MATHEMATICS

Paper 0580/11
Paper 11 (Core)

General comments

To succeed in this paper, candidates need to have completed the full Core syllabus coverage, be able to remember and apply formulae and give answers in the form asked for in the question. Candidates must check their work for sense and accuracy. All working must be shown to enable candidates to access method marks in case the final answer is wrong. This will also help the candidates' checking of their own work. This is vital in 2-step problems, in particular with algebra. Candidates' attention must be drawn to the cover instruction in particular to giving answers in their simplest form and the acceptable values for π.

The questions that presented least difficulty were **Questions 2**, **5**, **11(a)**, **13(c), 14(a)**, **19(a) and (c)**. Those that proved to be the most challenging were **Questions 8**, **9**, **10**, **11(b)**, **14(b)**, **15** and **17**. The questions or part questions where candidates did not give any answer were scattered throughout the paper or to whole questions suggesting that candidates were not confident with certain syllabus areas rather than having a lack of time to finish the paper. The questions that showed a high number of blank responses were **Questions 7**, **8**, **11(b)**, **13(b), and 17(a) and (b).** In particular, **Questions 8, 11(b),** and **17** were on topics that were challenging for many candidates.

Comments on specific questions

Question 1

Most responses to this question on converting between percentages and fractions were correct but poor cancelling of fractions was the main cause of lost marks. A small minority gave their answer as a decimal, which although the value is identical, was not what was required.

Answer: $\frac{9}{20}$

Question 2

Some candidates attempted to form a calculation using the given numbers in this question on negative numbers but made errors with minus signs so a response of –5 (the result of 3 – 8) was often seen. However, most candidates were able to answer correctly.

Answer: 11 or –11

Question 3

Whilst there were many correct answers seen in **part (a)** of this question on calculator use and rounding, there were also a large variety of errors. It was quite common to see answers that were rounded or truncated when all the figures from the calculator display were asked for. The most commonly seen wrong answer, from ignoring the order of operations, was 2.153857… In **part (b)**, answers with an incorrect number of decimal places were seen quite frequently, but there were only a few cases with trailing zeros. A surprising number of candidates seemed to have no understanding of what was required here; these usually multiplied the number in **part (a)** by a power of 10, often by 1000. Also, some candidates confused decimal places with significant figures. A follow through mark was available for those who correctly wrote their value in **part (a)** to 3 decimal places for **part (b).**

Answers: **(a)** 1.32656… **(b)** 1.327

Question 4

This was the more difficult version of the ratio problem and many candidates did not realise they should start by dividing 84 by 7 not by the sum of the two parts. Candidates should first determine if the initial information gives the overall total or the amount that relates to one part only. In the case of money or time such as this, an answer that is not a whole number (or whole dollars or cents) is likely to be wrong. A variety of incorrect methods were seen, with 84 ÷ 13, 84 ÷ 13 × 6, 13 × 6 and 84 – 13 being seen particularly often.

Answer: 72

Question 5

For those who knew the vector rules for addition and multiplication by a number this was a very straightforward question and mainly correct. The inclusion of an incorrect 'fraction' line between the two entries was used by some candidates although this is becoming less common over the years.

Answers: **(a)** $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$ **(b)** $\begin{pmatrix} 8 \\ -12 \end{pmatrix}$

Question 6

There were some very good answers seen to this question on angles, but the main errors were due to making assumptions about the diagram. This diagram, on first sight, could be an isosceles triangle which caused many to find an answer of 115° but on closer inspection, there was nothing to support this. Candidates should not assume facts not given or indicated on diagrams. Others gave 75° as their answer but this was in fact one of the other angles in the triangle and the supplement of the correct answer. Many did not realise that this was a 2-stage problem so stopped their calculations once they reached 75°.

Answer: 105

Question 7

When the answer is given to a fraction calculation, the temptation for many candidates is to try and jump to given answer without showing all the stages necessary. In cases when the answer is given it should signal to candidates that at least two stages are necessary before the answer is reached. Most were able to gain at least the first mark for expressing 1½ as $\frac{3}{2}$. The methods that followed were often incomplete. A wide variety of errors were seen, including inverting $\frac{3}{2}$, incorrect attempts at dividing numerators and denominators separately and assuming that $\frac{1}{8} = \frac{8}{1}$. Some candidates produced attempts which involved a variety of calculations with the given numbers, but showed no real understanding of how to tackle the question.

Answer: $\frac{3}{2} \times \frac{16}{3} = 8$

Question 8

Some candidates find dealing with numbers to the nearest hundred or thousand easier than those to a number of decimal places, so this was one of the slightly harder versions of the topic of upper and lower bounds. Generally responses were poor with most not realising they had to go to the second place of decimals. 11.3 and 11.5 were seen frequently along with other variations of incorrect responses. It was very rare for candidates to give the right values but reversed in the answer space.

Answer: 11.35, 11.45

Question 9

This was answered well by some candidates, although most were unable to complete the rearrangement entirely correctly. The division of the letter by 5 rather than the more usual multiplication did cause confusion. The most common error involved this division, with 5a + 9 = b and a + 45 = b being seen quite frequently. It was often difficult to give any credit at all because many candidates attempted the entire re-arrangement in one step. Others had obscured their result for the first step by adding working for the next step to their result, rather than starting a new line of working.

Answer: $5(a + 9)$ or $5a + 45$

Question 10

This question on sequences caused significant difficulty for a large number of candidates. Answers showing the next term, the ninth term and $n + 7$ were all very common along with the next number in the sequence (32) or the term-to-term rule (+7).

Answer: $7n – 3$

Question 11

Most candidates were able to answer **part (a)** correctly in this question on inequalities. Many candidates did not realise that **part (b)** was a more complex version of the previous part. Here, there were two complications, that of converting the fractions into sixteenths and that the required answer was only the numerator. The wrong answer 15 was very common as it is one less than 16 in the same was as 3 is one less than 4 and 7 is one less than 8. In some cases the denominators were ignored and 5 given as the number mid way between 3 and 7.

Answers: **(a)** – 6 **(b)** 13

Question 12

Many candidates were able to answer **part (a)** correctly in this probability question. In **part (b)**, there were many answers with no method shown. Many answers for the number of matches did not make any sense as non-integers or integers greater than the total number of matches were quite common. Some gave 22 matches from assuming they had to use the probability of not winning any match from **part (a)**.

Answers: **(a)** 0.55 **(b)** 18

Question 13

In **part (a)** of this question on vocabulary, the most common answer was rectangular prism, with rectangle was the most common incorrect answer, with cube seen quite frequently. Most could identify a pentagon in **part (b)**, but a variety of spellings were seen. Shape and polygon were also fairly common answers. In **part (c)**, most were able to answer obtuse although acute and reflex were seen.

Answers: **(a)** cuboid **(b)** pentagon **(c)** obtuse

Question 14

For **part (a)** of this mensuration question the most common error was to give the answer as 14. In **part (b)** a variety of problems were seen. A large number of candidates seemed unclear about how to find the volume as $2\pi r \times l$ and $2\pi r^2 \times l$ were used very commonly; attempts at length × width × height were also seen. Others found the area of the circular face but forgot to multiply by π. Quite a number did not know how to start.

Answers: **(a)** 7 **(b)** 1270

Question 15

This question on compound interest caused considerable problems with very few completely correct answers. Many candidates only attempted simple interest. Others offered a partially correct formula, or multiplied by 0.04^2. A small number of candidates subtracted the interest. Few candidates appeared to check whether their answers were reasonable within the context of the question – answers involving hundreds or thousands of dollars in interest were not uncommon.

Answer: 454.27

Question 16

This change of currency was well done with the vast majority realising that division was the necessary operation. Candidates should consider which currency will be numerically the larger – here, the number of Euros should be less than the number of Swiss Francs (as 1 is less than 1.14). Rounding to the nearest euro however was not always observed.

Answer: 175

Question 17

Many struggled with these constructions. In both parts, correct lines were often accompanied by incorrect or spurious arcs which appeared to have been added after the line had been drawn. A lot of candidates knew the meaning of angle bisector but the majority did not know how to construct it accurately. Some drew the arcs but then not draw the lines while others just drew a line which looked correct. In **part (b)** some drew a line at right angles to *DE* but not at the centre point.

Answers: **(a)** correct ruled angle bisector with two pairs of correct arcs
(b) correct ruled perpendicular bisector with two pairs of correct arcs

Question 18

In **part (a)** of this question on decimals and indices, candidates who showed working usually gained at least one mark, however many showed no working at all. The most common incorrect pair was $\frac{2}{5}$ and 0.2^2. Of those who showed conversions to decimals, most scored 1 mark (often for $\left(\frac{2}{5}\right)^2 = 0.16$ and $0.2^2 = 0.04$). Overall, many candidates do not really know how to deal with the negative index in 5^{-2}. With **part (b)(i)** many candidates found it difficult to give the correct index with common wrong answers being a^{18} or a^3. If the answer to **part (b)(ii)** was incorrect most scored 1 mark, usually for $4b^k$, with 4 being the most common incorrect value of k but 20 was also seen several times.

