MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

Candidates need to have completed full syllabus coverage, remember necessary formulae, show all necessary working clearly and use a suitable level of accuracy.

Candidates must read the question carefully and check that the answer is sensible for the context and is in the form required by the question.

General comments

There were many well-presented scripts with full working shown and many questions very well answered by candidates. Challenges came in questions which required more than one step in the solutions, particularly **Questions 11**, **13** and **21**. Candidates also found some of the problem-solving questions challenging, such as **Questions 5(a)** and **6(b)**.

Comments on specific questions

Question 1

(a) Most candidates gained credit for the order of rotational symmetry but angles of 180 or 360, as well as the number 4, were seen a number of times. A few candidates wrote a word, e.g. symmetry, as the answer.

(b) While many candidates showed the two correct lines of symmetry, some either only gave one line (usually the horizontal one) or added a diagonal line. There were a few cases of horizontal lines joining the top and bottom points of the figure and there were some who did not attempt any lines or decided there weren't any.

Question 2

(a) While some drawings were inaccurate or un-ruled, nearly all candidates managed to draw a kite.

(b) Only a small number of candidates gained full credit for the properties of a rhombus. General properties of quadrilaterals, 360° or 4 sides were not specific enough and properties such as opposite sides equal did not distinguish between a parallelogram and a rhombus. The properties needed to be from two different aspects of the rhombus, namely sides, angles, diagonals and symmetry. There were quite a large number of blank responses, suggesting that many did not know what a rhombus was.

Question 3

Almost all candidates gained credit for the square root.

Question 4

A few candidates gave a multiple of 9 that was not in the range requested in the question. While the vast majority gained the mark, there were quite a number who gave the answer 12, the multiplier of 9 rather than the multiple.

Question 5

(a) This question was not well understood since many candidates did not realise that an alternative rounding to the nearest 100 was required. An incorrect rounding given was to the nearest 1000, while some stated that it was not correct to the nearest 100, a given fact in the question.

(b) The vast majority of candidates could work out the calculation correctly but many found the rounding to 3 decimal places challenging. Consequently, partial credit was more common than full credit with many responses of 8.67 or 8.68 seen (3 significant figures instead of 3 decimal places). Some gave 8.677 or answers with more places of decimals.

Question 6

(a) While this question was answered well, many only gained partial credit since they did not apply the instruction to give the answer in centimetres. The term range was not known by some who found the mean. Of those attempting a range, the common error was not being able to identify the largest and smallest heights.

(b) This part was challenging for many candidates and there was a lack of understanding of what was being asked. An answer of 0.18 was seen and others thought it was related to greatest and least values, 17.5 and 18.5. Many did find one of the correct values but 165 + 18 and 153 – 18 were worked out quite often. Many gave answers which were not sensible for the height of a person.

Question 7

(a) There was a lack of knowledge of vectors seen by some candidates. Some regarded the vectors as fractions, leading to $\frac{-6}{7}$ in this part. Some with the correct components also added a fraction line.

(b) Some candidates made errors adding directed numbers resulting in more incorrect answers from those who did understand vectors.

Question 8

The standard ratio question was very well answered with most achieving fully correct solutions. The main error was finding $\frac{5}{8} \times 78$ leading to answers of 48.75 and 29.25.

Question 9

Whilst some responses showed a pyramid rather than a prism, most candidates who understood nets gave a drawing having three rectangles and two triangles, although not all the correct size. Many candidates lost credit by drawing a triangle with a height of 3 cm or 4 cm. A significant number appeared unfamiliar with drawing a net leading to no attempt or a 3-D drawing.

Question 10

This question was well answered by those who understood what was required. Those attempting it usually had all the leaves in the correct rows but often did not have them in order. A few candidates only wrote one 9 and one 4 in the first and second rows respectively and some included the stem with each leaf.

Question 11

The key to success in this question was to realise the first step was to find the total of the nine numbers from 9×17. Many candidates did not do that and consequently could not make much progress. Those who did reach that stage usually found the 21 but were not sure what that meant. Many then either gave two numbers adding to 21 or two numbers with a difference of 5. It was a small number who combined both properties of the two numbers to reach the correct final answer.

Question 12

The factorising was well done and the vast majority who understood the topic took the two common factors outside the bracket. The main error then was writing *t*, rather than 1 as the final item in the bracket. Only a few candidates lost credit from having a fully correct response but then giving a further step combining the parts of the answer.

Question 13

This question was found the most challenging on the paper with most candidates not realising that they had to relate the 96 biscuits left to the fraction $\frac{8}{13}$ and not to the sold fraction, $\frac{5}{13}$. The decimal answers resulting from this error perhaps should have made candidates realise that it had to be incorrect.

Question 14

(a) The vast majority of candidates gained full credit although there were occasional errors seen in subtracting 7 twice. A few did not read the question correctly and gave 36 and 43, terms greater than the first term.

(b) The expression for the *n*th term was not as successfully answered as the first part with many not understanding the topic. Those with some understanding usually applied the method of using the formula $a + (n - 1)d$. However, many did not realise that d was negative and the positive difference led to the commonly seen answer of $22 + 7n$. Others had a correct un-simplified expression but made errors in attempting to simplify it.

Question 15

There were many correct responses seen to this question but a significant number of candidates gave the highest common factor instead of the lowest common multiple. Only a few listed the multiples of each number, rather than using a factor method and a small number gained partial credit from $126k$, usually 378.

Question 16

(a) There were many correct responses seen to this straightforward standard form question. However, common errors were 5.67×10^6 and 567×10^6. A few candidates thought they had to round the number.

(b) This calculation was found more challenging, mainly due to the fact that many candidates did not have a full understanding of the word ‘product’. Some gained partial credit from identifying the largest and smallest number but then made no further progress or added or subtracted them. Few candidates gained full credit, even if the correct numbers were multiplied, since the answer was often rounded, instead of the full exact one and in standard form. Many found it helpful to convert all the numbers to ordinary numbers to determine the largest and smallest.

Question 17

There were many correct responses to this similar triangles question but some didn’t gain full credit as their answer was rounded to 2 significant figures. Some made errors in the ratios or thought area was involved but the significant error was to add or subtract corresponding lengths. Some of those showing correct working lost accuracy by rounding, for example, $3.2 \div 2.8$ to 1.14, before multiplying by 1.61, producing a close but not exact answer to the question.

Question 18

(a) (i) Nearly all responses were correct but some candidates divided the indices and very occasionally the answer was given as just the number 9.

(ii) Again this part was very successfully answered even though a small number of candidates gave y^7.

(b) Candidates found this part challenging with few gaining credit. Whilst 4 was a common incorrect answer, there were many attempts involving square roots, 81 and 9. Many did not attempt the question.

Question 19

This question involving multiplication of fractions with mixed numbers was well answered. Some good solutions were spoiled by giving the answer as a decimal. Some candidates were confused between multiplication and addition and so found a common denominator, usually 12, for the fractions. While this should still lead to a correct solution, the denominators were not always multiplied. Answers were often left as improper fractions and some did not cancel the fraction part to its lowest terms.

