

MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key messages

To succeed in this paper, candidates need to have completed the full Core syllabus. Candidates are reminded of the need to read the question carefully, focussing on key words and instructions.

General comments

Candidates must show all working to enable method marks to be awarded. This is vital in multi-step problems, where each step should be shown separately to maximise the chance of gaining marks. Candidates must take note of the form or units that are required, for example, in **Questions 1, 2, 5 and 10**. Many candidates incorrectly handled negative numbers, for example in **Questions 6, 8, 11 and 12**.

The questions that presented least difficulty were **Questions 6, 8, 12(a) and 17(a)**. Those that proved to be the most challenging were **Questions 5(a)** rounding, **10** upper and lower bounds, **18(b)** indices, **20(b)** properties of parallelograms, **25(a)(ii)** calculating a mean from a frequency table. The questions that were most likely to be left blank were **Questions 9(b), 14, 20(b) and 25(b)**. It is likely that the blank responses were due to the syllabus areas being tested rather than a lack of time.

Comments on specific questions

Question 1

This question was a straightforward start to the paper and a majority gave the correct answer. Incorrect answers were usually due to rounding up to 4700, rounding to the wrong accuracy, 4650 or missing a zero. A few candidates divided by 100.

Answer: 4600

Question 2

This was very well answered. The numerator, 7, was more likely to be correct than the denominator when that was sometimes a different power of ten. Some candidates gave the incorrect answer of $\frac{0.7}{100}$ showing a lack of understanding of how to form a fraction.

Answer: $\frac{7}{1000}$

Question 3

Again, this was well answered but some candidates made arithmetic slips in their subtraction. These slips lost candidates the mark.

Answer: 136

Question 4

This question was only worth one mark so all three terms had to be correct. Some candidates gave $-3, 2, 7$ from starting with $n = 0$ rather than $n = 1$. A few focused on the constant term only giving terms such as $2, -1, -4$ or $5, 2, -1$. Some candidates did not know what the n th term meant and gave answers such as, $5, n, -3$ or $5n - 1, 5n - 2, 5n - 3$.

Answer: 2 7 12

Question 5

Part (a) was not handled nearly as well as **Question 1** even though the skills tested were similar. Some of the incorrect answers seen were, 2.68, 0.268, 0.0026, 0.002 and 0.003. A few answers of the form 000.268 were also seen. Candidates dealt with part (b) in a slightly more assured manner but answers with more than one figure in front of the decimal point or the minus sign missed off the exponent were errors that came up regularly.

Answers: (a) 0.0027 (b) 3.87×10^{-5}

Question 6

This was the best answered question on the paper. Those that did not score both marks were able to access a method mark for one of the two substitutions and multiplications, i.e. for 84 or -18 . Generally, it was the signs in the second term that caused problems for the occasional candidate.

Answer: 66

Question 7

There were many correct responses here. Candidates had a choice of methods and had various steps to go through to get to the answer, for example, alternate angles, recognition of the isosceles triangle then application of angles in a triangle or to drop a perpendicular and use $\frac{1}{2}x = 90 - 43$, then to double the value to find x . Some got as far as 47 but did not take the final step. 137 was seen as the most common error (from $180 - 43$). A few candidates gave an incorrect answer with no working to back it up.

Answer: 94

Question 8

This question was answered well with clear, well set out working. Again, it was the negative number that caused some problems as the right hand side became $7 - 5 = 2$ instead of $7 + 5$. Candidates must remember to show one step at a time as combining steps into one can obscure a correct move. Some candidates left the answer as $\frac{12}{8}$ without cancelling this down.

Answer: 1.5

Question 9

In part (a) the conversion of kilometres to metres was done reasonably well although a significant number multiplied by 100, 10 or even 10000. In some cases, candidates changed the given figures and it was not clear what candidates thought they had to do. Part (b), the conversion of cubic centimetres to litres, was less well answered as it appears that the conversion factor is not generally known. This was a question that was often left blank.

Answers: (a) 6540 (b) 7.85

Question 10

This was the least well answered question on the paper and a fairly large number of candidates did not attempt it. The correct approach is to concentrate on the 'nearest centimetre' part first. This has to be split into 0.5 cm subtracted from the boy's height and 0.5 cm added on. As the height is given in metres not centimetres this is not as straightforward as if the height was in centimetres. The most understandable approach is to convert the height into centimetres, calculate the limits and then convert back to metres. If candidates left their limits in centimetres, they earned a special case mark.

Answer: 1.715 1.725

Question 11

The algebra here was not handled as well as that in **Question 8** and most errors occurred when candidates did not deal with the negative numbers correctly or made numerical slips in the initial multiplication. The most common working was $12y - 18 - 5y + 5$ and an answer of $7y - 13$; this gained only one mark for either multiplying of the first bracket correctly or for the $7y$ seen in the answer.

Answer: $7y - 23$

Question 12

A few candidates inserted a horizontal line between the numbers, so treating vectors as fractions. Part **(a)** was generally correct but part **(b)** less so. Again, candidates had to deal with negatives or maybe the concept of $-h$ was not understood. In each case, both numbers had to be correct to earn the mark.

Answers: **(a)** $\begin{pmatrix} -1 \\ 9 \end{pmatrix}$ **(b)** $\begin{pmatrix} 3 \\ -4 \end{pmatrix}$

Question 13

To succeed with this type of question on LCM (or even HCF), candidates should break down each number into its prime factors so $18 = 2 \times 3^2$ and $21 = 3 \times 7$. Then the LCM will be $2 \times 3^2 \times 7 = 126$. There is another method which can go wrong if candidates make arithmetic slips, that of listing out multiples of each number, until the first number that is common to both lists is found. The most common misunderstanding was to give the HCF, 3.

Answer: 126

Question 14

Sometimes these types of questions have a diagram to aid candidates so the first step is to draw a diagram of an octagon and mark one or all the exterior angles. The majority of candidates correctly identified this as an 8-sided shape and a significant number showed $360 \div 8$ but many spoilt their work by then subtracting the answer, 45, from 180 (this is the interior angle) or from 360. Some used the formula $\frac{(n-2) \times 180}{n}$ and either got to 135 and stopped instead of subtracting this from 180 or made arithmetic slips.

Answer: 45

Question 15

Many candidates did not take note of the instruction to write down the full calculator display in part **(a)** but did give the correct 4 decimal place answer in part **(b)**, although sometimes this was incorrectly given to 4 significant figures instead. The common incorrect answer of 42.50272... came from inputting the calculation of $\sqrt{2.38} + 6.4^2$.

Answers: **(a)** 6.58331... **(b)** 6.5833

Question 16

Many candidates drew an enlargement of the correct size but did not use the given centre of enlargement. Some attempted an enlargement from the correct place of 4 times the original size as if they started counting 3 times the length of rays from the shape instead of starting at the centre of enlargement. It was quite common to see a small rectangle (of 3×2 or 2×2 squares) to the immediate right of the original shape. Many candidates did not use a ruler.

Question 17

Part (a) was very well answered but part (b) far less so. For part (a), it did not matter what form the probability was given, but this is not always the case so candidates must check the form of their answers. In part (b), some gave their answer as a probability, for example, $\frac{40}{240}$ or $\frac{6}{240}$.

Answers: (a) $\frac{8}{15}$ (b) 40

Question 18

Like with the last question, part (a) was well answered but part (b) less so. Incorrect answers to part (a) included x^7 or x^{81} . Many candidates found part (b) more challenging; there were a variety of incorrect responses, most commonly seen were $\frac{1}{4}$, 0.01, 4, 2 and 4^{-2} . This last did not earn the mark as it was only the power of 4 that was asked for. Many struggled to find a starting point but it was also common to see $\frac{1}{16} = 0.0625$ followed by incorrect or no further working.

Answers: (a) x^{12} (b) -2

Question 19

The majority of candidates wrote at least one correct value but relatively few got both. It was fairly evenly split between $\sqrt{3}$ and π being chosen alongside an incorrect value. 3^{999} and 33.3% were seen often as a wrong choice.

Answer: π $\sqrt{3}$

Question 20

For part (a), the common incorrect answers were square and rhombus. Part (b) was not answered by quite a few candidates. Candidates should have looked at part (a) again to see the kind of statements that were made there and adapted them for a parallelogram. Of those that gave an answer, many were correct for other quadrilaterals but incorrect for parallelograms, for example, 1 or 2 lines of symmetry, rotational symmetry of order 1 or 4 right angles but others were completely wrong for any shape for example, all the sides are parallel, the sides add to 360° or the angles are parallel. Like with **Question 14** a reasonably sized diagram would help candidates pin-point the properties – there were diagrams but some too small to be of use. The correct properties most often seen were: opposite sides (or angles) are equal, opposite sides are parallel and rotational symmetry order 2. There were other acceptable properties, for example, has no lines of symmetry or the diagonals are not equal in length.

Answers: (a) rectangle

Question 21

Candidates had to be able to recognise the 3-dimensional shape from the 2-dimensional net but some gave answers of rectangle (a 2-dimensional shape) or cube. In part (b) it was required to work out the dimensions first, then find the volume. Many candidates gave the incorrect dimensions, for example, $4 \times 3 \times 4$ or $4 \times 3 \times 5$. Some picked out the correct dimensions but went on to find the surface area (52 cm^2).

Answers: (a) cuboid (b) 24

Question 22

Although many struggled with factorising the expression in part (a), there were a number of correct responses. Misconceptions about combining terms meant that the answer $26w$ was seen quite regularly as well as the 'solution', $w = -6$. Some candidates showed $\div 2$ in their working and gave $5 + 8w$ as their answer. Another misconception was to list all the factors of 10 and 16. For part (b), similar errors were seen, as those that combined terms in part (a) also did it in part (b). Often the candidates who gave $5 + 8w$ gave a similar answer, $3x - 2t$, for this second part. A mark was available for those who only partially factorised this second expression.

Answers: (a) $2(5 + 8w)$ (b) $4t(3x - 2t)$

Question 23

There were many candidates who showed complete, logical working. A few candidates made arithmetic errors, which should have been picked up when checking. The wrong method seen most often was to invert the second fraction (sometimes changing the \times sign to \div). A further wrong method was to 'cross multiply'

leading to their answer of $\frac{24}{245}$. In many of these cases, one mark was earned from the first step of successfully converting the mixed number to a vulgar fraction. The answer was asked for in its simplest form but many left their answer as $\frac{42}{140}$ so could not go on to gain the last mark. Some candidates showed

working with a common denominator and then added the numbers in the numerator. A few candidates gave decimal answers but they should be made aware that, in fraction questions, working in decimals or converting a fraction answer to a decimal is not acceptable.

Answer: $\frac{3}{10}$

Question 24

There are various methods to solve simultaneous equations and candidates should be aware that sometimes, depending on the structure of the equations, one method might be quicker or involve fewer opportunities for arithmetic slips to spoil good method. The elimination method for these simultaneous equations involves multiplying both equations by different numbers. Re-arranging both equations to equal x , for example, and then solving the equation was a method used by quite a few candidates. Cramer's Rule for solving simultaneous equations was also seen – this does seem to have more opportunities for arithmetic errors to be made especially if candidates are not completely sure of the method. Candidates should check their values in both equations. Correct answers with no working or wrong working only got one mark out of the four available.

Answer: $[x =] 7$, $[y =] 8.5$

Question 25

This question as a whole was not well answered and part **(b)** had many blank answers spaces. In both parts **(a)(i)** and **(ii)**, it was clear that candidates were not experienced at working with frequency tables. To find the mode, it is necessary to look for the highest frequency and see which category or value that refers to. Here, the highest frequency is 7 which refers to 4 visits. The mode is 4 visits not the frequency of 7. Another misunderstanding was for candidates to pick the number that appears the most frequently in the table, 6 (appears four times). In order to find the mean from grouped data candidates will have to understand what the table is showing. Here, of the 40 people, 5 visited the cinema once, 6 went twice, 6 went three times and so on. So, it is not correct to just add up the top line (getting 28) as many did or the bottom line (getting 40, the number of people asked the question) or even, all the numbers. Each number of visits must be multiplied by its frequency and all of these products added together, and finally, the total is divided by 40. It is worth checking there is a reasonable answer for the mean, for example, an answer of 5 (from $40 \div 8$) is too big a number to be correct. For part **(b)**, many were not successful at producing the full method but did gain a method mark for giving $\frac{3}{40}$, the fraction who went to the cinema 5 times or $\frac{360}{40}$, the number of degrees for each person in the pie chart. Some candidates went on to draw the pie chart or just this sector, neither of which is asked for in the question.

Answers: **(a)(i)** 4 **(ii)** 3.2 **(b)** 27

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

Do not round off calculations at an intermediate stage.
Answer precisely what is asked in the question.
Check answers to see if they are sensible in the context of the question.

General comments

The paper was felt to be accessible to candidates. Candidates need to be reminded that any question or part with more than one mark has a method or part stage mark. Without any working it is just full marks or no marks. Also questions which state working must be shown cannot gain full marks for just a correct answer. Many candidates clearly understood topics but did not always answer fully, usually missing required rounding or not giving sufficient accuracy when it was not specified.

Comments on specific questions

Question 1

While this time difference was well done overall, there were a significant number of candidates unable to work out the subtraction. Some used a calculator, resulting in an answer of 2 h 95 min. Others found 3 h 55 min or 3 h 5 min from $11 - 8$, with some manipulation of the number of minutes.

Answer. 2[h] 55[min]

Question 2

Most candidates had no problem with this basic simplification. The answer was left as $9g - g$ or $9g$ by some while $4g$ was quite common.

Answer. $8g$

Question 3

The expansion of a bracket was very well done although a few candidates did not multiply both terms, giving $7x - 8$. Some candidates changed the sign to $+$ or multiplied 7 by 8 incorrectly.

Answer. $7x - 56$

Question 4

This question required some thought and quite a number gave 5 from $13 - 8$. Others realised 21 was needed but did not answer the question which simply asked for the value of the index, p . Occasionally an attempt was made to work out the values of the terms but this did not lead to the correct answer.

Answer. 21

Question 5

Most candidates could find the two prime numbers although some did not complete the subtraction. The most common incorrect choice was 39 although quite a few clearly did not know what prime numbers were by choosing 4 and 22 or the two square numbers, 4 and 25.

Answer. 24

Question 6

While this question was quite well done, there was little evidence of candidates writing the differences between terms in the working. Some took the difference between a and 13 to be the same as between 13 and 9 and b as -25 from a difference of -10 .

Answers: [$a =$] 15 [$b =$] -27

Question 7

The back bearing question was by far the most challenging question on the paper. Very few seemed to know that the difference between the given value and the answer was 180. Subtracting from 360 giving 247 was the most common error although $180 - 113 = 67$ occurred often. A few gained a mark from a diagram but most of these inadequately represented the situation.

Answer. 293°

Question 8

Only around half the candidates gave correct answers for both the number of lines of symmetry and order of rotational symmetry. There was a wide variety of responses in both parts from 0 to infinity, but the most common incorrect answer was 2. The number of lines of symmetry was better answered than order of symmetry as the latter is often not as understood.

Answers: (a) 4 (b) 4

Question 9

This question was well done with a large proportion of correct answers. The most common error was to make 5^{-2} the smallest value, probably due to the negative index. While seeing decimal equivalents was common, many made errors over for example 0.36 instead of 0.036. Not showing enough decimal places also occasionally resulted in errors.

Answer. $\frac{2}{55}$ $\frac{1}{27}$ 0.038 5^{-2}

Question 10

There was quite a lot involved in this factorisation and many candidates gained just one mark for a partial factorisation. The most common answer was $2y(2xy - 3y^2)$. Some took x as a common factor and a number took out the correct term but made an error with the bracket part, at times $+$ instead of $-$.

Answer. $2y^2(2x - 3y)$

Question 11

Most selections were correct for each part although part (a) was considerably better done than part (b). The incorrect choices were most commonly 2.4×10^5 in part (a) and 4.3×10^{-2} in part (b).

Answers: (a) 1.36×10^6 (b) 5.21×10^{-3}

Question 12

The question was well answered with most gaining the two marks. Some did not multiply the vector **b** by 3, just working out **a + b**. Otherwise, the problems of multiplying and adding directed numbers caused many to lose one or two marks. Loss of a mark due to a fraction line between components was rare.

Answer. $\begin{pmatrix} -16 \\ -11 \end{pmatrix}$

Question 13

An attempt to solve the equation instead of changing the subject was one reason why this question was not done well. It was quite common to see a correct expression for $2y$ or $-2y$ although different signs for the terms $5x$ and 7 were often seen. The last step was often division by 2 rather than -2 when the numerator terms were negative. While inclusion of a zero in the answer was not penalised it was included quite often. Both marks were often lost due to inadequate or no working shown.

Answer. $[y =] \frac{5x+7}{2}$

Question 14

Most candidates correctly multiplied by the exchange rate but lost the second mark due to not applying the second line of the question, rounding to the nearest dinar. A few rounded incorrectly to the nearest 100 dinars.

Answer. 257

Question 15

(a) There were very few incorrect responses to this part as it was simply the 1-step solution to a simple linear equation. The rather unfamiliar form of the question did confuse just a few candidates and there were some who did not respond.

(b) This part required more thought but most gained the mark. Finding $12x$ after the step of first finding x presented a problem for a small number of candidates. Once again there were some blank responses suggesting the form of the question was not familiar.

Answers: (a) 7 (b) 36

Question 16

Over half the candidates found the angle correctly, choosing cosine with a correct fraction, although $\frac{8}{5}$ instead of $\frac{5}{8}$ was seen. Some candidates realised it was cosine and gave the correct fraction but did not understand how to progress. A few candidates were determined to make it a long question by finding the other side by Pythagoras' theorem and then using tangent or sine for the angle. This often produced an inaccurate answer.

Answer. 51.3

Question 17

Diagrams that say 'not to scale' mean that unmarked lengths cannot be assumed. In this case quite a number of candidates assumed the height was 1 cm, without considering the relationship between area, volume and height. Even those who realised the height was 3 cm usually could not work out the surface area. The main error was to not recognise the different dimensions for the top and the side so four faces of 7 by 1 or 7 by 3 resulted.

Answer. 62

Question 18

Many candidates did not apply an obvious case of Pythagoras' theorem to this question and simply subtracted the two sides to give 11.7 m. Many squared and added resulting in an answer of 42.2 which should have been realised as not possible. Following **Question 16** a number tried to find the angle using cosine and the sine or tangent to find the required side. Once again this generally at least lost a mark due to premature rounding.

Answer. 26.2

Question 19

A little more than half the candidates succeeded in finding the correct value after compound interest, most often using the formula. Some used simple interest in error. There were candidates who were familiar with the formula but could not recall it correctly resulting in such calculations as $1200 + (1.056)^3$, $1200\left(1 + \frac{5.6\%}{100}\right)$ or even $1200(1.056) \times 3$. Those who calculated year by year often lost accuracy by not keeping sufficient figures in their calculations. A small number added or subtracted 1200 from the correct answer.

Answer. 1410 or 1413

Question 20

- (a) This question was found challenging by candidates even though most knew the correct formula for the volume of a cylinder. There was evidence in seemingly correct answers that a value of π as 3.14 or $\frac{22}{7}$ was used, resulting in the loss of one mark. Some worked out the area, πr^2 , first but then rounded that before multiplying by 11, again likely to lose accuracy. The circumference, $2\pi r$, multiplied by the height was also a common error. Some thought that, with cubic centimetres in the question, multiplication by a power of 10 was needed.
- (b) Even with follow through applied, this part was not well answered. Division by 100 was most common but multiplication or division by incorrect powers of 10 were much in evidence. Some responses were totally unrelated to the answer found in part (a).

Answers. (a) 448 (b) [0].448

Question 21

Many candidates found the several stages of this calculation confusing for an arithmetic problem. Finding the remaining cost after the first day was common but was all that many did, even leaving that as the answer. Simply dividing 167.90 by 12 or 11 was often seen and candidates should realise that all data given in such a question will be needed in working out the solution.

Answer. 13.4[0]

Question 22

- (a) The whole question was very well answered, in particular this part, where it was quite rare to find an incorrect answer, usually Saturday. Just a few lost the mark by writing 94, instead of the day or as well as the day, without making it clear which was their answer.
- (b) This was not quite as well answered as part (a). A few candidates attempted the median, instead of the mean. An incorrect use of the calculator, $67 + 75 + 53 + 68 + 94 + 87 \div 6 = 371.5$ should have alerted the candidate to an impossible answer for the mean of the six items of data.
- (c) Most candidates gave a single value for the range and not just $94 - 53$. Just a few were mixed up between these measures and the mean was seen in part (c) with the range or the mode in part (b).

