Qualification Accredited

Oxford Cambridge and RSA

GCSE (9–1)

Examiners' report

MATHEMATICS

J560

For first teaching in 2015

J560/05 Summer 2023 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. 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 our secure Teach Cambridge site (https://teachcambridge.org).

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Paper 5 series overview

This is the second of the three papers taken by Higher tier candidates for the GCSE (9-1) Mathematics specification. Calculators are not allowed on this paper. Candidates were correctly entered at this tier in almost all cases. Most of the questions appeared to be accessible and there was no evidence to suggest that candidates ran out of time. Marks for the paper covered the almost the full range. It is clear that centres are encouraging candidates to attempt all questions. Only two of the questions (18 and 20(b)) were frequently not responded to by candidates, which were both 'Show that…' questions involving more challenging content. When answering a 'Show that…' question, candidates should be aware they have to provide step by step working leading to the given answer, rather than using the given answer in their working.

There were just a small number of candidates making frequent arithmetic errors on straightforward calculations. When faced with questions that require a written statement to justify or explain a situation, candidates need to determine the nature of the response required and write their response in concise terms, using correct mathematical language where appropriate. Candidates should be encouraged to clearly display their working with full calculations shown. The stronger responses follow a clearly labelled, systematic process in working; this enables candidates to be given credit for method where the final answer is incorrect.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• performed standard calculations and routines following the required rubric • showed clear, concise and step by step methodology on multi-mark questions • used appropriate terminology and precision when asked to give reasons for answers.	• showed a more random approach in the working, including trial and improvement on some multi-mark questions • had weaker skills, knowledge and understanding of the specification, including the recall of key terminology, formulae, and routines • were unable to use correct terminology in geometrical reasoning, or to use a step-by-step approach on questions that required reasons or a given result to be shown.

Question 1

1 Work out.

$$\frac{33}{35} \div 1\frac{4}{7}$$

Give your answer as a fraction in its simplest form.

.... [3]

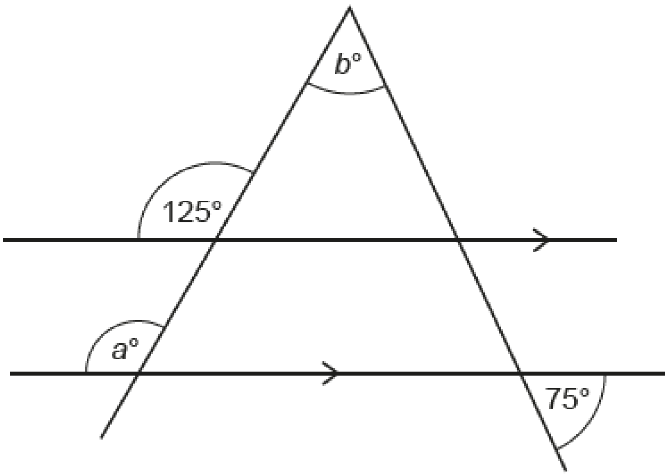
This question was attempted by all candidates, with most gaining at least 2 of the 3 marks available. The most common approach was first converting the mixed number to an improper fraction and then multiplying using the reciprocal of the improper fraction. The majority of the candidates then attempted long multiplication with the values in the denominator and numerator, rather than attempting to cancel common factors. The calculation $\frac{33}{35} \div \frac{55}{35}$ was also seen as an approach. The most common answer was $\frac{231}{385}$; only a minority gave the fraction in its simplest form.

Assessment for learning

This division calculation requires answers to be given in their simplest form. For this, the most efficient approach is to cancel common factors when the fractions are in their product form in the method, e.g. at this stage $\frac{33}{35} \times \frac{7}{11}$. This avoids the more difficult simplification of $\frac{231}{385}$ and avoids having to do a long multiplication within the method that can lead to arithmetic errors.

Question 2 (a)

2 The diagram shows two straight lines crossing a pair of parallel lines.



Not to scale

(a) Write down the value of *a*.
Give a reason for your answer.

a = ... because ....

.... **[2]**

Most candidates were able to score at least 1 mark in this part, usually for *a* = 125°. Many did give the correct reason of 'corresponding angles'. Common errors were to explain how they found the answer for angle *a* and not refer to the geometrical reason, or to give an incorrect geometrical reason such as alternate angles or co-interior angles.

Question 2 (b)

(b) Work out the value of *b*.

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

Many were successful here and gave the answer 50°. Of those that didn't, they were often able to correctly identify the angle 55° or 75° in the correct position within the relevant triangle, usually marked on the diagram and credit was given for this. The most common error was to assume that the triangle is isosceles leading to an answer of 70° from 180° – 55° – 55°, or less often 30° from 180° – 75° – 75°. There were a few candidates that made arithmetic errors within an otherwise correct method.