Question 20

Whilst the elimination method required both equations to be multiplied, all signs positive did ease the calculations, resulting in few arithmetic errors and many fully correct answers. Many reached the stage of $28y = 7$ but then gave $y = 4$. The substitution method was seen quite a number of times but rarely produced the correct working once the substitution into the other equation had been shown. The algebraic manipulation needed with a denominator was challenging for most of these candidates.

Question 21

This question proved to be quite challenging but there were a good number of fully correct answers. Some thought that the two shapes could be combined into a single calculation. Many gained partial credit for the area of the triangle, although not dividing by 2 was quite common. Often it was just the area of the whole circle that was added to the triangle area. Candidates should use the π key on the calculator or 3.142 since using 3.14 or $\frac{22}{7}$ didn't gain the accuracy mark. There was some confusion between area and circumference formulas.

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key messages

To succeed in this paper candidates needed to have completed a full coverage of the syllabus, remember necessary formulae, show all necessary working clearly and use a suitable level of accuracy.

General comments

There were many excellent scripts with a significant number of candidates demonstrating an expertise with the content and proficient mathematical skills. Very few candidates were unable to cope with the demand of this paper. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Omissions were due to lack of familiarity with relatively new topics, such as **Questions 21(b)** and **24**, or difficulty with the question, rather than lack of time. Other than new topics and **Question 1(b)** there were very few occasions of non-response. Candidates showed particular success in the basic skills assessed in **Questions 2**, **3(a)**, **7**, **14(a)** and **20(a)**. The more challenging questions were **Questions 10**, **15**, **19**, **21(b)**, **22(b)** and **24**. Candidates were very good this year at showing their method and it was rare to see stages in the working omitted. Some candidate lost marks due to rounding or truncating prematurely within the working, or giving answers to less than the required 3 significant figures. This was particularly evident in **Questions 6**, **13** and **23**.

Comments on specific questions

Question 1

Part (a) was generally well answered with many candidates giving the correct answer. Common incorrect answers were 1 and 4. Other answers that were seen occasionally were 90° and 180°.

Part (b) was also well answered with many candidates drawing the two correct lines of symmetry. Some only noticed one line, usually the vertical line rather than the horizontal one, and others included the diagonals and drew four lines of symmetry. This was also one of the questions with the highest number of non-responses.

Question 2

Nearly all candidates gave a fully correct answer to this question, with clearly set out working. Very occasionally $78 was divided by 5 and 8 respectively instead of by 13, there were no other common errors.

Question 3

The majority of candidates understood how to complete and interpret a stem-and-leaf diagram. A few candidates did not order the numbers in the rows but the most common loss of a mark was due to one of the values being omitted. Candidates should be encouraged to count to check that they have the correct number of data values in their diagram. The most common error in **part (b)** was to give the number 4 from the table rather than the value of 24 which it represents.

Question 4

Two common errors were to round to one decimal place such as $\frac{3.0 \times 80.0}{30.0 - 10.0}$ or to the nearest whole number so $\frac{3 \times 83}{28 - 14}$. Sometimes the subtraction was incorrectly changed to a multiplication in the denominator to give $\frac{3 \times 80}{30 \times 10}$. A few candidates calculated the exact answer which they then rounded to one significant figure or one decimal place. Some showed insufficient working such as $\frac{3 \times 8}{3 - 1}$ and although this gave the correct answer, due to the tens cancelling, only one of these figures was correctly rounded to one significant figure, as the question had asked them to show.

Question 5

It was common to see incorrect answers that seemed to indicate the candidates understood the fact that there was a relationship; for example, inverse, opposite and indirectly proportional. There were a number of candidates who gave answers such as positive, direct and proportional. A few candidates tried to explain the relationship in a sentence, often simply rephrasing the first line of the question.

Question 6

This question was well answered with the common approach to be 56.50 ÷ 5 = 11.3 then multiplied by 24. The main error was to calculate $\frac{5}{24} \times 56.50$ = 11.77. Some candidates converted $\frac{5}{24}$ to a rounded percentage, often 20.8%. Due to this premature rounding, it was common to see the inaccurate answer \$271.63 . Some candidates used an alternative approach, calculating $\frac{19}{5} \times 56.50$ (= 214.70) then adding it to 56.50. A few candidates had the incorrect starting point of $\frac{19}{24} \times 56.50$.

Question 7

This was generally very well attempted. Most candidates were able to write both fractions as improper fractions and multiply successfully. A common error was to find a common denominator and then just multiply the numerators. A small number over complicated their method by finding a common denominator, usually 12, before multiplying which then made the multiplication and subsequent simplification unnecessarily difficult.

For those candidates that did not score full marks the most common error was related to the instruction to give the answer both as a mixed number and in its simplest form. Consequently $\frac{33}{4}$ was a common incorrect final answer, as was $8\frac{3}{12}$. Very occasionally the decimal answer 8.25 was given.

Question 8

Most candidates gave the correct answer here and showed detailed working. Common incorrect answers were $\frac{37}{100}$, $\frac{37}{90}$ and $\frac{34}{90}$, the latter resulting from confusing $0.\dot{3}\dot{7}$ with $0.3\dot{7}$. A small number left answers with decimals within fractions, such as $\frac{3.7}{9.9}$.

Question 9

Most candidates correctly calculated the sum and gave the answer in standard form. A calculator was permitted in this question. Some treated it as a non-calculator question and these candidates tended to be less successful. A small number of candidates made a correct calculation, but gave the final answer in an incorrect form, such as 41.8×10^6 or 418×10^5. A very small number either made an error in the calculation or did not make an attempt at standard form. The most common error in the calculation occurred when candidates added together 4.8 and 3.7 and added the indices, giving an answer of 8.5×10^{13}. Occasionally the final answer was only given correct to two significant figures, but this was usually preceded by a fully correct answer.

Question 10

This bearings problem was one of the more difficult questions on the paper. The most successful candidates were those who marked the correct angles of 103 and 60 on the diagram and added a north line at *N*. The bearing of 103 was often marked incorrectly on the diagram; either as one of the interior angles of the triangle, as the bearing of *N* from *M*, as the bearing of *N* from *L* or as the co-interior angle at *M* between north lines at *L* and *M*. A large proportion of candidates did not use the essential information given, that it was an equilateral triangle, so working such as 180 + 103 and 360 – 103 were common. The most common errors for those who did take the 60 in account were to give answers of 103 + 60 (the bearing of *N* from *L*), 360 – (103 + 60) and 180 – (103 + 60). Many other candidates did not take the 103 into account, and used the incorrect assumption that the north line at *N* bisected the interior angle of the triangle, giving answers of 30, 360 – 30 and 180 – 30.

Question 11

Many candidates answered this question correctly. Common incorrect answers included 2, 3, 4 and 6. A common error was to calculate the lowest common multiple. The most common approach was to use repeated division to find the prime factors of 36 and 84, often in tabular form. If a single table is used it should look like either of these following tables:

	36	84
2	18	42
2	9	21
3	3	7

	36	84
2	18	42
2	9	21
3	3	7
	3	7

Many spoilt the method by further dividing by 3 and 7 when only one of the two pairs of numbers was divisible by 3 or 7, as shown below:

	36	84
2	18	42
2	9	21
3	3	7
3	1	7
7	1	1

Those who used factor trees, rather than a tabular method, to find the prime factors of 36 and 84 were more likely to score well in this question.