Answers: (a) Friday (b) 74 (c) 41

Question 23

- (a) The scatter diagram question was answered well and in particular this part was nearly always correct. Most errors were slips in the number of zeros. The 2016 scale value, if stated, should have been followed by the word 'thousands' but was allowed alone for the answer.
- (b) The easier lower point was almost always plotted correctly, but the higher point did cause problems for some candidates. A clear small cross, and not a dot, is the best way to plot points.
- (c) Most candidates drew ruled lines and the vast majority were within the limits. Any line not ruled or not a single line did not score the mark. A few were short and these lines needed to go to at least the extent of the points. Just a few gave zig zag lines or a line with a negative gradient.
- (d) There was a very good response to this part.

Answers: (a) 140 000 (d) 80 000 to 110 000

Question 24

- (a) Working was required in the question and it was more common to see just answers in this part but it did occur in part (b) also. Although it was not necessary to have a denominator of a higher multiple of 12, it was not incorrect. At times those using 36 as the denominator made errors in cancelling or didn't cancel at all.
- (b) A common incorrect answer was $\frac{9}{10}$, presumably from $\frac{3 \times 3}{7}$ divided by $\frac{4 \times 5}{14}$. Although involving mixed numbers and division, it was quite straightforward but only around two-thirds of the candidates succeeded in finding the correct answer. Some divided the integers separately from dividing the fractions but the vast majority did complete the correct conversion to improper fractions. Inverting the wrong fraction occurred quite often as did lack of cancelling.

Answers: (a) $\frac{7}{12}$ (b) $\frac{48}{61}$

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key messages

Ensure answers are given to the required accuracy and avoid premature rounding in working.
Show working for questions worth more than one mark.
Check answers to ensure they are reasonable in the context of the question.

General comments

The standard of candidates' responses was generally very good. However, checking answers would help to eliminate errors. Candidates should ensure they read the questions carefully, and give the answer in the format asked for, e.g. a fraction in its simplest form. Candidates should ensure that working is shown where required and certainly for ones which state 'you must show all your working', e.g. **Question 18**.

Comments on specific questions

Question 1

Many correct answers were seen. The most common incorrect answers were $\frac{75}{100}$ or 0.75.

Answer. $\frac{3}{4}$

Question 2

Many candidates seemed confused as to what was left when w was taken out as a factor. Common incorrect answers were, $w(0 + w^2)$, $w(w^2)$, $2w^3$ and w^4 .

Answer. $w(1 + w^2)$

Question 3

Many correct answers were seen. Some candidates wrote 6.2 without showing a greater degree of accuracy and so lost out on the mark.

Answer. 6.15

Question 4

Although several candidates were able to give the correct answer, many could not. Common incorrect answers were 8, 25.49, 27.20 or 37.75 from a straight continuous calculation with nothing bracketed.

Answer. 12

Question 5

Almost all candidates were able to give the correct answer with the decimal form being seen more than the fraction.

Answer: [0].0625 or $\frac{1}{16}$

Question 6

- (a) Many candidates gave the correct answer. Common incorrect terms were obtuse, reflex and arc.
- (b) Again many candidates were able to give the correct answer but radius, chord, semicircle and straight line were seen.

Answers: (a) acute (b) diameter

Question 7

Many candidates scored both marks and it was rare for candidates to score zero.

Answers: [0].24 $\frac{1}{4}$ 26[%] $\frac{4}{15}$

Question 8

Many candidates scored both marks but several missed out some factors, particularly 18. The majority appeared to understand the term factors but were not thorough in working them out.

Answer. 3, 4, 6, 9, 12, 18.

Question 9

The majority of candidates were able to calculate 15% as 3.3. Some had not read the question carefully and left their answer as 3.3 rather than calculating the increase.

Answer. 25.3[0]

Question 10

- (a) Many correct answers were seen with common incorrect answers being 200 000 and 209 800.
- (b) This part was less well answered than part (a) with common incorrect answers being 4.123, 412, 4100 and 4000.

Answers: (a) 210 000 (b) 4120

Question 11

Most candidates gave the correct answer. A common error was calculating $2500 \div 10$ but then multiplying incorrectly by 7, while others calculated $2500 \div 3$.

Answer. 750

Question 12

This question was not well answered. Many candidates found $1 - 0.72$ first. A lack of understanding resulted in some impossible answers being seen.

Answer. 162

Question 13

- (a) Several candidates gave the correct answer. Common incorrect answers were 0.0482, 4820, 0.000482 and 0.482.
- (b) This part was less well answered. Common incorrect answers were 5.2×10^{-7} , 5.2×10^6 , 52×10^6 , 52 000 000.

Answers: (a) [0].004 82 (b) 5.2×10^7

Question 14

Many candidates were able to score one mark for $1 - p = 12$, but few were able to reach $p = -11$ as they were unable to deal with $-p$. Answers were usually 11, 12 or 13. A significant number of candidates did not know how to start and had as their first line of working $p = 4 - \frac{1}{3}$.

Answer: -11

Question 15

Overall this question was not well answered. Some candidates were able to give both correct answers but many appeared not to understand this topic. The main error was to find 6.2 ± 0.5 , giving 5.7 and 6.7, or answers of 615 and 625.

Answer: 6.15 6.25

Question 16

Some candidates understood what was required in this question, but accuracy let some down with 9.17 or 9.2 as the final answer. Many struggled with basic trigonometry and cosine rather than sine was often used.

Answer: 9.18

Question 17

The majority of candidates were unsuccessful as they calculated the volume rather than the surface area which the question asked for.

Answer: 304

Question 18

A considerable amount of correct solutions were seen showing candidates knew how to manipulate fractions. Many others scored one mark for $\frac{6}{5}$ but they were unable to do the division. A small number had given the answer without any working which didn't score.

Answer: $\frac{5}{9}$

Question 19

- (a) (i) This addition of vectors was mainly correct.
- (ii) This multiplication of vectors was mainly correct.
- (b) This was less well answered than part (a). Many candidates did not show an understanding of the movement using a vector.

Answers: (a)(i) $\begin{pmatrix} 7 \\ 5 \end{pmatrix}$ (ii) $\begin{pmatrix} -20 \\ 8 \end{pmatrix}$ (b) 3, -1

Question 20

- (a) Many candidates appeared not to understand what this question required; few appeared to know that the coefficient of x is the gradient. $5 + 12 = 17$, $12 \div 5 = 2.4$ and $5x$ were all seen. Several candidates did not attempt this question.
- (b) Again many candidates did not know how to start here so left it blank. There was a variety of incorrect answers, such as $y = 6x + 3$. Some scored a method mark for answers $y = x + 6$ or $y = 8x - 3$.

Answers: (a) 5 (b) $y = 8x + 6$

Question 21

- (a) This part was mainly correct. Common incorrect answers were 568 and 56 800.
- (b) (i) This part was not well answered. Several candidates appeared not to understand how to measure a bearing and some gave the distance 20 km. It was well answered by those who knew what a bearing was.
- (ii) Although many candidates were able to correctly measure the distance and score one mark for 9.2, a significant number gave this as their answer, not realising they had to use the scale to calculate the actual distance.

Answers: (a) 5680 (b)(i) [0]68 (ii) 46

Question 22

- (a) This question was well answered on the whole. Some candidates found the perimeter, while others wrote $8.4 + 3.5 = 11.9$ or $\frac{1}{2} \times 8.4 \times 3.5$.
- (b) Many candidates wrote $18 \times 12 \times 10 = 2160$ or $\frac{1}{2} \times 18 \times 12 \times 10$ for this trapezium area. Some made it very difficult for themselves by trying to split the shape up and were rarely successful.

Answers. (a) 29.4 (b) 168

Question 23

This simultaneous equations question was not well answered with just a small number of fully correct solutions seen. Mixed addition/subtraction of equations was a common error. Candidates who equated the y -coefficients were often more successful than those who equated the x -coefficients. Many earned the first method mark but then added rather than subtracted the two equations. Several candidates who attempted subtraction could not handle $-4y - (+15y)$. Some scored the special case mark but again many errors were seen trying to find the second value to secure this mark.

Answer: $x = 7$, $y = -1$

Question 24

- (a) Several candidates did not attempt any of this question. Some drew numerous arcs, but did not attempt to use them. Several candidates drew a bisector without arcs.
- (b) As with part (a) some candidates scored one mark for the bisector without arcs.
- (c) There were a considerable number of candidates who picked up all four marks for the bisectors but did not extend them enough to find the correct area for shading. Some who did extend them far enough were confused by their own construction arcs and shaded incorrect areas.

MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key messages

To succeed in this paper candidates need to have completed full syllabus coverage, remember necessary formulae, show all necessary working clearly and use efficient methods of calculation. They should be encouraged to spend some time looking for the most efficient methods suitable in varying situations.

General comments

The level and variety of the paper was such that candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as most candidates attempted the whole paper.

Candidates showed very good number work in **Questions 1** and **13**, and a good understanding of shape and space with correct use of formulae in **Questions 5, 6** and **7**.

Candidates particularly struggled with the matrix transformation in **Question 16**, probability in **Question 20(b)** and the co-ordinate geometry problem, **Question 24(a)**.

Comments on specific questions

Question 1

The vast majority of candidates gained the mark by giving one (or both) prime numbers. The most common error was to give a prime number outside of the given range. The most common incorrect values within the given range were 25 and 27, often alongside a correct value.

Answer: 23 or 29

Question 2

The majority of candidates knew what was meant by standard form and could write the number correctly. The most common error was to give a positive power of 5 and some wrote the number as a fraction.

Answer: 3.87×10^{-5}

Question 3

The majority of candidates gave the correct fraction, with some showing a method from first principles. The answer $\frac{63}{100}$ was by far the most common incorrect one.

Answer: $\frac{7}{11}$

Question 4

There were very few candidates who did not gain both marks for this substitution. Any errors made were generally arithmetical and in these cases candidates were usually able to gain 1 mark.

Answer: 66

Question 5

Candidates demonstrated a very good knowledge of the angle facts involved in this question, with the vast majority gaining both marks. A small number of candidates gave an answer of 137 from $180 - 43$ and a few got as far as $90 - 43$ to give 47 but then did not double it.

Answer: 94

Question 6

The vast majority of candidates could recall the formula for the area of a circle and used it correctly. It was occasionally confused with the formula for the circumference and sometimes marks were lost due to premature rounding within the working.

Answer: 81.7

Question 7

Virtually all candidates used Pythagoras' theorem correctly to gain both marks. Those who scored 1 mark usually did so because of rounding; either to $\sqrt{23}$, leading to 4.79..., or $\sqrt{23.1}$, leading to 4.806... A very small number of candidates used trigonometry to calculate an angle.

Answer: 4.80

Question 8

This question was generally well answered with the majority of candidates scoring full marks. Candidates who were awarded part marks were generally aware of the need to expand the brackets and did so correctly for at least one of the two. Arithmetic slips were sometimes made when expanding the brackets or collecting terms. The most common incorrect answer was $7y - 13$ from $-5y + 5$ as the expansion of the second bracket. A minority of candidates correctly expanded the two brackets but then multiplied these together to give a quadratic expression.

Answer: $7y - 23$

Question 9

This question proved quite challenging for a large proportion of candidates, with many multiplying 27 by 81 to get 2187 rather than looking to see if they could make the numbers have the same base as the unknown index number. Some who got to 2187 did arrive at the correct answer by trial and error and there were lots of calculations seen in the work space. 729 was a popular answer from those who got to 2187 and then divided by 3. A significant number of candidates scored 1 mark as they did not deal with the negative power, hence giving an answer of 7.

Answer: -7

Question 10

Most candidates followed the instructions in the question to part (a) to write the full calculator display, but the majority who did not gain the mark for this question rounded their answer. There were many who made the error of omitting a bracket when calculating and so found $\sqrt{2.38} + 6.4^2$ leading to an answer of 42.502... Follow through marks were awarded in part (b) and the vast majority gave the correct answer or gave their answer to part (a) correct to 4 decimal places.

Answer: (a) 6.58331... (b) 6.5833

Question 11

It was a minority of candidates who scored both marks for the exact answer required in this question. Candidates should understand that a rounded or truncated decimal is not an exact value; many got to the correct fraction and then chose to write $0.571\dots$ as the answer. The value of 4 was seen far more commonly in the working than $\frac{1}{7}$ which was more usually seen as a decimal, a sign that candidates were using a calculator rather than interpreting the indices. The most common misunderstanding amongst those who did not score was to combine the numbers and indices, hence leading to answers such as $392^{-\frac{1}{3}}$.

Answer: $\frac{4}{7}$

Question 12

The majority of candidates were able to rearrange correctly and gain the first mark. Dealing with the inequality proved more challenging, with a high proportion of answers given as an equality, or with the incorrect inequality sign. Some had the misconception of making the -4.4 positive by reversing the inequality sign. Candidates who were not able to obtain -4.4 had generally made sign errors when attempting the process of rearrangement.

Answer: $n < -4.4$

Question 13

A thorough understanding of the multiplication of a mixed number with a fraction was demonstrated with the vast majority gaining all 3 marks for this question. The final answer mark was occasionally lost by those not fully simplifying the fraction or making arithmetic errors when simplifying. Candidates should be encouraged to cancel fractions before multiplying, in order to reduce these errors. A small minority showed confusion in the methods of dealing with fractions and made the denominators equal or cross multiplied the fractions.

Answer: $\frac{3}{10}$

Question 14

This question was answered correctly by the majority of candidates. Premature rounding of the sine value led to the accuracy mark being lost for some. The most common error was to assume that the triangle was right-angled, despite angle ACB being clearly labelled as 84.6 , and attempt to use $\sin ABC = \frac{5.9}{17.8}$. Some candidates set up the sine rule correctly but then struggled to rearrange it to find the angle. Less common was to confuse taking the sine of the lengths rather than the angles.

Answer: 19.3

Question 15

Candidates should ensure that they read the information in proportion questions very carefully, as the majority of errors come from setting up the incorrect relationship at the beginning of the working. It was often seen as an inverse relationship, or without the square. Those that set up the correct relationship usually went on to gain full marks. A mark was sometimes lost when candidates arrived at $k = 4$ following $16k = 4$, although they usually gained both method marks here. Of those who did not score, the most common answer was 36, gained from ignoring the information given in the question and simply substituting 7 into $(x - 1)^2$.

Answer: 9

Question 16

It was a minority of candidates who knew how to deal with this matrix transformation. Of those who were successful, there was a fairly even split between those who had memorised the effect of the matrix and showed no working and those who worked out the co-ordinates, showing the multiplication. The most common incorrect transformation was a reflection in $y = x$.

Question 17

Most candidates understood the need to find the area under the graph in part (a) and many did so successfully. Most others scored 1 mark for splitting the graph into three and finding at least one correct area, usually 90×20 , the middle rectangle. Sometimes this was alone, with candidates not taking the triangles into consideration or sometimes forgetting to divide the base \times height by 2. Those who did not score normally multiplied total time by the top speed, i.e. 130×20 or were calculating gradients to work out acceleration. Part (b) was not attempted as successfully and although the majority found the correct answer or gained a follow through mark, there were many who did not see the link between their answer to part (a) and the average speed. Even with a correct answer to part (a), the answer 20 was fairly common, either from $2600 \div 130$, or with no working, perhaps being confused with the constant speed within the journey. Other misunderstandings were to calculate the average speed for each section and add, sometimes dividing by 3, or to have a calculation involving gradients.

Answer: (a) 2200 (b) 16.9

Question 18

Finding the interquartile range from a cumulative frequency diagram proved challenging for many candidates with a range of incorrect answers seen in part (a). Some candidates gave the range, some worked out 90–30 and gave the answer 60 or then referred to the diagram and read off 25 (the value corresponding to 60). A small number of candidates were able to find the value of the lower quartile or upper quartile correctly, but did not correctly identify the other value. A higher proportion of candidates were aware of the process that needed to be followed in part (b) with the majority scoring both marks and some gaining the part mark for 116, not recognising the need to subtract from 120. The majority of marks were lost due to mis-reading the scale on the graph rather than not understanding the process involved and candidates need to take care to check their answers.

Answer: (a) 10 (b) 4

Question 19

The majority of candidates recognised that the cosine rule was required to find the angle and some executed this perfectly. There were many candidates who set up the correct equation with a^2 as the subject and substituted the sides correctly but then made the error of calculating $(b^2 + c^2 - 2bc) \cos A$, resulting in $9 \cos A$. There were also many candidates using an incorrectly stated formula and some with the correct formula but an incorrect substitution of sides. Candidates need to learn the formula and then be well practised in rearranging it to find the correct side or angle. Some candidates assumed a right angle and used right-angled trigonometry to try and find the required angle.

Answer: 46.2

Question 20

The overwhelming majority of candidates gave the correct probability in part (a). Dealing with the probability in part (b) proved much more challenging, even for higher achieving candidates. Many treated the pens as being replaced and multiplied fractions all with 15 as a denominator. Others recognised the need to consider probabilities with denominators of 15 and 14 respectively, but did not consider all of the possible combinations. Finding the probability of only one of the combinations or omitting the probability of two orange pens was common. Few candidates chose the most efficient route of calculation of 1 – probability of two black pens.

Answer: (a) $\frac{8}{15}$ (b) $\frac{168}{210}$

Question 21

Using inequalities to describe regions proved challenging, with only the most able candidates gaining more than one or two marks. There were various combinations of ways to score marks within the question and many scored a mark for $y \geq 1.5$ alongside being rewarded for finding the equations of the other lines, even if the inequality signs were incorrect. Candidates should be encouraged to choose a point within the region to check whether their inequality sign is the correct way round. Common errors in finding the equations of the lines were to have $\frac{4}{3}x$ rather than $\frac{3}{4}x$, or $2x$, $-2x$ or $\frac{1}{2}x$ instead of $-\frac{1}{2}x$. It was quite common for x to be omitted after the gradient within the equations of the lines. Candidates who did not understand what the question was asking often used the example given as a starting point to continue with, for example, $y \leq x + 2$, $y \leq x + 3$.

Answer: $y \geq 1.5$, $y \geq \frac{3}{4}x$, $y < -\frac{1}{2}x + 3$

Question 22

Part (a) was the best attempted part of the question with the majority of candidates gaining the correct answer or demonstrating a correct process for the part mark. This often involved arithmetic errors when dealing with the negative numbers or errors with brackets. The most common misconception was to think that $f(-3) = f(-3) \times f(-3)$ and some stopped after finding $f(-3) = 11$. The most common response for part (b)(i) was $2x^2 + 8$, either stemming from a misconception or following the correct first step of $(2x)^2 + 8$. Others multiplied both terms by 2 to give $2x^2 + 16$. Many correct answers were seen in part (b)(ii) alongside a large number of candidates gaining a part mark for making a correct first step in finding the inverse function but then making some errors in the rearrangement, often involving the $-2x$. There were many blank answer spaces seen throughout this question, particularly in the final part, indicating that candidates were unfamiliar with the terminology.

Answer: (a) -17 (b) $4x^2 + 8$ (c) $\frac{5-x}{2}$

Question 23

The majority of candidates could give the mode as 4 in part (a)(i), although there were many who thought it was 7, the highest frequency, or 6, the frequency that occurred most often. More candidates struggled to find the mean in part (a)(ii) with many showing no understanding of finding the total number of cinema visits, 40 (total frequency) $\div 8$ (number of groups) being an extremely common response. Some did start correctly by finding the total number of cinema visits to gain a mark but then also divided by 8. There were many correct answers in part (b) but there were just as many who struggled to find a method to find the angle of the pie chart. One mark was often scored, usually for showing a correct step of dividing 360 by 40 which was often followed by a multiplication of 5, the number of visits, rather than the frequency of 3. It was also fairly common to award a mark for 3 divided by 40 which was often left as 7.5% rather than being converted into an angle. The most common error which did not score was $360 \div 8 = 45$ and some used 128 calculated in part (a)(ii) as the frequency rather than 40.