Misconception

In problems involving angle calculations, always use the given information to find the missing angles. Do not assume properties of angles or shapes that are not given in the question, such as the triangle here being isosceles.

Question 3

3 Work out.

$3.8 \div 0.02$

.... **[2]**

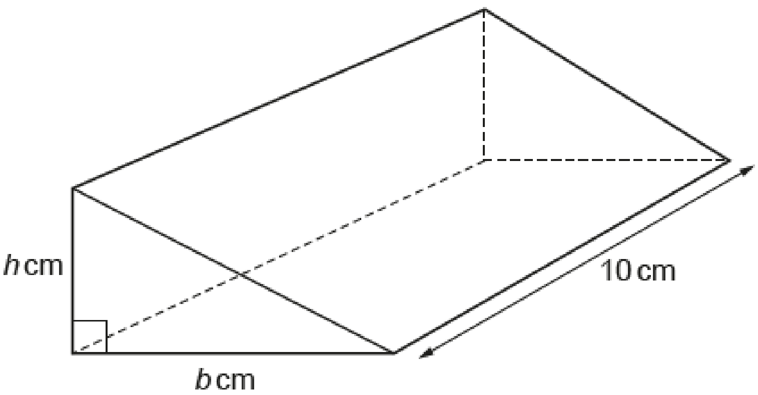
The majority of candidates struggled to deal with the place value in this division. Many showed a correct initial method to create an equivalent division, e.g. multiplying both values by 100 to give 380 ÷ 2 and then showed the value 190. However, in the majority of these cases this was then spoiled by dividing, e.g. 190 by 100 to give an answer of 1.9.

Assessment for learning

When dividing by a decimal and making a place value adjustment to both numbers to create an **equivalent** division involving integers, the answer does not need further place value adjustment; the adjusted calculation is equivalent to the original calculation.

Question 4

4 The diagram shows a prism of length 10 cm.



The cross-section of the prism is a right-angled triangle.
The base, b cm, is 2 cm longer than the height, h cm.
The volume of the prism is 240 cm^3.

A student is explaining how they worked out the value of b.

They say

b is 6 because that means h is 4 and $6 \times 4 \times 10 = 240$.

Describe the student's error and find the correct value of b.

The error is ....

....

b = ... **[3]**

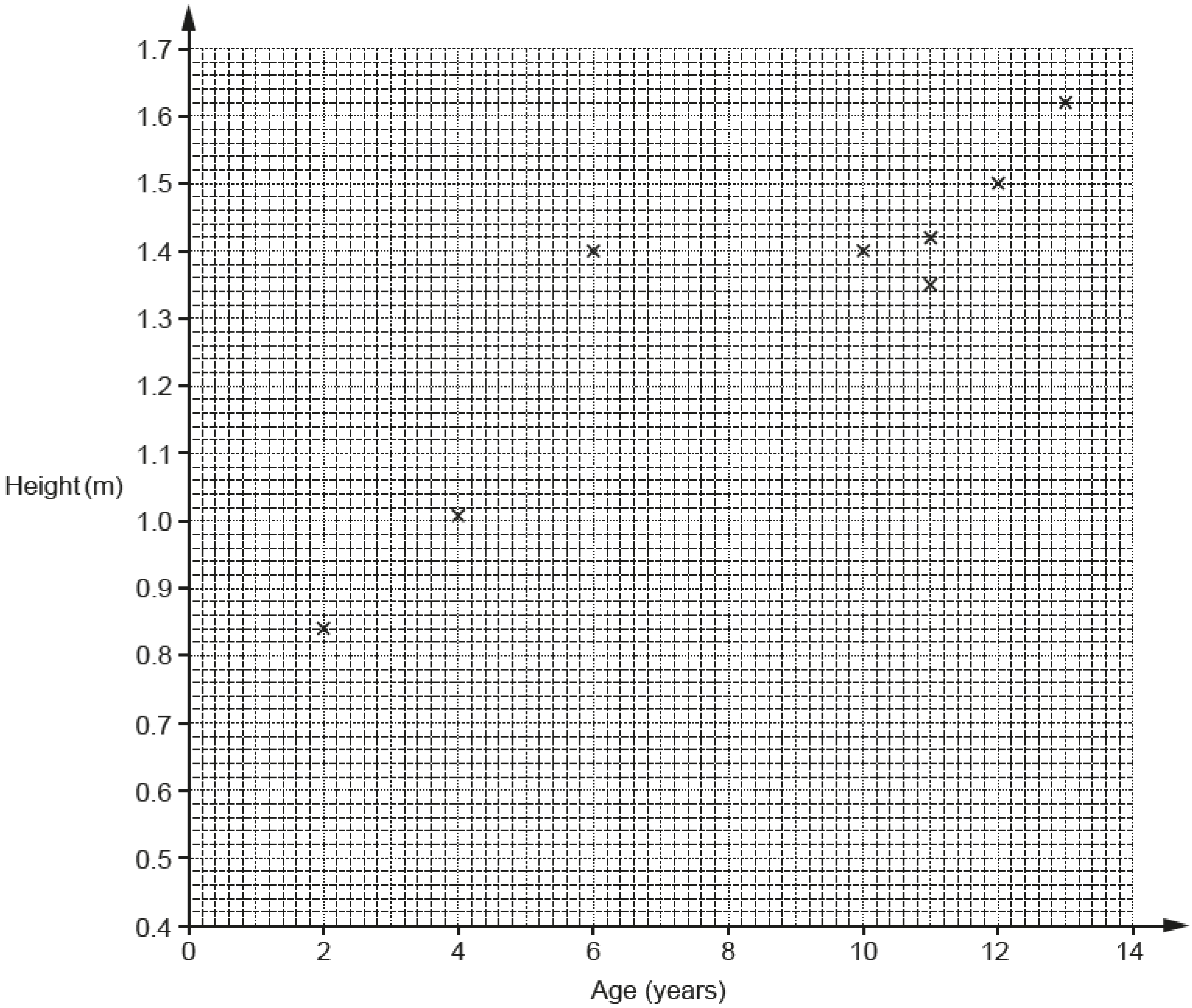
Most candidates were able to identify that the correct value of *b* was 8, although a common error was to give the answer 120. Most candidates could identify the error that the triangular cross-section had not been multiplied by $\frac{1}{2}$ / divided by 2, however many were unable to express this clearly. A common error was to simply state 'it should be divided by 2' rather than identifying that it was the area of the cross-section that should have been divided by 2. Another error that was seen on occasions was to state the correct calculation rather than identify and describe the actual error.