Answers: **(a)** 5^{-2} and 0.2^2 **(b)** a^9 **(c)** $4b^{12}$

Question 19

Most candidates were able to attempt **part (a)** of this algebra question, although some gave answers of $5x + 3$. Some candidates attempted to solve for x. In **part (b)**, the candidates who attempted to factorise were usually able to produce a reasonable attempt at the answer, but errors in algebraic manipulation were quite common. Partially correct answers that involved errors with factorising one of the two terms were quite common. A surprising number of candidates thought that removing a factor of x would leave ($12y – {}^2$). Many candidates seemed to have no real idea of what was required and attempted to simplify the given expression. Most were able to attempt **part (c)**, with many completely correct answers. The main error was to write $5x = 27$ as the first step. Confusion about the order of operations required to solve the equation was common, as were attempts where the first step was a subtraction. This echoes problems seen in the rearrangement needed for **Question 9**.

Answers: **(a)** $5x + 15$ **(b)** $3x (4y – x)$ **(c)** 15

Question 20

Part (a) of this question on probability and data handling was answered correctly by the majority of candidates. In **part (b)**, many did not seem to realise the need to use frequencies and so used the scores on the dice instead. In **part (c)**, there were few completely correct answers. Finding the mean of 1, 2, 3, 4, 5 and 6 was a common error. Many of those who reached the stage of finding 90 went on to divide by 6. A few candidates spoiled otherwise correct methods by failing to show their answer to 3 significant figures. In both **parts (b)** and **(c)**, a number of candidates made arithmetic errors despite having calculators available.

Answers: **(a)** 4 **(b)** $\frac{21}{27}$ **(c)** 3.33(3…)

MATHEMATICS

Paper 0580/12
Paper 1 (Core)

Key Messages

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

General Comments

Most candidates made a good attempt at the majority of questions on this paper. The questions gave a fair testing of the skills and applications outlined in the syllabus and none were considered beyond the understanding of any candidate who had covered the syllabus thoroughly. The main area of difficulty was in responding to questions that asked for a worded explanation.

Showing clear, logical working is still an area needing improvement for many candidates and it was clear that many marks were lost for incorrect answers with none or inadequate working shown.

Once again there were many cases of candidates not following the instructions of the question correctly. The significant figures in **Question 12(b)**, writing in standard form in **Question 16** and compound interest and total amount in **Question 21** were common examples of this.

There was no indication of lack of time by any candidates and no questions were omitted by a substantial number of candidates.

Comments on Specific Questions

Question 1

While this question was answered well in general there was a significant number of candidates who were unable to read the scale correctly. Counting on from 0.5 without reference to the end point of 1.0 caused errors of 0.8 and 0.53 to be seen often. Also some tried to combine decimals and fraction with an unacceptable response of 0.6½.

Answer. 0.65

Question 2

All the choices offered were seen but 999 was a particularly common incorrect response. However, most responses were correct although a few gave 7^3 in the answer space rather than the actual cube number from the list.

Answer. 343

Question 3

This question required knowledge of prime numbers. Many responses of 25 and 27 were seen and also some even numbers. Some who did seem to understand prime numbers missed the correct response and gave 31.

Answer. 29

Question 4

Most candidates realised what was required in the question and answered correctly. However, 3 × 60 = 180, reading minutes for seconds, and 60 × 60 = 3600, ignoring the 3 hours, were the most common errors seen.

Answer. 10 800

Question 5

Those candidates appreciating a solid sometimes gave 'cube'. Some candidates did not seem able to take the step from a 2-dimensional net to the 3-dimensional solid created from it. Rectangle was a common incorrect response.

Answer. Cuboid

Question 6

Many candidates struggled with this explanation question. Many suggested that numbers were absent from the frequency column. Reading the second line of the stem with understanding should have eliminated this error. Some felt that all frequency tables needed a tally column or most commonly that the number of pets should be a single value rather than a range.

Question 7

While many candidates did draw an angle for part **(a)**, it was common to find no indication of the acute angle as opposed to the reflex one. This was clearly requested in the second line of the question. Mixing acute and obtuse was very common and a significant number drew a right angle. In part **(b)** a high proportion of correct responses were seen, but many candidates did not attempt it.

Answers: **(b)** Obtuse

Question 8

This question was answered well. Some candidates gave the answers of 9 and 12, not recognising the increase by one more for each new term. Although many questions on sequences deal with the development of a general expression for a linear sequence, it is important to cover other sequences as far as the patterns and term-to-term rules are concerned.

Answer. 10, 15

Question 9

Many candidates found this question challenging, with many not appreciating that the probabilities for win, lose and draw had to add to 1. Some added but either left the answer as 0.75 or divided it by 2, while others subtracted to give 0.15. There were some responses of probabilities greater than 1, presumably from dividing the given probabilities.

Answer. 0.25

Question 10

The vector question was very well answered. A few candidates lost a mark by putting a fraction line between the components, which is penalised on the first occasion it is seen. It was very rare to see a response not in the correct vector form.

Answers: **(a)** $\begin{pmatrix} 24 \\ 42 \end{pmatrix}$ **(b)** $\begin{pmatrix} -1 \\ 9 \end{pmatrix}$

Question 11

This question demanded more than just a straightforward area of a triangle as it was working from the area to find the length of the base. The most successful responses usually quoted the formula with the given values, namely ½ × base × 8 = 42. The main incorrect response was 5.25 which did not consider the ½ in the formula. Over rounding 5.25 to 5.3 and then doubling to 10.6 was seen at times. Even Pythagoras' theorem was attempted by some candidates who struggled to interpret what was required.

Answer. 10.5

Question 12

Part **(a)** was very well answered with the only significant error being to regard the square root sign as over the whole expression. A few candidates did not give enough figures.

Part **(b)** was less successful for many with answers of 5.1, 5.20 and 5.17 the most common errors. Those who made an error in part **(a)** often gained the part **(b)** mark on a follow through basis.

Answers: **(a)** 5.17225...... **(b)** 5.2

Question 13

Many candidates seemed to think that part **(a)** was more complicated than it was. Just 1-mark should have indicated that very little was involved in finding the answer. Specifying a pentagon (to supposedly help with part **(b)**) seemed to have the effect of leading many to responses of 540°, a repeat of 72° or 72 or 108 divided by 5. Other candidates gave 360 or 180.

Many candidates found part **(b)** challenging. Many worded responses concentrated on the sides being the same length.

Answers: **(a)** 108° **(b)** 3 × 108 ≠ 360 or equivalent

Question 14

Most candidates realised the correct transformation although quite a number spoilt the whole question by adding a translation when a single transformation was, as always, specified. While the scale factor was usually correct (although ⅓ and a ratio were sometimes seen) only the more able candidates found the centre of enlargement correctly. Many just assumed that the centre would be the origin.

Answer. Enlargement, scale factor 3, centre (5, 4)

Question 15

This was one of the best answered questions on the paper. In part **(a)** some gave an answer of 128, an obtuse angle, when the diagram (even though not to scale) made it very clear that the required angle was acute. The only error of note in part **(b)** was 202 from subtracting from 360.

Answers: **(a)** 52 **(b)** 22

Question 16

Most candidates now seem to understand the standard form notation. The common error in part **(a)** was to round to 3.8 or 3.84 when it was given as an exact value so should not have been rounded. Some put the exponent as 2, possibly from the number of zeros in the number while others did not count back the number of places correctly to put the decimal point after the first figure.

Part **(b)** was well answered but some struggled to get both marks, gaining just the mark for figures 455. Again exact answers were rounded by some candidates.

Answers: **(a)** 3.844×10^5 **(b)** 4.55×10^8

Question 17

The question as a whole was answered well with many gaining all the marks.

Part **(a)** was the least well answered and part **(c)** the most successful but it is difficult to comment on specific errors as few candidates showed any significant working. A few got all the signs the wrong way round but nearly all understood the inequality symbols.

Answers: **(a)** $<$ **(b)** $>$ **(c)** $<$

Question 18

The vast majority of candidates gained the marks on this question, in particular part **(a)**. A few, however, didn't follow the instructions and changed some of the given numbers or signs. Although some had difficulty with sorting out the signs in part **(b)** the vast majority answered it correctly. The main error was not being able to resolve −10 −12 correctly giving an answer of 2 or −2 at times. Nearly all candidates understood the algebra of substitution into an expression, so 52 – 34 = 18 was rarely seen.

Answers: **(a)** −4, −7, 5 **(b)** −22

Question 19

Many more candidates now seem to realise that full working is needed and the question was better answered than many times in the past. Most candidates correctly changed $1\frac{2}{3}$ to the improper fraction, but some did not then invert and multiply this improper fraction. Some inverted the $\frac{6}{7}$ instead or as well. Those who showed $\frac{18}{21} \div \frac{35}{21}$ still had to show cancelling in order to gain the 3 marks for the answer. Some tried to give a cross multiplying method without a clear explanation of what they were doing.