Answer: (a)(i) 4 (ii) 3.2 (b) 27

Question 24

Candidates were challenged by the final question of the paper. Many candidates drew a sketch of the problem in part **(a)** which enabled them to understand the question being asked and to find the correct angle. Many candidates gained a mark for recognising the need to use trigonometry, even when they were finding an incorrect angle or using an incorrect ratio. A common error on the diagram was to label the difference in the x -values as 2 rather than 1. Those who did not score were often finding the equation of the line or using Pythagoras' theorem to find the length of the line. Most candidates attempted part **(b)** and there were many fully correct equations. Candidates made errors in finding the gradient of the perpendicular, either finding a line parallel to that given, or using -3 or $\frac{1}{3}$. A good number of candidates knew to substitute the co-ordinates given into the general equation of a straight line and were able to gain this mark whether or not they had the correct perpendicular gradient.

Answer: **(a)** 78.7 **(b)** $-\frac{1}{3}x + 12$

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key messages

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

General comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates showed evidence of good basic skills with particular success in **Questions 2, 4, 6, 8 and 21**. There were few candidates showing just the answers and many method marks were awarded. The questions candidates found the most challenging were some of the matrices work in **Question 20**, particularly the terminology in part **(b)**, the reverse bearing question **7**, the probability question **24** and the geometry question **25**.

Comments on specific questions

Question 1

The majority of candidates answered this question well. The most common incorrect answers were 3 hours 55 minutes, 3 hours 35 minutes and 14 hours 55 minutes. Candidates are advised to read questions carefully: 'One morning' will not give an answer of more than 12 hours. The most common method shown, when working was shown, was 0820 to 1120 is 3 hours, then subtract 5 minutes. There were a few candidates who did not answer this question; these were not necessarily the less able candidates.

Answer: 2 h 55 min

Question 2

This question was very well answered with nearly all candidates providing the correct answer. There were a number of different incorrect answers seen, including trying to solve $7x = 8$; equating the expression to zero resulting in $x = 8$ and an expansion with only the first part of the bracket multiplied i.e. $7x - 8$. Also seen was $7x - 15$, suggesting the error of adding 7 to both terms. Arithmetic errors in attempting 7×8 were occasionally seen, sometimes, e.g. 58 in place of 56.

Answer: $7x - 56$

Question 3

Many candidates found the correct numbers in the sequence. The most common error was to subtract 2 from 13, instead of adding, to give a common incorrect answer of 11 for a . When finding b , some omitted the negative sign and a common incorrect answer was 27.

Answer: $a = 15$ $b = -27$

Question 4

Part **(a)** was well answered. Nearly all candidates were awarded the mark but a small number of candidates did not answer the question or gave the answer 70. Part **(b)** again was well answered with most candidates being awarded the mark. A small number gave the answer 3 having found x but forgetting to multiply by 12.

Answers: **(a)** 7 **(b)** 36

Question 5

Most candidates correctly identified the two prime numbers from the list and understood that a subtraction was required. A common error was to see 39 selected, often instead of 41. A few candidates incorrectly selected the two square numbers, 25 and 4.

Answer: 24

Question 6

This question was very well answered with nearly all candidates scoring both marks. Most candidates worked with a common denominator of 12. Occasionally common denominators of 24 or 36 were used.

A small number of candidates added their fractions, to give $\frac{8}{12} + \frac{1}{12} = \frac{9}{12} = \frac{3}{4}$. A few incorrectly converted to a decimal at the end but that was very rare. Only a very small number of candidates gave the correct answer without showing their working.

Answer: $\frac{7}{12}$

Question 7

This question proved to be one of the most challenging questions on the paper. More able candidates realised that the reverse bearing will be 'different' by 180° , equivalent to turning 180° to look back where they came from and that in this case they needed to add 180° . The most common error was to subtract 140° from 360° to get the very common incorrect answer of 220° . Also common was to subtract 140° from 180° to get 40° . Some candidates sketched diagrams, which for many helped. However some still made the errors above as some diagrams showed a lack of proper understanding of bearings.

Answer: 320

Question 8

Nearly all candidates scored full marks in both parts of this question. The most common incorrect answer for part **(a)** was 2.4×10^5 and for part **(b)** was 4.3×10^{-2} or 3.4×10^{-1} .

Answers: **(a)** 1.36×10^6 **(b)** 5.21×10^{-3}

Question 9

The majority of candidates correctly constructed the perpendicular bisector of AB scoring two marks for also leaving in their construction arcs. A number of candidates only received one mark for not drawing the bisector after creating correct arcs or for correctly drawing a bisector without the use of two pairs of construction arcs. Some candidates only used one pair of arcs and joined this to the midpoint of AB . It was extremely rare to see an instance of a correct bisector with no arcs at all. The most common fully incorrect responses included drawing two circles that did not overlap; the creation of a running track like drawing around A and B showing a misinterpretation of the question by giving the locus of points equidistant from the line AB ; and either one pair of arcs creating a triangle when joined to the dots at A and B . It is important that candidates are taught to leave daylight between their two 'circles' to ensure that a bisector can be drawn; sometimes the compasses were set to exactly half way and therefore the arcs touched rather than intersected. A small minority of candidates included the extra step of drawing arcs on AB , and using these points on AB as the centres for the necessary construction arcs. The only effect of this practice is to increase the chance of inaccuracies. There was a significant number who made no attempt at this question which may indicate they did not have the required equipment or did not understand the question.

Question 10

Most candidates were able to fully factorise the expression. Those who did not score both marks often scored one mark for a correct partial factorisation with a repeated bracket and stopped at this stage. A few went on to make an error after this, sometimes by including a plus sign in between the brackets.

Answer: $(x + 2)(y + 3)$

Question 11

This question was answered correctly in roughly half of the papers seen. Correct answers usually came from a good structured response demonstrating the calculation of the linear scale factor and hence the area scale factor. Some candidates were unable to gain any marks on this question as they applied the linear scale factor to the area of the small triangle, showing no appreciation of the link between linear and area scale factors. This gave the most common incorrect answer 20. Some others knew that squaring was involved but squared the 5 rather than the $\frac{12}{3}$, leading to another fairly common incorrect answer of 100. Some found the square root of the linear scale factor leading to a common incorrect answer of 10. Candidates who used the formula for area of a triangle and calculated the perpendicular height of the small triangle, were generally able to score the method mark by then applying the linear scale factor to this height and multiplying by the 12 from the larger triangle. However due to recurring decimals and premature rounding in this method the accuracy mark was sometimes lost.

Answer: 80

Question 12

Candidates who were most successful with this question often wrote down the lower and upper bounds for each variable first, and then considered which values to use in the quotient in order to obtain the largest possible result. The most common error was for the upper bound of both the distance and the speed to be used resulting in the common incorrect answer 5.72. Some candidates incorrectly began by dividing 31 by 5, and then attempted to apply limits to the result. The relationship between speed, distance and time was generally known by the candidates but very occasionally the product, rather than the quotient, of distance and speed were found.

Answer: 7

Question 13

A large proportion of candidates got both answers correct. Candidates appeared to know that both answers had to add to 37, as the total frequency had to be 80, but often both answers were incorrect. The method was rarely shown. Errors seen using frequency density were multiplying it by the upper bound of the group or used with a group width of 10 for both. Problems arose when reading the vertical scale of the graph, so that the frequency density for the 30–50 min class was sometimes taken as 1.2 instead of the correct 1.1 leading to an answer of 24.

Answer: 15 and 22

Question 14

Many candidates were able to obtain at least one mark on this question by deducing the height of 3 cm using volume and base area. Many went on to gain full marks. However a lack of care in their overall strategy meant they often assumed the ends were square (either 1×1 or 3×3) rather than 1×3 . Hence they had four faces of either 7 cm^2 or 21 cm^2 . Candidates need to take note of labels such as 'not to scale' on diagrams and not make false assumptions. Occasionally candidates found correctly the three different face areas but didn't double to include the three opposite faces.

Answer: 62

Question 15

Candidates who knew the formula for the volume of a cylinder usually achieved full marks here. Some candidates forgot to write the required units (cm^3), while there were a few who gave the answer as cm^2 or cm. Common errors were to use the formulae, $\frac{1}{3}\pi r^2 h$, πrh , $2\pi rh$ with the volume of a cone being the most commonly incorrectly chosen. Some found the surface area of the cylinder instead of the volume. Candidates are advised that the front of the paper directs them to using their calculator value for π or 3.142; a few used the approximation $\frac{22}{7}$ which fell outside the answer range and caused a few to lose the accuracy mark.

Answer: 628 cm^3

Question 16

This question proved challenging for a few candidates. Identification of OA or OB as a radius was well done and the recognition of angles OMB or OMA as right angles was either stated or implied by a correct method. Since candidates received a mark for correctly identifying the right angle in the diagram, the importance of showing their method needs to be highlighted. A few candidates used trigonometry to solve the problem, either using the cosine rule or right-angled trigonometry. Using right-angled trigonometry required finding one of angles MOB , MOA , OBM or OAM . So long as the angle value used was not prematurely rounded too much, the correct answer could be found. However, some got waylaid in the additional work and sometimes gave angles as answers rather than the length. A few candidates found OB or OA correctly but then did not know this was the radius and continued with further calculations. The most common incorrect response was to use 12 as the base of a right-angled triangle and 4.5 as the height; this led to 12.8 as an incorrect answer. $4.5 \times 2 = 9$ was also seen a number of times. Incorrect methods leading to an answer of 7.5 included $6 - 4.5 = 1.5$ followed by $6 + 1.5 = 7.5$, $12 - 4.5 = 7.5$ and $4.5 + \frac{1}{2} \times 6 = 7.5$. The latter method, where they extended OM to the circle and assumed the extended part is half of 6 by looking at the diagram shows that they need to understand that diagrams are not usually drawn to scale. The least able candidates did not identify the right-angled triangle and attempted to either find the radius by making use of the formula for circumference or area of a circle.

Answer: 7.5

Question 17

Many candidates understood the need to use the area under the graph and set up an equation, usually splitting the area into a triangle and a rectangle. Those who got this far generally went on to gain full marks, although one common error following the correct starting point of $\frac{1}{2}6v + 2v = 150$ was to then write $6v + 2v = 300$. By far the biggest misunderstanding was to use $v = \frac{d}{t}$ and so $150 \div 8 = 18.75$ was a very common incorrect method and answer.

Answer: 30

Question 18

In part (a) around half of the candidates were able to score full marks for this question with many more candidates able to score one mark. A considerable number of candidates were able to identify the correct proportional equation and then calculate the value of k but did not substitute their value for k into the original equation, leaving $d = kt^2$ on the answer line. Other common errors were to write d proportional to \sqrt{t} , $\frac{1}{t^2}$ or $\frac{1}{\sqrt{t}}$. In part (b) most who answered part (a) correctly went on to answer this correctly as well and those who received one mark for finding k to be 4.9 in part (a) also usually gained this mark. The most common incorrect answer was 29.4 following $d = 14.7t$ in part (a). A few candidates achieved follow through marks in part (b) after finding an incorrect value of k in part (a).

Answer: (a) $d = 4.9t^2$ (b) 19.6

Question 19

The most able candidates gained full marks on this question and many were able to score at least some of the marks. Some candidates identified the shaded rather than the unshaded region and some did not appear to understand the significance of the solid and dashed lines on the grid, so errors in the inequalities were quite common. Those that gained part marks often had $y > 2$ correct and/or identified the line $y = 3 - x$ correctly, but made an error with the inequality. A few incorrectly wrote $x > 2$ rather than $y > 2$ and a small number gave co-ordinates rather than inequalities for their answer.

Answer: $y > 2$, $y \geq 3 - x$

Question 20

Part (a) was often well answered with a correct answer of \mathbf{C}^2 on the answer line without working. For those with an incorrect answer, they were often able to score one mark for a correct matrix calculation. Errors in multiplication were often seen leading to the candidate selecting the incorrect answer. Matrix multiplications were often very confused with a common incorrect matrix multiplication for \mathbf{C}^2 calculated as $\begin{pmatrix} 1 & 1 \\ 9 & 9 \end{pmatrix}$.

Part (b) proved to be the most challenging part of the question; approximately half of the candidates gave the correct answer. Many calculated -9 but then carried on to give a final answer of $-\frac{1}{9}$ often as part of an inverse matrix. Another common error was to calculate -9 and then give 9 as the answer, possibly believing that $|\mathbf{B}|$ meant the absolute value was required. Part (c) was usually answered well, although many candidates found it difficult to explain in words why the matrix \mathbf{A} had no inverse. Many candidates seemed to appreciate that the determinant was zero although there were some vague answers such as 'because it is 0' or 'because the numbers in the rows are the same' which was insufficient explanation. A common incorrect answer was 'the matrix has no determinant.' Many candidates gave a correct answer of 'because the determinant is 0' or because $|\mathbf{A}| = 0$. Other answers also given credit involved showing the calculation $1 \times 9 - 9 \times 1 = 0$.

Answers: (a) \mathbf{C}^2 (b) -9 (c) The determinant is 0

Question 21

A significant majority of candidates were able to read from the graph correctly in part (a); very rarely the number of zeros was incorrect. Nearly all candidates plotted both points accurately in part (b). Occasionally the second point was sometimes not plotted or plotted with a clear misunderstanding of the scale. In part (c) lines of best fit were commonly within tolerance to gain the mark although greater thought could be applied by some candidates who had the line below most points at one end or the other. Lines were usually ruled and sufficiently long. Some were a little short; candidates are advised that a line of best fit ought to span the entire range of data in a graph where possible. Some candidates left this part blank whilst others joined the points, sometimes with a curve or dot-to-dot pattern. In part (d) most candidates were able to state an acceptable estimate reading from the graph.

Answers: (a) 140 000 (d) 80 000 to 110 000

Question 22

In part (a) the more able candidates wrote $\overline{CD} = \overline{CO} + \overline{OD}$ followed by $-\overline{OC} + \overline{OD}$ or $= -(-2a + 3b) + 4a + b$. Many candidates did not use brackets and some of those who used brackets only applied the minus sign to the first term in the brackets instead of to both terms. Some candidates had the correct answer $6a - 2b$, but then gave the answer as $3a - b$, perhaps a misunderstanding of the part of the question that asked them to write it in its simplest form. Candidates did not seem aware that whilst $3a - b$ has the same direction as $6a - 2b$ it does not have the same magnitude. By far the most common incorrect method was to ignore the directional arrows and to work out $\overline{OC} + \overline{OD}$. Part (b) was often better answered than part (a), but some candidates did not know the meaning of position vector and it was very regularly left blank. A common incorrect answer was $\begin{pmatrix} a \\ -2b \end{pmatrix}$, i.e. thinking they were writing the $a - 2b$ given in the question as a 'vector'.

Answers: (a) $6a - 2b$ (b) $5a - b$

Question 23

Part (a) was well answered with candidates correctly finding that $x = 5$. However, some candidates who found the correct equation, went on to make errors when attempting to solve it. These included $28 - 3x = 23$ or $28 + x = 23$. Some correctly reached $-x = -5$ but then incorrectly gave -5 as the answer with no appreciation that the context of the question does not allow negative answers. Some candidates got the answer by inspection or trial and improvement methods but these were less frequent. This sometimes occurred after a candidate substituted for x on the diagram, and realised they had made a mistake in solving the equation. The most common incorrect working was to include the 7 in their calculation leading to an answer of 12 or -12 . This came from $20 - x + x + 8 - x + 7 = 23$ and this method would have been correct if candidates had used 30 instead of 23. The other initial error was to use $20 - x + 8 - x = 23$ and to not include $+x$. This resulted in the common incorrect answer of $x = 2.5$; candidates are advised to always consider the context of the question which would not allow decimal answers.

In part (b) for candidates who had the correct answer for part (a) the majority had the correct answer of $\frac{7}{30}$.

$\frac{7}{23}$ was a very common incorrect answer as candidates did not take into account the 7. As a denominator,

25 was occasionally seen from candidates calculating everything but the intersection as the total. $\frac{23}{30}$, $\frac{7}{28}$,

$\frac{1}{4}$ (from $\frac{7}{28}$ or from 1 in 4 of the regions of the Venn diagram) and 7 were also common incorrect answers.

Their x occasionally appeared as a numerator.

Answers: (a) 5 (b) $\frac{7}{30}$

Question 24

This proved to be one of the most challenging questions on the paper. In part (a), a large number of candidates understood that this problem involved the multiplication of probabilities and so a division was required to solve it. Less able candidates chose to subtract, either $\frac{2}{3} - \frac{8}{15}$ or $\frac{8}{15} - \frac{2}{3}$, the second of which led to a negative value for a probability. If part (a) was correct, part (b) usually also followed correctly, although some candidates gained all three marks by following through from an incorrect answer in part (a). Many candidates gained a mark for using $\frac{1}{3}$; sometimes this was used incorrectly, either by adding $\frac{1}{5}$ rather than multiplying, or using it alongside $\frac{7}{15}$ or $\frac{8}{15}$. Many others simply subtracted $\frac{8}{15}$ from 1 to give an answer of $\frac{7}{15}$, not recognising the need to work with two separate fractions for both Paulo and Raphael.

Answers: (a) $\frac{4}{5}$ (b) $\frac{1}{15}$

Question 25

In part (a) most candidates scored some marks on this question. Most worked out the gradient of PQ to be 2.5 but not many went on to find the perpendicular gradient correctly, with $-m$ rather than $-\frac{1}{m}$ seen quite often. A reasonable number did correctly substitute (5, 1) into their equation $y = mx + c$ to score a further mark. Others scored two marks by successfully calculating the gradient of the perpendicular line, with no further credit being earned due to incorrect substitution of the wrong co-ordinate. If candidates scored three marks it was usually for not cancelling down their gradient to its simplest form, $-\frac{2}{5}$ or -0.4 .

Part (b) proved to be a challenge for many and many left it unanswered. Only a small minority scored two marks and then a few more scored one mark with the majority of those coming from the special case answer (18, 14). Responses with only one of the co-ordinates being correct were very rare. Most of the incorrect methods seen involved finding the mid-point, giving the common incorrect answer (19, 16.5). Some candidates tried using Pythagoras' theorem to find the length of the line but were unable to progress beyond that. Only a few candidates used diagrams or geometric methods as a way to visualise the problem.

Answers: (a) $y = -\frac{2}{5}x + 3$ (b) (20, 19)

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key messages

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

General comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time. Many candidates are relying too much on their calculators and there were many mistakes seen due to keying errors even on simple calculations. Most candidates struggled with the questions on vectors and they were unable to use vector algebra to express one vector as a combination of two other vectors.

Comments on specific questions

Question 1

This was answered very well with -11 or -17 as some of the incorrect answers seen.

Answer: -5

Question 2

A few candidates wrote their answer as $w(1+w)^2$. Some gave w^3 or $w(w+w^2)$.

Answer: $w(1+w^2)$

Question 3

Most candidates attempted the correct working, $400 \div 65$, but some gave the answer as 6.2.

Answer: 6.15

Question 4

Most candidates understood factors but some missed out a few such as 12 or 18. The inclusion of 13 was often seen, possibly from the incorrect division by 3.

Answer: 3, 4, 6, 9, 12, 18

Question 5

The increase of 3.3 was sometimes given as the answer whilst others subtracted it to give an answer of 18.7.

Answer: 25.3[0]

Question 6

In part (a) a common incorrect answer was 209000. In part (b) some gave the answer in standard form, which was accepted if it was correct. The most common incorrect answer was 412.

Answers: (a) 210000 (b) 4120

Question 7

Almost all candidates either multiplied the two numbers or divided them with more giving the correct answer than not. Some divided the correct answer by 100 thus giving an answer of 1.62.

Answer: 162

Question 8

In part (a) a small number of candidates wrote the incorrect answer of 4820. This was also written as a fraction. In part (b) the most common error was an answer of 52×10^6 .

Answers: (a) [0].00482 (b) 5.2×10^7

Question 9

Many candidates reached the stage of $1 - p = 12$ but then gave the answer as 11 instead of -11 . A few attempted to work with fractions, but most found it easier to remove the fractions at the beginning by multiplying and this proved to be the most successful method to use.

Answer: -11

Question 10

The only method that gave the correct answer was to get two linear expressions with a common bracket and many achieved this first step. One way was to write $2(a + 2b) - x(a + 2b)$. It was quite common to see the second bracket written as $(a - 2b)$ because they didn't realise that the two minus signs make a plus sign.

Answer: $(a + 2b)(2 - x)$

Question 11

Generally most candidates noticed that a square root was required. The most common incorrect answers were seen in those who did not obtain an expression for x^2 in the first stage of working.

Answer: $\sqrt{\frac{A}{2\pi + y}}$

Question 12

There were many who did not understand the symbols for sets. Those who placed the 5 in the correct place usually went on to answer the question correctly. The most common method was to work out $10 + 13 - (20 - 5)$. Some candidates placed the 5 in the intersection of the two sets and they often gave that as the answer too.

