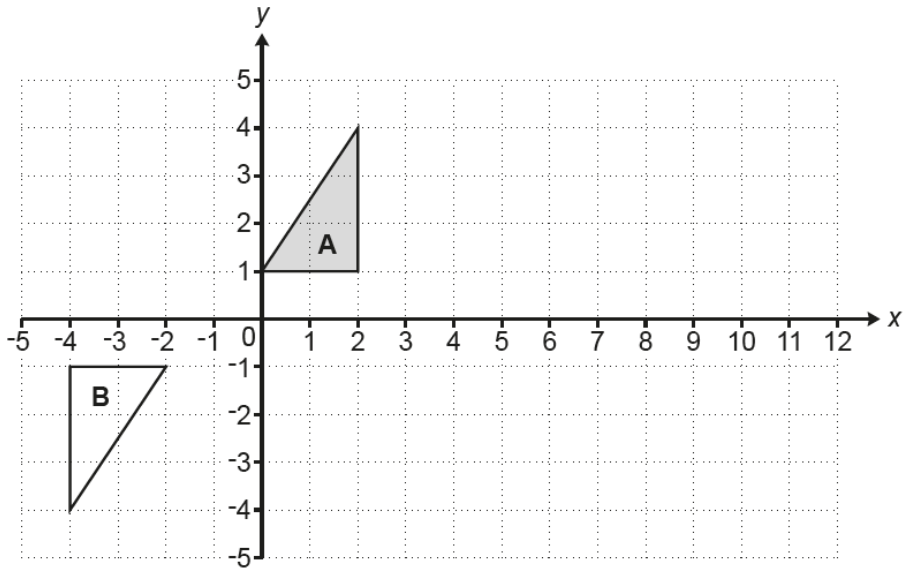
..... m **[6]**

This is a multi-step question. The candidates need to work out which sides, AE + ED + DC + arc CB + BA, need to be calculated. Most candidates worked out FC (or FD or FB) as 18 divided by 2. Many realised that DC was obtained using Pythagoras' theorem, though some tried trigonometry and that usually failed. AB (or ED) was found by doing 41 – 9 though some used 41 – arc CB. For arc CB, it is a quarter of the entire circumference of the whole circle; many used the formula for the area instead. Some candidates used 18 for the radius or were confused between the two formulae of πd and $2\pi r$. Few candidates stated the formula they were using so it was not always clear what they were using for the radius.

	AfL	When solving problems involving a circle, you must: • be clear whether you require the area or the circumference • work out the radius carefully • write down the formula you are using.

Question 8 (a)

8 Triangle **A** and triangle **B** are drawn on the coordinate grid.



(a) Describe fully the **single** transformation that maps triangle **A** onto triangle **B**.

.....

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

Some candidates thought that it was a 'reflection' but the main error was to give two transformations when the question clearly demands a single transformation. Some candidates gave 'rotation' and the correct centre but did not give the angle just the direction.

Question 8 (b)

(b) Describe fully the **single** transformation that is equivalent to:

- a reflection in the line $x = 3$, followed by
- a translation by $\begin{pmatrix} 4 \\ 0 \end{pmatrix}$.

You may use the grid above to help you.

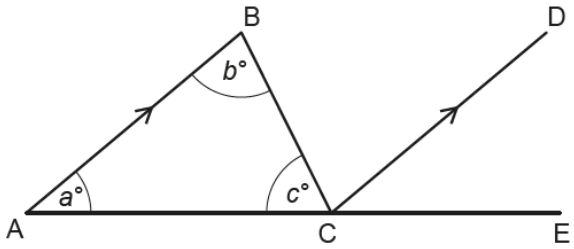
.....

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

This type of question has been set before and the responses are improving. This time many more candidates attempted to do these transformations on triangle A and many obtained the correct images. They gained credit for this. Fewer were able to give the single transformation but overall the responses were better this year.

Question 9 (a)

9 The diagram shows triangle ABC.
CD is parallel to AB.
A, C and E lie in a straight line.
Angles of size $a°$, $b°$ and $c°$ are shown.