Answer. $\dfrac{18k}{35k}$

Question 20

Candidates found part **(a)** challenging. The syllabus states the property 'Angle in a semicircle' and the word 'semicircle' in the explanation was essential for the mark. Descriptions referring to diameter or right- angled triangle were not sufficient alone.

Part **(b)** was answered more successfully. The formula for circumference was given by some candidates and not halving the diameter was also sometimes seen.

Answers: **(b)** 7.07

Question 21

Most candidates applied the formula, although not a requirement of the syllabus. However, using the formula did not always produce the correct result as the 6250 was often added on again at the end. Rounding 1.02^3 before multiplying by the principal produced inaccurate results for some. Those working the interest a year at a time often went back to the original each time for adding on. However, many did achieve the correct answer, although some of these rounded instead of leaving the 2 decimal place answer required. There are still some candidates who apply simple rather than compound interest to all interest questions.

Answer. 6632.55

Question 22

The equation was very well answered by candidates. There was some inaccurate multiplying out of the brackets seen, such as $10y – 17$, and some subtracted 85 from 60 instead of adding, but nearly all showed enough to gain at least one of the method marks.

Answer. 14.5

Question 23

The majority of candidates knew the answer to part **(a)**. An answer of y was often seen as well as an occasional zero.

In part **(b)** an appreciable number of more able candidates showed an acceptable correct solution. Many gained 1 or 2 marks from dealing with ½ and m. For the 3 marks it was necessary to have a clear fraction, rather than a triple-decker and a square root sign clearly intended to be over the complete fraction. Many lost the last mark for one of these two reasons. Other errors were multiplying by ½ instead of dividing by ½ or multiplying by 2. Several divided by 2 instead of finding the square root.

Answers: **(a)** 1 **(b)** $\sqrt{\frac{2E}{m}}$

Question 24

In part **(a)** the vast majority of candidates were able to plot the point P correctly although a few plotted it at (−2, −5). Candidates found drawing the line $y = x$ more challenging. Lines $x = 2$ and $y = 2$ were quite common responses while some joined (−2, 0) to (0, −5) presumably relating it to part **(a)(i)**. Some who did know the line only drew it in the first quadrant which was not enough for the mark.

In part **(b)** the rotational symmetry was well answered although the angle of 180° was often seen as well as 1, 4 and 8. Most candidates who attempted the last part of the question gained at least 1 mark from a correct shape and orientation even if they did not place the shape in the correct position.

Answers: **(b)(i)** 2

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

General comments

The standard of performance was generally quite high and the vast majority of candidates could tackle all questions with some degree of confidence, though quite a lot of errors were made, especially on questions which required more than 1 stage of working to arrive at the answer.

Generally presentation was good. Many candidates showed method and were able to earn partial credit if they did not obtain the final answer, although as always, a lack of working, even when specifically requested, (for example in questions which said " show that") was evident on some scripts. Many cases of faint pencil work on drawings made marking a little difficult at times but in general work could be clearly seen. Careful checking of the wording of the questions would help to reduce errors in, for example, calculating the volume rather than the area, not giving the total amount when interest is requested and giving answers to the required degree of accuracy.

Candidates did not appear to have a problem completing the paper in the allotted time.

Comments on specific questions

Question 1

This question involving a table of distances was not well answered, clearly candidates are not familiar with the use of this style of two way table. 19 was a common wrong answer from 319 – 300 Some added the whole row for Rotorua then subtracted the whole column for Hamilton to get 722.

Answer: 109

Question 2

The majority of candidates gave the correct answer to this question on using a calculator, often 3.176523 was seen with 3176.523 given as the final answer. Others did not read the question correctly and only gave the answer to 2 decimal places.

Answer: 3.177

Question 3

Quite a lot of candidates ignored the time for Lisbon to Funchal and gave an answer of 13.10. Others dealt with time as though it was a decimal and unfortunately then achieved the correct answer of 15.00 through wrong working and were not awarded the marks.

Answer: 1500

Question 4

In this probability question, many thought there were 29 rooms ending in zero and others had something divided by 299, despite being told there were 300 rooms in total in the question. A small number of candidates did not understand the concept of the question and gave the answer as a whole number.

Answer: $\frac{30}{300}$

Question 5

This algebra question was generally well answered. In cases where it was not, the main error was to do 16 – 5 as the first step.

Answer: 7

Question 6

Many correct answers were seen to this question on upper and lower bounds, common errors were 75 and 85 or 79.95 and 80.05 or a correct 79.5 with 80.4. A small number of candidates gave both correct values but reversed them.

Answer: $79.5 \le s < 80.5$

Question 7

Most managed to get the method mark for multiplying or dividing the correct values in this question on currency conversion, some then spoiled their conclusion with £372.81 or 416.1 as their answer. Others had 365 x 1.14 and 425 x 1.14 so reached the correct conclusion of pounds through wrong working and thus were not awarded any marks.

Answer: Pounds with correct working shown.

Question 8

The majority of candidates were able to answer this question on fractions correctly. The main error was changing the sign to multiplication but not inverting the second fraction.

Answer $1\frac{3}{5}$

Question 9

The majority of candidates were able to factorise correctly. This was answered well and it was rare to award no marks. Several candidates scored 1 mark for partial factorisation, usually for $2y$ seen.

Answer: $2y(3xy - 4)$

Question 10

(a) This question on calculator use was generally well answered.

(b) Many candidates were able to answer this question, however some gave the answer as 0.11 and not to the required degree of accuracy.

Answer: **(a)** ±2.28 **(b)** 0.109

Question 11

(a) This part-question on angles was generally well answered with the majority of candidates knowing that 360° was the key to a correct response.

(b) Many candidates were able to correctly name the angle, Isosceles was often seen as were; parallel, wide, regular, triangle and prism.

Answer: **(a)** 129 **(b)** Obtuse

Question 12

(a) This question on vectors was generally well answered.

(b) Generally well answered although a small number of candidates did reverse the coordinates. A common incorrect answer was (–1, –1)

Answer: **(a)** $\begin{pmatrix} 9 \\ -7 \end{pmatrix}$ **(b)** (–1, –3)

Question 13

Although the question stated in bold that it was the interest that was required many candidates calculated the total amount. Some candidates calculated simple rather than compound interest. Several had totally unrealistic answers for example $157 000, and had clearly not checked whether or not their answer was realistic.

Answer: 461.25

Question 14

Many candidates did not appear to know how to answer this question on finding the area of a compound shape, several confused perimeter and area, others were confused between the length 18 and 22 cm. On questions such as this candidates really need to understand the importance of showing their working. Of those who did, several gained 1 mark for one small area calculated correctly.

Answer: 260

Question 15

(a) This question on indices was generally well answered, it is pleasing to see that the rules of indices appear to be well known.

(b) Although many candidates gave the correct answer to this question on simplifying indices, there were more errors than on part **(a)**. The majority of candidates had 3 but $3h^{-5}$ was quite common.

Answer: **(a)** 7 **(b)** $3h^5$

Question 16

(a) The calculation involving standard form was usually correct, however candidates found the conversion to standard form difficult.

(b) Candidates found this part more difficult. Many candidates who gave the correct answer had converted both numbers to ordinary form, done the subtraction and then converted back to standard index form. Few appeared to subtract and convert 0.5×10^4

Answer: **(a)** 1.1×10^5 **(b)** 5×10^3

Question 17

(a) The majority of candidates gave the correct answer to this question on equilateral triangles.

(b) The majority of candidates scored 2 of the 3 marks available for their net, usually for 3 accurate rectangles and the triangles in the correct position. The main error was to have the height of the triangles as 3 or 4 cm rather than 3.5 cm. There was little evidence of compasses being used.

Answer: **(a)** 60

Question 18

(a) Although several candidates did not attempt this question on drawing a scatter diagram, the ones who did usually scored both marks.

(b) Many candidates were able to draw a suitable line of best fit, however, some lines were poorly done with some just joining all the points.

(c) Those who knew correlation generally gave the correct type.

Answer: **(c)** Negative

Question 19

(a) This part on plotting a point and joining it to form a line was nearly always correct, however a small minority did not draw the required line.

(b) (i) Gradient was not understood by many candidates, the scale of the diagram appeared to confuse some candidates who just counted every small square as 1, leading to 6/8. Those who did understand generally got the correct answer. Some gave the equation which was not asked for.

(ii) Few candidates had the correct equation, often as a result of not understanding part **(b)(i)**. Many appeared not to understand the form $y = mx + c$. A small number of candidates did manage to score 1 mark for using their answer to **(b)(i)**.

(c) Very few correct lines were seen, with candidates giving a variety of vertical, horizontal and parallel lines.