Question 12

This question was very well answered. Some candidates used unnecessarily complicated working such as $\frac{1}{2} \times a \times b \times \sin 90$ to find the area of the triangle. Some candidates were unsure what to do to because they did not recognise the base of the triangle was 5 cm because they did not realise it was also a radius of the quarter-circle. The most common errors were in working out the area of the quarter-circle. These ranged from using the full circle area or not using $\frac{1}{4}$ as a multiplier, instead having other multipliers such as $\frac{4}{3}$, $\frac{1}{3}$ and $\frac{1}{2}$. Sometimes the radius was not squared or a radius of 10 or 2.5 were used. Only a very few candidates had arithmetic errors. Occasionally the two areas were calculated separately with some candidates then forgetting to add on the triangle and so a common incorrect answer was 19.6.

Question 13

Some candidates attempted a year-by-year approach and usually truncated or rounded their figures causing inaccuracies in the final answer. The most successful approach was to use the formula $125.9 \times \left(1 - \frac{34}{100}\right)^5$. Some candidates unnecessarily wrote 125.9 million in full, not always correctly, with an often incorrect number of zeros. Some candidates used 1 or 6 in the formula as the index. Other common errors related to the formula such as using the addition sign, $125.9 \times \left(1 + \frac{34}{100}\right)^5$, or using 66% so $125.9 \times \left(1 - \frac{66}{100}\right)^5$. A small minority of candidates used the equation incorrectly i.e., $125.9 = x \times \left(1 - \frac{34}{100}\right)^5$

Question 14

Part (a) was by far the most successful question on the paper with only a very few candidates failing to score both marks. Of those that did not, most were from errors that could have been picked up if answers had been checked (e.g. omission of negative sign, arithmetic slip).

Part (b) was less well answered, however many candidates still scored one or two marks. Most candidates either found the correct second differences or reached an *n*th term that was quadratic. Finding the second differences were commonly seen as a starting point leading to recognition that the *n*th term was of the form $an^2 + bn + c$. Some then followed this by a strategy of $2a = 2$, $3a + b = 3$ and $a + b + c = 4$. This was often successful but if misremembered or misapplied, did lead to some very convoluted algebra that would have taken more time than a two-mark question merited. The more successful candidates realised that the second difference of the sequence was halved to get the coefficient of n^2 then wrote out the sequence 1, 4, 9, 16, 25 and compared it with the given sequence noting that the adjustment required was to add 3.

Question 15

This question was one of the least well-answered questions on the paper with the alternate segment theorem proving a challenge to many candidates. By far the most common error was to think that *EHG* = 47°, having incorrectly applied the alternate segment theorem. Consequently 86° was the most common incorrect answer. The most successful method was to use the alternate segment theorem to give *EHF* = 47° and angles in the same segment to give *FHG* = 25°. Then using the isosceles triangle *EHG* to reach the correct answer. Some assumed angle *HET* was a right angle and so 18° was another common incorrect answer. A small number of candidates thought that *EHG* = *EGH* = 25° and gave the answer as 130°.

Question 16

In this question the three straight lines need to be ruled, with those used to represent the first two inequalities dashed and the third one a solid line. There were many fully correct solutions, accurately drawn with a ruler. The most common error seen was for all three lines to be solid. A few candidates used a dashed line where they should have used a solid line and vice versa. A common error was for the straight line used to represent the first inequality to be drawn along $x = 1$ rather than $y = 1$. Most candidates correctly shaded the unwanted region and labelled the region that satisfied the three inequalities correctly. Those that made an error with one of the lines often labelled a region that satisfied two of the inequalities and therefore achieved some of the marks for their region.

Question 17

Successful candidates employed an efficient algebraic strategy to this problem and were able to solve the equation which they set up. Many set up the correct equation $\frac{5\times4+6\times5+7x+8\times11+9\times7+10\times5}{32+x} = 7.6$, although some only had the expression on the left-hand side and did not equate to 7.6. After the correct equation, some made mistakes either collecting the terms or attempting to solve it, the most common of which was omitting the brackets in $251+7x = 7.6(32+x)$ when multiplying the denominator. It was fairly common to see $32x$ as the denominator and less frequently $251 \times 7x$ as the numerator, either as a starting point or after incorrectly simplifying. Common fundamental errors were to set up the mean as $\frac{\sum f}{6}$ or $\frac{\sum fx}{6}$ where 6 is the number of categories, or to add the number of books in each category, 5 + 6 + 7 + 8 + 9 + 10 as either the numerator or denominator for the mean calculation. Weaker candidates tried to find a sequence within the frequency, often giving an answer of 6 following the first two frequencies of 4 and 5.

Question 18

Most candidates answered this question correctly. Some weaker candidates found the question beyond them and did not attempt the question.

A small number of candidates left their answer only partially simplified such as $[7x^3]^2$. Some candidates spoilt their correct simplified answer of $49x^6$ by changing it to 7^2x^6.

Question 19

This question proved rather difficult, particularly for the weaker candidates, with many of these scoring no marks at all. Some were able to show that they knew they had to rearrange one equation and substitute, thus scoring M1. However, $x = 7 - y$ was commonly incorrectly used. Others followed the correct rearrangement of $x^2 = 149 - y$ with the incorrect working $x = \sqrt{149} - \sqrt{y}$. There were a variety of rearrangements and substitutions possible and a common mistake was a sign error in the initial rearranging. The most successful candidates realised the easiest method was to add the two equations to give $x^2 + x = 156$. Others added incorrectly to give $2x^2 = 156$. These candidates then went on to give $x^2 = 78$ and $x = 8.8$. On occasion, it seems likely that the candidate had used their calculator to solve the quadratic since the values for y or x were often given with no working. Candidates need to be reminded that when the question states ‘you must show all your working’ no steps should be missed out. Many candidates took the easier route of factorising the quadratic although a considerable number preferred to use the formula to solve their quadratic. Some candidates who solved their quadratic in y completed the work correctly and then incorrectly equated their two solutions to x instead of y. Candidates are advised that during their checking stage it is a good idea to substitute both solutions back in to at least one, if not both, of the original equations.

Question 20

Part (a) was answered very well by nearly all candidates. The most common error was to calculate $\frac{3.2}{2.8}$ as 1.1 or 1.14 giving an inaccurate answer as a result of this premature rounding. There were a few who used addition rather than multiplication by a scalar so 1.61 + (3.2 – 2.8).

Part (b) was much more challenging. The best attempts usually started with either of the factors $\sqrt[3]{\frac{4}{7.8}}$ (=0.8) or $\sqrt[3]{\frac{7.8}{4}}$ (=1.249.. or 1.25) and then they used it correctly with 11.5. Many converted the litres to cm^3, which was unnecessary but rarely led to an error. The most common error was to use a linear factor, from $\frac{11.5}{x} = \frac{7.8}{4}$ to reach the common incorrect answers of 5.897 or 5.9 or even 6. Less common was the use of the area factor $\left(\frac{11.5}{x}\right)^2 = \frac{7.8}{4}$ to give 8.24. A significant number of candidates used the incorrect volume factor from $\frac{11.5}{x} = \left(\frac{7.8}{4}\right)^3$ giving 1.55 . Sometimes a method would be muddled, for example instead of starting with $\frac{11.5^3}{x^3} = \frac{7.8}{4}$ they might have $\frac{11.5^3}{x^3} = \frac{4}{7.8}$ or $\frac{11.5^3}{7.8^3} = \frac{x}{4}$ or other similar variations.