Not to scale

(a) Insert $a°$, $b°$ or $c°$ to make this statement true.
Give a reason for your answer.

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

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

Most candidates gave the angle correctly. Few were able to name the property of parallel lines of 'corresponding angles', and many stated 'alternate angles'.

Question 9 (b)

(b) Use the diagram and the answer to part **(a)** to show that the angles of a triangle add up to 180°.
Give a reason for each statement you make. **[3]**

Most candidates were able to gain some credit, usually identifying angle BCD as '*b*'. They were often unable to name the property as 'alternate angles', with some using the phrase 'Z angles' which is not accepted as a correct term. Most candidates were able to give the second reason that angles on a straight line add to 180°.

Question 10

10 Claudia invests £25 000 at a rate of 2% per year compound interest.

Calculate the total amount of **interest** she will have earned after 5 years.
Give your answer correct to the nearest penny.

£ ..... **[4]**

The main error here was to miss the word 'interest' as many candidates gave the total amount. Some wrote the multiplier as 1.2 or 1.002. Some candidates gave the answer correct to the nearest pound and not the nearest penny as requested. A few attempted to work this out with a year-by-year approach but most of them made numerical errors or inaccuracies and they rarely found the correct answer. This method is not to be encouraged in a written examination; it is more suitable for use in a spreadsheet.

Question 11

11 The area of a rectangle is 56 m^2, correct to the nearest m^2.
The length of the rectangle is 9.2 m, correct to the nearest 0.1 m.

Calculate the smallest possible width of the rectangle.

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

This question was answered better than previous questions set on the same topic. It is good technique to write down both bounds for each number. The upper limit for each number can be the halfway point e.g. we allow 9.25 for 9.2 even without an inequality symbol so that candidates avoid considering numbers such as 9.249999… . The final division must be shown because there is usually quite a few numbers written down and we need to know which two numbers have been used.

Question 12 (a)

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

-1 4 9 14

Write an expression for the nth term of this sequence.

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

This part was answered well. Some candidates found the difference + 5 but did not know what to do with it. Common incorrect answers were $5n + 6$ and $6n + 5$.

Question 12 (b)

(b) The nth term of another sequence is given by

$$an^2 + bn$$

The third term is 9 and the sixth term is 126.

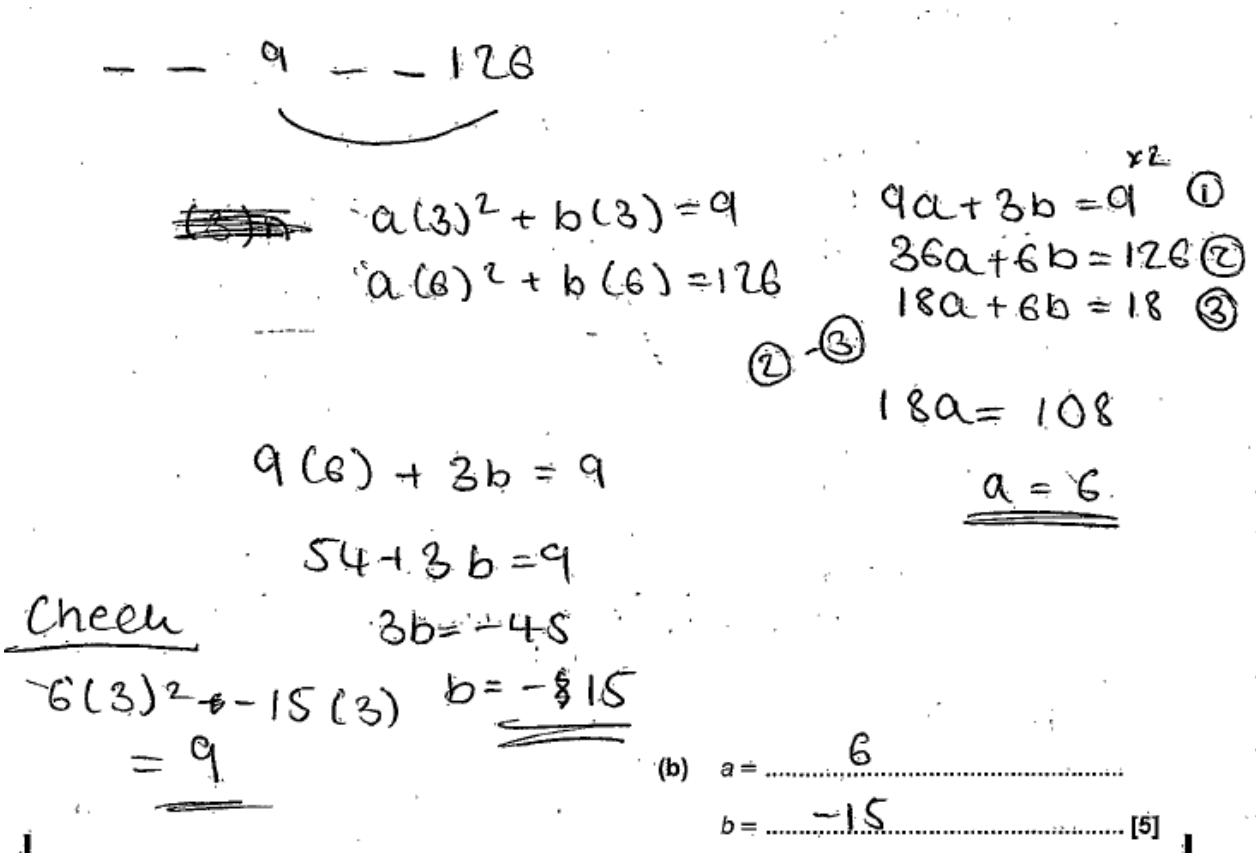
Find the value of a and the value of b.