Answer: 8

Question 13

The main challenge in this question was around the factorisation of $9 - x^2$. A significant number of candidates presented $x^2 - 9$ factorised as $(x - 3)(x + 3)$ without correcting the fraction and not seeing that they had changed the fraction. A few incorrectly cancelled the 3 with the 9 and the x with the x^2 .

Answer: $\frac{1}{3-x}$

Question 14

Many candidates struggled with this question. The most common error from those who did demonstrate some knowledge of vectors was to write e.g. \overrightarrow{QP} as $\mathbf{q} - \mathbf{p}$ and not $\mathbf{p} - \mathbf{q}$. Many knew that they were looking for \overrightarrow{OT} but they could not write down a correct path from O to T .

Answer: $\frac{2}{3}\mathbf{p} + \frac{1}{3}\mathbf{q}$

Question 15

This question was answered very well. The common error was not to correctly write the second fraction as an improper fraction but to try and divide or multiply as it is.

Answer: $\frac{5}{9}$

Question 16

The common incorrect method used in part (a) was to attempt 12×4 and then adjust the answer to give the upper bound. In part (b) a lot of attempts were written in centimetres and there were many different answers given.

Answers: (a) 50 (b) 12.3

Question 17

In part (a) many candidates gave the correct answer with 9 as the most common incorrect one. In part (b) $3t^3$ was seen more than any other incorrect answer.

Answers: (a) 27 (b) $3t^9$

Question 18

A common reason why some candidates made an error was that they incorrectly expanded the brackets, e.g. some candidates worked out $3 \times 3p$ as $6p$ instead of $9p$ or for $2p \times 3p$ some wrote $6p$ instead of $6p^2$. Another common error by a small number of candidates was to expand the brackets to give the correct answer but then proceed to re-factorise and gave as their answer either $(2p + 3)(3p - 2)$ or even $p(6p + 5) - 6$.

Answer: $6p^2 + 5p - 6$

Question 19

This question was answered correctly by many candidates. However, a common error was to ignore the first piece of information and work out just $(6 - 1)^2 = 25$. Some also wrote down the formula for inverse proportionality or made arithmetic errors.

Answer: 150

Question 20

In this question most candidates showed very little working. A common error was to give $w = 85$ and $x = 95$, the other way round to the correct answer. Most candidates did use the fact that $x + w = 180$.

Answer: 95 85 48

Question 21

The most common error was that some candidates could not multiply and simplify the numerator so that $1(y) - (y - 1) = y - y - 1$ was often seen. The denominator could be left as $y(y - 1)$ although some did expand it but this was accepted for full marks.

Answer: $\frac{1}{y(y-1)}$

Question 22

In part (a) the most successful method was to use the formula $a + (n - 1)d$. Also a very successful method was to find the difference in the sequence of -4 and using that to write the $-4n$ term. Those who used this method did struggle to find the rest of the formula and some used a difference of 4 instead of -4 . In part (b) many candidates struggled to find the correct algebraic expression. Some incorrectly attempted to use a quadratic expression to find the general term.

Answers: (a) $15 - 4n$ (b) $3 \times 2^{n-1}$

Question 23

Most candidates used the cosine rule and they were successful. A very small number of candidates drew a perpendicular line from the top vertex onto the base of the triangle and they used Pythagoras' theorem in the two right-angled triangles. They equated the common height to find its value. Some used the cosine rule to find one of the other two angles and then the sine rule to find the required angle. They did not realise that there are two solutions with sine and they needed to find the obtuse solution rather than the acute one. Some candidates lost accuracy marks for premature approximation at various stages of the above calculations.

Answer: 102.1

Question 24

In part (a) the common errors were to divide by 60 and not 60^2 or to multiply by 60^2 and divide by 1000. Some candidates used 100 instead of 1000. In parts (b) and (c) candidates would often revert back to using 90 even though they gave the correct answer to part (a) so in part (b) an answer seen would be 4.5 and in part (c) 4500 from such working.

Answers: (a) 25 (b) 1.25 (c) 1250

Question 25

In part (a) this question was generally well answered with a wide variety of different workings leading to the correct answer, often using fractions or ratios. A common error was to leave the answer as 7.2 rather than attempting $9 - 7.2 = 1.8$. In part (b) the common error was to use the ratios as they are, leading to the common incorrect answer of 6.5, or the square or the square root of the ratios.

Answers: (a) 1.8 (b) 10.3

Question 26

In part **(a)** the most common error was to give more than one transformation, typically a translation, in addition to the enlargement. Other errors were writing the centre of enlargement as (0, 7) which indicates a misunderstanding of co-ordinates rather than transformations and describing the scale factor as $\frac{1}{2}$ instead of 2. In part **(b)** the most common error was to rotate through the correct angle and direction but using the incorrect centre of rotation.

Answers: **(a)** enlargement, [scale factor] 2, [centre] (7, 0)

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key messages

To be successful in this paper, candidates had to demonstrate their knowledge and application of various areas of mathematics. Candidates who did well consistently showed their working out, formulas used and calculations performed to reach their answer.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time. Few candidates omitted part or whole questions. Candidates generally showed their workings and gained method marks. However many candidates were unable to gain marks in the 'show that' question **9(c)(ii)** if they used the value they had to show from the beginning.

Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. This was particularly evident in **Question 3(c)** and **Question 6(d)**. Candidates should also be encouraged to process calculations fully and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set.

The standard of presentation was generally good; however candidates should be reminded to write their digits clearly. Many candidates overwrite their initial answer with a corrected answer. This is often very difficult to read and is not clear what the candidates' final answer is. Candidates should be reminded to re-write rather than overwrite. There was evidence that most candidates were using the correct equipment.

Comments on Specific Questions

Question 1

- (a) (i) Candidates found completing the tally and frequency columns of the table challenging. Many did not use the words given in the question to complete the table and just completed the frequency column for the tally marks already given. A significant number of candidates recorded the seven words in the empty space for eight letter words and then gave the correct frequencies for their tallies. In both cases candidates were able to gain one of the two marks. Good presentation was key in this question. Extra tally marks needed to be clearly shown to gain full marks.
- (ii) Finding the range from their table proved to be one of the most challenging questions of the whole paper. More able candidates correctly identified from the table that the shortest word had 1 letter and the longest 9 letters so the range was 8. However the vast majority of candidates who attempted this question used the frequencies and found the difference between the highest and lowest frequencies, the most common incorrect answers being 14, 12, 11, 10 and 9 using this method.

- (iii) Candidates were more successful in finding the median from their frequency table. This was usually found by candidates listing all 50 values from the table and then finding the middle value. Few candidates identified the middle as between the 25th and 26th values. The most common incorrect answers were 5 (from median of the number of letters column) and 3 (from listing the frequencies in order and then finding the middle).
- (b)(i) The vast majority of candidates correctly completed the key. However a large proportion of candidates left the space blank, maybe not sure where the key was on a pictogram.
- (ii) Completing the pictogram proved to be the best answered question of the whole paper with nearly all candidates drawing the correct number of boxes and giving the correct frequencies.
- (iii) Candidates found interpreting the data in the pictogram challenging. A large proportion of candidates gave their answer as 16 instead of the type of book. Other common incorrect answers were 'No mode' and '10', which was the sum of the frequencies divided by 6.
- (iv) Finding the difference between detective and music books was answered correctly by most candidates. Few did not attempt it and some were able to gain the mark as a follow through if they had made an error when writing the frequencies in part (ii).
- (v) Candidates showed good understanding of fractions, with very few non-fractional answers seen. Most candidates gave the answer of $\frac{52}{60}$ and many went on to simplify, although this wasn't required to gain full marks. The few incorrect answers seen often gained one of the two marks as they calculated the fraction of students who did choose romance books ($\frac{8}{60}$) or had found 52 students did not choose romance books but did not write it as a fraction or as a fraction with the wrong denominator.

Answers: (a)(i) 3, 5, 14, 10, 11, 3, 3, 0, 1 (ii) 8 (iii) 4 (b)(i) 4 (iii) Comedy (iv) 5 (v) $\frac{52}{60}$

Question 2

- (a)(i) Nearly all candidates attempted this question. However many did not get the correct number of zeros or zeros in the correct positions. The most common incorrect answers seen were 2736045 and 7360045. Candidates who were not consistent with their use of commas or dots were also penalised.
- (ii) Candidates showed very good understanding of factors, with the vast majority gaining full marks for a correct list of six factors. Common errors were omitting the 1 or the 20 or writing a list of multiples instead of factors.
- (iii) Finding an equivalent fraction was well answered by most candidates with the most common fractions being $\frac{14}{18}$ or $\frac{70}{90}$. Some candidates attempted to write as a decimal, and candidates should be reminded to reread the question once they have given their answer to check it is in the form asked for in the question. $\frac{77}{100}$ was a common incorrect fraction from rounding the decimal equivalent to two decimal places and then rewriting as a fraction.
- (iv) About two thirds of the candidates correctly identified 31 or 37 as the prime number. Common incorrect answers were 33 or a prime number outside of the range. Again candidates must reread the question once the answer is given to check it satisfies all criteria asked for in the question.

- (b)(i) The majority of candidates placed their brackets in the correct position. Common errors were around $17 - 3$ and 3×5 .
- (ii) This question proved more challenging with less than half the candidates placing the brackets in the correct position. Common errors were around 2^2 or using two brackets. A significant number of candidates did not attempt this question.
- (c) Candidates demonstrated good use of their calculators to find the cube root of 4913 as 17. Common errors indicated that candidates had square rooted instead of cube rooted or divided by 3.

Answers: (a)(i) 27360045 (ii) 1, 2, 4, 5, 10, 20 (iii) $\frac{7k}{9k}$ (iv) 31 or 37 (b)(i) $17 - 3 \times (5 - 3) = 11$
(ii) $(3 + 2)^2 - 4 = 21$ (c) 17

Question 3

- (a)(i) Most candidates showed understanding of ratios and percentages. Good solutions saw \$240 found as 40% of \$600 and then using the ratio to find the amount spent on music. Those that did not gain full marks either found the 40% but then made errors with the ratio, or did not find 40% but used the ratio correctly with the \$600. In both cases these candidates gained one mark.
- (ii) Candidates who had correctly found the amount spent on music usually gained full marks for this part of the question. Candidates with incorrect answers in part (i) were able to gain one mark by dividing the amount spent on music by 3 and then multiplying by 10, 2 or 8. Some candidates started again with the \$600 and found the amount spent on clothes and books separately and then found the difference. This still only gained one mark as they were not using the 40% of \$600.
- (b) Calculating compound interest proved to be the most challenging part of this question with many less able candidates not attempting it or calculating simple interest instead of compound interest. The correct formula was seen often and the full amount of \$684.70 was a very common answer. This however only gained two marks as the question asked for the interest received not the total amount of the investment after 3 years. Candidates again should be encouraged to reread the question after giving their answer to check they have satisfied all parts of the question. Other common errors were using $1 + 0.45$ instead of $1 + 0.045$ in the formula and rounding errors often led to answers of \$684.69 or \$684.6 or \$84.69 or \$84.6.
- (c) Candidates showed understanding of exchange rates with the majority of candidates able to do one conversion correctly. However only the most able candidates gained full marks as candidates were required to multiply by the exchange rate, subtract and then divide by the exchange rate. Often candidates did the first two steps but did not convert back to dollars. Very good solutions saw candidates convert the €325 to dollars and then subtract. Many candidates who did complete all three steps correctly often did not gain full marks as they did not round their final answer to the nearest cent. Common errors were to round to 1 or 3 decimal places with 223.8 and 223.843 seen often. A small but significant number of candidates divided, subtracted and then multiplied.

Answers: (a)(i) 48 (ii) 128 (b) 84.7[0] (c) 223.84

Question 4

- (a) Most candidates gave one of the acceptable answers of rhombus, parallelogram or kite. The most common error was quadrilateral.
- (b)(i) The vast majority of candidates gave the correct co-ordinates with very few incorrect answers which included $(-2, 0)$.
- (ii) Measuring the obtuse angle was the most challenging part of this question. Candidates struggled to measure angles with many using the wrong scale on their protractor and giving an acute angle or 157 which was measured from the horizontal rather than between lines *RS* and *PS*.

- (c) (i) Candidates demonstrated good use of rulers to measure accurately the length of the line PQ . Few candidates rounded to the nearest whole number of centimetres and the vast majority measured within acceptable tolerances.
- (ii) Candidates who had correct answers for part (i) multiplied their length by 4 to gain the mark here. Many candidates were able to gain a follow through mark if they had made an error in part (i). The most common error was to calculate the perimeter of the triangle and then multiply by 4.
- (d) (i) Good solutions in this part contained the correct transformation, reflection, and a correct line described either as the y -axis or as the equation $x = 0$. The most common error was describing the line as $y = 0$. Very few double transformations were seen.
- (ii) Good answers contained all three parts to describe a rotation. Less able candidates could correctly identify the transformation as rotation but did not include the centre. A common error was to describe two reflections over the y -axis and then the x -axis which gained no marks.
- (e) Candidates found translating the triangle by the given vector challenging. Many less able candidates did not attempt this part or translated in the wrong direction, often one left and two up. Some candidates translated the whole rhombus instead of triangle **D**.

Answers: (a) rhombus (b)(i) $(0, -2)$ (ii) 136 (c)(i) 5.4 (ii) 21.5 or 21.6 (d)(i) reflection, y -axis
(ii) rotation, 180, $(0, 0)$

Question 5

- (a) Most candidates were able to plot two of the points and gained one mark. The vertical scale caused most difficulty with the most common error being to use one square to equal one level rather than two squares. Similarly the horizontal scale was often read as one square equalling one hour rather than one square representing two hours.
- (b) Fewer candidates correctly identified the point representing the person who completed more levels per hour than any others. A large number of candidates did not circle any point. The most common incorrect points indicated were $(90, 22)$ or $(70, 7)$.
- (c) Candidates generally identified the correlation as positive. However a significant number described the correlation using levels and hours rather than the type of correlation seen. Few candidates gave negative or no correlation, although a large number of candidates did not attempt this part.
- (d) Around half of the candidates drew an acceptable line of best fit. The most common wrong line simply joined the corners of the grid. Less able candidates often joined all the points with straight lines.
- (e) Most candidates gave a number of hours within the acceptable range. Many candidates correctly used their line of best fit to gain a follow through mark. Most common errors involved values around 40 and 50 hours from the middle of the horizontal scale.

Answers: (b) $(40, 18)$ indicated (c) positive (e) 76 to 80

Question 6

- (a) Successful solutions showed candidates' ability to find a fraction of a quantity and then to subtract. Candidates who used the fraction $\frac{1}{3}$ generally found the correct answer. However a large number of candidates attempted to find $\frac{1}{3}$ of \$13.50 by using decimals or percentages. This led to inaccuracies due to rounding their decimal to 1 or 2 decimal places. $0.3 \times 13.50 = 4.05$ and $0.33 \times 13.50 = 4.455$ both gained no marks and therefore 9.45 and 9.045 also gained no marks. Candidates who used the decimal to 3 decimal places were able to gain one method mark if they then subtracted from 13.50. Many candidates successfully found $\frac{1}{3}$ of 13.50 as 4.50 but then did not complete the question by subtracting.

- (b)(i)** Candidates showed understanding of 24-hour and 12-hour times and the vast majority of candidates changed the time to 1 45. However fewer candidates gained the mark as the time was often given without the required pm for a 12-hour clock time.
- (ii)** Candidates were more successful in finding how long the train took to travel from Redtown to Southford. Less able candidates attempted this question with a vertical subtraction sum $16\ 39 - 13\ 45 = 2\ 94$ which was interpreted in a variety of ways including 3 h 34 min and 4 h 54 min. This method does not take into consideration that 60 minutes equals 1 hour.
- (iii)** There was a wide variety of correct methods to find by how many minutes Georgina missed her train. Most candidates showed understanding that they had to add 46 mins to 16 39 and then find the difference from 17 12, although many errors were seen in using time. $16\ 39 + 46 = 16\ 85$ was a common start but then $17\ 12 - 16\ 85 = 27$ mins. Good solutions included using minutes past 16 00, i.e. $39 + 46 - 72 = 13$ mins or finding the difference between 16 39 and $17\ 12 = 33$ mins and then $46 - 33 = 13$ mins.
- (c)** Successful candidates divided monetary values by quantities or vice versa. Many different versions of this method were seen including $\frac{\$}{\text{ml}}, \frac{\$}{\text{l}}, \frac{\$}{\text{ml}}, \frac{\text{l}}{\$}, \frac{\text{cents}}{\text{ml}}, \frac{\text{cents}}{\text{l}}, \frac{\text{ml}}{\text{cent}}$ or $\frac{\text{l}}{\text{cent}}$. Some good solutions saw candidates calculating the same quantity from each cup, often converting regular and large cups to 500 ml. When completed correctly candidates generally identified the correct cup. The most common incorrect approach was to investigate the difference in price and quantity. Most candidates identified the Extra large cup as best value but to gain any marks it had to be accompanied by a correct division or multiplication.
- (d)** Most candidates used the speed, distance, time formula correctly to find the time as 1.583 hours. Errors then followed when attempting to change this time to hours and minutes, commonly because of premature rounding. 1.583 was rounded to 1.6 which converted to 1 h 36 mins, leading to the common incorrect answer of 19 48. 1.58 hours was commonly converted to 1 h 58 mins leading to a very common incorrect answer of 20 10. A large number of less able candidates did not attempt this part of the question.

Answers: **(a)** 9 **(b)(i)** 1 45 pm **(ii)** 2 [h] 54 [min] **(iii)** 13 **(c)** Extra large **(d)** 19 47

Question 7

- (a)** Candidates demonstrated good measuring and conversion skills. The vast majority of candidates measured the line accurately and converted correctly by multiplying by 300.
- (b)** Candidates struggled to measure bearings. A large proportion of candidates did not attempt this part or gave a measurement of length rather than an angle. Most candidates showed evidence that protractors were used but many measured Annika's house from Bernhard's or read the wrong scale.
- (c)(i)** The perpendicular bisector was attempted by the majority of candidates with some very accurate drawings seen with clear construction arcs. Some candidates did not show arcs and therefore must have used a ruler and protractor. Candidates should be reminded that when asked to show all construction arcs that a compass must be used.
- (ii)** Good solutions seen used the perpendicular bisector from part **(i)** and extended it to a line drawn south from A. This was not the only method used and a number of candidates gained full marks despite not drawing extended lines but used a protractor and ruler to get C in the correct position. Most candidates gained at least one mark for C either south of A or the same distance from Annika's and Bernhard's house. There were, however, still a large number of candidates who did not attempt this question.

- (d) Few candidates gained full marks on this question. Successful solutions contained an accurate line drawn 320° from B and an arc from A with radius 5.5 cm which intersected their line twice. Many candidates drew an accurate line but did not use an arc to find the position of D on their line and used a ruler only. Most of these candidates only marked one position of D and therefore only gained two marks. A significant number of candidates attempted to find D without any construction lines or arcs, which were rarely accurate. The most common method mark was for 5.5 cm seen in the working or an arc of 5.5 cm drawn from A .

Answers: (a) 3300 (b) 117

Question 8

- (a) Most candidates demonstrated that they understood that the two lines intersecting showed that Caroline and Rob passed each other. This was described in a large variety of ways including; they were in the same place at the same time, they met on the road, Caroline overtakes Rob or they cross paths. A few candidates incorrectly believed that it showed that they were travelling at the same speed.
- (b) Finding Rob's speed proved to be the most challenging part of this question. Most candidates showed that they understood that they needed to divide distance by time but only the most able candidates could do this accurately using the fraction $\frac{50}{60}$ or $\frac{8}{50} \times 60$. Many candidates did divide $\frac{50}{60}$ but then rounded their solution to 0.83 and therefore when dividing into 8 km reached the solution of 9.64 instead of 9.6 and therefore did not gain full marks. It is important that candidates do not round prematurely and use the full solution on their calculator to reach an accurate answer. Another common error was to divide time by distance, $\frac{50}{8}$, and 6.25 was a common incorrect answer.
- (c) Drawing William's journey proved equally challenging. Many lines were too steep and reached the school before Caroline. Successful candidates plotted the point at (08 25,6) and then joined it to (07 25,0) and extended it to (08 45,8).
- (d) A variety of times from 07 25 to 08 45 were seen. As Rob travels faster than William they are the greatest distance apart when Rob leaves home at 08 00. Few candidates made this conclusion and many candidates gave the time that William or Rob reached the school. A significant number of candidates did not attempt this question.
- (e) Candidates who had drawn William's journey correctly generally gained full marks by giving the correct order as they arrived at school. A large number of candidates were able to gain this mark despite drawing William's journey incorrectly but correctly reading their travel graph. Most candidates attempted this question even if they had not drawn William's journey.