Question 21

Curve sketching proved to be a challenge to some candidates, and it is a relatively new topic to the syllabus. There was a significant variation in the quality of the sketches in both parts of this question.

In **part (a)** some candidates clearly knew what the shape of $\frac{1}{x}$ should look like. The best sketches clearly demonstrated how the branches approached the asymptotes; the worst had significant curving away from the axes and no attempt at the symmetry. Several looked like they were only partially remembered, e.g. having two branches in the correct quadrants but nothing of their asymptotic nature, or only drawing the sketch in one quadrant, usually the first. Of those that didn’t know what $\frac{1}{x}$ looked like, a few did successfully work out a table of values and used these to produce their ‘sketch’. Quite often this approach was not successful as usually insufficient points were found to give the structure. There were many incorrect responses, usually linear, although occasionally $\frac{1}{x^2}$ was sketched. A significant number of candidates offered no response.

Part (b) was the least well-answered question on the paper. Those candidates that knew what an exponential curve looked like tended to do a better sketch on this than with the $\frac{1}{x}$ sketch, but fewer knew the exponential shape than the reciprocal graph and again, a significant number of candidates offered no response. Common incorrect responses were a straight line, a parabola and sometimes the reciprocal graph that should have been in **part (a)**. This tended to be less successful for those that attempted the plotting points method as there usually weren’t enough points for $x < 0$ to clearly show it approaching the asymptote.

Question 22

Part (a) was generally well attempted with most giving the correct answer of 245 kg. Of the rare incorrect responses, the most frequently seen was from those who found 10×25 and then rounded down to give 249.5 as their answer. 245.5 was also often seen. Occasionally the number of bags was rounded down to 9.5 then multiplied by 25 to give 232.75.

Part (b) was not so well attempted with the majority of candidates giving incorrect responses. Many were able to give the correct bound for 200 rounded to the nearest metre, although a few gave the lower bound instead of the upper. Many were unable to give the correct bound for 3 metres to the nearest 20 centimetres, with 3.2 and 2.8 metres frequently seen. Quite a few of those who gave the correct bounds found 200.5 ÷ 2.9 = 69.1378 and left that as their answer, not realising that the final number of pieces must be an integer. Another group used two upper bounds in their calculation, or divided a lower bound by an upper bound instead of an upper bound by a lower bound. There was a sizeable minority who simply divided 200 by 3 to give 66.666 and the gave their answer as 66 or 67 showing no understanding of the concept of bounds.

Question 23

Many fully correct solutions were seen, although some candidates prematurely rounded some of the calculated lengths which lead to accuracy errors in the final result. For example, it was common to see the length *AC* rounded to 15.6 leading to a result of 7.8 for the length of *MC* and an angle of 56.14…° rather than 56.09…°. It is important to use more significant figures in the working than are required in the final answer. Most candidates who made this error earned method marks for their work, but it was important that the working was clearly shown, and this was not always the case. Some candidates calculated the size of the wrong angle and some weaker candidates tried to use all three of the given lengths and the cosine rule.

Question 24

This question was one of the more difficult questions on the paper and is a relatively new topic. A minority of candidates offered no response to this question. Many candidates who attempted the question understood that the demand to find the stationary points required them to differentiate the equation and most did this correctly for at least one term. The most common errors were forgetting to multiply the coefficient by the index, hence giving $-2x$ rather than $-4x$ and to leave in the constant of 5 or change this to 1 in the derivative. Some candidates could progress no further but many understood the need to equate the derivative to 0. Some candidates confused the purpose of the second derivative and equated that to 0 instead of the first derivative. Others found both solutions correctly for *x* but then substituted these into the second derivative to find the *y* coordinates. Some candidates struggled to solve the quadratic, perhaps thrown by the fact that there was no '*c*' value to factorise or use in the quadratic formula. Some divided $3x^2 - 4x = 0$ by *x* instead of taking it out as a factor therefore only finding one solution. Sometimes these candidates then used the second derivative equated to 0 to find the second solution. Candidates with a fully correct method sometimes lost an answer mark due to arithmetic errors when substituting $\frac{4}{3}$ to find the y coordinate and others working in decimals often rounded prematurely, giving either 1.3, 3.8 or both. Candidates need reminding that answers should be given as exact or correct to three significant figures. Candidates who did not score were generally trying to solve the cubic equation for $y = 0$. This often consisted of using the coefficients of the cubic as $a = 1$ $b = -2$ and $c = 5$ incorrectly in the quadratic formula. Others with no clear starting point tried substituting various values of *x* into the original equation.

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key messages

To succeed in this paper, candidates need to have completed full syllabus coverage, remember necessary formulae, show all working clearly and use a suitable level of accuracy. Particular attention to mathematical terms and definitions would help a candidate to answer questions from the required perspective.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper and made an attempt at most questions. Although many questions have a common theme, candidates should realise that a number of different mathematical concepts and topics may be tested within the question. The standard of presentation and amount of working shown was generally good. Centres should encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be paid to the degree of accuracy required, and candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer. In 'show that' questions, candidates must show all their working to justify their calculations to arrive at the given answer. In 'explain' questions candidates must answer fully and use the correct mathematical terminology. Candidates should also be reminded to show all steps in their working for a multi-stage question and should be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set.

Comments on specific questions

Question 1

(a) This part on reading and interpreting the given bar chart was answered correctly by the majority of candidates.

(b) This part on finding the required fraction was generally well answered although common errors of $\frac{3}{12}$, 3, 0.15 and 15% were seen.

(c) This part on finding the required probability was generally well answered although common errors of 9, $\frac{11}{20}$ and $\frac{9}{12}$ were seen.

(d)(i) The whole of **part (d)** proved challenging for a significant number of candidates with many not appreciating what was required. In **part (i)** common errors included a variety of numerical answers, median or mean.

(ii) In this part the correct answer of Biology was rarely seen, with common errors including 11 and 6.67 (from an attempted mean).

(iii) This part proved challenging for the majority of candidates who did not realise that the explanation was that the data was qualitative and not quantitative. The most common correct explanations were in the form of '*because there are no numbers*', '*the data is not numerical*' and '*they are subjects not numbers*'. Common errors included '*there are only 3 values*', '*it is a bar chart*', '*not enough information*', '*it is inaccurate*'.

(e) (i) This part on completing the table for the required pie chart was generally well answered although common errors included 55%,15% and 30% for the angles, and incorrect angles from incorrect or inaccurate calculations.

(ii) This part on completing the pie chart was less successful although a good number of correct and accurate diagrams were seen. A small yet significant number of candidates were unable to draw the angles within the required accuracy after correct angles were seen in the previous part.

Question 2

(a) This part on calculating a percentage was answered correctly by the majority of candidates, although the common errors of 12.5 and 114 were seen.

(b) This part on working out the temperature from the given information was less successful. Most candidates worked this out in two stages with many being able to score partial credit for a correct first step. The two methods of (21 – 26.7) + 3.2 and 21 – (26.7 – 3.2) were equally seen. Common errors included 2.5, – 8.9, 8.9 and 44.5.