(b) $a =$ .....

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

The intention of this question is to set up two simultaneous equations and then to solve them. Those candidates who tried to use trial and improvement found it a lengthy and usually impossible task and very few found the correct answer this way.

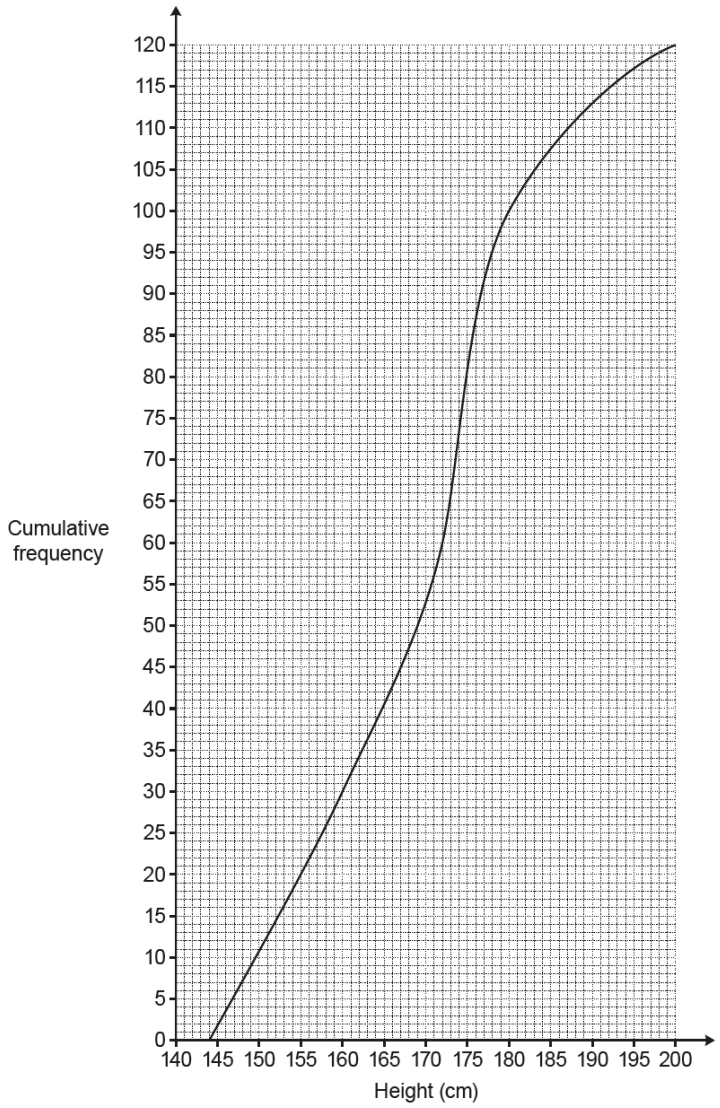
Exemplar 4



Here is an exemplar that shows a solution using simultaneous equations.