Answers: (a) Caroline cycles past Rob (b) 9.6 (d) 0800 (e) Caroline, William, Rob

Question 9

- (a) (i) The correct answer of diameter was seen the most. Hypotenuse was also accepted as a correct answer. Common incorrect answers were chord and radius.
- (ii) Identifying the line AB as a chord was less successful. A wide variety of incorrect answers were seen including adjacent, bisector, rope, string, tangent, sector and segment.
- (b) Giving a geometrical reason why angle ABC is 90° was the most challenging question of the whole paper with few correct answers seen. Candidates had to use the circle theorem that angles in a semi-circle are 90° . Most candidates stated that the angle was a right angle without any geometrical reason.

- (c) (i) Using trigonometry proved challenging for many candidates and was only answered correctly by the most able candidates. Many were able to quote SOH CAH TOA but were unable to go further. If candidates correctly used cosine another common error was prematurely rounding $\frac{20}{52}$ to 0.38 which gives the common incorrect answer of 67.6... or 67.7. Candidates should use the whole calculator value or the fraction when using trigonometry. Rounding errors were common with 67.38... rounded to 63.3.
- (ii) Successful answers included squaring, subtracting and square rooting. To gain full marks candidates must show all elements without errors as this is a 'show that' question. Many less able candidates attempted to find 48 without the use of Pythagoras' theorem, by using angles or adding values. Some more able candidates used their previous answer and trigonometry to find BC correctly. A large proportion of candidates did not attempt this question.
- (iii) More candidates attempted to find the area of triangle ABC . However most did not use the correct base and height. The most common error was to use 20 and 52, giving the area as 520.
- (iv) Finding the shaded area proved challenging for most candidates. Good solutions showed all working and utilised the area formula for a circle. Most candidates who attempted the question used the correct formula but often did not use the radius as 26, using 52 instead. The circumference formula was also seen. Many candidates found the area of the whole circle and then the area of the triangle was subtracted without halving the area of the circle to find the area of the semicircle. A very large proportion of candidates did not attempt this question.

Answers: (a)(i) diameter (ii) chord (b) angle [in] semi-circle [is 90] (c)(i) 67.4 (iii) 480 (iv) 582

Question 10

- (a) (i) A large proportion of candidates did not attempt any part of part (a). Identifying the gradient proved challenging with many incorrect answers seen, the most common being 4, $-4x$, $4x$, 7 and 3 or $3x$.
- (ii) Writing the equation of a line parallel to $y = 2x + 3$ proved equally challenging. The most common incorrect answer was $y = 4x + 6$. Also seen were $5x$, $-2x - 3$ and $2x + 3$, in equal proportions.
- (iii) Equally challenging for most candidates was identifying the co-ordinates of the point where the graph of $y = 6x - 5$ crosses the y -axis. The correct answer was rarely seen with (6, -5) the most common incorrect answer.
- (iv) Of the candidates who attempted this question only the most able candidates found the correct answer. Most candidates who attempted it substituted 7 into the expression $4x - 3$ reaching the most common incorrect answer of 25. Candidates who formed the correct equation $4k - 3 = 7$ were able to then solve it and reach $k = 2.5$.
- (b) (i) Completing the table was the most successful part of this question. Nearly all candidates attempted the question and most gained at least one mark for at least three correct values. The most common error was $y = -7$ for $x = -2$ from $(-2)^2 = -4$.
- (ii) There was good plotting of points with many scoring at least three marks following an incorrect value for y in their table. The follow through from part (b)(i) was seen often. Very few straight lines joining points were seen and even fewer thick or feathered curves drawn.
- (iii) Very few correct co-ordinates were seen in this part. Most candidates who attempted this gave the lowest point from their table (0, -5) or (1, -5) or (0.5, -5) and did not take into consideration the curvature of the graph.

(iv)(a) Nearly half of candidates did not attempt this part. Of those that did attempt to draw the line of symmetry the majority got it correct, with few hand drawn lines seen.

(iv)(b) An equal number of candidates did not attempt this question. The most common error was to repeat the equation of the curve or to omit the $x =$ in the equation and just give the value 0.5.

Answers: **(a)(i)** -4 **(ii)** $2x + k$ where $k \neq 3$ **(iii)** $(0, -5)$ **(iv)** 2.5 **(b)(i)** $1, -5, -3, 1, 7$
(ii) $(0.5, h)$ where $-5.5 \leq h < -5$ **(iv)(b)** $x = 0.5$

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 making an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer and the loss of the accuracy mark. In 'show that' questions candidates must show all their working to justify their calculations to arrive at the given answer. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. When candidates change their minds and give a revised answer it is much better to rewrite their answer completely and not attempt to overwrite their previous answer. Candidates should also be reminded to write digits clearly and distinctly.

Comments on specific questions

Question 1

- (a) (i) This was generally answered correctly.
- (ii) This was generally answered correctly.
- (b) (i) This was generally answered correctly, although a small number of candidates gave correct multiples that were outside of the given range, or factors of 45.
- (ii) This was generally answered correctly, although a small number of candidates gave correct square numbers that were outside of the given range, or 11^2 .
- (iii) This was generally answered correctly, although a small number of candidates gave correct factors that were outside of the given range, or multiples of 402.
- (iv) This was generally answered correctly, although a small number of candidates gave correct cube numbers that were outside of the given range, or 5^3 .
- (c) This was generally answered correctly, although a significant number of candidates incorrectly applied the BIDMAS rule resulting in a numerator of 18 rather than -24 , and/or a denominator of 9 or 1 rather than -1 . Common errors included 18, -18 , -24 , and 2.

- (d) This part proved more challenging for many candidates with few appreciating that rounding each number to 1 significant figure was required, and could then be used to give an estimate of the given calculation. The correct rounded numbers of 20, 9, 30 and 6 could then be used as $20 \times 3 = 60$, $30 \div 6 = 5$, giving $60 \div 5 = 12$. Common errors included the use of 19, 32, 8.6, 6.3, or 19, 32, 9, 6, or 2, 3, 9, 6, or the use of a calculator to give the exact answer of 11.287 or 11.3.

Answers: (a)(i) 138 (ii) 128 (b)(i) 135 (ii) 121 (iii) 134 (iv) 125 (c) 24 (d) $\frac{20 \times \sqrt{9}}{30 \div 6}$, 12

Question 2

- (a) The given shape was generally correctly identified as a trapezium although rhombus, parallelogram and enlargement were common errors.
- (b) The majority of candidates were able to identify the given transformation as an enlargement but not all were 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, -4) and -5 being common errors. The scale factor also proved challenging with -3 and 3 being the common errors. A small number of candidates gave a double transformation, usually enlargement and translation which results in no marks.
- (c) This part proved to be a good discriminator. A large number of candidates gave the incorrect answer of $\frac{1}{3}$ assuming that the area scale factor was the same as the scale factor of the enlargement. The expected method of finding and comparing the two areas was rarely seen.
- (d)(i) Although many were able to correctly draw the required translation this part proved to be challenging for some candidates. Common errors included drawing a translation with one of the vertices at the point (-4, 7), or a trapezium with only one of the vector components correct.
- (ii) The majority of candidates were able to correctly draw the required rotation. Common errors included drawing a rotation with one of the vertices at the point (-1, -1), or a trapezium with a different centre of rotation.
- (iii) The majority of candidates were able to correctly draw the required reflection although common errors included reflections in the y-axis or $x = 1$ or $y = 2$.

Answers: (a) trapezium (b) enlargement, scale factor $\frac{1}{3}$, centre (-5,-5) (c) $\frac{1}{9}$

Question 3

- (a) This part was generally answered well, although common errors included simply rewriting the given numbers as a ratio, and $\frac{7}{48}$; $\frac{4}{48}$; $\frac{5}{48}$.
- (b)(i) This part was generally answered well with the two alternative fractions of $\frac{7}{16}$ and $\frac{21}{48}$ being equally used. A small yet significant number converted the fraction to 0.4375 but then truncated or rounded which resulted in the loss of accuracy. Candidates should appreciate that in a 'show that' question all working should be shown and justified; in this question 7×78 and 21×26 are not sufficient on their own. Candidates should also appreciate that the given value of 546 cannot be used in a reverse method.
- (ii) This part on using a ratio was generally answered well.

- (c) Few candidates appeared to appreciate that the given statement meant that $\left(\frac{3}{7}\right) \times \text{total profit} = 1248$, and the method of $\text{total profit} = 1248 \div \left(\frac{3}{7}\right)$ was rarely seen. Common errors included $\left(\frac{3}{7}\right) \times 1248$ giving incorrect answers of 534 or 1782, $\left(\frac{4}{7}\right) \times 1248$ giving incorrect answers of 713 or 1962.
- (d) This part was generally answered well. However candidates should appreciate that in a 'show that' question all working should be shown and justified; in this question $16\% \times 13\,500$ or 84% of $13\,500$ are not sufficient on their own. Candidates should also appreciate that the given value of 10840 cannot be used in a reverse method.
- (e) (i) This part was generally answered well, although a small number attempted to use an erroneous compound interest type method.
- (ii) The most successful method used was $\frac{12240 - 10840}{10840} \times 100$. Common errors included the use of $\frac{12240 - 10840}{12240}$ or $\frac{12240 - 10840}{100}$.

Answers: (a) 7 : 4 : 5 (b)(ii) 312, 390 (c) 2912 (e)(ii) 12.9

Question 4

- (a) The table was generally completed well with the vast majority of candidates giving four correct values. The one common error was evaluating the y co-ordinate as -4 when $x = -1$ possibly due to misuse of the calculator.
- (b) The quadratic graph was generally plotted well. The majority were able to draw a correct smooth curve although a small yet significant number made the error of joining points with straight lines particularly the two points at (2, 6) and (3, 6).
- (c) Stating the equation of the line of symmetry caused problems for a number of candidates with many seeming not to appreciate that a vertical line will be of the form $x = k$. Common errors included $y = 2.5$, $y = 2.5x$, 2.5 , and attempting to use $y = mx + c$.
- (d) (i) The table was generally completed well with the vast majority of candidates giving three correct values.
- (ii) As the question asked for the graph to be drawn for $-1 \leq x \leq 6$ the line had to be drawn for the full width of the grid. Although the majority of candidates correctly plotted their points many only drew their line for $0 \leq x \leq 5$ or stopped at $x = 4$. A small yet significant number joined their points freehand rather than using a ruler to get a continuous straight line as required.
- (iii) Full marks were rarely scored in this part although the majority were able to score one mark for the positive solution of $x = 4$. The second value was often missing or incorrect, particularly by those candidates who had drawn a 'short' line in the previous part. Common errors included the omission of the negative sign, misreading the scale, giving the y co-ordinates, and giving the values of 0 and 5 coming from the intersection of the curve with the x -axis.

Answers: (a) $-6, 4, 4, 0$ (c) $x = 2.5$ (d)(i) $-2, 1, 5.5$ (iii) -0.6 to -0.4 and 3.9 to 4.1

Question 5

- (a) The majority of candidates were able to measure accurately at 5 cm and then use the given scale to correctly convert to give the actual distance required as 250 m. A very small number gave answers of 5 or $5 \times 100 = 500$ m.
- (b) The majority of candidates were able to construct the required point E accurately using a compass, clearly showing the pair of construction arcs and joining the sides with a ruler. Common errors included omission of the required arcs, drawing the shape with only one side of the correct length, inaccuracies in arcs/lengths. Less able candidates were often unable to answer parts (b), (c) and (d) and left the diagram blank.
- (c) (i) Most candidates realised that the angle bisector needed to be constructed using arcs, and there were many well-constructed accurate angle bisectors which showed all the working clearly. A common error was to draw the bisector just long enough to reach the intersecting arcs without interpreting the context of the question. To be fit for purpose the line needed to reach the opposite side DE , as it represented a path across a park. A common construction error was to either base the arcs from A and C instead of equidistant from B or too close to B to make it accurate.
- (ii) Most candidates made a good attempt to construct the perpendicular bisector of the line, showing two pairs of arcs. Again, many lost a mark for drawing the bisector too short. To be fit for purpose the line needed to reach the opposite side DE , as it again represented a path across a park. It was a common construction error for only one pair of intersecting arcs to be drawn inside the pentagon or no arcs at all.
- (d) (i) This part proved to be a good discriminator. A good number of candidates were able to draw a circle with the correct radius and in the correct location, with others following through correctly. The most common error was to draw a circle of correct radius but often centred incorrectly within the shape or on B rather than on the angle bisector 7 cm from B .
- (ii) A good number of candidates calculated the actual circumference of the circular lake correctly. Common errors included using the formula for the area of a circle, using 3 cm for the radius without scaling it up to the actual value, and using a variety of other incorrect formulas. Candidates need reminding of the rubric instruction that 'For π , use either your calculator value or 3.142'.

Answers: (a) 250 (d)(ii) 942 or 943

Question 6

- (a) A significant majority of candidates were able to complete the two-way table correctly. A few errors were made completing the column for French more than other values. Candidates should be encouraged to check that the numbers in each row and column add up correctly to match the totals.
- (b) (i) This part of the question caused problems for many candidates. Whilst most realised a fraction was required many could not interpret the question and gave an incorrect denominator. Often the probability was given for the number of girls studying Spanish out of everyone studying Spanish $\left(\frac{54}{102}\right)$, or out of all the students in the college $\left(\frac{54}{262}\right)$, rather than out of the total number of girls. A small number gave an incorrect answer in the form of a ratio, or just the total of 54.
- (ii) This part of the question caused the most problems. Most candidates realised that the frequencies for French and Italian needed to be added but the denominator was often incorrect. The common errors were denominators 87 (from adding the number of students studying French and Italian) or 262 (the total number of students in the college) rather than 123 (the total number of boys), or just the total of 46.
- (iii) This part was more successful. Common errors included a numerator of 53 (the number who did study German rather than those who did not), or just the total of 209.

- (c) (i) The majority of candidates were able to score full marks for this part of the question which required them to calculate the angles for two sectors on a pie chart.
- (ii) There were many accurate and well-drawn pie charts scoring full marks. A small number of inaccuracies were possibly due to the incorrect or lack of use of a protractor.

Answers: (a) 21, 8, 30, 11, 139, 57, 102, 20 (b)(i) $\frac{54}{\text{their } 139}$ (ii) $\frac{46}{123}$ (iii) $\frac{209}{262}$ (c)(i) $80^\circ, 155^\circ$

Question 7

- (a) The vast majority of candidates were able to find the correct time. Common errors included the times of 1000 or 1005.
- (b) (i) This part proved to be a good discriminator. The more able candidates had no difficulty in earning the mark, usually using division by 0.25 or $\frac{15}{60}$, with a smaller number opting for the easier and more efficient multiplication by 4. The less able candidates found it more challenging in that the correct formula had to be identified and the correct conversion from minutes to hours made. Common errors included $\frac{5.6}{15} = 0.373$, $\frac{5.6}{0.15} = 37.3$, $\frac{15}{5.6} = 2.68$, and the attempted use of the times of 0955 or 1010.
- (ii) The majority opted to convert their previous answer from km/h to m/s. A significant number struggled with the conversion factor, often due to the use of 100 instead of 1000 and also the use of just 60 rather than 60×60 . Other common errors included only multiplying, or dividing, by 1000, and not considering the change in the time. A smaller number opted to use the data from the start of the question, and were generally more successful. Often a lack of attention to detail led some candidates to lose a mark as they did not give their answer to 1 decimal place.
- (c) This part was generally answered well with candidates able to correctly draw the two lines representing the journey to the supermarket and the time spent at the supermarket. Common errors included starting the journey at 0950 instead of 0955, drawing the horizontal line at 5.5 km instead of 5.6 km, misreading the time scale, and drawing freehand lines rather than ruled lines.
- (d) (i) The correct method to calculate the time was seen often, however errors were made converting from hours to minutes. Many reached 0.2 hours but often gave this as 20 minutes and occasionally 2 minutes. The most common incorrect answer was 5 minutes arising from speed divided by distance.
- (ii) This part was generally answered well particularly with a follow through applied. Common errors included starting the journey at 0950 or 1005, misreading the time scale, and ending this journey at (1033, 5.6).
- (e) (i) This part was generally answered well particularly with a follow through applied.
- (ii) Although a significant number of correct or follow through answers were seen, many candidates found this part quite demanding in that the correct formula had to be identified, the correct journey time had to be found, and the correct conversion from minutes to hours made. Common errors included $\frac{5.6}{21}$, $\frac{5.6}{0.21}$, $\frac{21}{5.6}$, 21×5.6 , and the attempted use of the times of 1033 or 1054.

Answers: (a) 1010 (b)(i) 22.4 (ii) 6.2 (d)(i) 12 (e)(ii) 16

Question 8

- (a) (i) The majority of candidates were able to give the correct answer. A small yet significant number however had the correct answer clearly marked on their diagram but then gave a different value on the answer line, showing a misunderstanding of the three letter notation used to represent an angle. Other common errors included 72 (from $180 - 108$) and 44 (from $180 - 136$).
- (ii) The majority of candidates were able to give the correct answer particularly with a follow through applied, although similar errors to that made in part (i) were again seen. Other common errors included 64, 60 and 58.
- (b) (i) The majority of candidates were able to correctly identify the given polygon as a pentagon although the full range of mathematical names were seen, with the most common errors being trapezium and parallelogram.
- (ii) Fully correct mathematical explanations, containing the three required key words of angle, tangent and radius (or diameter), were rare. For many candidates trying to express what they knew, in an acceptable way, was challenging. Common errors included incomplete explanations such as 'it's on a tangent', 'a tangent is 90', 'the radius is at 90', 'it is 90', or incorrect explanations such as 'it's in a semi-circle', 'it's on a straight line' and ' $180 \div 2$ '.
- (iii) The majority of candidates were able to give the correct angle of 108° . However, once again fully correct mathematical explanations, containing the three required key words of angles, line and 180, were rare. Common errors included incomplete explanations such as 'it's on a straight line', 'a line is 180', 'the angles are 180', 'angles on a line', or incorrect explanations such as 'it's in a semi-circle', 'it's in a triangle' and 'the lines are parallel'.
- (iv) This part was answered reasonably well although common errors of 108 and 90 were seen.
- (v) This part proved to be a good discriminator and proved demanding for the majority of candidates with a significant number unable to make any attempt. However a number of fully correct answers were seen together with clear working, often done in stages. The possible starting line of $90 + 108 + 72 + 2x = 540$ was rarely seen. Common errors included the use of 360 rather than 540, omission of the dividing by 2, and answers of 90, 72 and 108.

Answers: (a)(i) 116° (ii) 32° (b)(i) pentagon (ii) angle between tangent and radius
(iii) 108° , angles on a straight line add up to 180° (iv) 72° (v) 135°

Question 9

- (a) This part on solving a linear equation was generally answered well with a good number of responses gaining full marks. The majority of candidates were able to expand one or both brackets correctly although not all were able to rearrange their resulting equation into a correct $ax = b$ form. Common errors at this stage included $10x = 40$, $10x = 16$, and most usual $2x = 16$.
- (b) (i) This part on writing down a second linear equation from the given information was generally answered well with the majority of responses gaining both marks.
- (ii) Some very good solutions to the simultaneous equations were seen although less able candidates were often unable to attempt this part. The majority of candidates used the elimination method to solve their equations. The setting out was generally very clear with very few errors or slips being made and only the rare candidate choosing the wrong operation for the elimination. Less able candidates could often score one mark for two values satisfying one of the original equations. On the rare occasion when candidates did choose to use the substitution method, most were able to rearrange one of the equations and correctly substitute into the other. However this method did cause more candidates to lose accuracy marks with the resulting fractional equations often causing numerical and algebraic errors leading to incorrect final values for a and b .

Answers: (a) 20 (b)(i) $3a + 8b = 93$ (ii) $a = 7$, $b = 9$

MATHEMATICS

Paper 0580/33
Paper 33 (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 learning mathematical terms and definitions would help all candidates to answer questions giving the relevant name or using the relevant process.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Candidates were able to complete the paper within the required time and most candidates made an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show all working including any formulae used and substitutions made, as some candidates, showing no working and giving incorrect answers, are not able to score any of the available method marks.