Answer: **(b) (i)** 1.5 **(ii)** $1.5x + 2$

Question 20

(a) Many candidates clearly know the formula for the area of a circle, however some used 17 (the diameter) or 17^2 rather than the radius, others used 6 or 6^2 from the chord. Some candidates are still confusing the area and circumference formula.

(b) (i) As in previous sessions, many candidates did not give the correct definition and missed the word semi-circle.

(ii) Many correct answers were seen. Some candidates knew to use Pythagoras' Theorem but added rather than subtracted. Had candidates checked their work and realised the answer had to be smaller than 17, some may have eliminated their error.

Answer: **(a)** 226.98 to 227.01 **(b) (i)** Angle in a semi-circle **(ii)** 15.9

MATHEMATICS

Paper 0580/21

Paper 21 (Extended)

Key message

It is important to ensure that each topic is learned thoroughly and practiced. It was common to see many candidates who lacked confidence in the execution of various skills.

General comments

In this paper it is important that candidates use their calculators correctly and give a rough estimate of what the answer should be. There was evidence too that some calculators were in the wrong mode. Answers should be rounded correctly and it is good practice to write down the figure given on the calculator first.

The manipulation of numerical and algebraic fractions needs to be learned thoroughly because many candidates only demonstrated superficial knowledge.

The questions that were found to be accessible were 1, 2, 3, 4 and 13, whilst the questions that were found to be the most challenging were 15, 16, 17, 21, 22 and 23.

Comments on particular questions

Question 1

The majority of candidates answered this question on negative numbers correctly and the most common incorrect answer was 5 or -5 obtained from subtracting 3 and 8.

Answer: 11 or −11

Question 2

Part **(a)** of this question on using a calculator and on rounding was usually answered correctly, with the square root being the final operation as the main error. In part **(b)** the common error was to round down.

Answers: **(a)** 1.32656 **(b)** 1.327

Question 3

This question on ratio was well answered, the common errors were either an attempt to divide 84 by 13 and then multiply by 6, or divide 84 by 6 and multiply by 7.

Answer: 72

Question 4

There were a good number of correct answers to this question on angles. In the cases where the answer was not correct, candidates were often able to gain 1 mark because of the correct marking of 55 in the triangle or 180 - (50 +55) leading to 75. The most frequently seen incorrect answer was 125, obtained from 180 - 55.

Answer: 105

Question 5

There were a pleasing number of correctly set out and fully correct answers to this question on fractions. A number of candidates preferred to use $\frac{24}{16}$, or similar, leading to large values in the numerator and denominator of the fraction from multiplication as cancellation was not commonly attempted. When candidates used $\frac{3}{2}$ they were usually able to complete the calculation correctly. A minority of candidates who got as far as $\frac{3}{2} \div \frac{3}{16}$ mistakenly 'flipped' the first fraction and obtained an answer of $\frac{1}{8}$ which was a common incorrect answer. They would then try to show that $1/\frac{1}{8}$ was 8. Instead of checking their working, many candidates would try to manipulate their answer to get 8.

Question 6

Some candidates were clearly confident at factorisation and correctly factorised the expression in a single step with a good number of scripts also showing evidence of multiplying out and checking their answer. Some correct partial factorisations were seen such as $3(4xy - x^2)$. For other candidates this question proved difficult and it was disappointing to see some answers which demonstrated a complete lack of understanding with $-12x^2y$ or similar seen as responses.

Answer: $3x(4y - x)$

Question 7

There was some confusion as to what was required in part **(a)** of this question on loci and some just gave lengths such as BC with no condition attached. Part **(b)** was answered much better; the main error was to shade only a part of the actual answer.

Answers: **(a)** Equidistant from *A* and *B* **(b)** correct region shaded

Question 8

A surprising number of candidates were able to fully solve the inequality with the answer most commonly being seen as a decimal, such as $x \geq -0.375$. Some candidates made a good start to solving the inequality obtaining an inequality, or equation, such as $-3 < 8x$ or more simply obtaining $-\frac{3}{8}$. However they struggled with the inequality signs generally due to not knowing how division by 8 or -8 would impact on the inequality.

Answer: $x \geq -\dfrac{3}{8}$ oe

Question 9

Many did get credit in this question on upper and lower bounds. The common error was to multiply 16.1 by 3 to get 48.3 then to give the bounds of this number as 48.25 and 48.35.

Answers: 48.15, 48.45

Question 10

A large number of responses to this question on factorising were totally correct but many started correctly and showed the partial factorisation, either $a(p - 2) + b(p - 2)$ or $p(a + b) - 2(a + b)$ and then they gave this as their answer. Some were confused by the negative sign and wrote the partial factorisation as $p(a + b) - 2(a - b)$ or $p(a + b) + 2(a - b)$ where the two brackets are not the same so further progress is not possible from this position.

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

Question 11

Candidates seemed to get part of the expression more often than the entire expression correct and this tended to be for obtaining $3x^k$ rather than those who could not deal with $27^{1/3}$.

Answer: $3x^4$

Question 12

Part **(a)** of this question on Venn diagrams was well answered, the main error being to give the total as 9 with the 2 being omitted. Part **(b)** was also well answered with alternatives being just the intersection shaded or everything but the intersection shaded.

Answers: **(a)** $\frac{3}{11}$ **(b)** region outside both circles but within the rectangle

Question 13

This question on exchange rates was well answered with the main error being that their answer was not given to the required accuracy or where candidates attempted to multiply them rather than divide.

Answer: 175

Question 14

Many candidates attempted simple interest and of those who wrote the formula out correctly many were unable to calculate it correctly with the 420 somehow becoming involved in the power of 2. Despite the request for two decimal places there were some who rounded their answer to the nearest whole number.

Answer: 454.27

Question 15

Many candidates wrote out the initial equation correctly but they would often use a short approximate for π rather than use the fuller version on their calculator. Many also calculated $\frac{4}{3}\pi$ and then truncated that answer before dividing it into 80. The common error after that was to attempt square root to find the value of *r* rather than cube root.

Answers: 2.67

Question 16

This question was found to be challenging and few actually calculated the cross sectional area with πr^2, many using $2\pi r$ in its place. Very few then found the volume in one second from volume = cross sectional area × length.

Answers: 35.4

Question 17

It was common to see the equation of the line in the form $y = mx + c$ where either the gradient or the intercept were correct. The most common errors were in calculating the gradient where 5 – -1 was often 4 and in the gradient calculation, the fraction was often the reciprocal, difference in *x* divided by difference in *y*. Sometimes the candidates mixed up the *x*'s and *y*'s and subtracted an '*x*' from a '*y*'. Many used the point (3,5) to find the intercept when the other point would have given them the correct answer without the need for any calculation.

Answer: $y = 2x - 1$

Question 18

In part **(a)** of this question on factorising and simplifying, many concentrated on the two end terms and so the responses included (x - 6)(x + 5), (x + 1)(x - 30), (x -1)(x + 30) and (x +3)(x - 10). Most of these did not give the middle term of the quadratic expression when expanded. Some then continued to give the solutions to this expression equalling zero. Therefore for many there was no possibility of cancellation in part **(b)**.

Answers: **(a)** $(x+6)(x-5)$ **(b)** $\dfrac{x+4}{x+6}$

Question 19

This question caused problems for a large number of candidates. A significant number did not know how to deal with proportionality and therefore could not start. A reasonable number had some idea about proportionality, but were not able to deal with it being inversely proportional to the square root of u. Many treated it as direct proportionality, some with just u and many used the square of u. The correct responses to the question usually wrote down the equation $t=\dfrac{k}{\sqrt{u}}$ and then proceeded to work out the value of k.

Answers: $\dfrac{6}{7}$

Question 20

In both parts **(i)** and **(ii)** some wrote the answers using the vector bracket notation. Those who used the correct notation often gave the correct response, some gave double the answer so in **(i)** they wrote 2**p** + **r** and in **(ii)** 4**p** + 2**r**. In **(b)** many said it was the centre of the shape or the parallelogram or on the line QS.

Answers: **(a)(i)** **p** + $\frac{1}{2}$**r** **(ii)** 2**p** + **r** **(b)** Midpoint of *R*Q

Question 21

Fully correct answers were rarely seen in this question on circles. The length 9π, or its decimal equivalent, was often seen but candidates neglected to add on the 2 × 12 and here a quick check back to the question would have been beneficial. Common errors included use of area rather than circumference of the circle in the calculation or use of an incorrect fraction in calculating the length of the arc through the incorrect cancellation of the fraction.

Answers: 52.3

Question 22

Many candidates knew what to do in this question on algebraic fractions and usually the response started correctly with the correct two single brackets as the numerator and the correct double brackets as the denominator. However, then, many candidates started to either cancel the brackets or they expanded all the brackets and then they cancelled any common terms, such as the 5x. They did not realise that you can only cancel common factors and that this fraction does not have any. In the correct responses it was common for the denominator to be expanded which was unnecessary work.