Question 13 (a) (i)

13 (a) The cumulative frequency graph shows the distribution of the heights of members of a rowing club.



(i) Find the median.

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

Most candidates gave the correct answer of 172 with a few candidates giving an answer of 170.

Question 13 (a) (ii)

(ii) Find the interquartile range.

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

Some candidates gave both 160 and 176 or 177 but they did not subtract the two. Some candidates gave 172 because they subtracted 90 – 30 = 60 and then they read the 60 on the vertical scale which gives the median.

Question 13 (a) (iii)

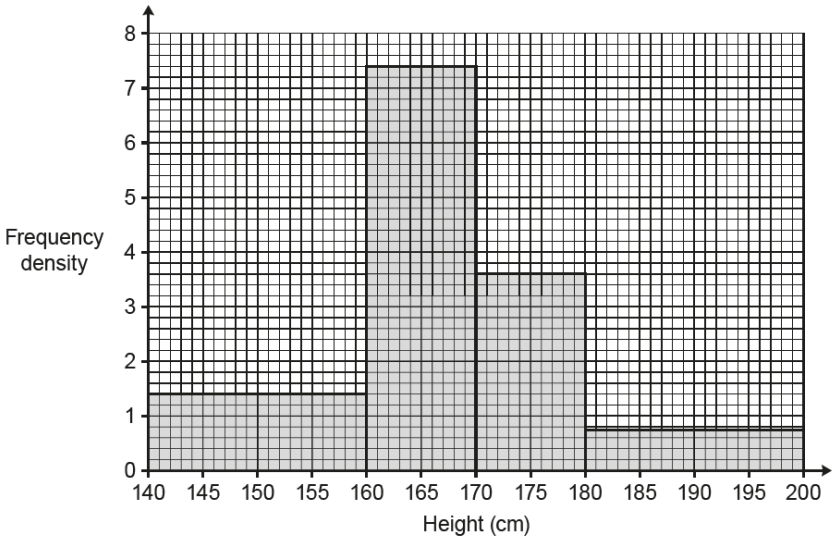
(iii) Calculate the percentage of the members who are at least 180 cm tall.

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

Many candidates read 100 from the graph and then converted the 100 out of 120 to a percentage (83%). Fewer candidates then subtracted the 100 from 120 or the 83% from 100% to get the correct answer.

Question 13 (b)

(b) The histogram summarises the heights of the 153 members of a swimming club.



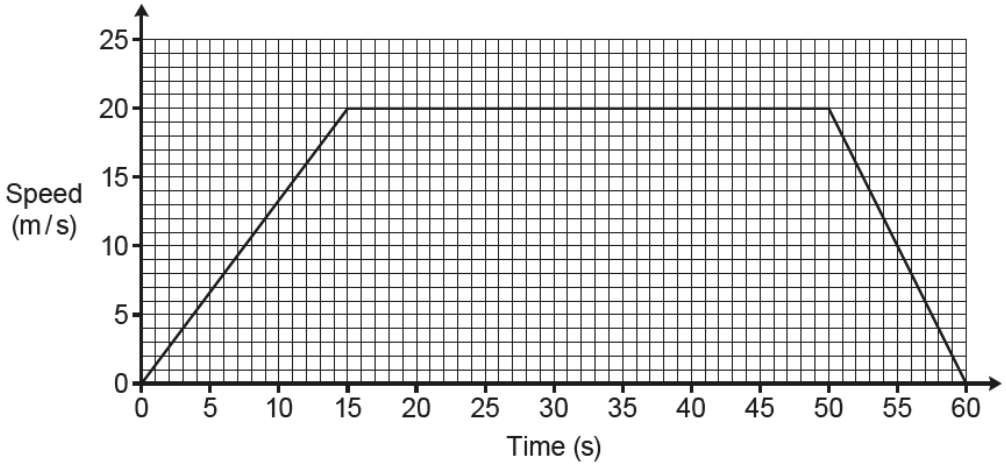
Which club has the greater median height?
You must show all your working.