A lack of understanding of speed/distance/time and unit conversion was evident in **Question 1(b)(i)** and calculations dealing with time and its correct notation in **Questions 1(c), 1(d)** and **3(a)**. Calculating percentage increase caused problems for many candidates as did rules of indices.

Attention should also be made to the degree of accuracy required, and candidates should be encouraged to avoid premature rounding in workings.

Comments on specific questions

Question 1

- (a) (i) A large majority of candidates gave the correct answer. A few realised which day had the lowest temperature but gave the temperature, -5 , rather than the day.
- (ii) Nearly all candidates scored the mark for ± 7 .
- (iii) Many fully correct answers of -5 were seen although some had a positive 5.
- (b) (i) Whilst most candidates attempted this part, about half had fully correct answers. Many scored a method mark for $6.5 \div 39$ although not all candidates had three significant figures. Other incorrect methods included $39 \div 6.5$ and 6.5×39 . Some then multiplied these by 60 showing an understanding of changing hours to minutes. Premature rounding of 0.16 often lost the accuracy of the final answer.
- (ii) This part was not answered well and fully correct answers were very rare. Few candidates recognised they needed to find the circumference of the wheel. Others used πr^2 . Even when candidates found the circumference they did not know how to proceed. Their answer was multiplied or divided by 6.5 or 6500 rather than divided into 6500. Many incorrect methods were seen, the most common being $6.5 (\times 1000) \div 1.8$ and 6.5×1.8 . A few candidates went on to score a final mark by rounding their decimal answers down to an integer, but most either went straight to an integer from their calculator or gave a decimal as their final answer. Many candidates didn't show their unrounded answers in their working and hence could not score the last mark.

- (c) A slight minority of candidates scored full marks with few realising the question was based on finding the LCM of 30 minutes and 45 minutes. Most listed times of buses and trains, with some just finding the time of the next bus or train. Many added 30 minutes and 45 minutes to 11 40 to reach a final incorrect answer of 12 55 or added 180 minutes rather than 90 minutes to give the answer 14 40.
- (d)(i) Many fully correct answers were seen with quite a number that were out by one minute with 46 being quite a common answer. A common misconception was to subtract the times $1001 - 914$ giving 87 as the final answer ignoring the fact that there are 60 minutes in an hour.
- (ii) Most candidates identified the correct choice of train.
- (e) A small majority of candidates scored full marks. Most scored a method mark for $437 \div 62$ or 7.04 or 7.05 and gave the answer as 7 not realising that being slightly over 7 meant an extra coach would be required.

Answers: (a)(i) Friday (ii) 7 (iii) -5 (b)(i) 10 (ii) 1149 (c) 13 10 (d)(i) 47 (ii) 10 21 (e) 8

Question 2

- (a) The majority of candidates scored three marks. For the star 3 or 4 lines of symmetry were frequently seen rather than 6. Most candidates gave the correct 2 lines of symmetry for the rectangle although some spoilt their answer by drawing the diagonals also.
- (b) This part was generally well answered with candidates understanding that angles in a triangle and on a straight line add up to 180° . Most did the correct first step of subtracting 48° from 180° . A variety of errors were made but most common was not dividing by 2 to correctly identify angle x . Answer pairs of 48° with 132° were frequently seen as well as angles of 42° , 84° and 48° .
- (c) Candidates found this part challenging and a wide variety of incorrect answers were offered. A correct answer of 144 was found either by calculating the exterior angle first or more commonly by calculating the sum of the interior angles. A significant number of candidates did not know that a decagon has ten sides and some went on to find the interior angle of other regular polygons.
- (d) This part was answered well by the majority of candidates with most scoring full marks and many others getting one of the two angles correct. Most errors stemmed from candidates subtracting from 180° rather than 90° so answers of 53° with 127° were sometimes seen.
- (e) Many candidates found this part challenging. Most candidates who approached the question by finding the areas of the two separate triangles and subtracting them obtained the correct answer. A significant number of candidates added them instead. Those who started by subtracting the bases to work with the shaded area often lost their way and often gave an answer that was double the correct one or completely wrong. A few used Pythagoras' theorem to find the slanting sides of the triangles, which could not be used to find the required area.

Answers: (b) 66, 114 (c) 144° (d) 53, 37 (e) 72

Question 3

- (a) Most candidates found the daily number of opening hours, 8, $9\frac{1}{2}$ and 10, although it was common to count one hour more or one hour less. A common error was writing $9\frac{1}{2}$ hours as 9.3. Most candidates only scored one method mark for adding these three times for single days rather than multiplying the 8 hours by 4 to represent Monday to Thursday. This resulted in the most common incorrect answer seen, $27\frac{1}{2}$. A small number lost the final mark for 51.3 or for rounded answers of 51 or 52.
- (b) Most candidates had a good understanding of this monetary calculation question. Errors were frequently made in combining the incorrect number of adult and child tickets.

- (c) Nearly all candidates scored full marks.
- (d) A high proportion of candidates were able to write the number in figures. A common error was omitting the zero.
- (e) Finding the required percentage increase proved challenging for a significant number of candidates. The most successful method was to use $\frac{14100 - 12400}{12400} \times 100$. Many found the actual increase but just divided this by 100 to get their answer. Many used a multiplier approach but had the figures inverted in their division.
- (f) A minority scored full marks. Many did not understand the context of the question so even though they were able to state the next prime number and calculate $\sqrt{225}$ and 2^6 , they were unable to place the digits correctly in the table. Some found the next two prime numbers and entered both or used 27 instead of 29 or other odd numbers. Many seemingly random incorrect numbers were used.

Answers: (a) 51.5 (b) 13.4[0] (c) 2.2[0] (d) 27053 (e) 13.7 (f) 2 9 1 5 6 4

Question 4

- (a) (i) A large majority of candidates successfully solved this simple equation. A few subtracted 3 from 18.
- (ii) Many candidates were able to solve the given equation correctly with clear working shown. Most candidates knew what was required but errors with signs were sometimes made when collecting x terms and number terms on each side.
- (b) A large majority of candidates were able to factorise $5x - 15$ correctly. Any errors made were varied with a few omitting the brackets hence leaving $5x - 3$ as the answer, and some thought they were solving an equation.
- (c) A large majority were able to simplify the expression correctly by collecting like terms. Most other candidates scored one mark for correctly collecting the two positive x terms. Errors with signs were made when collecting the y terms as one was positive and the other negative so $-8y$ or $+4y$ were often seen instead of $-4y$.
- (d) A very high proportion of candidates scored full marks in this part and most of those that didn't scored one mark for evaluating $5u$ correctly as 55 or for showing a correct substitution into both terms. The usual error was evaluating $-2v$ with $v = -3$ as -6 .
- (e) Many candidates correctly re-arranged the formula to make p the subject. Some candidates made a sign error in the first step resulting in the answer $p = \frac{H-3}{7}$ or $p = \frac{-H-3}{7}$. Other incorrect answers included $p = \frac{\pm 3H}{7}$.
- (f) (i) This part was answered very well with a large majority of candidates finding the correct index number. Those who did not score the mark gave a variety of incorrect values with 13 and 30 seen regularly from adding or multiplying the powers seen within the question.
- (ii) Few candidates had the correct answer of -10 with many having 10 or ± 9 , whilst others had 0 or 1.

Answers: (a)(i) 6 (ii) 8.5 (b) $5(x-3)$ (c) $5x-4y$ (d) 61 (e) $p = \frac{H+3}{7}$ (f)(i) 7 (ii) -10

Question 5

- (a) (i) This was answered well with nearly all candidates able to write the mode for the number of goals scored. Some candidates gave the answer as 8, the highest number in the list.
- (ii) This part was answered well. A high proportion of candidates found the correct range.
- (iii) Many candidates were able to find the correct median. While most candidates understood the need to order the numbers to identify the correct middle pair, a common error was not re-ordering the list and attempting to find the mean of the incorrect middle pair. Some didn't know what to do with two middle values, sometimes picking just one of them. A small number of candidates gave the correct calculation of $\frac{(3+5)}{2}$ but a lack of brackets and knowledge of BIDMAS resulted in an answer of 5.5. A small number of candidates calculated the mean instead.
- (b) (i) This part was answered very well. A common incorrect answer was 9.
- (ii) Candidates struggled to find the mean from the table of discrete data. Rather than multiply the number of goals by the number of games and divide this total by 50, some candidates just added the number of goals, 36, or the number of categories, 9, and used combinations of 50, 9 and 36 in their divisions. Candidates need to be more familiar with the method involved in this type of question. The common error that $0 \times 5 = 5$ was also seen.
- (c) (i) This part was generally answered well with a majority scoring full marks and almost all candidates getting at least one mark for calculating 114° as the missing angle for the pie chart sector. Less than half of all candidates showed any working.
- (ii) The majority of candidates completed the pie chart accurately.

Answers: (a)(i) 1 (ii) 7 (iii) 4 (b)(i) 50 (ii) 3.28 (c)(i) 23, 38, 114°

Question 6

- (a) The table was completed very well with the majority of candidates giving all six correct values.
- (b) The reciprocal graph was generally plotted very well. The majority were able to draw a correct smooth curve with a few making the error of joining points with straight lines or joining the points $(-1, -6)$ and $(1, 6)$.
- (c) This part was generally answered well. Common errors included drawing the lines $y = 5$ or $x = -5$ instead of $y = -5$ and a few drew the correct line dotted rather than continuously.
- (d) Most candidates achieved the correct answer.

Answers: (a) -1 -2 -6 6 2 1 (d) -1.2

Question 7

- (a) Most candidates recognised the transformation was an enlargement and were able to give the correct scale factor. The centre was often incorrect or omitted, many having $(0, 0)$ or $(3, 1)$ and a number used incorrect vector notation.
- (b) Most candidates recognised the transformation was a rotation and were able to give the correct angle of 180° although there was more variation for this with both 90° and 270° seen. Again the centre was often missing.

- (c) (i) Candidates had more success drawing the transformations in this part and the next than describing them in parts (a) and (b) when often they only gave partial descriptions. Most scored full marks. Diagrams were usually ruled but some lost the marks because their triangles were not congruent to A.
- (ii) This part was generally answered well but more errors were seen than in the previous part. The question required triangle A to be reflected in the line $y = -3$. Problems arose from candidates not identifying the correct line with some reflecting the triangle in incorrect lines, whilst others reflected the wrong shape, often using C. Again, some candidates lost the marks because their triangles were not congruent to A.

Answers: (a) enlargement, centre (3, -1), s.f 2 (b) rotation, centre (0, 0), 180°

Question 8

- (a) (i) Most candidates were able to find the correct probability of picking a green ball from the 14 balls in the bag.
- (ii) Most candidates were able to find the correct probability of picking a green or red ball from the 14 balls in the bag.
- (iii) Nearly all candidates recognised it was impossible to pick a yellow ball from the bag and gave an acceptable answer to represent a probability of 0.
- (b) (i) This was answered well by the majority of candidates who were able to complete the missing probability in the table.
- (ii) Nearly all candidates identified brown as the most likely colour.
- (iii) A large majority of candidates were able to find the number of black balls in the bag containing 50 balls altogether using the given probability of 0.14. More errors were seen in this part of the question than in previous parts. The most common were based around the division of the numbers 0.14 and 50 in either order with most written as fractions or with evaluations often multiplied by 10 or 100.

Answers: (a)(i) $\frac{6}{14}$ (ii) $\frac{11}{14}$ (iii) 0 (b)(i) 0.18 (ii) brown (iii) 7

Question 9

- (a) (i) Nearly all candidates identified the next term of the sequence correctly.
- (ii) Most candidates successfully described the rule for the next term although $n + 7$ was a common error.
- (iii) Many correct answers for the n th term of the sequence were seen. The common error was $n + 7$. Candidates often scored at least one mark for $7n$.
- (b) Most candidates successfully completed this question, although many random incorrect answers were also seen.
- (c) This was answered poorly with few recognising the sequence for cube numbers. Most candidates approached the question by finding the first and often the second and third sets of differences between successive terms, which quite often led to answers involving $6n$. Many different incorrect answers were seen and many more abandoned attempts.

Answers: (a)(i) 36 (ii) add 7 (iii) $7n + 1$ (b) 11 14 19 (c) n^3

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key messages

Candidates need to ensure that they have a good understanding and knowledge of all of the topics on the extended syllabus.

Candidates need to read the questions carefully. In particular, when questions have been completed candidates should read the question again to ensure that they have a sensible answer and one that precisely answers what is asked.

Some candidates are giving answers to less than 3 significant figures without a more accurate answer being seen. If a candidate has shown working they are likely to lose only one mark but those candidates showing no working may not be awarded any marks.

Questions that include the word 'show' require candidates to work towards the result rather than using the given result. They also require candidates to show all the steps in their working.

General comments

Many candidates demonstrated that they had a clear understanding across the wide range of topics examined. The majority of candidates attempted every question on the paper.

The presentation of some working makes it very difficult to follow the thought processes. In addition, by setting their work out in a clearer order, some candidates would make fewer slips and mistakes.

The most able candidates were able to demonstrate their ability to apply their knowledge to problem solving. However, some candidates would benefit by thinking more carefully about the mathematical skills required so that they use the most efficient route to answer questions.

Candidates should avoid rounding prematurely in the middle of a response, as this can affect the accuracy of their final answer.

The questions involving money (**Question 3**), transformations (**Question 4**), graphs (**7(a)(b)(c)**), angles (**Question 8**) and probability (**Question 9**) were completed particularly well.

Weaker topics included responses to the questions which included the word 'show', (**1(a)**, **5(d)** and **7(d)**), the algebra questions, (**Question 5** and **Question 12(d)**), solids (**Question 6**), vectors (**Questions 11(a)** and **11(b)**), wordy questions (**Questions 1(d)**, **1(e)**, **10(c)**) and interpretation of graphs (**Question 7(e)**).

Comments on specific questions

Question 1

- (a) Nearly all candidates gained this mark, mostly with a two-stage solution. Both the division and the multiplication needed to be seen. The second step of multiplying 34 by 9 was missed by some while a few others multiplied each person's share by 34 without showing the first step of $680 \div 20$. Only rarely was working starting from 306 seen and these candidates could not score.

- (b) An incorrect answer was rarely seen in this part since most of those not producing a full solution in part (a) did know how to find the other shares. The main error seen was to share the remainder, after $680 - 306$, equally between Barbara and Collette but there were only a few of these seen and other errors were rare.
- (c) Most candidates divided by the exchange rate correctly. The main error seen was to multiply instead of divide, but this did not occur very often.
- (d) Quite a number of candidates found \$4.11 but then did not complete the question and omitted to divide by 3. Some misreading of the question was evident occasionally with the two fruits being mixed up. Otherwise some arithmetic slips were seen resulting in the question not being done quite as accurately as it might have been.
- (e) Almost all candidates correctly found the amount of money Collette spent on clothes. A very common error was then to work out one-fifth of the remainder rather than one-fifth of the original share. Those who did find the correct amounts often then correctly completed the question but a significant number did not go on and subtract the total spent from her share. This question was one where candidates clearly had the basic mathematics skills but lost marks through not following precisely what the question was asking.

Answers: (b) 238, 136 (c) 272 (d) 1.37 (e) 40.80

Question 2

- (a) (i) The vast majority of candidates correctly gave 9 cm as the lengths of CD and AD .
- (ii) Although many candidates correctly constructed the position of D , there were many who showed no arcs but managed to position D within tolerance. Less able candidates drew one of the two lines 9 cm long and then joined the other one to its end point.
- (b) The perpendicular bisector of AB was usually better attempted than the angle bisector. Most candidates appeared to understand what lines were needed and correct constructions were often seen with clear evidence of construction arcs, although a small number did not appear to have the lower arcs for the perpendicular. There were quite a number who measured rather than constructed, particularly the angle bisector, but most lines were drawn within tolerance and earned some marks. A small number found the perpendicular bisector of BC rather than the angle bisector.

Answer: (a)(i) 9

Question 3

- (a) Many correct answers were seen in this part. Only a few candidates made the error of using 77 500 as the denominator. Answers of 6 or 6.1, without a more accurate value seen or with incomplete working shown, lost marks.
- (b) Most candidates seemed to be familiar with the formula for compound interest meaning only occasionally were year-by-year solutions seen. Inaccuracy came from working out 1.022^6 and rounding it to 1.14 before multiplying by 12 000. In addition, many did not round to the nearest dollar which lost a mark. Simple interest was only seen a small number of times.

Answers: (a) 6.06 (b) 13674

Question 4

- (a) (i) Most candidates recognised this as a translation but the word translate was not always given. Other words such as transformation, translocate, shift, slide and move were seen which were not acceptable. A correct vector was often seen and in addition answers such as 8 left and 2 up were also seen. Errors included an incorrect number of units, incorrect negative signs, translations from B to A or answers expressed as co-ordinates.
- (ii) Whilst the word enlargement was frequently given, words which did not score included reduce and shrink. Some candidates combined enlarge with a movement and this did not score as it is not a single transformation. Common errors in the scale factor included -0.5 , 2 and -2 . The centre of enlargement was often incorrect. Some candidates just wrote 'origin', others used inaccurate construction lines which did not meet at $(-4, 0)$.
- (iii) Those that recognised rotation often went on to give an angle and a centre. The direction of the rotation was often omitted when using 90° , although some correctly used 270° . The centre was often inaccurate and some again just wrote 'origin'. As in the previous part, those giving rotate with another transformation, usually translation, scored zero.
- (b) Whilst there were some accurate answers there were many triangles drawn that were either not twice as long in each linear direction or were drawn in the wrong position. Many answers were drawn with part of the triangle off the grid to the right and it seemed that candidates were not recognising the triangle had to be to the left of triangle A, or indeed understanding how to use the centre of enlargement.

Answers: (a) translation $\begin{pmatrix} -8 \\ 2 \end{pmatrix}$ (ii) enlargement, 0.5, $(-4, 0)$ (iii) rotation, 90° clockwise, $(1, -1)$

Question 5

- (a) (i) Whilst some candidates were able to factorise the expression correctly, many others were clearly not familiar with expressions of this form and the process for factorising them. Of those who understood the process, it was quite common to see errors made with the negative signs.
- (ii) Unless candidates recognised that this was the difference of two squares it was difficult to be successful. Common errors included $(2y - 9)(2y - 9)$. It was quite common for less able candidates to try to solve $4y^2 - 81 = 0$.
- (iii) Candidates were more successful with this part as it was of a more usual form. Common errors included slips with negative signs within the brackets. Candidates who factorised correctly but went on to multiply the brackets back out or then solve the correct factorised expression equated to zero and gave these as their final answer, were penalised.
- (b) Some candidates produced eloquent solutions and clearly knew the approach to take when rearranging a formula with x appearing more than once. Misunderstanding of BIDMAS was very evident here with candidates unsure as to which stage to do first. However, a significant number of candidates were able to score the first method mark by correctly multiplying both sides by x . Candidates often could not then correctly combine the x s together with $2x$ and x^2 frequently seen. Those candidates who reached the stage of correctly factorising the x out usually went on to correctly complete the question. It was very difficult to award any marks to candidates who unsuccessfully tried to complete more than one operation at a time.
- (c) Candidates were required to show their working in this part and many produced clear and accurate solutions. Those who made slips with signs were often able to either gain a method mark or a special case mark for solutions which satisfied one of the original equations. The majority of solutions used the elimination method rather than the substitution method.

- (d)(i) The most able candidates were clearly familiar with the process required to combine algebraic fractions and rewrite the given equation as a quadratic and there were many solutions which were perfectly executed. Other candidates had the general idea but there were frequent errors seen with signs and lack of brackets. Candidates who recognised they had made sign errors went back to amend their errors but often made their work unclear or missed some of the changes and were penalised for these slips. The least able candidates had little idea where to start with this.
- (ii) This should be a routine question involving the quadratic formula but there were a wide range of errors seen. These included incorrectly quoting the formula, short square root sign, short division sign, errors with negatives, premature rounding of $\sqrt{241}$ and incorrect rounding of answers. Candidates not showing any working before giving the correct answers could only score a maximum of 2 marks.