Answer: $\dfrac{5x+13}{(x+3)(x+2)}$

Question 23

Initially many candidates indicated the required angle as angle CEB rather than angle CEA. Therefore a lot of work was done on triangle CEB. Some candidates were not convinced that triangle AEC was right-angled and they also struggled to use Pythagoras' Theorem to find EA first because they did not recognise angle EBA as a right-angle or they did not join EA in the first place. Once sides were found the trigonometry proved less demanding.

Answers: 24.8

Question 24

It was a surprise to find part **(b)** often answered better than part **(a)** in this question on matrices. In **(a)** the candidates made arithmetic errors as there was little evidence of a calculator being used. Sometimes the numbers were put in the wrong positions. In **(b)** some forgot to calculate the determinant whilst others confused the two 'rules' so they swapped the wrong numbers and made the other two wrong ones negative.

Answers: **(a)** $\begin{pmatrix} 6 & 7 \\ 16 & 17 \end{pmatrix}$ **(b)** $\frac{1}{5}\begin{pmatrix} 2 & -3 \\ -1 & 4 \end{pmatrix}$

Question 25

In part **(a)** of this question on travel graphs the main error was to divide 280 by 20 giving 1.4 and in **(b)** some tried to use distance = speed × time. Those who did find areas often gave the answer of 840 by failing to half the area of the triangle, which was a more common approach than using the formula for the area of a trapezium.

Answers: **(a)** 2.8 **(b)** 700

Question 26

A large number of candidates were able to give fully correct answers to this question on surface areas. Many of the remaining candidates gained some marks for the question, often for calculation of the three easiest rectangles such as 4x15, 9x15, and 6x15 with their addition or for calculating the area of the trapezium. The area of the trapezium was commonly calculated by splitting the shape into a triangle and a rectangle rather than by use of the area formula. Finding the length of the sloping face (5) was often missing or given an incorrect value, such as 15. A small number of candidates were confused between area and volume so they calculated the volume of the trapezoid.

Answer: 420

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key message

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

There was no evidence that candidates were short of time as almost all candidates were able to complete the question paper and to demonstrate their knowledge and understanding. The occasional omissions were due to difficulty with the questions rather than lack of time.

Candidates not giving answers to the correct degree of accuracy continue to be a concern. Marks are being lost through premature rounding in the intermediate stages of calculations. Candidates also lost marks by rounding answers to money questions where the answer was exact. The general rubric needs to be read carefully at the start of the examination and candidates need to ensure that they have noted the accuracy requirements of particular questions in their checks at the end of the paper.

The questions that presented least difficulty were 4, 5, 12 and 17**(a)**. The questions that proved to be the most challenging were 1, 8, 9, 18 and 21**(b)**.

Methods were generally well presented, although it was noted that some candidates used arrows between numbers/variables without showing the operation being undertaken or in which order.

Comments on particular questions

Question 1

Most candidates scored at least one mark. The most common error involved the first diagram where candidates left all of set A unshaded.

Question 2

Most candidates scored at least one mark for the partial factorisation with a significant number scoring the full two marks. A common error for not scoring two marks was to include a + sign between the two pairs of brackets.

Answer: $(p + 3)(k + m)$

Question 3

Many correct expressions for the nth term were seen. Those candidates who did not score two marks often gained a mark for either $4n$ or $-4n$ being seen in the working. Weaker candidates had often written -4 underneath the sequence but were then unable to progress with the question. A common incorrect answer was $n - 4$.

Answer: $17 - 4n$

Question 4

Many correct answers were seen to this question on standard form. Most candidates gained at least one mark for figs 455 being seen either as part of an ordinary number or in an incorrect standard form answer where the index was incorrect. Some candidates lost a mark by truncating their number to 4.5×10^8.

Answer: 4.55×10^8

Question 5

The general response to this question on areas of triangles was very pleasing. A small number of candidates incorrectly assumed that the triangle was equilateral and used trigonometry. The most common incorrect answers were 5.25 and 21.

Answer: 10.5

Question 6

This was a well answered question on exchange rates with many candidates scoring two marks. Some candidates successfully converted Jane's payment into dollars but then failed to find the difference in the amounts that the two friends paid. Candidates also failed to score full marks due to premature rounding within their calculations.

Answers: 2.20

Question 7

The first part of this question on calculator use and rounding was correctly answered by most candidates, who then usually correctly wrote their answer to 2 significant figures. Where answers to part **(a)** were incorrect, the response 7.880989… (taking the square root of the whole expression rather than just of 65) was frequently seen. The most common error in part **(b)** was to give 2 decimal places instead of 2 significant figures.

Answer: **(a)** 5.17225... **(b)** 5.2

Question 8

Numerous misconceptions were observed in the candidates' responses to this question on upper bounds. Some candidates divided the area by 2 or 4 instead of square rooting. Some candidates obtained 6.15 or 6.1 from incorrect working, this was usually from subtracting various quantities from 37.8225 before square rooting thus obtaining 6.15 or 6.1 through incorrect working. Some candidates rounded up the 6.15 to 6.2. A small number of candidates gave the final answer as 6.10.

Answer: 6.1

Question 9

This question on the volumes of similar shapes proved to be the most difficult questions on the paper and it was evident that many candidates did not understand the relationship between the ratio of the lengths and that of the volumes of similar figures. Many candidates assumed the ratio of the lengths to be equal to the ratio of the volumes, thereby obtaining an unrealistic answer of 0.338 cm. Only a minority of candidates were able to give a fully correct solution.

Answers: 40.3

Question 10

Candidates often failed to recognise the cyclic quadrilateral *ABDE* which would have enabled them to find the angle in part **(a)**. Most candidates were able to score at least one mark in part **(b)** for showing one of the relevant angles on the diagram. Those candidates who did not show the relevant angles on the diagram often failed to show which angle they were referring to in their calculations in the working space.

Answer: **(a)** 95 **(b)** 77

Question 11

Most candidates at all levels of ability attempted this question on fractions in the expected manner and scored full marks. A few candidates went straight from $\frac{6}{7} \div \frac{5}{3}$ to the final answer, failing to show the correct intermediate multiplication step, thus failing to score full marks. Some thought that the denominators needed to be the same and $\frac{18}{21} \div \frac{35}{21}$ was often seen but candidates then failed to show the cancelling of the 21's. It was pleasing to see fewer candidates attempting to work in decimals although a surprising number did convert their final fraction to 0.514 unnecessarily.

Answer: $\frac{18}{35}$

Question 12

This algebra question was the most successful question on the paper for the vast majority of candidates. Even the less able achieved a high level of success with this question. Some arithmetical errors were seen in the expansion of the brackets or the addition of 17 or 85.

Answer: 14.5

Question 13

Candidates demonstrated a good understanding of compound interest. Those that used the compound interest formula or used a multiplying factor of 1.02 were more successful than those calculating interest year by year, where arithmetic errors were sometimes made. A few candidates spoiled their answers by adding on the $6250 again. A significant number of candidates lost the final mark by rounding their answer to the nearest $ or to the nearest 10 c instead of giving the exact answer required. A common error was the use of simple interest. There were also a few rather unrealistic answers – candidates should be encouraged to reflect of the reasonableness of their answers.

Answer: 6632.55

Question 14

The response to this question on proportionality was very pleasing with the majority of candidates setting their method out correctly and clearly. Some mistakes were made, however, in deciding upon the initial relationship. Common incorrect relationships that were used were $y = kx^3$ or $y = \frac{k}{x}$. Reading the question carefully was the key to making a correct start. The most common error following a correct initial relationship was failing to cube 4 in the final step of the solution leading to an incorrect answer of 10.

Answers: 0.625

Question 15

Most candidates read the instruction to use the quadratic formula, which was generally quoted correctly although many incorrect versions of the formula were also seen. Common mistakes made in using the formula were to use 3 instead of −3 for the value of *c* or failing to deal with subtracting a negative number correctly. Another common error was failing to extend the fraction line under the whole numerator in the working. Many candidates lost marks through ignoring the instruction to give their answers correct to 2 decimal places - three significant figure answers of −3.89 and 0.386 were often seen. Premature rounding of $\sqrt{73}$ to 8.5 led to incorrect final answers of 0.375 and −3.875. A few candidates attempted to solve the question by alternative methods and these candidates generally scored no marks. It was pleasing that it was rare to see correct answers with no evidence of working.

Answers: 0.39, −3.89

Question 16

Most candidates understood that they needed to find the area under the graph in this kinematics question, which many did, successfully scoring at least three of the four available marks. The most commonly seen incorrect answer was 900 which resulted from candidates not recognising that the time was given in minutes and that the speed was given in km/h and that some conversion was necessary. Candidates who noticed that a conversion was necessary often dealt with it at the beginning and worked in decimals, which often led to an inaccurate answer due to premature rounding. Those who worked with fractions were more successful. Some candidates multiplied by 60 instead of dividing for the conversion. Numbers such as 0.07 were often seen in area calculations with no indication of the fraction from which they arose. Candidates must be encouraged to show their method clearly. Other occasional errors were omitting the ½ in triangle area calculations or dividing the rectangle area by 2.