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

A higher proportion of the candidates were able to read the frequencies from the histogram than on similar questions in previous papers. They then needed to identify the middle frequency and 76.5 and 77 were both accepted. Once we have seen this number then 160 to 170 can be identified as the group containing the median; if calculated, it lies between 166 and 167. Finally the correct decision for rowing club can be made. The main omission was not to find the position of the middle reading. The group containing the median is also the modal group so examiners need to see how candidates have identified it.

Question 14 (a)

14 The graph shows the speed of a train during the first 60 seconds of motion.



(a) What is the speed of the train after 9 seconds?

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

Most candidates were able to correctly read the answer from the graph.

Question 14 (b)

(b) What does the straight line suggest about the speed of the train over the first 15 seconds?

.....

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

Answers must not contain the words 'constant speed' because the speed is increasing and is not constant. Many candidates did state that it was 'accelerating' or the 'speed was increasing' which were accepted as that was all that was required. Any qualification was best dealt with by adding 'at a constant rate'.

Question 14 (c)

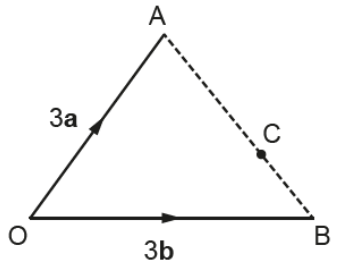
(c) Work out the average speed of the train, in m/s, during the 60 seconds.

(c) ..... m/s **[5]**

The average speed requires the total distance travelled and to find that the area beneath the graph must be calculated. Most candidates managed to work out the area of the rectangle but they did not half the areas of the two triangles, hence giving 300 + 700 + 200 = 1200 and 1200 ÷ 60 = 20. Sometimes only one of the triangles' areas was halved. Calculating the area of the trapezium is the easiest method but very few candidates attempted this. There is another method involving averaging all the speeds at set positions but few attempted this and even fewer found the correct answer this way.

Question 15

15 The diagram shows triangle OAB and points C and D.



Not to scale

D

$\overrightarrow{OA} = 3\mathbf{a}$ and $\overrightarrow{OB} = 3\mathbf{b}$.
C lies on AB such that AC = 2CB.
D is such that $\overrightarrow{BD} = 2\mathbf{a} + \mathbf{b}$.

Show, using vectors, that OCD is a straight line. **[5]**

Candidates struggled with this vectors question. There were very few who used the correct notation, for example many used OCD for vector OD and so on. The other main error was not to work out vector AB and hence vector CB which they needed to find vectors OC or CD.

?	**Misconception**	Many candidates thought that if OC + CD = OD then this showed that OCD was a straight line.

Question 16 (a)

16 (a) The table shows values of *x* and *y*.

x	4	16	36
y	6	3	2

Show that these values fit the relationship that *y* is inversely proportional to $\sqrt{x}$. **[2]**

This part was well answered, though the expected method of multipliers was rarely used. Instead candidates chose to work out the formula and check that it worked for the other two pairs of numbers. The main error was to use direct proportionality or to omit the root when they substituted the value of 4 for *x*.

Question 16 (b)

(b) a is inversely proportional to b^2 and $a = 3.75$ when $b = 4$.

Find a formula linking a and b.

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

The most common error was to use direct proportionality, followed by candidates who 'lost' the square power during their calculations so that they calculated *their k* as 3.75 × 4 = 15.