(c) The majority of candidates understood the method to be used in this multi-stage calculation and a good number of fully correct answers were seen. Most candidates worked this out in stages with many being able to score partial credit for a correct stage. The most common method was to find the cost for the child, the cost for the two adults, and then adding these values together. Common errors included finding the cost for just one adult, omitting the cost for hiring the helmets, and using the wrong value from the table for one or more components. A small number did not appreciate the values given in the table and used, for example, 47.60 × 3 instead of 47.60 in their calculations. Candidates should be reminded that as the answer was an exact answer it should not have been rounded to $432.

(d) The majority of candidates understood the method to be used in this multi-stage calculation and a good number of fully correct answers were seen. Most candidates worked this out in stages with many being able to score partial credit for a correct stage or value. A very common error was in not appreciating the significance of the 3 hours and the 7 hours, resulting in an answer of 3600 + 3000 = 6600. Other common errors included the use of 40 000 (from 4000 × 10), calculation errors, and incorrect methods to find a percentage, such as 4000 ÷ 90 × 100.

(e) This 'show that' question on exchange rates and money conversion was answered reasonably well, with the two valid methods equally seen. However, the method of first changing the $684 into rupees, which therefore only involved one conversion, was the more successful. As this was a 'show that' question the full working of, for example, 684 ÷ 0.0129 = 53 023 and 53 023 – 51 400 = 1623 had to be explicitly seen.

(f) This part was generally answered reasonably well although a significant number found the concept of upper and lower bounds challenging. Common errors included 2641 and 2643, 2641.5 and 2642.4, 2640 and 100, 2645 and 2655.

Question 3

(a) This part on measuring a marked angle was not generally answered well, with many candidates not appreciating that all they had to do was measure the stated angle with a protractor. Common errors included 68°, 108°, (–3, 7), a variety of other coordinates or vectors and distances such as 7 cm.

(b) This part on congruency was generally answered reasonably well, with the acceptable answers of '*same size and shape*', '*lengths are equal*' '*SAS*', '*it's a rotation*', and '*same lengths and angles*' being the most common. Common errors included '*the angles are the same*', '*it's a reflection*', '*AAA*', '*same area*', '*it's similar*' and '*the height and width are the same*'.

(c) (i) This part was generally answered reasonably well with a number of candidates able to identify the given transformation as an enlargement and able to correctly state the three required components. The identification of the centre of enlargement proved the more challenging with a significant number omitting this part, and (0, 0), (4, –3) and (3, 4) being common errors. The scale factor was sometimes omitted or incomplete, with 2 being the common error. Another common error was simply to list coordinates.

(ii) This part was generally answered well with the majority of candidates able to identify the given transformation as a rotation and able to correctly state the three required components. The identification of the centre of rotation proved the more challenging with a significant number omitting this part, and (3, 1) and (–3, –1) being common errors. The angle of rotation was sometimes omitted or incomplete, with 90° being the common error. Other common errors were simply to list coordinates, and to describe the transformation as a reflection and/or a translation.

(d) (i) Many candidates were able to correctly draw the required translation although common errors included getting only the horizontal or vertical component correct.

(ii) A smaller number of candidates were able to correctly draw the required reflection and this part proved to be challenging for many candidates. Common errors included reflections in $x = –1$, reflections in a variety of other horizontal lines, particularly $y = 0$.

Question 4

(a) This part was generally answered well with the most successful candidates drawing the two given bearing lines to identify their intersection as the position of *J*. The bearing of 284° proved to be the more challenging bearing line to draw.

(b) (i) The majority of candidates were able to measure accurately at 12 cm and then use the given actual distance to correctly complete the scale as 1 cm represents 800 metres. Common errors included 960, 12 and 19 200.

(ii) This part involving a formula calculation and a conversion to find the required time of arrival proved challenging for many candidates and was a good discriminator. Although the majority of candidates were able to identify and correctly use the formula T = D ÷ S, as 9.6 ÷ 4.5 = 2.13… hours, the common errors of 9600 ÷ 4.5, 96 ÷ 4.5 and 9.6 × 4.5 and use of 10 15 were seen. However, the conversion to either 128 minutes or 2 hours 8 minutes proved more challenging and few correct final answers were seen. A very common error was 12 28.

(c) (i)(a) Although the majority of candidates were able to identify and correctly use the formula D = S × T, many had an inaccurate answer by using 4.5 × 0.3, 4.5 × 0.33 or 4.5 × 20. The common errors of 4.5 ÷ 20, and use of 15 00 were also seen.

(i)(b) This part on drawing the travel graph was generally answered well, with a follow through allowed, with the most successful candidates drawing the two necessary lines to show the arrival at (16 00, 7.5). However, a very common error was to not appreciate that the distance they ran was a further 6 km, and so ended their journey at (16 00, 6).

(ii) This part on completing the travel graph was less successful although candidates were able to score marks on the follow through basis. A good number of candidates were able to draw a horizontal line ending at 18 05 to show the time spent at the cinema. However very few correct answers to the final part of the journey were seen, with the very common error of finishing at (19 00, 0). There was little evidence of candidates using the formula T = D ÷ S to calculate the time taken on this final part of the journey.

Question 5

(a) The table was generally completed very well with the majority of candidates giving 6 correct values for full credit.

(b) This part was well answered by many candidates who scored full credit for accurate, smoothly drawn curves. Most others scored partial credit, commonly as one or more points were plotted out of tolerance, or for just plotting the points without drawing the curve through them.

(c) (i) This part on identifying the equation of the line of symmetry was poorly answered. Common errors included $x = 0.5$, $y = –0.5$, 0.5, –0.5, $y = mx + c$ and $y = –x^2 – x + 14$. Although not required it may have helped candidates to draw the line of symmetry first.

(ii) This part on finding the coordinates of the highest point was poorly answered. Common errors included (0, 14), (–1, 14), and inaccurate answers such as (–0.4, 14.2). Using the symmetry of the graph would have given the required *x*-coordinate directly.

(d) This part on solving the given equation was generally answered reasonably well. Common errors included using the intersection of the graph with the *x*-axis, or misreading the scale giving 3.2, –4.2. Those candidates who attempted to use the quadratic formula rather than the graph were rarely successful.

Question 6

(a) This part on explaining what parallel means was generally well answered. The most common correct explanations were in the form of '*they never meet*', '*do not intersect*', '*same gradient*' and '*same distance apart*'. Common errors included '*equal lines*', '*next to each other*', '*opposite and equal*' and '*have same length*'.

(b) This part was generally answered very well, although the common error of (8, 5) was seen.

(c) (i) This part was generally answered very well, although a variety of other names were seen.

(ii) This part was generally answered well, although a number of incorrect formulas and inaccurate measurements were seen.

(d) (i) This part on finding the gradient was generally well answered, although the common errors of 2.5, 6, –0.4 and –2.5 were seen.

(ii) This part on finding the equation of the given line was generally well answered, particularly with the follow through of their gradient allowed. Common errors included $0.4x + 6$ (partial credit only as not an equation), $x + y = 6$ and $y = 6$.