Answers: 15

Question 17

Most candidates were able to plot the points accurately in part **(a)**. In part **(b)** the majority of candidates correctly stated that the correlation was negative. A few candidates left the answer space blank. Common incorrect responses were: indirect, decreasing, inverse and positive. Occasionally candidates wrote a sentence to describe the relationship. Part **(c)** was better understood with the majority of candidates drawing a ruled straight line within the accuracy range. If it was out of range it tended to be too high, with all the points lying underneath their line. Some lost the mark through their line being too short and others simply joined point to point. Occasionally, a line with positive gradient starting at the origin was drawn.

Answers: **(a)** 7 correct points **(b)** negative **(c)** correct line of best fit

Question 18

This question was not well answered with few candidates scoring all four marks and many, usually those who tried to work with all three expressions at once, scoring zero marks. Even those candidates who worked towards the correct values of −0.6 and −4.5 tended to be confused by the negative values and inequalities with reversed signs were common. Those who succeeded in reaching the correct inequalities were often unable to give the correct final answer as integers. In cases where integer answers were given, an additional 0 and/or −5 were sometimes seen.

Answer: −1, −2, −3, −4

Question 19

Part **(a)** of this question on loci was usually well answered with most candidates using the correct radius and correct centre. In a few cases the arc was incomplete within the rectangle, which resulted in a loss of marks. There was little evidence of candidates attempting to draw the arc without compasses but some blank answers may indicate lack of equipment rather than lack of knowledge. Freehand arcs were penalised.

Part **(b)** was also generally well done although some perpendicular bisectors were penalised due to the correct construction arcs not being shown. Common errors included bisection of one of the sides of the rectangle or bisection of angle *A*.

Those candidates who drew correct arcs and bisectors in the previous parts usually shaded the correct region for part **(c)**. Common errors were to only shaded part of the required region using *DB* as a boundary line or only shading up to the arc used in the construction of the bisector rather than to the bisector itself.

Answers: **(a)** arc centre *A* radius 5 cm **(b)** ruled perpendicular bisector of *DB* with 2 pairs of correct arcs

Question 20

Part **(a)** of this question on data handling was reasonably well answered with a significant proportion of candidates writing down the correct interval. Some candidates gave the modal interval, $6 < h \le 10$, as their answer and a few thought that a combination of the two central intervals were required and gave $10 < h \le 17$ as their answer. A small number of candidates gave the frequency rather than the interval as their answer.

The majority of candidates understood what was required for part **(b)**, with many earning full marks. Common errors included errors in finding the mid-interval values or in using a different value from within the intervals. Those who scored zero marks usually used the class width instead of the mid-interval value or attempted to find the mean of the frequencies.

Part **(c)** was very well answered with most candidates earning two marks. Common errors were to copy the frequencies from part **(a)**.

Answers: **(a)** $10 < h \le 13$ **(b)** 12.12 **(c)** 70, 115, 153, 185, 200

Question 21

Part **(a)** of this question on functions was one of the better-answered questions. Those candidates who did not score full marks usually scored one mark for correctly finding g(5) but then tried to calculate f(5) x g(5) rather than f(g(5)).

Part **(b)** was not so successful as the 'double reciprocal' appeared to confuse many candidates. The majority were able to start correctly with the expression $\frac{1}{2(\frac{1}{2x})}$ but were then unable to simplify correctly. An incorrect final answer of $\frac{1}{x}$ was often seen. Some candidates prevented themselves from progressing towards the correct solution by incorrectly assuming that $2\left(\frac{1}{2x}\right)$ expanded to $\frac{2}{4x}$. It was not unusual for candidates to try to find $g(x) \times g(x)$. Some candidates made the error of not making their fractions clear and $\frac{1}{2x}$ was often incorrectly written as $\frac{1}{2}x$.

Part **(c)** was well answered with few incorrect answers seen. A small minority thought that inverse meant reciprocal and offered $\frac{1}{5x+4}$ as their solution.

In part **(d)**, the majority of candidates obtained the correct answer often with little or no working being shown. Common incorrect answers were 3 and $\frac{1}{256}$.

Answers: **(a)** 4.5 **(b)** x **(c)** $\frac{x-4}{5}$ **(d)** −3

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, as almost all attempted the last few questions. Candidates showed evidence of good work in algebra questions. Candidates found the topic of vectors challenging.

Not showing clear working and in some cases any working was less of a concern this year, however still evident. When there is only an incorrect answer on the answer line and no relevant working the opportunity to earn method marks is lost. More candidates gave their answers to the correct degree of accuracy than in previous years, although this was still an issue with some, particularly in **Question 4**. Premature rounding part way through calculations was less evident this year and caused problems for only a small number of candidates when it came to final accuracy marks in **Questions 6** and **18**.

Comments on Specific Questions

Question 1

This questions was well answered by many candidates. The most common errors were to multiply 425 by 1.14 or divide 365 by 1.14, instead of the correct operation. Occasionally no decision, or the incorrect decision, was reached on whether pounds or euros offered the lowest cost.

Answer: pounds

Question 2

Many candidates scored full marks on this question. Those that did not usually correctly identified either that 30 of the room numbers ended in zero or that the denominator of the fraction should be 300. The most common errors were to see 29 or 299 in place of 30 or 300 in the fraction.

Answer: $\frac{30}{300}$

Question 3

The most successful candidates showed clear working, and came to the correct decision of 1500 or 3 pm. Some showed insufficient or no working and, in conjunction with an answer of 3 or 0300, was the most common cause of lost marks. When working with time candidates should be encouraged to either work in 24 hour clock or ensure that am/pm are always used when writing 12 hour clock times.

Answer: 1500

Question 4

The most successful candidates took careful note of the accuracy requirements stated on the front of the exam paper. The most common error was a 2 significant figure answer of 0.11 in part **(b)**.

In part **(a)** $5\frac{5}{24}$ was sometimes misunderstood as $5\times\frac{5}{24}$ so consequently a common incorrect answer was 1.02. Very occasionally an answer in part **(b)** was seen arising from the calculator not being set in degree mode.

Answer: **(a)** 2.28 **(b)** 0.109

Question 5

The most successful candidates showed the conversion of all four values into their decimal equivalents going on to correctly order them as a consequence. The most common error was to assume, without working it out, that $\left(-\frac{2}{3}\right)^{\frac{2}{3}}$ was negative and this was often placed as the lowest value with decimal conversions only being worked out for $(1.5)^{\frac{2}{3}}$, $\left(\frac{2}{3}\right)^{1.5}$ and $\left(\frac{2}{3}\right)^{-1.5}$. There were also a number of occasions when $\left(-\frac{2}{3}\right)^{\frac{2}{3}}$ was shown evaluated to –0.763 or 0.148; candidates are advised to ensure that they key the brackets into the calculator when working with powers of negative numbers and in the case of some calculators a fractional power also needs to be in brackets.

Answer: $\left(\frac{2}{3}\right)^{1.5}$ $\left(-\frac{2}{3}\right)^{\frac{2}{3}}$ $(1.5)^{\frac{2}{3}}$ $\left(\frac{2}{3}\right)^{-1.5}$

Question 6

Many candidates answered this question well and with clear working. Those candidates who recognised that the ratio of the radii would be the same as the ratio of the cube roots of the volumes usually produced fully correct solutions to this problem, although occasional premature rounding caused answers that were not exactly 6. The most common incorrect answers were 24 and 8.49, the first arising from using the volume ratio as the length ratio, the second from using the square root of the volume ratio as the length ratio or finding the height of the smaller cone and assuming that the larger cone would have the same height.

Answer: 6

Question 7

This was well answered by nearly all candidates. The most common incorrect answers were 220 arising from 2 × (4 × 5 + 5 × 18) or 130 arising from working out one half of the shape and forgetting to double. It was very rare for candidates to not score anything as the majority were able to complete at least one correct area calculation.

Answer: 260

Question 8

This was well answered by many candidates, with the most success arising from the starting point $m = kr^3$, then going on to find the value of k. The most common error was to use r instead of r^3 with 400 being the most common incorrect answer. Other errors seen were the use of r^2 or the cube root of r or inverse proportion. Sometimes where candidates had correctly started with $m = kr^3$ there were instances of incorrect evaluation of k, for example $k = 2$ was seen a few times. There were also a few occasions where the candidate had correctly worked out $m = 20r^3$ but then instead of using 5^3, 5 or 5^2 were used, consequently common incorrect answers were 100, or 500.

Answer: 2500

Question 9

The majority of candidates read the instruction carefully about writing answers in standard form and scored full marks in both parts. Sometimes standard form was misunderstood either by writing as ordinary numbers 110000 and 5000 or with variations such as 11×10^4 or 0.5×10^4. Whilst these variations gained some credit, they could not score full marks as they are not correct standard form.