Answers: (a)(i) $(2n + m)(m - 3)$ (ii) $(2y - 9)(2y + 9)$ (iii) $(t - 4)(t - 2)$ (b) $\frac{2m}{k + 1}$ (c) 6, -2 (d)(ii) -0.79, -3.38

Question 6

- (a) Whilst there were many accurate answers, a very significant error was that many candidates did not recognise the need to adapt the given formula for the volume of a sphere to that of a hemisphere. In addition, rearranging the formula was not done very well, with the most common errors arising from mistakes in dividing by the $\frac{2}{3}$ and the inability to be able to find a cube root using a calculator. Consequently this fairly straightforward question was not done very well.
- (b)(i) A lot of confusion was evident in this part due to many candidates not reading the question carefully. Instead of recognising that the volume of the cylinder was 70 cm^3 often the volume of the whole toy or just the hemisphere was used. Quite a number of candidates had an incorrect expression for the volume of the cylinder, with $2\pi rh$ and $2\pi r^2h$ seen a number of times as well as $2\pi rh + \pi r^2h$.
- (ii) For those candidates that understand similar solids this question was straightforward. Whilst many realised that 19200 had to be divided by 300, few then cube rooted 64 but simply multiplied the answer of 64 by 1.6. A variety of attempts were seen involving much more complicated methods that usually started by dividing 19200 in the ratio 230 : 70 but these candidates generally made little progress.

Answers: (a) 4.79 (b)(i) 8.70 (ii) 6.4

Question 7

- (a) Whilst the correct answer was often seen, common incorrect answers included y-axis, x-axis or $y = 0$.
- (b) Many candidates drew accurate ruled tangents touching the given graph and were able to find the gradient well within the given answer range. Errors included drawing the tangent at $x = -0.5$, lines that were close to but either crossed the graph or had a gap between the tangent and the graph, gradients without the minus sign, or gradients arising from misreading of the scales.
- (c)(i) Most candidates completed the table correctly.
- (ii) Candidates were generally able to plot the points accurately and smooth curves were drawn. Errors mainly arose from misreading the y-axis and points mis-plotted. Smooth curves were required and candidates were penalised if they either used a ruler, had the wrong curvature between the points or had multiple lines or feathering between points.
- (d) Few candidates understood that they needed to arrive at this equation by equating the equations of the two curves. Many candidates tried to substitute x values which they had read off from the intersection of the two curves and try to make the result zero.

- (e) Only a few candidates understood how to find the correct equation of the line to draw and these usually went on and scored full marks. A common approach, which was not asked for, was to draw the graph of $y = x^3 + 5x + 2$ and read off where this cut the x-axis. In addition, a common misconception was that this cubic could be solved using the quadratic formula.

Answers: (a) $x = 0$ (b) -9 to -6.5 (c)(i) $0, 2.4, 4$ (e) $y = -2x + 2, -0.45$ to -0.35

Question 8

- (a) Many candidates gave clear and concise correct solutions to this question. Most candidates attempted to take the approach of $8x + x = 180$ but it was quite common to see the error $8x + x = 360$. In addition, candidates who correctly found $x = 20$ did not always go on and complete the question by finding the number of sides. Those who attempted to use the sum of the interior angles and nothing else could make no progress as they frequently had two unknowns in their equation.
- (b) Many candidates gave the correct answer with most doing the working on the diagram. Of those who did not get to 32, many picked up one mark for either $DBC = 58$ or $BCD = 90$ and sometimes got both. Some assumed triangle ADC was isosceles and gave 61 as their answer, even showing it on the diagram as angle ADC , and others just wrote an answer of 58.
- (c) (i) Fewer scored full marks here than in part (b). The majority used the parallel lines correctly but many assumed that PRQ was 48 and therefore so was OPR . Many remembered something about angles at the centre and circumference but got them the wrong way round and gave PRQ as 96 and hence 96 as their answer. Others assumed OQ and PR intersected at right angles.
- (ii) There were few fully correct answers to this part. Most calculated an arc length with the majority giving the length of the minor arc and a few giving the total circumference as the answer. A common error made by some was to use the formula for the area, finding either the area of the whole circle or a sector with angle 48 or 312.

Answers: (a) 18 (b) 32 (c)(i) 24 (ii) 29.4

Question 9

- (a) The majority of candidates were able to fill in the tree correctly. The errors that occurred mainly arose because candidates unnecessarily tried to give their answers as decimals or percentages and these were frequently at less than the 3 significant figure accuracy required.
- (b) Many candidates gave the correct answer or were able to earn a method mark for demonstrating that they were attempting to multiply the probabilities. The most common error was to add the probabilities.
- (c) Most candidates selected $\frac{5}{6}$ and $\frac{3}{10}$ but they were not always put together with the fractions in the first stage. When candidates did select $\frac{5}{8}, \frac{5}{6}$ and $\frac{3}{10}, \frac{3}{8}$ many candidates did not know when to add or multiply. In addition, although candidates can use calculators, there were a number of basic arithmetic errors seen.

Answers: (a) $\frac{5}{8}, \frac{3}{8}, \frac{1}{6}, \frac{5}{6}, \frac{7}{10}, \frac{3}{10}$ (b) $\frac{5}{48}$ (c) $\frac{304}{480}$

Question 10

- (a) Reverse percentages is always a topic producing errors and this was no exception. Subtracting or adding 6% to 79.50 were very common errors. It was very rare for part marks to be awarded in this question as those who understood the method of reverse percentages nearly always gave the correct answer.
- (b) Bounds is a challenge for candidates at all levels of ability and there were not many fully correct solutions to this question. However, many did gain one mark usually from identifying 35 as the lower bound of the number of members. 25 minutes was the most common error for the lower bound of the time. The vast majority of candidates did realise that the bounds had to be multiplied in order to get a sensible answer.
- (c) (i) Few candidates did not get this question correct. The only significant error was 35 from ignoring the word 'only' in the question.
- (ii) Again incorrect responses were rare. The only significant error came from adding the word 'only' to give 33.
- (iii) Candidates did not always read the words in the question carefully. There were a number of different errors made, including, for example, using everyone, 93, instead of just the swimmers, 50, as the denominator and/or using some combination of 4, 5, 8 and 33 instead of 4, for the numerator.
- (iv) This question was answered well by many evidencing clear knowledge of set notation. A few errors were seen, namely 4 from $n(T \cap (E \cap S))$ and 40 from $n(T \cup (E \cap S))$.

Answers: (a) 75 (b) 962.5 (c)(i) 16 (ii) 50 (iii) $\frac{4}{50}$ (iv) 19

Question 11

- (a) (i) Some candidates were able to correctly find the vector \overline{OB} but only a few candidates then went on to use Pythagoras' theorem to find the length. Of those using Pythagoras' theorem, a common error was $\sqrt{12^2 + -4^2}$ resulting in $\sqrt{128}$. Candidates who chose to work out the length of one of the given vectors were not credited.
- (ii) Most candidates did not use $\overline{BC} = -\overline{AB} + \overline{AC}$ but more commonly found either $\overline{AB} - \overline{AC}$ or $\overline{AB} + \overline{AC}$.
- (b) This vector question proved challenging for most candidates. Candidates rarely showed any valid method or intermediate working so it was rare to award any part marks. The most common incorrect answer seen was $\frac{1}{2}(\mathbf{b} + \mathbf{a})$.
- (c) (i) This part was well answered by many, although errors in arithmetic were seen. Candidates with little knowledge of the language of matrices merely squared the individual elements.
- (ii) Many candidates demonstrated good knowledge of the inverse matrix with many correct answers seen. Candidates set their work out clearly and consequently were often awarded one mark if an error was made. Candidates with little knowledge of matrices frequently found the reciprocal of each of the individual elements in the matrix.

Answers: (a)(i) 12.6 (ii) $\begin{pmatrix} -11 \\ 13 \end{pmatrix}$ (b) $\frac{1}{2}(\mathbf{b} - \mathbf{a})$ (c)(i) $\begin{pmatrix} 9 & 50 \\ 10 & 69 \end{pmatrix}$ (ii) $\frac{1}{11} \begin{pmatrix} 8 & -5 \\ -1 & 2 \end{pmatrix}$

Question 12

- (a) Most candidates were able to complete the table correctly.
- (b) Most candidates scored at least one mark in this part. Candidates usually gave the expression in its simplest form but other equivalent expressions scored full marks. Common errors included $n + 3$, $3n$, $n = 3n + 3$ and $6n + 3$.
- (c) This question proved straightforward for most candidates with many of them extending the table to the 7th pattern. A few arithmetic errors were seen but otherwise many scored full marks. A more complex correct solution, done by a few, was to find the formula for the total mats as $\frac{1}{2}(n+2)(n+3)$, or equivalent, with $n = 7$ correctly substituted to give 45. Otherwise, the most common error seen was 24 substituted into their expression in part (b) and an attempt to find the number of mats relating to 75 grey mats. This usually resulted in a long string of numbers because the formula for the total mats was not given.
- (d) This part was challenging for the majority, with only a few correct solutions seen. These candidates also usually demonstrated an efficient method of solving their equations. Other candidates were able to score some marks for one or more correct equations. However some candidates could not connect this part with the previous part and did not even substitute values for n .

Answers: (a) 18, 28 (b) $3n + 3$ (c) 45 (d) $\frac{3}{2}, \frac{13}{3}$

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key messages

To achieve well in this paper, candidates need to be familiar with all aspects of the extended syllabus. The recall and application of formulae and mathematical facts to apply 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 answers written to an appropriate accuracy.

Candidates need to be aware that in drawing graphs, linear functions should be ruled and curves should be drawn freehand with a sharp pencil.

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

General comments

Some questions allowed candidates to recall and demonstrate their skills and knowledge, others provided challenge where problem solving and reasoning skills were tested. Solutions were usually well-structured with clear methods shown in the space provided on the question paper.

Candidates had sufficient time to complete the paper and omissions were due to lack of familiarity with the topic or difficulty with the question rather than lack of time.

Most candidates followed the rubric instructions with respect to the values for π and three significant figure accuracy for answers. A few approximated values in the middle of a calculation in some parts and lost accuracy for the final answer as a result. Some did not show all of the required steps on questions where they were asked to establish a given result and this resulted in the loss of some marks

The topics that were done well included reverse percentages, drawing transformations, statistics, drawing graphs of functions, applying the sine rule, solving quadratic equations using the formula, simple algebraic manipulation and using composite functions.

The weaker topics included applying ratio to problems, problem solving in mensuration questions involving establishing a given result, harder algebraic manipulation, reasoning with angle calculations and using correct acceptable mathematical language when giving reasons for answers.

Comments on specific questions

Question 1

- (a) (i) This part was nearly always answered correctly. A few candidates gave the answer as 0.85% and there were a small number who found the mass of rice as a percentage of some other amount, such as the mass of rice and sugar.
- (ii) Most candidates calculated the mass of butter usually by a unitary method.
- (iii) This part proved to be much more challenging with only the more able candidates realising that the ingredient with the largest mass needed to be used alone. A common misunderstanding was to add the four masses of the ingredients and divide that mass into the 2 kg. A number of candidates gave an answer 60, thinking that the biscuits could only be made in multiples of 20.
- (b) (i) Many candidates calculated the percentage profit correctly. A fairly common error was to have the selling price as the denominator of the fraction when calculating the percentage.
- (ii) Candidates appeared familiar with reverse percentage questions. The success rate in a challenging topic was good. The error of treating the given amount as 100% was seen occasionally however.
- (c) This exponential growth question was a discriminating part and many candidates did find this challenging. Many candidates did set the question up correctly with an exponential equation. There was then the challenge of interpreting the cube root into a percentage change and the cube root needed to be 1.101 or 1.1006... to be able to arrive at 10.1 or 10.06. Candidates who only gave the cube root as 1.10 were unable to achieve a 3 significant figure final answer. There were many attempts without any exponential statement, such as finding the overall percentage change over 3 years and dividing this by 3.
- (d) (i) Candidates generally find ratio questions straightforward but this question was more challenging. Candidates had to obtain a common number for the middle number (i.e. group B). The most common way seen was to find a common multiple of 10 and 4, e.g. 40, which was often seen. Then candidates had to multiply the other parts of the two ratios by appropriate numbers to give the common multiple of the common term. Many candidates succeeded whilst many appeared to be unsure of how to sort out the numbers they were working with. This part was sometimes not attempted and the answer 7 : 3 demonstrated that this question proved to be too challenging for some.
- (ii) Candidates with correct answers to part (d)(i) usually went on to succeed in this part. In addition, some candidates started this part without part (d)(i), by dividing 45 by 3 and then multiplying the 15 by 4 to obtain the number in group B. They then had to divide the 60 by 10 and multiply the 6 by 7 for group A. There were also candidates who found 60 in group B but multiplied 15 by 7 for group A.

Answers: (a)(i) 85 (ii) 455 (iii) 61 (b)(i) 40 (ii) 1.75 (c) 10.1 (d)(i) 14 : 15 (ii) 147

Question 2

- (a) (i) This was well answered. The most common incorrect answer was $20 < t \leq 45$.
- (ii) This was less well answered than part (a)(i). The most common incorrect answer was $30 < t \leq 35$.
- (iii) The vast majority of candidates scored full marks in this question. Occasionally there were the usual errors of adding the mid-values and dividing by 5 or using the interval widths or the upper bounds instead of the mid-values.
- (iv) This was usually correctly answered. A few candidates included those in the previous interval whilst others gave the answer for the probability of choosing a student taking 40 minutes or less.

- (b)(i) Completing the table was almost always done without error. Occasionally the frequencies rather than the cumulative frequencies were stated.
- (ii) The plotting of points and drawing of the diagram was exceptionally well done with most candidates gaining full marks. There were few instances of plotting at mid-values but there were a few block graphs drawn which meant that later questions were inaccessible to some candidates.
- (iii) Most candidates gave the correct value as a very high proportion knew that it was found from the frequency of 60 but a small number gave the answer of 60. A few errors did occur from misreading the horizontal scale.
- (iv) Candidates were less successful in this part of the question. Many correctly stated the value of the upper quartile or the lower quartile or both but some added these while others gave an inequality as the answer. A small minority of candidates subtracted the frequencies at which the upper (90) and lower quartiles (30) occur and reached the frequency of 60 and then read the time at this frequency not realising that this was the same as the median.
- (v) This part was well answered as candidates appreciated the cumulative frequency value corresponding to 37 minutes was required. A few gave this as the answer but most obtained an acceptable integer value.

Answers: (a)(i) $20 < t \leq 25$ (ii) $25 < t \leq 30$ (iii) 28.3 (iv) $\frac{4}{120}$ (b)(i) 76, 104, 116, 120 (iii) 27 to 27.5
(iv) 8.5 to 9.5 (v) 8, 9, 10, 11 or 12

Question 3

- (a)(i) Candidates usually gave the correct reflection of triangle A. Occasional errors seen included reflecting in $x = 1.5$ or in $x = 2.5$ and, more rarely, in a line $y = k$.
- (ii) The majority of candidates performed the required translation correctly. Occasional errors such as translation by $\begin{pmatrix} 2 \\ 4 \end{pmatrix}$ or $\begin{pmatrix} 4 \\ 2 \end{pmatrix}$ instead of $\begin{pmatrix} -2 \\ 4 \end{pmatrix}$ were seen and less able candidates did not preserve the shape and orientation of the object.
- (iii) This question part was the most challenging of the required transformations. Many correct answers were seen but the error of enlargement by scale factor $\frac{1}{2}$ instead of $-\frac{1}{2}$ was also common. Other candidates drew correct 'ray' lines through the centre to locate two of the image vertices but did not use a third line and consequently misplaced the third vertex to give an image with incorrect orientation. Some other candidates used an incorrect centre and thus produced an image with correct size and orientation but in the wrong place.
- (b) The majority of candidates correctly stated 'rotation' and many also gave 90° . Some incorrectly added 'clockwise'. Most difficulty was experienced with trying to find the correct centre of the rotation. The centre was often omitted completely or given as (0, 0) and other candidates were not accurate enough and gave (-5, -2) for example. Some candidates gave (-2, -6). Less able candidates stated a rotation *and* a translation instead of describing the *single* transformation required.
- (c) A significant number of candidates incorrectly identified this matrix as representing a rotation of 180° or omitted this question part completely. Of those that did correctly state 'reflection' some omitted the mirror line or incorrectly gave $y = x$.

Answers: (b) rotation, 90° anti-clockwise, centre (-6, -2) (c) reflection in $y = -x$

Question 4

- (a) (i) This index question was very well answered. Some candidates didn't evaluate 3^5 and $(p^2)^5 = p^7$ was occasionally seen.
- (ii) This index question involving division was very well done.
- (iii) The fraction with a negative power proved to be more challenging and many answers were not simplified, e.g. $\left(\frac{m}{5}\right)^2$ and $\frac{0.25}{m^{-2}}$.
- (b) This algebra problem produced very mixed responses. The more able candidates used $5x - 9 = 3x + 7$ and found the problem very straightforward. A large number of candidates did not spot the equation and gave two equations in terms of x and w for the area of the rectangle. This still led to success for many candidates and this method, if done correctly, led directly to the value of w without using the value of x . A number of candidates using this method omitted brackets, writing, for example, $5x - 9w = 310$ and $3x + 7w = 310$.

Answers: (a)(i) $243p^{10}$ (ii) $9xy^4$ (iii) $\frac{m^2}{25}$ (b) 10

Question 5

- (a) Almost all candidates followed the instruction to use the cosine rule and accurately applied it. Many correctly reached $\sqrt{89.7\dots}$ but then did not show the value of this to at least four figure accuracy to justify the rounding to the given value. A significant number of candidates went directly from the cosine rule to the given value 9.47.
- (b) Some candidates used the cosine rule again with varying degrees of success. Those who used the sine rule were generally more successful in finding the angle correctly. Inaccuracies occurred due to premature approximation in the calculation and it was quite common to see $\sin A = 0.72$ leading to the answer 46.05. A small number of candidates assumed that triangle AOC was right-angled.
- (c) Many candidates correctly found the length of the arc by subtracting CA , AO and OB from 29.5. Most of these went on to equate this with $\frac{x}{360} \times 2 \times \pi \times 7$. The complete rearrangement of this equation to give the required calculation for x was seen only on the very best scripts. Most candidates rearranged in stages, often going directly to the calculated value rather than the calculation leading to that value and consequently method marks were lost as this was a 'show that' question and each step needed to be shown. Many candidates lost the final mark because a more accurate value of the angle was not shown to justify the rounding to 41.2.
- (d) There were many correct solutions to this question as most candidates used correct formulae for the area of the triangle and of the sector. A small minority used $\frac{1}{2} \times 7 \times 8$ for the triangle whilst others used the radius as 3.5 cm in the sector.

Answers: (b) 46.3 (d) 45.0

Question 6

- (a) The table of values was usually correct. The common error was with $x = 1$, when -0.16 was given rather than -0.17 or -0.2 .
- (b) Candidates generally drew the curve very well with relatively few cases of feathering or ruled sections. The points were usually plotted accurately, although some plotted $(1, -0.2)$ at $(1, -0.4)$. Most understood the graph had an asymptote at the y -axis with just a quite small number joining the two branches across the y -axis.

- (c) (i)** Good tangents were usually seen and these almost always had a gradient in the accepted range. A few candidates managed to get their tangent to go through the point $(-1, 0)$ for some reason. In this case the gradient was out of range but two marks were still gained. Only a very small number of candidates appeared to have little or no knowledge of tangents.
- (ii)** There were many correct answers for the equation of the tangent, following through the gradient found in part **(c)(i)**. Many candidates extended their line to find the y -intercept, which was the easiest method. Many of the more able candidates used their gradient and a chosen point, substituting in $y = mx + c$, thus doing quite a lot of work.
- (d) (i)** This was a straightforward reading of where the graph crossed the x -axis and was usually correctly answered. A number of answers were out of the accepted range however.
- (ii)** This part proved to be more challenging, probably because the candidates had to decide that $y = -4$ was the required line that was needed to solve the equation. There were many correct answers as well as some which included an answer or two just out of range. A fairly large number of candidates omitted this part.
- (e)** This final part was a discriminating part testing candidates' ability to manipulate an algebraic equation with denominators. Candidates with good algebraic technical skills were very successful with this part, gaining full marks with little difficulty. Others who were weaker in algebra had difficulty in multiplying by $6x^2$ to clear the fractions and others simply omitted this part. A few candidates realised that the highest power would be 5 and scored the mark for the value of n despite finding the rearranging too difficult.