Question 5 (a)

5 The table shows the ages and heights of 12 children.

Age (years)	2	4	12	6	10	11	13	11	5	7	9	14
Height (m)	0.84	1.01	1.5	1.4	1.4	1.35	1.62	1.42	1.14	1.24	1.26	1.68

The points for the first eight children (shaded in the table above) are plotted on the scatter diagram.



(a) Plot the points for the remaining four children. **[2]**

Almost all candidates plotted the four points correctly.

Question 5 (b)

(b) Describe the type of correlation shown in the completed scatter diagram.

.... **[1]**

Almost all candidates gave positive as the answer. Some added a strength such as 'weak' or 'strong', which was not required and was ignored by examiners. A few gave word descriptions such as 'older children are taller', which did not answer the question asked.

Question 5 (c)

(c) One of these children is taller than expected for their age.

On the scatter diagram, circle the point representing this child. **[1]**

Almost all candidates identified the correct point.

Question 5 (d) (i)

(d) **(i)** Kai is 8 years old.
By drawing a line of best fit, estimate Kai's height.

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

Almost all candidates drew a ruled line of best fit of sufficient length and accuracy in response to this question and went on to read off the relevant height from their line of best fit. Some drew a line of best fit through the origin, which was inaccurate; they did however usually score the follow through mark for reading the scale correctly at 8 years for their ruled line.

Misconception

A few candidates appeared to believe that the line of best fit **must** go through the origin, but this is not the case. Candidates should base their line of best fit on the pattern shown by the plotted points.

Question 5 (d) (ii)

(ii) Describe an assumption you have made in giving your answer to part **(d)(i)**.

....

.... **[1]**

Most candidates were able to give a correct description of the assumption that Kai needed to fit in with the trend or was of average height for his age. A small number were vague in their description and gave responses such as 'As you get older you get taller', which did not answer the question.

Question 5 (e)

(e) Explain why using this data to estimate the height of a child that is 17 years old may be unreliable.

....

.... **[1]**

Most candidates were aware why the data would be unreliable to estimate the height of a 17-year-old, but a number did not score that mark. One common reason for not scoring the mark was to not reference the data provided and only refer to the graph. Careful reading of the question would identify the importance of referencing the given data in the answer. A second type of response was to write about rates of growth of 17-year-olds compared to 14-year-olds; again, as no reference to the data was made, no mark was given.

Exemplar 1

It is outside the list of collected data.
No data is collected past 14 years. **[1]**

This is an example of an acceptable explanation that refers to 17 being outside the range of the data provided.

Reasons that just referred to the graph not going to 17 were not enough. Responses needed to reference no **data** at 17, or that the value 17 was beyond the **data** provided in the question.

Question 6

6 Taylor has a full bottle of medicine.
The bottle holds 20 doses of medicine.

Each day Taylor takes one dose of medicine out of the bottle.
After 8 days, there are 180 millilitres of medicine left in the bottle.