Question 7

(a) The majority of candidates understood the method to be used in this multi-stage calculation and many fully correct answers were seen. Most candidates worked this out in stages with many being able to score partial credit for a correct stage. The most common method was to find the number of bunches required, then the cost of two bunches under the special offer, and then perform the calculation 3×5.36. Common errors included 9×2.68, 9×5.36, 6×5.36 and 45×2.68. As the answer was an exact answer it should not have been rounded to \$16.10 or \$16.

(b) This part was generally answered well, although a number of ratios given as the answer were not in their simplest form, gaining only partial credit. Common errors included 15:18:33, 15:18:45 and 0.3:0.4:0.26.

(c) (i) Many candidates found this 'show that' question involving the use of algebra to set up the given equation very challenging and it proved to be a good discriminator. Many candidates did not appreciate that the given information had to be written in algebraic form, or did this incorrectly, and that then the four terms could be added and equated to 45, which after simplifying would give the required equation. A very common error was to solve the given equation to obtain $x = 11$, and then to use this value to confirm the numbers 11, 19, 5 and 10. Other common errors included the use of $(6 - x)$, $(12 - 2x)$, $x^2 - 6^2$, omission of the x, and incorrect simplification.

(ii) This part on solving the given equation was generally answered well, with the majority of candidates obtaining the correct solution. A common error was $5x = 45 - 10$ leading to $x = 7$.

(iii) This part on using the value obtained was generally answered well, although common errors included not appreciating that the initial data was to be used, using the data incorrectly, and using different people to give answers of 11, 19 or 10.

Question 8

(a) This part on completing the clock diagram was generally answered very well, although there were some incorrectly drawn diagrams indicating a time of 2.30, and times of 5.50, 6.05 and 5.10 shown.

(b) The majority of candidates understood the method to be used in this calculation and many fully correct answers were seen. Common errors included answers of 24 750, 247.5, 2.475 and $0.55 \times 360 = 198$.

(c) This part on calculating the best value was generally answered well, with the most common method being to compare the g/cent values, although a number of other valid methods were seen. Common errors included selecting the incorrect bag after correct comparisons seen, calculations not evaluated to enough accuracy for comparison, and incorrect methods involving the differences between costs and masses.

(d) This part on finding the percentage profit was generally found challenging and few correct methods were seen. Common errors included the use of $\frac{41}{65}$, $\frac{24}{65}$, $\frac{65}{41}$ and $\frac{24}{41}$.

(e) (i) This part on using the given Venn diagram was generally answered well although the notation used in the question was not always fully understood. A very common error was to write down the actual elements rather than the number of elements, often Jai and Nera, Taj, or a list of all 12 names.

(ii) This part was generally answered well although common errors of $\frac{11}{12}$, $\frac{2}{12}$, $\frac{1}{12}$, $\frac{6}{12}+\frac{3}{12}$ and $\frac{3}{9}$ were seen.

(iii) This part on using the given Venn diagram was generally answered well although the notation used in the question was not always fully understood.

(iv) This part was generally answered well. One common error was in interpreting the diagram as shown by such answers as '*likes both cakes*', '*likes no cakes*' and '*likes chocolate and/or lemon*'. The other common error was in interpreting the given information as shown by answers such as '*Taj is the baker*', '*it is universal*', '*he doesn't like anybody*' and '*nobody chooses Taj*'.

Question 9

(a) This part on the perimeter and area of rectangles was generally answered well. A number of responses such as rectangles measuring 2 by 9, 4 by 7, 5 by 6, or 4 by 6 fitted one of the two required conditions and so could be awarded partial credit. A small number of candidates drew rectangles such as 4 by 8 and 3 by 9 that fitted neither condition, or drew a triangle.

(b) This part involving finding the value of an unknown angle was generally reasonably well answered although significantly fewer candidates were able to give acceptable reasons. Common errors included 62, 86 and 139. Candidates should be reminded that when a geometrical reason is asked for it must be correct, complete and use the relevant mathematical terms.

(c) This part involving the drawing of a tangent was generally very well done, although common errors of drawing diameters, radii and chords were seen.

(d) This part on working out the number of sides of a regular polygon was generally reasonably well answered with the most successful candidates performing the calculation $\frac{360}{24}$ to obtain the correct answer of 15. A variety of incorrect or incomplete methods were seen.

(e) This problem-solving part involving a multi-stage calculation to find the required length proved challenging and demanding for many candidates and was a good discriminator. Candidates often recognised the initial stage of using Pythagoras' theorem, although the use of trigonometry for the second stage was not always appreciated. Common errors included premature approximation, incorrect use of Pythagoras' theorem and/or trigonometry, incorrect assumptions that triangle *ACD* was right-angled or *BD* = 7.4 or *BC* = 7.4, and incorrectly attempting to use the area.

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key messages

To do well in this paper, candidates need to be familiar with all aspects of the syllabus. The recall and application of formulae in varying situations is required as well as the ability to interpret situations mathematically and problem solve with unstructured questions.

Work should be clearly and concisely expressed with intermediate values written to at least four significant figures and only the final answer rounded to the appropriate degree of accuracy.

Candidates should show full working with their answers to ensure that method marks are considered where answers are incorrect.

General comments

The paper proved accessible for almost all candidates and this was reflected in the excellent responses to some questions. Candidates appeared to have sufficient time to complete the paper and any omissions were due to lack of familiarity with the topic or difficulty with the question, rather than lack of time. The presentation in most cases was very good with methods clearly shown.

Most candidates followed the rubric instructions but there continue to be a number of candidates of all abilities losing unnecessary accuracy marks by either making premature approximations in the middle of a calculation or by not giving answers correct to the required degree of accuracy. This was particularly obvious in questions involving trigonometry, Pythagoras' theorem and mensuration.

The topics that caused most difficulty were harder probability involving different arrangements, manipulative algebra involving fractions, using statistics to compare two distributions, harder factorising and problems involving vectors. The topics where candidates were most successful were problems involving household finance, transforming given shapes, drawing algebraic graphs, currency conversions, drawing histograms and area of a sector.

Comments on specific questions

Question 1

(a) All candidates obtained the correct amount.

(b) Most candidates demonstrated a good understanding of a fixed charge and found the correct number of hours. A common error involved adding the fixed charge and the hourly rate before attempting a division and, in a smaller number of cases, some ignored the fixed charge and only used the hourly rate.

(c) Candidates were less successful in this part. A common error was to give the answer 4 hours, which is the number of hours charged at $32 per hour without adding the first 2 hours of work. It was also common for candidates to misinterpret the charging information and read it as a total of $48 for the first 2 hours rather than $48 per hour for the first 2 hours. Some candidates added the two hourly rates and divided $224 by this total.

(d) Most candidates started correctly and went on to obtain the final answer. Some could not identify the common factor and left the answer unsimplified. Numerical slips and cancelling too far were the common causes of incorrect final answers. A small number attempted to divide the ratio by 721, the sum of the three parts. A small number wrote a ratio of hours worked or hourly rates.

Question 2

(a) (i) A majority of candidates successfully described the rotation and its properties. The most common error involved an incorrect centre of rotation.

(ii) Only a minority of candidates successfully identified the correct enlargement and its properties. The most common error involved an incorrect scale factor, usually 2, –2 or $\frac{1}{2}$, followed closely by an incorrect centre of enlargement. A significant number of candidates gave a combination of two separate transformations.