Answer: **(a)** 1.1×10^5 **(b)** 5×10^3

Question 10

Candidates who used the elimination method tended to be more successful than those who tried the substitution method, particularly those who made x or y the subject of the first equation. For the substitution method, candidates should be encouraged to look for the easiest rearrangement. In this case that is to make y the subject of the second equation, as that does not result in any fractions, which were the biggest cause of subsequent errors. Mistakes made by candidates using the elimination method generally arose from subtracting to eliminate the y terms, instead of adding, or subtracting to eliminate the x terms with an incorrect attempt at subtracting $-5y$. Following the correct solutions $x = 11$ and $y = 3$, some candidates found $2x - y$ rather than $2x + y$.

Answer: 25

Question 11

It was quite common to see candidates ignore the information in the question about the sum of the prime numbers less than 8. Many began a new list of prime numbers, often including 1, so a common incorrect answer to part **(a)** was 78. A few candidates included 9 or 15 or both as prime numbers. In part **(b)** it was common to see the working $17 + 11 + 13 + 17 = 58$ (or $2 + 3 + 5 + 7 + 11 + 13 + 17 = 58$) with the incorrect decision of 17 on the answer line, thus ignoring or misunderstanding the fact that the question included a strict inequality.

Answer: **(a)** 77 **(b)** 18 or 19

Question 12

Many correct answers were seen to both parts of this question. A common incorrect answer in part **(a)** was $1\frac{1}{25}$, arising from the working $\frac{1}{5} \times \frac{1}{5}$. More candidates scored full marks in part **(b)**, where it was rare to see an incorrect answer, than in part **(a)**.

Answer: **(a)** $\frac{5}{25}$ **(b)** $\frac{4}{25}$

Question 13

Most candidates understood the need for a common denominator and this mark was the most commonly awarded. The most frequent problems arose from dealing with the numerator. Sign errors were common and $(x + 3)(x + 1) - (x - 1)(x - 3)$ was often expanded incorrectly to $x^2 + 4x + 3 - x^2 - 4x + 3$ (i.e. only changing the sign of the x^2 term) leading to a common incorrect answer of $\frac{6}{(x-3)(x+1)}$. Those candidates who were most successful worked in stages i.e. $(x + 3)(x + 1) - (x - 1)(x - 3)$ followed by $(x^2 + 4x + 3) - (x^2 - 4x + 3)$. These candidates were more successful in remembering to change the sign of every term in the expression in the second set of brackets. Missing brackets were also an issue with, for example, $x + 1\ (x + 3)$ was sometimes seen; often this error was recovered but not always.

Answer: $\frac{8x}{(x-3)(x+1)}$

Question 14

Part **(a)** was well answered by a significant number of candidates, with the most common wrong answers involving incorrect inequality signs, equal signs or just the answer 9. Part **(b)** was also well answered with the most common error being to only partially factorise e.g. having the answer as $b(a + c) + d(a + c)$. Another incorrect answer sometimes seen was $(b + d) + (a + c)$.

Answer: **(a)** $n < 9$ **(b)** $(b + d)(a + c)$

Question 15

Many candidates correctly obtained the answer of 4 in part **(a)**. Those who made errors often added only the terms involving x, then equated these to 74, or missed out one out of the 7 terms to be added. Some candidates included the intersections too many times, e.g. adding the four components of A, then the four of B and then the four of C and then equating to 74. Candidates need to consider the sense of their answer, i.e. a decimal or negative value is not possible when counting the number of elements in a region. Few candidates had incorrect answers in parts **(b)** and **(c)** although occasionally these parts were left unanswered.

Answer: **(a)** 4 **(b)** 26 **(c)** 8

Question 16

The most successful candidates in part **(a)** evaluated g(18) to get 4 then evaluated f(4). There were fewer candidates demonstrating the misunderstanding f(18) × g(18) although this was still occasionally seen. Those candidates who attempted to work out fg(x) then substituted in 18 were more likely to make errors. The most common error in evaluating $\left(\frac{x}{2}-5\right)+2\div\left(\frac{x}{2}-5\right)-3$ was to miss off the "– 3" at the end of this expression. Candidates generally answered part **(b)** well and the most common error in rearranging $y=\frac{x}{2}-5$ was the incorrect first step $2y = x - 5$. Occasionally the incorrect answer of $\frac{1}{\frac{x}{2}-5}$ was also seen, i.e. $(g(x))^{-1}$ rather than $g^{-1}(x)$.

Answer: **(a)** 1.5 **(b)** $2(x + 5)$ or $2x + 10$

Question 17

Part **(a)** was very well answered with the occasional arithmetic slip, although these were quite rare. Part **(b)** was generally answered with most candidates gaining at least one mark for either the determinant correctly used or the adjugate of **M** correctly found. The most common cause of lost marks was due to arithmetic slips in calculating the determinant or errors in writing the adjoint matrix, rather than a lack of understanding of the question. Those who found the inverse by finding the adjugate of **M** and multiplying by the reciprocal of the determinant were more successful than the candidates who used a simultaneous equations approach.

Answer: **(a)** $\begin{pmatrix} 7 & 23 & 16 \\ 12 & 45 & 27 \end{pmatrix}$ **(b)** $\frac{1}{3}\begin{pmatrix} 6 & -3 \\ -3 & 2 \end{pmatrix}$

Question 18

Often this was very well answered with the more successful candidates using the general formula for the area of a triangle (½absinC). Some chose to calculate the length of AB and the length of the midpoint of AB to O going on to use ½bh; these candidates were more likely to make errors with premature rounding. The more successful candidates worked to 4 or more significant figures or exact answers in their working, rounding only the final answer. There was evidence of candidates using incorrect formulae for the area of a circle and occasionally arc length AB was found instead of sector area OAB.

Answer: 15.4

Question 19

Part **(a)** proved to be a difficult question for many and it was evident that many candidates were not familiar with the word hexagon. Common errors were to call this shape a six sided polygon or a pentagon. This part was often left blank, even by the more able candidates. Part **(b)(i)** was well answered by nearly all candidates with the occasional sign slip seen. Part **b(ii)** proved more challenging with the more successful candidates showing a correct route, e.g. $\overrightarrow{OB} + \overrightarrow{BA}$ before attempting to write it in terms of **b** and **c**. The most common error was to write $\overrightarrow{AB}$ = **c** and consequently the most common incorrect answer was **b** – **c**. The most common error in part **(b)(iii)** was to write the answer $\overrightarrow{OE}$ although many realised it was the same answer as **(b)(i)**.

Answer: **(a)** hexagon **(b)(i)** **−b** + **c** **(b)(ii)** **b** − $\frac{1}{2}$**c** **(b)(iii)** **−b** + **c**

Question 20

The majority of candidates were able to obtain at least the method mark in part **(a)** with many gaining both marks. The most successful candidates read carefully the accuracy requirement of 4 decimal places. The most common incorrect answers were 3.16, 3.162, $\sqrt{10}$ and 3.1622 but 4.8284 was also seen a few times which is the answer to $\sqrt{8}+\frac{4}{2}$ rather than $\sqrt{8+\frac{4}{2}}$. Most candidates were successful in part **(b)** obtaining full marks for the correct rearrangement. Of those that did not, common errors were to separate the terms under the square root, or to deal with the reciprocal incorrectly; it was common so see $\frac{4}{x} = y^2 - 8$ followed by $x = \frac{y^2-8}{4}$. Other common errors occurred when candidates attempted to multiply through by x with errors such as $y^2 = 8 + \frac{4}{x}$ followed by $y^2x = 8 + 4$ often seen.

Answer: **(a)** 3.1623 **(b)** $\frac{4}{y^2-8}$

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. Areas which proved to be vital in gaining good marks on this paper were; using 24 hour clock times, correct rounding, knowledge of angle properties, understanding of bearings and trigonometry, properties of straight lines, forming and solving equations and accurate plotting of coordinates and points on graphs. Although this does not cover all areas examined on this paper, these are the areas that more successful candidates gained marks on.

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, and most were able to make an attempt at most questions. Few candidates omitted part or whole questions. The standard of presentation was generally good. There were occasions where candidates did not show clear workings and so did not gain the method marks available. Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed. 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 important in questions which required the use of π. Clear instructions are given on the front of the paper that candidates must use the calculator value for π or 3.142. However many candidates continued to use 3.14 or 22/7 which led to inaccurate answers. Candidates should also be encouraged to fully process calculations 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 use of correct equipment was evident; however a large number of candidates chose to attempt arithmetic calculations without a calculator and despite following a correct method led to inaccurate answers. The use of a ruler for drawing straight line graphs, lines of symmetry and lines of best fit should also be emphasised by centres.