Work out how many millilitres of medicine the bottle holds when full.

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

The vast majority of candidates answered this question well, showing a correct method and scoring full marks. The most common error was not recognising that 180 ml was the amount of medicine remaining, so they linked 180 ml to 8 days rather than 12 days. Where candidates did attempt to divide 180 by 12 within the method, a few made arithmetic errors in the calculation, but were then able to show a full correct method when multiplying the value of their division by 20. A few candidates with an incorrect answer showed limited working and as a consequence were unable to score any method marks.

Question 7 (a)

7 A volunteer packs boxes for a charity.
They can pack 5 boxes in 45 seconds.

(a) Use this information to show that they can pack 55 boxes in less than 9 minutes. **[4]**

Most candidates were able to access this question and gain full marks. The most common approach was to work out the number of seconds required to pack 55 boxes and compare that to the number of seconds in 9 minutes. Other candidates found that 495 seconds was required to pack 55 boxes and then tried to convert this to minutes. While most were successful (either using division or sometimes repeated addition), a few were unable to express the time correctly (for example, writing 8 minutes 25 seconds rather than 8.25 minutes or 8 minutes 15 seconds). The approach of establishing that 60 boxes could be packed in 9 minutes was seen less often, but was another successful strategy used by candidates.

Question 7 (b)

(b) What assumption did you make in part **(a)**?

....

.... **[1]**

The vast majority of candidates gave a suitable statement, generally referring in some way to maintaining the rate, pace or speed of packing the boxes. The few candidates who did not gain this mark generally either restated the answer for 7(a) (for example, stating that 55 boxes could be packed in 8 minutes and 15 seconds), or said that 1 box (as opposed to every box) takes 9 seconds.

Question 8

8 A block made of iron is in the shape of a cuboid.
The block is 3.1 cm by 4.9 cm by 2.2 cm.
The density of iron is 7.87 g/cm^3.
Sam thinks that the mass of the block is about 2.4 kg.

Use estimation to decide if Sam's answer is reasonable.
Show how you decide.

Sam's answer is .... because ....

....

....

.... **[5]**

Successful candidates tended to be very efficient in terms of the strategy, getting an estimate for the volume using the rounded values 3, 5 and 2 as a first step, then correctly multiplying the volume by the rounded density of 8 to get to 240 g. After getting to this point, it was rare for candidates not to compare the quantities correctly, but a few incorrectly stated there were 100 g in 1 kg and thus thought Sam's estimate was reasonable. Some candidates correctly estimated the volume, but then used the density formula incorrectly, e.g. 30 ÷ 8. Some did not recognise the need to estimate the values and attempted much more complex arithmetic than was necessary to answer the question. Almost all candidates were able to score at least 1 mark on this question.

Assessment for learning

Reading the question and looking for key words within the demand will help candidates to determine next steps. Here the key words 'Use estimation' appears in the demand. The method hence requires rounded values be used, which makes the calculations much easier.

Question 9 (a)

9 A zoo counts its animals.
The ratio of antelope to zebra is 3 : 2.
The ratio of meerkats to zebra is 7 : 3.

(a) Write the number of antelope as a percentage of the number of zebra.

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

Most candidates used the ratio 3 : 2, but worked with the fraction $\frac{3}{5}$ and gave an answer of 60%. The candidates who read the question carefully and showed the fraction $\frac{3}{2}$ went on to give 150%. There were some that inverted the fraction to give an answer of 66.6%, perhaps thinking that the answer had to be less than 100%.

Question 9 (b)

(b) There are 15 more meerkats than antelope.

Work out the number of zebra in the zoo.

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

This question really challenged candidates' understanding of ratio, but really demonstrated improvement in the topic when compared to previous series. Many correctly combined the ratios and gained part marks for showing a correct combined ratio, e.g. 9 : 6 : 14. The next stage of linking the combined ratio to the difference of 15 more meerkats than antelope proved more challenging, but a significant number reached a correct answer. Those who were more confident were able to link the 15 with, for example, 14 – 9 to find the correct multiplier to complete the calculation. Some showed a sequence of equivalent ratios until a difference of 15 between meerkats and antelopes was seen. A few attempted to combine the two ratios, but used addition rather than looking for a common multiple for the zebra element of both ratios.

Question 10

10 A student draws two different regular polygons.
The exterior angle of one polygon is $p°$.
The exterior angle of the other polygon is $q°$.

The sum of p and q is 112°.
The difference between p and q is 32°.

Find the **number of sides** of each polygon.
You must show your working.