(b) Correct translations were frequently seen. A correct horizontal or vertical displacement earned partial credit for some candidates. Some candidates had the vector components reversed and translations by $\begin{pmatrix} -10 \\ -5 \end{pmatrix}$ were seen. Several responses had images with an incorrect height or width.

(c) Candidates fared better with the reflection and many correct responses were seen. Common errors included images with incorrect heights. A small number of candidates appeared to reflect triangle *A* in the *y*-axis and then drop it down to rest on $y = 4$.

Question 3

(a) Many candidates obtained all three angles correctly. Where errors were made they usually involved angle *b* or *c*. Some candidates appeared confused as to which pairs of angles were co-interior.

(b) The use of angles in a triangle followed by alternative angles was the most common approach with only a few opting to use co-interior angles. Fully correct answers were rare. Not all candidates used the correct terminology when giving their reasons, for example, when explaining why the angle *PRQ* is 90° and incorrectly using 'alternate segment' or 'alternative angles' instead of alternate. Some candidates, however, did not give reasons for every stage of their working and a minority gave no reasons to support their answer. Occasionally the value of *x* was given incorrectly, usually as 58°. Some candidates incorrectly assumed that *PRQ* was an isosceles triangle.

(c) Stronger candidates had no difficulty in identifying the correct value of *y*. Common incorrect answers involved 71 (incorrect application of angle at the centre), 38 (incorrect application of opposite angles in a cyclic quadrilateral) and occasionally 142. A few that were able to identify a correct angle of 71 or 218 on the diagram did not go on to obtain the correct answer.

Question 4

(a) Most candidates obtained the correct number of people.

(b) (i) Most candidates obtained the correct probability.

(ii) Only the weaker candidates struggled to make any progress with some attempting the question with replacement. Most candidates were able to identify the three correct products and arrive at the given answer. Where errors were seen they were usually slips, either with a numerator or a denominator. In many of these cases, candidates equated the sum of their products to $\frac{37}{105}$, clearly not checking that this was the case.

(iii) Responses could be divided into three roughly equal groups. In one group, the responses demonstrated a good understanding of the triple products required, often identified as RRR, etc. and these were almost always evaluated correctly to obtain the correct answer. In the second group, products were identified correctly but the number of combinations of each of these products was often incorrect, usually taken as three, including 3 for RRR, or as 1 for all of the products. In the final group responses showed little understanding of what was required and very little progress was made, if any. Only a small number of candidates attempted the method of 1 – the probability of no red hats or 1 red hat.

Question 5

(a) Many candidates were able to quote the cosine rule and substitute the values correctly. Some candidates gave inaccurate final answers such as 26.9 which is a truncation of the more accurate value of 26.97 rather than a correct rounding to 27.0. Some substituted incorrectly into the cosine rule, perhaps because they misinterpreted the angle notation for angle *ADB*. Some candidates substituted correctly into the implicit cosine rule but made errors in rearranging to reach cos *ADB*. A small number of candidates assumed that triangle *ABD* was a right-angled triangle.

(b) Most candidates were able to find angle *BCD* as 73° and use it correctly in the sine rule. It was common to see candidates give an answer of 9.2 in this part without showing a more accurate calculated figure, so full marks could not be awarded. A small number of candidates used 42° in place of 73° in the sine rule. Only a small number of candidates attempted to use trigonometry in a right-angled triangle in this part.

(c) Candidates found this part more of a challenge and many were not able to identify that the shortest distance from *C* to *BD* would be found by drawing a line from *C* perpendicular to *BD*. Candidates who clearly indicated this perpendicular on the diagram were awarded a method mark. Most candidates who had identified the required length usually used $\sin 42$ with their calculated *DC*. As an alternative, a significant number used the sine rule to calculate *BC* and used their answer with sin 65 to calculate the required distance. A small number used the area method, calculating $\frac{1}{2} \times 9.7 \times DC \sin 42$ and then equating the result with $\frac{1}{2} \times 9.7 \times height$. A common misconception was to assume that the base of the perpendicular bisects *BD*, and then using Pythagoras's theorem with *CD* and 4.85.

Question 6

(a) (i) A majority of candidates correctly substituted the given coordinates into $y = a + bx^2$ and found the values of *a* and *b*. However, a significant number of candidates confused $y = a + bx^2$ with $y = mx + c$ and incorrectly calculated the value of *b* as the gradient of the line joining (0, 4) and (1, 1).

(ii) Most candidates were able to give the correct equation for the tangent. Common errors included giving the coordinates of the maximum point, using the equation from the previous part or giving an equation of a line with a gradient other than 0.

(iii) A small majority of candidates gave the correct equation of the required tangent. Many did not appreciate the reflection symmetry of the graph and gave equations with incorrect intercepts, usually –7. Common incorrect gradients were 6, $\frac{1}{6}$ and $-\frac{1}{6}$. Some had a correct answer in the working but gave their final answer with the '*y* =' omitted.

(b) (i) Almost all candidates were able to calculate the correct *y*-values but not all gave the second value rounded to 3sf or better.

(ii) Many candidates produced a correct curve. Loss of marks often resulted from curves not in tolerance at one or more points or incorrect plotting of one or more points. A small number of candidates joined points with straight lines.

(c) (i) Reading of the values of *x* at the points of intersection was often carried out successfully. A lack of accuracy for the positive value was the most common error followed by the omission of the negative sign for the negative solution.

(ii) Many candidates did not pick up on the connection with **part (a)(i)**. Those that did often had slips in their working and fully correct solutions were in the minority. Some candidates reached the correct answer in the working and transferred this incorrectly to the answer line. Many of those that did not use their earlier answer often substituted their answers from the previous part into the given expression. A significant number of candidates made no attempt at this part.

Question 7

(a) (i) Most candidates gave a correct value for the median.

(ii) Although many candidates gave a correct value for the range there were also a higher number of incorrect values. Most errors resulted from reading the scale incorrectly, for example an answer of 80 from 90 – 10 or 79 from 90 – 11. Some candidates gave the interquartile range and 33 was often seen. Occasionally the answer was given in the form 12 – 90 or $12 \leqslant x \leqslant 90$.

(iii) Many answers that were given were outside of the acceptable range. Some gave answers such as $x > 86$, forgetting that this would include marks greater than 90 which were not possible. Other incorrect answers included answers in the low 80's as well as answers going down as far as the 30's.

(iv) Correct comparisons were in the minority. Many comments referred to how statistics such as the median, range, IQR (or minimum and maximum values) had changed, with no attempt at interpreting these. Sometimes an incorrect reason was given to support a correct interpretation. If any numerical values were quoted these were generally correct. Comparisons of the shapes of the plots were also given occasionally

(b) Most candidates showed a good understanding of the method required. For these, many correct answers were seen and any loss of marks usually resulted from an error with a midpoint or a numerical slip in the calculations. For other candidates, errors with midpoints were more common or were calculated incorrectly, such as (30 – 20) ÷ 2. In a few cases the upper bounds were used as the midpoints. There was a higher proportion of candidates this year using the class widths for the midpoints. A few candidates divided by 5 instead of 50 and some found the sum of the frequencies and divided by 5.

(c) (i) Many candidates calculated the correct value of the frequency. The most common error was an answer of 76.