Question 17

17 Show that $(a^3)^{-\frac{1}{3}} \times (a^2)^{\frac{1}{2}} = 1$. **[3]**

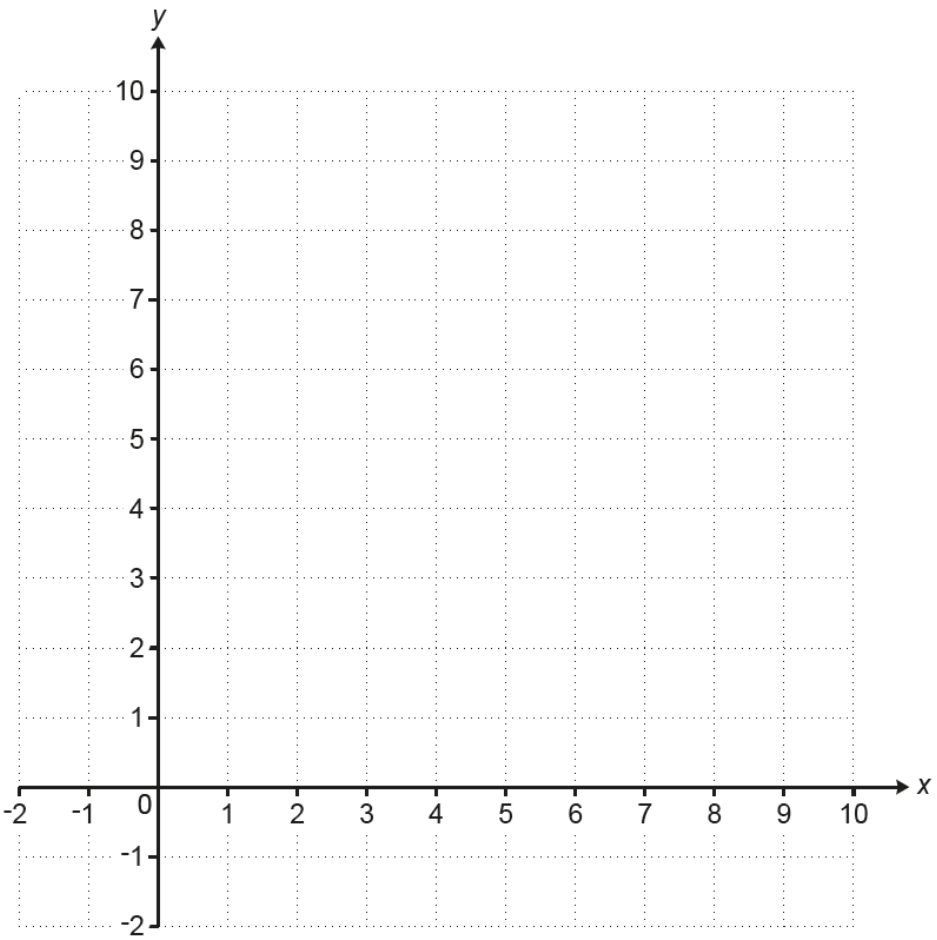
Many candidates used numbers in the place of *a* and this was not accepted in this 'proof'. The first term should be written as a^{-1} as -1 is not enough here. The second term needs to be written as a^1 or *a* and many in fact did show this. However, they needed to show these two multiply to give 1 and usually a^0, or similar, was sufficient.

Question 18

18 Region **R** satisfies these inequalities.

$y > 3$
$y \geqslant x$
$x + y \leqslant 9$

By drawing three straight lines on the grid, find and label the region **R**.



[6]

Many candidates could not accurately draw all three lines. For $y = 3$ many drew $x = 3$, for $y = x$ many simply did not draw a line and for $x + y = 9$ they drew $x + y = 10$ or $y = x + 9$. The region where they made the most errors was to find which side of $y = x$ to show and they often chose the wrong side.

Question 19

19 Solve this equation algebraically.
Give your solutions correct to 2 decimal places.

$$3x^2 + 8x - 5 = 0$$

$x =$ ..... or $x =$ ..... **[4]**

The required accuracy is a hint to candidates that they should use the quadratic formula. Despite this, many tried to factorise without any success and some attempted to use 'completing the square' which was particularly tricky and it was rare to see a successful attempt. Of those candidates who did attempt to use the quadratic formula, some wrote down the wrong formula and for some their numerator was too short and did not include the '– *b*' term. Most gave the answers to the correct accuracy but a few did not round their answers at all.

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