.... sides and .... sides **[6]**

There were three main approaches to answering this question. The first was to create and solve simultaneous equations to find the values of *p* and *q* as 72 and 40. The second involved trials to find the two values. The third involved writing tables of angles of polygons (usually 4 to 12 sided), giving both exterior and interior angle sizes and finding the pair that met the criteria. Many candidates appeared more familiar in using interior rather than exterior angles to find the number of sides having found the values of *p* and *q*. Some errors were made in division and adding or subtracting in repeated addition or subtraction to try to make 360°. Answers of 5 sides and 9 sides did not automatically score full marks as candidates had to show sufficient working to justify these values. A few candidates showed quite random approaches, where working was not coherent or clear enough to earn credit for method.

Question 11

11 y is directly proportional to the square of x.

Find the percentage decrease in y when x is decreased by 30%.

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

Only a small number of candidates reached the correct answer here. Most were able to give an equation of proportionality, but some confused direct and indirect proportion, or square and square root. Many reached 0.7 or 0.7^2, which was awarded partial credit. Those that reached 49% often did not complete the question by subtracting from 100% to get the correct answer. For many candidates, working was quite random. Many included multiple attempts, where awarding credit for method was not possible owing to the number of choices given.

Question 12 (a)

12 Here are the first four terms of a sequence.

$$\frac{2}{5} \qquad \frac{5}{10} \qquad \frac{8}{17} \qquad \frac{11}{26}$$

(a) Find the next term.

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

Most candidates were able to give the next term correctly. Common errors were adding either 5 or 9 to the denominator (from the difference of the first two or last two denominators respectively), leading to answers of $\frac{14}{31}$ or $\frac{14}{35}$.

Question 12 (b)

(b) Find the *n*th term.

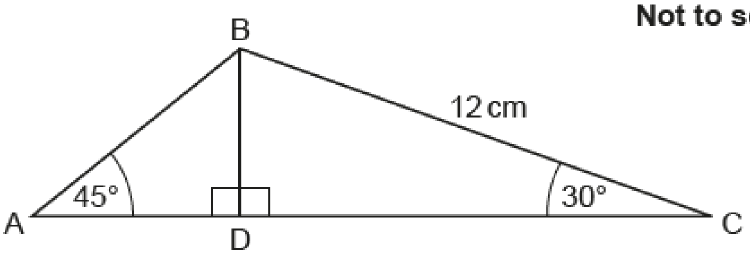
(b) .... **[3]**

Many found this part of the question difficult and did not reach the correct expression. Candidates who attempted to work on the sequence for numerator and the denominator separately did reasonably well and generally scored at least part marks for either one correct expression or one of a similar form. Finding the *n*th term of the numerator was done better than the denominator. Many candidates were unable to visualise the fractional form of the *n*th term and made little progress.

Question 13 (a)

13 The diagram shows a triangle, ABC, with perpendicular height BD.

Not to scale



BC = 12 cm, angle BCD = 30° and angle BAD = 45°.

(a) Work out the length of BD.

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

This question was attempted by most candidates. The majority recognised that it required them to use trigonometry. A small proportion of candidates tried to use angle properties or Pythagoras' theorem and were unsuccessful. Some candidates used the sine rule as opposed to right-angled trigonometry, with varying success. The majority of candidates who used trigonometry correctly identified the need to use sin30 and many completed the calculation to give the correct answer. The most common error for those using trigonometry was using an incorrect value for sin30, or in some cases using cos30.

Question 13 (b)

(b) Work out the exact length of AB.
Give your answer in its simplest form.

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

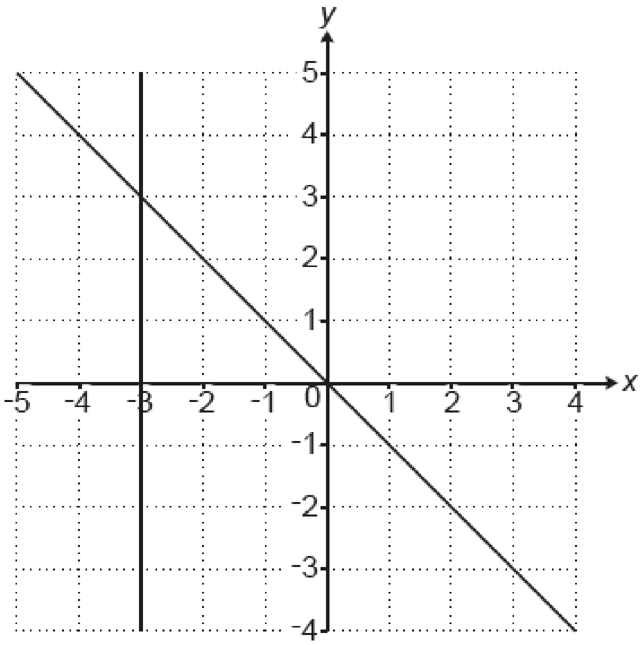
Candidates were less successful in this part than in (a). Most candidates who attempted this question used trigonometry rather than Pythagoras' theorem. Those that used sin45 often made a common error in attempting 6 × sin45 rather than $\frac{6}{\sin 45}$. Others using trigonometry used tan45 or were unable to recall the exact value of sin45 within their method. There was a reasonable proportion of candidates who showed a fully correct method, but were unable to simplify their expression involving surds and scored 2 out of the 3 marks. A minority of candidates did not attempt this part at all.