(ii) Most candidates were able to complete the histogram accurately. Where errors were seen they usually involved an incorrect height for the interval $125 < m \leqslant 140$ with most dividing the frequency by 10 instead of 15.

Question 8

(a) (i) Almost all candidates began with the appropriate numerical substitution into the correct formula for the area of a sector. Giving an answer of 41.7 was a very common error. Candidates needed to provide an answer to at least four figures in order to show that it rounded to 41.7 .

(ii) The use of $\frac{1}{2}ab\sin C$ for area of the triangle required candidates to recognise that $OX = OY$.

Those that did equated $\frac{1}{2}x^2\sin 53$ to $\frac{1}{3}$ of the area of the sector and almost always obtained the correct answer, although some lost out on accuracy by giving a 3-figure answer of 5.89. After realising $OX = OY$, a fairly common error involved processing it as $2x$ instead of x^2. Another major error involved candidates treating the shape and triangle as two similar shapes.

(b) Only a minority of candidates demonstrated a clear understanding of the method required and reached a correct answer with some losing out on the final accuracy by premature rounding at intermediate stages. A wide variety of errors were seen. When finding the radius of the cone some divided the arc length by 2 with others assuming the vertical angle of the cone was either 60° or occasionally 30°. When calculating the height some used Pythagoras' correctly while others used trigonometry with the incorrect vertical angle. Some simply started by using the formula for the volume of a cone using 24 for either the radius or the height of the cone. Occasionally some had an incorrect formula for the volume.

Question 9

(a) (i) Most candidates were able to factorise this expression correctly. The most common errors occurred with the signs, particularly the partial factorisation $5a(m+2p)-b(m-2p)$ in place of $5a(m+2p)-b(m+2p)$.

(ii) Candidates found this factorisation very challenging and few were able identify that the two terms had a common factor of $5(k+g)$ and reach the correct answer. Some correct partial factorisations were seen, usually extracting a common factor of either 5 or $(k+g)$, and fewer extracting $(5k+5g)$. Some candidates just expanded the given brackets and were then unable to simplify further and others attempted to cancel $(k+g)$.

(iii) Many candidates identified this expression as the difference of two squares and reached the correct answer. While attempting the difference of two squares some made errors in the expressions, such as $(4x+y^2)(4x-y^2)$ or $(2x^2+y^2)(2x^2-y^2)$. Some careless presentation of answers was seen, such as $(2x+y)^2(2x-y)^2$. A common error was to identify that the terms were both squares but to then give the answer $(2x-y^2)^2$.

(b) Many candidates were well-drilled in the process required and expanded to give the correct answer or attempted the correct process but made one or more sign errors when expanding. Most candidates reached a cubic expression for their answer.

(c) Many candidates understood the identity $(x + a)^2 = x^2 + 2ax + a^2$ could be used to state $a = 11$ and then b could be found by squaring a. Some used a longer method and either completed the square on the right-hand side or expanded the left-hand side, compared coefficients, or having found a, expanded $(x + 11)^2$ to find b. Having found a correctly, a small number of candidates found b as $2a$ rather than a^2. Some candidates attempted to manipulate the given equation to give algebraic expressions in terms of x for a and b.

Question 10

(a) Most candidates displayed a good understanding of volume and density and many fully correct answers were seen. Incorrect conversion of units was the most common error with the volume divided by a variety of powers of 10 to convert from cubic centimetres to cubic metres. Those that converted the dimensions to metres before starting the calculations were generally more successful. Some gave an answer in kg/cm^3 and a small number used surface area instead of volume.

(b) Most candidates had a good understanding of the method required: find the volume of the hole and find this volume as a percentage of the volume of sand in the bag. Many correct answers were seen but some slipped up right at the start by using an incorrect formula for the volume of a cylinder. Finding the volume of sand remaining in the bag was another common error. In a small number of cases lost out on the final accuracy mark by rounding off intermediate values.

(c) This reverse percentage question proved challenging and correct answers were in the minority. Some of those that used a correct method were able to calculate the pre-tax cost of \$86 but then forgot to subtract this to find the amount of tax. In the majority of cases, candidates calculated 15% of \$98.90, usually giving this as their answer or sometimes adding it to \$98.90 or subtracting it from \$98.90.

(d) Almost all candidates were able to calculate the cost of the sand in dollars.

Question 11

(a) The majority of candidates found the correct expression, although answers were sometimes written incorrectly as, for example, $x = \frac{48}{x}$, $nx = 48$, $x = \frac{48}{n}$ or $\frac{x}{48}$.

(b) Many candidates had a good idea of what they needed to do but errors in setting up the equation or in the algebraic manipulation meant that completely correct solutions were in the minority. When setting up the initial equation a significant number of candidates struggled with placing the 4. In some responses it was omitted leading to $\frac{48}{x} = \frac{60}{x+2}$ and in three-term equations it was common to see sign errors. Most attempted to eliminate the denominators but it was common to see errors with the use of brackets, such as $(48)x + 2$. Candidates sometimes recovered from these slips but were not able to earn full marks.

(c) Most candidates attempted factorisation, as required, although a number of candidates solved the equation using the quadratic formula. Where factorisation was attempted, this was usually done correctly, although in some cases candidates produced factors such as $(x – 6)(x + 4)$, and more commonly $(x + 3)(x – 8)$. Sometimes, the incorrect answers –3 and 8 followed correct factorisation. Occasionally candidates did not make their factorisation explicit, instead only writing $(x – 3) = 0$ and $(x + 8) = 0$ in their working.

(d) A majority of candidates obtained the correct answer of 12. A variety of incorrect answers, such as 16 (from $48 \div 3$) or just 3 were seen. There were several candidates who made no attempt at a response.

Question 12

(a) A small majority of candidates demonstrated a good understanding of calculus and obtained the correct gradient. Squaring –2 incorrectly was a common error at this stage. A significant number of candidates obtained the gradient of 17 but then used this value in a further incorrect calculation. Many of the incorrect responses involved substitution of $x = –2$ into the equation of the curve to find y. This point was often used with another random point to find a gradient.

(b)(i) Calculating the length of AB was carried out correctly by many candidates who clearly indicated their method. In other responses, errors were seen with the calculations, such as adding the corresponding coordinates or incorrect use of Pythagoras.

(ii) Many candidates coped well with three stages in the method and fully correct answers were in the majority. Most candidates made an attempt at the gradient of AB but numerical errors resulted in several incorrect values, such as $\frac{1}{2}$, 2 and –2. Several candidates referred back to their answer of **part (a)** and the use of 17 as the gradient was seen. A greater number of errors were seen at the second stage with some candidates ignoring 'product of gradients = –1' or using it incorrectly. At the final stage sign errors were common, for example $3 = 2 \times –1 + c$ leading to $c = 1$.

(iii) Candidates found this vector question very challenging and fully correct answers were in the minority. Many candidates appreciated that the use of Pythagoras was needed. When applied correctly it often led to $a = b = 2$ which for many was as far as they could go. In several responses the Pythagoras expression was incorrect, for example $–a^2 – b^2 = 8$ or $a^2 + b^2 = \sqrt{8}$. The better solutions involved a clear diagram, which with the correct values of a and b, made the step to finding the coordinates of D straightforward.