Answers: **(a)** $-2, -0.2, 2.5$ **(d)(i)** 1.05 to 1.25 **(ii)** -2.3 to $-2.2, -0.4$ to $-0.3, 0.3$ to 0.4 **(e)** $2, 24, 5$

Question 7

- (a)** In a 'show that' question such as this, a rigorous approach in which each line of working is clear, complete and correct is expected. Many candidates began by correctly applying Pythagoras' theorem to write $(2x - 3)^2 + x^2 = 6^2$ or equivalent. It was then required to show the correct expansion of the brackets, the evaluation of 6^2 to 36 and the correct final statement equated to zero. Common errors seen included omission of the brackets in the first line of working, incorrect expansion of the brackets to give a $2x^2$ term, no x term or just one $-6x$ term, or a -9 term and/or omission of the equals zero. A few candidates never showed the evaluation of 6^2 to 36. Less able candidates attempted to solve $5x^2 - 12x - 27 = 0$.
- (b)** The majority of candidates showed sufficient working and gave correct answers. Candidates should be aware that the numerical version of the formula should be written down carefully, ensuring that for example, the division line is drawn underneath all of the numerator and that $(-12)^2$ is written with the brackets in order to earn the marks given for the substitution. Some candidates did not give their answers to the required accuracy of two decimal places. Just a few candidates went straight to a simplified surd answer or gave a decimal answer with wrong working suggesting a solving function on the calculator had been used. This did not gain full credit.
- (c)** Most candidates understood to substitute their positive value for x from part **(b)** into $x + 2x - 3 + 6$ and evaluate to get the perimeter. Some candidates wrote $3x + 3$ but did not go on to substitute in their value for x .
- (d)** Most candidates wrote a correct statement involving sine, cosine or tangent for one of the angles in the triangle. Some candidates did not select the smaller of these two angles.

Answers: **(b)** $-1.42, 3.82$ **(c)** 14.4 or 14.5 **(d)** 39.5

Question 8

- (a) (i) Few candidates didn't reach the answer of 1 after reaching $h(0)$. A few did not evaluate $8 - 3\left(\frac{8}{3}\right)$ correctly. Some gave the answer 0.
- (ii) Many candidates applied the functions in the correct order and reached $10 \div \left(\frac{1}{4} + 1\right)$ and then most evaluated this correctly. A small minority of candidates applied the functions in the wrong order and reached 2^{-10} whilst less able candidates multiplied the functions.
- (iii) There were significantly fewer fully correct solutions to this part than in the previous parts as candidates were unable to correctly rearrange the expression that they used as a starting point. Brackets were often omitted in products resulting in errors such as $xy + 1 = 10$ instead of $xy + x = 10$. Many of those who correctly reached $xy + x = 10$ were either unable to proceed to rewrite this with y as the subject or made errors in its rearrangement.
- (iv) Few candidates realised that $f^{-1}f(x) = x$ as very few wrote 5 as the answer without going into lengthy calculations. This led to many errors at varying stages in the calculations. Many correctly evaluated $f(5)$ to be -7 but then evaluated $f(-7)$ to give the answer of 29. A small number of candidates used f^{-1} as $(x - 8) \div 3$ to give -5 as the answer whilst others evaluated $f^{-1}(5)$ to reach the answer of 1.
- (b) Many candidates scored full marks in this part. Most were able to establish the common denominator but then various errors occurred on a significant number of scripts. The product of $8 - 3x$ and $x + 1$ was sometimes incorrect, usually with omission of important brackets, incorrect signs in one or two terms, or forgetting to add 10 to the expansion of the brackets. A number of candidates had the correct expression in the working but gave an incorrect final answer.

Answers: (a)(i) 1 (ii) 8 (iii) $\frac{10-x}{x}$ (iv) 5 (b) $\frac{-3x^2 + 5x + 18}{x+1}$

Question 9

- (a) (i)(a) The majority of candidates gave the correct value for angle EBD demonstrating the ability to make correct use of appropriate angle rules. Very few candidates gained full marks for stating their reasons. As a minimum it was necessary to state *isosceles* triangle and to use the correct vocabulary of *centre* and *circumference* along with either *double*, *twice* or *half* as appropriate. Words such as *middle*, *origin*, *top*, *edge* and *perimeter* are not acceptable alternatives. The syllabus gives the terminology expected of candidates when giving reasons.
- (i)(b) Many candidates recognised that angle EAD was equal to angle EBD . Similar errors with wording were seen as in **part (a)(i)(a)**. Other candidates gained credit for stating angles in the same segment are equal, or angles on the same arc. Angles on the same *chord*, or facing the same *chord*, is not rigorous enough since angles on opposite sides of the same chord are not equal.
- (ii) Many candidates again demonstrated good understanding and application of circle theorems to give a correct answer. The most common error was to incorrectly assume that opposite angles in a cyclic quadrilateral are equal instead of adding to 180.

- (b)(i)** This question part elicited a mixed response from candidates. Although many correct answers were seen it was also common for candidates to confuse the multiplication by 11 and write incorrectly $11 \times \frac{180(n-2)}{n} = \frac{360}{n}$. Other candidates divided only one side of their equation by n . Another common error was to state that $x + 11x = 360$ instead of 180. Some candidates who started with a correct equation made algebraic errors when solving it to get a non-integer answer for the number of sides. The most efficient and successful method seen was $12x = 180$ followed by 360 divided by x .
- (ii)** The majority of candidates understood that the interior angle sum could be calculated from $180(n-2)$ and were able to score full marks if they used their credible value for n . Candidates were expected to realise that a non-integer value for n was not credible. A few candidates spoiled a correct answer by going on to divide their interior angle sum by n .

Answers: **(a)(i)(a)** 62° , isosceles triangle, angle at centre is twice the angle at the circumference
(i)(b) 62° , angles in the same segment **(ii)** 8 **(b)(i)** 24 **(ii)** 3960

MATHEMATICS

Paper 0580/43
Paper 43 (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 level 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 most 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 some cases was very good with methods clearly shown.

Most candidates followed the rubric instructions but there was a significant number of candidates 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. Candidates should be particularly careful regarding change of units from cm^3 to litres in **Question 7(a)**.

The topics that proved to be more accessible were percentages, mean of grouped data, drawing graphs and their interpretation, algebraic manipulation, right-angled triangle trigonometry and Pythagoras' theorem, much of the work on matrices and functions. The more challenging topics were gradients and 3-D trigonometry.

Comments on specific questions

Question 1

- (a) (i) Most candidates had a good understanding of percentage profit and earned all three marks. Some calculated the selling price as a percentage of the original price but then forgot to subtract 100 from their answer. Some less able candidates calculated the profit as a percentage of the selling price rather than the original price.
- (ii) Many simply divided by 1.2 or multiplied by $\frac{100}{120}$ while a few started with $\frac{42.60 - x}{x} = 0.2$ and were usually successful. Several candidates did not realise that this was testing a reverse percentage situation and calculated 80% or 120% of \$42.60.
- (b) Candidates were less successful in this part largely due to the common error of adding the interest to the money invested and getting 650. However, most candidates were awarded at least one mark. Some confused this with compound interest and used $500 \times (1.02)^{15}$.

- (c) (i) Many fully correct responses were seen. Some lost the final mark, missing the instruction to give their answer to the nearest \$100. Others reached the solution from a year-on-year approach, but this method was prone to premature rounding errors. Others subtracted their answer from 21000.
- (ii) There were many clearly presented solutions with accurate rearrangement of the compound interest formula. The award of three marks was common but some reached 0.09 or 1.09 and gave this as their final answer. Some had difficulty with the 12th root while others found the root but then prematurely rounded its value to 2.81, or even 2.8 in some cases, resulting in a loss of accuracy for the final answer.

Answers: (a)(i) 13.5 (ii) 35.5 (b) 150 (c)(i) 7800 (ii) 9.00

Question 2

- (a) (i) This part was almost always correct with the common error being $2^0 = 0$.
- (ii) This part was almost always correct.
- (b) There were many fully correct graphs and few gained less than four marks. The plotting of points and the drawing of the curves were generally carried out accurately, with very few joining the points with straight line segments. A recurring error was drawing the curve or curves through the wrong point for $x = 3$. This could have been avoided if one of the graphs had been drawn completely before plotting the points for the other graph.
- (c) (i) Many correct answers were seen.
- (ii) Fewer correct answers were seen on this part with values just outside the range as the answer was dependent on the accuracy of both curves.
- (d) (i) Most of the more able candidates had no trouble in drawing the correct line. For many of the others the gradient proved to be the major difficulty as a result of the different scales on the two axes. Lines with a gradient of -8 , $+4$ or $\pm \frac{1}{4}$ were common errors from the less able candidates.
- (ii) Success in this part was usually dependent on the line drawn in the previous part. Good lines tended to produce both marks but slight inaccuracies resulted in either the wrong point of intersection or answers other than tangent. 'Gradient' was often seen instead of 'tangent' along with answers such as bisector, perpendicular and intersecting.

Answers: (a)(i) 1, 16 (ii) 14, -2 (c)(i) 3.5 to 3.7 (ii) 2.65 to 2.8 (d)(ii) tangent, (2, 10)

Question 3

- (a) (i) Many correct answers were seen, some of which were qualified with descriptors such as strong, weak, etc. However, a significant number of candidates gave no answer or an incorrect answer. Some common incorrect answers included parallel, line graph, point and mark.
- (ii) A majority of candidates were able to draw a line within the tolerance required. A number of lines were just outside but several had gradients that were far too steep. Some less able candidates simply joined the points dot-to-dot style.
- (iii) Many correct answers were seen but were not always dependent on the accuracy of the line drawn in the previous part. Some candidates were able to make a judgement based on the plotted points.
- (b) This was answered well by many candidates, with the majority getting the mode and the median mark, although a few gave the frequency rather than the number of days for the mode. Calculating the mean was less successful, especially for the less able candidates. Errors often involved incorrect multiplication and $10 \times 0 = 10$, $4 \times 0 = 4$ were common. Some candidates divided 25 by 6 whilst others divided 24 by 6. Other candidates gave the mean as 1, but without showing sufficient working or a more accurate answer of 1.04, they lost at least one mark as a consequence.

- (c) (i) Many fully correct solutions with clear working were seen. In cases where the answer was incorrect it was common to see class widths used rather than mid-points and to a lesser extent end-points were used.
- (ii) Almost all candidates earned some or all of the marks in this part. Common errors usually involved an incorrect width for the first bar, usually starting from the vertical axis. If the heights of the bars were incorrect it was more likely that it was the first or the last. Some candidates used the class widths to represent the frequency densities.

Answers: (a)(i) positive (iii) 2 (b) 0, 1, 1.04 (c)(i) 60.9

Question 4

- (a) (i) Many candidates were able to calculate the probability of two cards with the same number. Common errors usually involved replacement of the first card or arithmetic slips with the fractions. The use of a probability tree was rare as were answers greater than one. Many of the less able candidates struggled to make any progress, with a greater proportion making no attempt. The use of a possibility space or 2-way table was rarely seen, not only in this part, but also in part (ii) and part (b).
- (ii) Success in this part was usually linked with success in the previous part. Many of the more able candidates earned all three marks, coping well with the choice from two sets of cards. Common errors included treating the two choices as coming from 10 cards and 9 cards respectively.
- (iii) If candidates had the correct probabilities in the two previous parts they almost always went on to explain who was the most likely. Most did this by comparing fractions with the same denominators and to a lesser extent some converted to percentages. Some were able to give the correct name but did not show the necessary working in order to earn the mark.
- (b) Many candidates earned full marks. Common errors usually involved choosing the cards with replacement or not to consider all the correct combinations. Some only seemed aware of one possible outcome. Others could list the three outcomes but could go no further.

Answers: (a)(i) $\frac{8}{20}$ (ii) $\frac{9}{25}$ (iii) Jojo, $\frac{40}{100} > \frac{36}{100}$ (b) $\frac{24}{60}$

Question 5

- (a) Most candidates were able to form the correct equation and solve it, usually showing clear evidence of each step. The most common error came from incorrect manipulation after reaching $20900x - 6000 = 320040$, subtracting the 6000 from 320040. A few reached the correct answer but then multiplied by 18500 to give the total amount paid for adult tickets.
- (b) (i) The vast majority of answers were correct. Some candidates showed no working while others listed factor pairs of 84 and chose those with a difference of 5. A few had the signs reversed within the brackets and others attempted to complete the square.
- (ii) Not all candidates realised that they had already factorised this equation in the previous part and often repeated the method already used or used the quadratic formula. Some reached $y = 7$ but didn't then find the perimeter. Some were able to set up $y(y + 5) = 84$ and see the solutions without any further work but others could proceed no further. A few misunderstood the problem and set up an equation for the perimeter equal to 84 rather than the area.

- (c) (i) This question discriminated well across the ability range. More able candidates could set up an equation and proceed with very good algebraic manipulation to reach the required result. Where errors occurred they usually involved the omission of the variable m somewhere in the working or losing the '=' from the equation. Less able candidates struggled to make a start, some earning a mark for a correct term. Some candidates seemed confused, attempting to solve the equation rather than deriving it.
- (ii) Only a few candidates realised that the equation factorised easily, with many preferring to use the formula method and a few completing the square. Some showed -225^2 in the formula incorrectly but often recovered from this error. Accuracy of calculation was generally good but some candidates need to ensure the square root sign and the fraction line are of sufficient length. Others need to give more detail when asked to show all their working to ensure full marks. Most candidates realised that 0.3 was not a suitable answer for the context.

Answers: (a) 15.6 (b)(i) $(y + 12)(y - 7)$ (ii) 38 (c)(ii) 4.2

Question 6

- (a) (i) The most common error here was to assume that triangles ABC and ADE were identical. As the lengths of AC and AD were given it was a simple case of using trigonometry to find the required angles. However, many candidates worked out either the 30° or the 26.56° and doubled them to add to the 60° from the equilateral triangle. This was a question where truncation of 26.56 to 26.5 gave an inaccurate final answer. Several candidates did not choose to use right-angled triangle trigonometry, preferring instead to use Pythagoras' theorem combined with the sine or cosine rule. Apart from being a long-winded method it left candidates prone to more errors, both with the method and with rounding.
- (ii) Most candidates applied Pythagoras' theorem correctly and earned full marks. A small number used trigonometry, sometimes successfully but in some cases they used the wrong angle following their incorrect assumption in part (i).
- (iii) Again, most candidates earned all three marks for applying Pythagoras' theorem correctly.
- (iv) Candidates were less successful in this part than in the previous parts, especially the less able ones. Most candidates calculated the three separate areas, usually using $\frac{1}{2} \times \text{base} \times \text{height}$. As in part (i) some assumed the area of triangles ABC and ADE were the same. A common error was to use 13.4 as the 'height' in triangle BAC , and not 12. Some of the more observant candidates realised that triangle ADE was half of triangle ACD and used the fact to simplify the calculation of the area.
- (b) (i) Roughly half of the candidates knew the correct number of planes of symmetry. There was no pattern to the incorrect answers which usually varied between 2 and 12, with 6 being the most common.
- (ii) Few candidates were able to visualise which angle was required and the award of four marks was not common. The most common incorrect angle found was ARC . However, some marks were earned by candidates that calculated one of the unknown lengths of triangle ABR .

Answers: (a)(i) 116.6 (ii) 13.4 (iii) 10.4 (iv) 130 (b)(i) 3 (ii) 51.3

Question 7

- (a) This part differentiated well across the ability range. Most candidates were able to calculate the area of the cross-section correctly. Calculation of the volume that flowed in one hour was attempted with varying degrees of success. Multiplication by $8 \times 60 \times 60$ was needed but some used 8×60 , some evaluated 60×60 as 360, others divided the area by this value and some divided this value by the area. The conversion from cm^3 to litres was not always known, with some dividing by 10 or 100. Some more able candidates converted the lengths to decimetres at the start, knowing that 1 dm^3 was the same as one litre.
- (b)(i) This was a straightforward question requiring candidates to show that the curved surface area was 108π . Although many correct solutions were seen a significant number lost marks by not showing sufficient working. Others evaluated the two individual areas as decimals, rounding them before adding. When converted back to a multiple of π it was not an exact multiple losing the final mark.
- (ii) Many of the candidates were able to calculate the radius of the sphere without too much difficulty. The radius of the hemisphere proved more challenging and far fewer correct solutions were seen. Common errors included the omission of the circular face with 7.35 the most common incorrect answer. Even when the circular face was included some forgot to halve the curved surface area of a sphere.

Answers: (a) 204 (b)(ii) $x = 5.20$, $y = 6$

Question 8

- (a)(i) In general, candidates seemed reasonably familiar with matrix multiplication and many correct answers were seen. Of the six calculations given \mathbf{M}^2 was almost always correct followed closely by \mathbf{NP} . Roughly the same number of errors were seen for each of the remaining four calculations.
- (ii) This was answered well by the vast majority of candidates. The inclusion of a fraction line and the omission of brackets were rarely seen.
- (iii) This question proved more challenging and fewer correct answers were seen. When the answer was given as a 2 by 2 matrix it was usually fully correct, although a number of these had the 8 and the 1 reversed. Common errors usually involved $\begin{pmatrix} 4 \\ 2 \end{pmatrix}$ or (6) .
- (iv) Many correct answers were seen. Common errors usually involved slips in calculating the determinant, changing the signs of the wrong numbers in the matrix and interchanging the wrong pair of values.
- (c) Most realised it was a rotation with a few giving reflection. Common errors usually involved the wrong direction for the rotation and the omission of the centre. A few correctly gave 270° clockwise or just 90° which implied anticlockwise.

Answers: (a)(i) $\times \checkmark \checkmark \times \times \checkmark$ (ii) $\begin{pmatrix} 5 \\ 3 \end{pmatrix}$ (iii) $\begin{pmatrix} 4 & 8 \\ 1 & 2 \end{pmatrix}$ (iv) $\frac{1}{2} \begin{pmatrix} 3 & -1 \\ -4 & 2 \end{pmatrix}$ (b) rotation, 90° anticlockwise, (0, 0)

Question 9

- (a) A large number of candidates were able to find the correct equation of the perpendicular line. The main difficulty here was calculating the perpendicular gradient and a significant number of less able candidates did not understand the relationship between gradients of perpendicular lines. A common incorrect gradient was $\frac{1}{2}$, possibly misunderstanding perpendicular as parallel. Those who had an incorrect gradient often gained credit for substitution of (1, 3) into their equation.
- (b)(i) Most candidates showed evidence of some understanding with respect to inequalities and usually earned at least one mark. There were a good number of totally correct answers with most of the errors involving the use of the wrong signs. Most candidates recognised the boundary lines at $x = 2$ and $y = 5$ with fewer recognising $y \geq \frac{1}{2}x$. Some candidates confused the x and y values.
- (ii) This part was well answered even by candidates who did not score well in part (i). The method used to get to the answer was often not clear. Trials of integer points were rarely seen as was seeing the line $3x + 5y = 35$ drawn. Substitution of a value for x (or y) was seen but these often led to a non-integer value of the second ordinate. This was sometimes ignored and decimal answers given.

Answers: (a) $y = -2x + 5$ (b)(i) $x \geq 2, y \leq 5, y \geq \frac{1}{2}x$ (ii) (5, 4)

Question 10

- (a)(i) Most candidates demonstrated a good understanding of the composite function and many correct answers were seen. Those evaluating $g(2)$, followed by $g(5)$ were generally more successful than those attempting to evaluate $gg(2)$ in a single step. Some attempted to find $gg(x)$ and a good proportion did so correctly but slips such as $(x^2 + 1) + 1, (x^2 + 1)^2 = x^4 + 1$ caused some to lose marks.
- (ii) This part produced almost as many correct answers as the previous part. Common errors included $g(x + 2) = (x^2 + 1)(x + 2)$, $g(x + 2) = g(x) + g(2)$ and incorrect expansions of $(x + 2)^2$ as $x^2 + 4$.
- (iii) This was the part where candidates were most successful. The common error usually involved the evaluation of $f(7)$.
- (iv) This was another successful part for many candidates. Most attempted the solution algebraically and seeing reverse flowcharts was extremely rare. Common errors usually involved treating f^{-1} as a reciprocal and $\frac{1}{2x - 3}$ was seen quite often.
- (b)(i) Yet again many correct answers were seen with candidates demonstrating good use of their calculators. Some lost the final mark, missing the instruction to give their answer correct to two decimal places, with answers such as 0.69 and 0.7 fairly common.
- (ii) Many correct answers in this part were seen. Some lost the mark by giving their answer as 4^4 or 256.

Answers: (a)(i) 26 (ii) $x^2 + 4x + 5$ (iii) 5 (iv) $\frac{x + 3}{2}$ (b)(i) 0.70 (ii) 4