Misconception

Some candidates struggled to rearrange sin45 = $\frac{6}{AB}$ to make AB the subject. A common error was 6 × sin45, leading to an incorrect answer of $3\sqrt{2}$.

Question 14

14 The graphs of $x = {}^{-}3$ and $y = {}^{-}x$ are drawn on the grid.



The region **R** satisfies the following inequalities.

$x \leqslant {}^{-}3$ $\quad$ $y \leqslant {}^{-}x$ $\quad$ $y - 1 > \frac{1}{2}x$

By drawing one more line, find and label the region **R**. **[5]**

A small number of candidates scored full marks here. Some scored 4 marks with the only error being drawing a solid line instead of a broken line for $y - 1 > \frac{1}{2}x$, however the majority of candidates drew the line incorrectly. After drawing an incorrect line, follow through marks for identifying the region were available and most candidates secured a follow through mark for a correct region relative to their line. Many candidates also gained the mark for a region satisfying $y \leq {}^{-}x$, but fewer gained the mark for a region satisfying $x \leq {}^{-}3$. A few candidates did not clearly label or shade their region and in those cases, marks were not given.

Misconception

When drawing the line $y - 1 > \frac{1}{2}x$, most candidates drew a solid line rather than a broken line. The strict inequality > indicated that the line should not be included in the region.

Question 15 (a)

15 (a) Factorise.

$$9x^2 - 4$$

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

Many candidates gave the correct answer here. A common incorrect answer was $(3x - 2)(3x - 2)$. The majority of candidates did not recognise the expression given as the difference of two squares and tried to work with a pair of brackets with other factors of $9x^2$ and 4.

Question 15 (b)

(b) Solve by factorisation.

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

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

Many candidates were able to correctly factorise the quadratic expression into the required form, but from there not all were able to extract the correct solutions. After correctly factorising, an answer of $x = {}^{-}4$ rather than $x = {}^{-}\frac{4}{3}$ was fairly common. Of those that didn't factorise correctly, some had incorrect signs in the brackets, such as $(3x - 4)(x - 2)$. A method mark was given where the expansion of the brackets led to two correct terms in the original equation including the term $3x^2$. Candidates were also given a follow through mark for the solutions, provided they came from factors of the form $(3x \pm a)(x \pm b)$. A small number of candidates did not follow the instruction in the question and attempted to use the quadratic formula to solve the equation.

Assessment for learning

When asked to factorise a quadratic expression involving 3 terms, always write the two factors as a product with brackets, e.g. $(3x + 4)(x - 2)$. Do not leave them as two separate expressions that are not linked.

Question 15 (c)

(c) Solve.

$$\frac{2(x-5)}{1-3x}=2$$

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

A number of candidates showed a clear step by step method by removing the denominator of the fraction and writing $2(x - 5) = 2(1 - 3x)$ before expanding the brackets, collecting terms and giving a correct solution. Some using this approach omitted essential brackets or made errors in expanding the brackets, but were able to score a method mark for correctly collecting like terms to reach $ax = b$ for their equation. Many candidates were however unable to deal with the fraction in the equation; a common error was to incorrectly cancel terms in the fraction as a first step.

Misconception

? Algebraic fractional expressions such as $\frac{2(x - 5)}{1 - 3x}$ do not share common numeric or algebraic factors in the numerator and denominator and consequently cancelling is not possible.

When removing the denominator from a fraction in an algebraic equation, always use a bracket initially, for example $2(x - 5) = 2(1 - 3x)$, so that all terms in the denominator are multiplied by 2.

Exemplar 2

$$2(x-5) = 2(1-3x)$$
$$2x - 10 = 2 - 6x$$
$$2x = 12 - 6x$$
$$8x = 12$$
$$x = \frac{12}{8} = 1.5$$

(c) $x =$ ......1.5...... **[4]**

This is an example of a model solution where each stage is shown as a separate line of working.

Brackets are used when removing the denominator of the fraction to make sure that the full expression is multiplied by 2. In line 2, the brackets are correctly expanded before the terms in *x* are isolated on one side of the equation.

The candidate completes the solution to earn 4 marks.

Question 16 (a)

16 (a) Work out.

$64^{\frac{2}{3}}$

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

A small majority of the candidates answered this correctly. Some found the cube root of 64 as 4 and were given partial credit. A common error was then to do 4 × 2 = 8. A small number attempted to square 64 first (some were successful), but difficulty was had in finding the square root of 4096. A minority of candidates were unable to interpret the index notation and multiplied 64 by $\frac{2}{3}$.

Question 16 (b)

(b) $\frac{p}{q} + 0.\dot{1}\dot{3} = \frac{5}{9}$

where $\frac{p}{q}$ is a fraction in its lowest terms.

Find the value of p and the value of q.

(b) $p =$ ....

$q =$ .... **[4]**

For a majority of candidates, converting the recurring decimal into a fraction was a well-practised skill and many were able to give a correct value for *p* and for *q*. Most candidates were able to secure partial marks at least by showing $\frac{13}{99}$. Some candidates incorrectly converted $0.\dot{1}\dot{3}$ to $\frac{13}{100}$ or $\frac{13}{90}$. Many candidates were able to reach a correct fraction of $\frac{42}{99}$, but then did not give the fraction as an answer in its lowest terms. Some candidates attempted to work with recurring decimals, converting $\frac{5}{9}$ to $0.\dot{5}$ as a first step. This strategy was far less successful in reaching the correct final answer.

Question 17

17 A rhombus is drawn on a coordinate grid.

One diagonal of the rhombus has equation $y = \frac{1}{2}x + 3$.

The other diagonal passes through the point (1, 7).

Find the equation of the other diagonal of the rhombus.
Give your answer in the form $y = mx + c$.

$y =$ .... **[4]**

This question was one that candidates struggled with most on the paper. The most common error was to consider that the other diagonal also had a gradient of $\frac{1}{2}$, but passed through (1, 7). Answers of $y = \frac{1}{2}x + 6.5$ were very common. Those candidates who understood the diagonals of a rhombus were perpendicular and used a gradient of −2 for the required diagonal invariably went on to give a correct equation. Only a few candidates attempted to sketch a rhombus, which may have helped some to establish the perpendicular property of the diagonals.

Question 18

18 $\sqrt[5]{p^2} = (\sqrt[3]{m})^2$ and $p = m^x$, where $p > 0$, $m > 0$ and $p \neq m$.

Show that the value of x is $\frac{5}{3}$. **[3]**

This proved very challenging for candidates and the majority did not make any attempt to answer it. Many of those making an attempt did not know really where to start and often misinterpreted the meaning of the root and index notation in the question, e.g. $\sqrt[5]{p^2} = p^{\frac{5}{2}}$ or $\sqrt[10]{p}$. Some tried to use a numeric value instead of p and/or m.

The most successful strategy used was to express both expressions in p and m using correct index notation $p^{\frac{2}{5}} = m^{\frac{2}{3}}$. To arrive at $x = \frac{5}{3}$ candidates needed then to show that $p = \left(m^{\frac{2}{3}}\right)^{\frac{5}{2}}$ leading to $\frac{2}{3} \times \frac{5}{2} = \frac{5}{3}$. A number were able to set up the index equation to earn method marks, but fewer were able to complete it correctly without errors seen, to earn the final mark

Other successful strategies made p the subject of the formula $\sqrt[5]{p^2} = (\sqrt[3]{m})^2$, where candidates showed correct single step line by line inverse operations involving the roots and indices.

Question 19

19 A box contains 25 discs.
The discs are either blue or yellow in the ratio 4 : 1.
Two discs are chosen at random from the box without replacement.

Find the probability that the two discs are different colours.
You must show your working.

.... **[5]**

Many candidates were successful with this question and the majority used a tree diagram to structure the problem. Almost all candidates were able to score at least 1 mark for finding the number of blue and yellow counters, or for working with some correct probabilities within their working. Most used fractions for the probabilities; those that used decimals such as 0.8 and 0.2 for the first disc often made errors with the probabilities for the second disc owing to the dependency of the second probability on the first. Some candidates incorrectly treated the problem as a 'with replacement' problem and gave the same probabilities for the second disc as the first disc.

For those showing the correct products of probabilities, many were able to multiply the fractions correctly and then add the two correct pairs. Some used unsimplified fractions for the products and made errors in multiplying the denominators (24 × 25). Other errors occurred in adding the product pairs, e.g. $\frac{1}{6}+\frac{1}{6}=\frac{2}{12}$.

A common error for those using tree diagrams was to record the first stage probabilities as simplified fractions $\frac{1}{5}$ and $\frac{4}{5}$ and then to use $\frac{0}{4}$, $\frac{4}{4}$, $\frac{3}{4}$ and $\frac{1}{4}$ for the second stage probabilities, thinking there were 5 discs in the bag originally. In this case the second stage probabilities were a correct 'follow through' of the first stage without replacement and so method marks for the products were available; many scored 3 marks for a correct method shown with their probabilities (which led to an answer of $\frac{2}{5}$ in this case). There were other cases of this where the first stage probabilities were incorrect, but the second stage correctly followed through and method marks were then earned for the products.

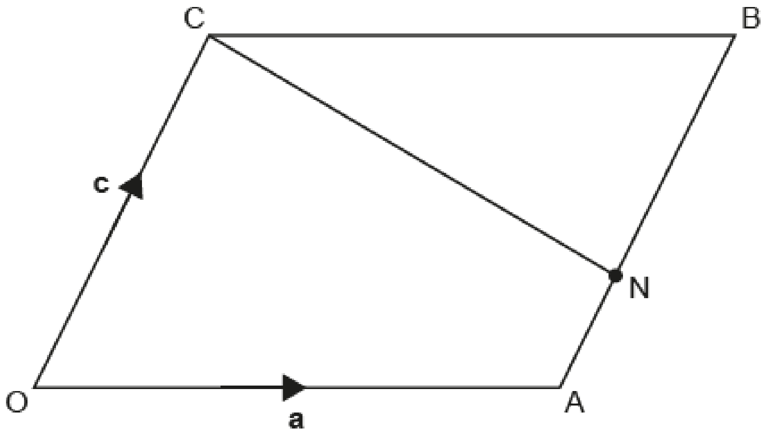
Most understood when to multiply and when to add probabilities in their method.

Assessment for learning

When recording fractional probabilities on a tree diagram, it is better to record unsimplified fractions on the branches to make sure that where the second stage probabilities are dependent on the first, the values used for the second stage are more easily recognised. Answers to probability questions do not need to be given as unsimplified fractions unless the question specifically requests that.

Question 20 (a) (i)

20 OABC is a parallelogram.



Not to scale

$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{c}$.
The point N lies on line AB such that AN : NB = 3 : 5.

(a) Find the following vectors in terms of **a** and **c**.
Give your answers in their simplest form.

(i) $\overrightarrow{OB}$

(a)(i) $\overrightarrow{OB}$ = ... **[1]**

A significant number of candidates did not attempt this part involving vectors. Of those candidates that attempted it, the majority did give a correct answer in terms of **a** and **c**. Common incorrect answers included **ac**, **a** + 8, and column vectors such as $\begin{pmatrix} 8 \\ 8 \end{pmatrix}$ or $\begin{pmatrix} \mathbf{a} \\ \mathbf{c} \end{pmatrix}$.

Question 20 (a) (ii)

(ii) $\overrightarrow{ON}$

(ii) $\overrightarrow{ON}$ = ... **[2]**

This part was often omitted, but those candidates who attempted the question often gave a correct answer. The most common errors included $\mathbf{a} + \frac{3}{8}$, $\mathbf{a} + 3\mathbf{c}$, $\mathbf{a} + \frac{1}{3}$ and $\mathbf{a} + \frac{3}{5}\mathbf{c}$. Only a few candidates wrote a correct vector route for $\overrightarrow{ON}$ or gave $\overrightarrow{AN} = \frac{3}{8}\mathbf{c}$ or $\overrightarrow{BN} = -\frac{5}{8}\mathbf{c}$ within their working (for which a part mark was given).

Assessment for learning

When attempting questions like this involving routes with more than one vector, candidates should always write the vector route in terms of the given line segments first, e.g. $\overrightarrow{ON} = \overrightarrow{OA} + \overrightarrow{AN}$. Examiners here could award a part mark for a correct route written in working.

Misconception

Candidates should recognise that if AN : NB = 3 : 5, then AN is $\frac{3}{8}$AB and not $\frac{3}{5}$AB.

Question 20 (b)

(b) Line CN is extended to reach point P, such that $\overrightarrow{CP} = \frac{8}{5}\overrightarrow{CN}$.

Show, using vectors, that OAP is a straight line. **[4]**

This question was a challenge for almost all candidates. The majority of candidates either didn't attempt this part at all, or annotated P on the diagram and wrote nothing further.

The candidates who made progress on this question attempted, often successfully, to find the vectors $\overrightarrow{CN}$ and $\overrightarrow{CP}$ or $\overrightarrow{NP}$ in terms of **a** and **c**. Some were then able to show that $\overrightarrow{OP} = \frac{8}{5}\mathbf{a}$ or $\overrightarrow{AP} = \frac{3}{5}\mathbf{a}$. Very few were then able to articulate the reasoning needed for the final mark, to show that OAP is a straight line using the vectors $\overrightarrow{OP}$ or $\overrightarrow{AP}$ and $\overrightarrow{OA}$.

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