Comments on Specific Questions

Question 1

The correct use of 24 hour clock times was vital in successfully answering this question. Only the very best candidates were able to give times in the correct form in **(b)(i)** and to use time given in hours to calculate speed in **(c)(ii)**. The majority of candidates attempted all parts of this question but a large number found rounding to the nearest 10 or 100 difficult.

(a) (i) Most candidates correctly answered this question which required a straight forward subtraction sum.

(ii) Despite answering **part (a)(i)** correctly candidates found using their value from **part (i)** very difficult. Many candidates correctly identified that they had to divide by 100 but then added instead of subtracting. An equally common mistake was to divide the original height of Hillibar Station (1047 m) by 100 and to reach an answer of 10.47 or 10.5.

(iii) Both rounding questions were attempted by the majority of candidates, however a surprisingly large number of wrong answers were seen. In this part the most common mistake was to move the decimal point and give answers of 2.97 or 29.7.

(iv) The rounding in part **(iv)** was found to be more difficult with a large number of candidates rounding to the nearest 10 instead of 100, or, again moving the decimal point to give answers of 104.7 or 10.47. Rounding to the nearest 10 or 100 or to the nearest decimal place are areas that Centres should remind candidates are essential mathematical skills to gain good marks on this paper.

(b) (i) Nearly all candidates understood that the question required a time 27 minutes after 12 35. All candidates attempted this question but only two thirds gained the mark as only the best candidates remembered to give their time as a 24 hour clock time or use pm as required. The most common incorrect answer was 1:02 instead of 1302 or 1:02 pm. Candidates must be encouraged to give times in the format used in the question.

(ii) This question was answered correctly by the vast majority of candidates as, unlike part **(i)**, the answer is the same in 24 and 12 hour times.

(c) (i) Most candidates were able to identify a correct period of time from the table. However, they were not as successful at using it to find the time of arrival. Candidates did show a variety of working around the table to gain a part mark, however a number of weaker candidates did not use the fact that there are 60 minutes in one hour and performed calculations which used 100 minutes in an hour. This led to answers such as 1:76.

(ii) The vast majority of candidates showed that they understood that to calculate speed they had to divide distance by time. The most common mistake was to use 1.36hr or 96 mins instead of 1.6hr; however this did allow candidates to gain a method mark. Weaker candidates showed little or no working, and did not show how they had found the time which they used. This question highlighted the importance of candidates showing their working as some candidates could have gained marks if they had shown their workings.

(iii) This question was well answered by most candidates. The most common mistake was to add the time they had calculated in the previous part to 1148 instead of using the timetable to see the time of the next train. Candidates should be encouraged to reread the question once they have found their answer to make sure it makes sense.

Answers: **(a)(i)** 750 **(a)(ii)** 11, 11.5 or 12 **(a)(iii)** 300 **(a)(iv)** 1000
(b)(i) 13 02 **(b)(ii)** 10 26 **(c)(i)** 16 24 **(c)(ii)** 40 **(c)(iii)** 12 32

Question 2

This question examined candidates ability to find missing angles in geometric problems. All candidates attempted this question and the majority were able to gain full marks.

(a) Most candidates were able to identify the missing angle as 29 degrees. This showed good understanding that angles on a straight line must add to 180 degrees.

(b) Most candidates were able to identify the missing angle as 42 degrees. This showed good understanding that angles at a point must add to 360 degrees.

(c) The vast majority of candidates correctly identified the two missing angles, with only the weakest of candidates making errors, such as subtracting 66 from 200 to get 134 instead of 114 or thinking r was also 48 and therefore making s=132. In both cases they were still able to gain part marks.

(d) Most candidates correctly identified the missing angle as 50 degrees. This showed good understanding of angles in parallel lines.

(e) This part proved to be the most difficult of this question with a number of candidates not making an attempt. Very few identified the two 90 degree angles in the diagram or in a calculation, however they were able to gain full marks by subtracting 124 from 180. The most common mistake was to half 124 to gain an answer of 62 degrees.

Answers: **(a)** 29 **(b)** 42 **(c)** 66 and 114 **(d)** 50 **(e)** 56

Question 3

All candidates were able to attempt most parts of this question with the majority gaining full marks. Candidates were able to identify lines of symmetry and transform shapes correctly. However most mistakes were made in describing the single transformation in part **(d)**, where many candidates wrote two transformations instead of one only. Candidates should be encouraged to use a ruler when drawing lines of symmetry and mathematical diagrams.

(a) (i) Most candidates identified the correct line of symmetry, however some lines were not straight and would have benefitted from the use of a ruler.

(ii) The vast majority of candidates identified correctly the two required lines of symmetry; again the use of a ruler would have improved a number of responses. The most common mistake was to draw 4 lines or to write that there were an infinite number of lines, mistaking the shape for a circle.

(b) The majority of candidates who attempted this question shaded the correct square. A small number did not give a response or shaded the wrong square.

(c) (i) This part proved to be the hardest of the transformation questions for the candidates. A large number of candidates reflected the shape in the x-axis instead of the line x=4.

(ii) Most candidates showed an understanding of translation and attempted to move the shape without rotating or reflecting it. However a large number of candidates incorrectly counted the number of squares left or down to move the shape.

(iii) This part was the most successful of the transformation questions, as most candidates were able to rotate the shape by 180 degrees. However many candidates assumed the centre of rotation was (0,0) and positioned their answer in the wrong place.

(d) (i) This part was poorly answered with candidates often giving more than one transformation or using the word 'flip' instead of rotated or rotation. Often candidates gained some marks but rarely all three marks as they did not know how to fully describe a rotation. Most forgot the centre of rotation.

(ii) This description was much better attempted with the vast majority of candidates using the correct terminology, 'translation'. Most attempted a vector and very few gave their answer as a description in words, i.e. 6 to the left and 3 up. Candidates made improvements in using vector notation from previous years, with very few giving it as a co-ordinate, missing brackets or putting a fraction line in the vector, as has been seen in previous years.

Answers: **(d)(i)** rotation, (0,0), 90° **(d)(ii)** translation, $\begin{pmatrix} -6 \\ 3 \end{pmatrix}$

Question 4

This statistics question was attempted by nearly all candidates. The pie chart question was more successfully answered than the averages part. It was evident that candidates were able to use protractors and rulers to construct the pie chart, with very few non-ruled attempts. Very few candidates used the wrong measure of average and almost all used a fraction to describe a probability, which is an improvement on previous years.

(a) (i) Most candidates correctly identified the two required angles.

(ii) Most candidates attempted to draw the pie chart with only a handful not using a ruler. Candidates demonstrated good use of protractors and then remembered to label the parts of the pie chart correctly.

(b) (i) Most candidates knew that the range was the difference between the largest and smallest values. However not all candidates gave their answer correctly as 40 with a number leaving it as a range i.e. 16–56.

(ii) Most candidates correctly showed that they understood how to calculate the mean by adding the values and dividing by 12. A small number of candidates made mistakes in adding the values, but however still gained a mark by showing their addition and division by 12. A number of candidates, however, showed no working out and an incorrect answer meant they could not gain any marks. Candidates should be encouraged to show all workings out.

(iii) Most candidates gave their answers as a fraction which is an improvement on previous years. The vast majority scored full marks, and the only mistakes seen were in careless counting of the total number of values. A large number of candidates did go on further and attempted to write their fraction as a percentage or decimal, however this was not penalised if they had given the correct fraction.

Answers: **(a)(i)** 140, 100 **(b)(i)** 40 **(b)(ii)** 29.5 **(b)(iii)** $\frac{7}{12}$

Question 5

This question on scatter graphs was well answered by all candidates. Candidates were more accurate in plotting points than in previous years and candidates were able to correctly identify the type of correlation. Candidates however should be reminded to use a ruler to draw a line of best fit and that points are not joined together in a scatter graph.

(a) Most candidates were able to plot all four points accurately with nearly all candidates gaining at least one mark for plotting three correctly.

(b) Nearly all candidates correctly identified the correlation as negative with only a small number using terms such as ‘decreasing’ or ‘reducing’.

(c) All candidates attempted the line of best fit but those that did not gain the mark drew it without a ruler or joined up the points.

(d) Most candidates correctly identified a value from their line of best fit, either in the correct range or gained a follow through mark by correctly using their line of best fit. The candidates who did not gain the mark generally read the scale on the vertical axis incorrectly, using one square as 0.1 instead of 0.2.

Answers: **(b)** negative **(d)** 22.4 – 22.8

Question 6

This question proved challenging to many candidates. Most made an attempt at all parts of the question but found it difficult to identify prime numbers and cube numbers. Candidates should be reminded that to be successful on this paper they must know how to find factors, multiples, prime numbers, square and cube numbers. Only the best candidates could use standard form accurately despite all candidates attempting this question.

(a) (i) All candidates attempted this question and the vast majority were able to gain part marks as they identified 3 of the 4 factors of 22. However it was very common for candidates to forget 1 or 22 from their list of factors.

(ii) This part was the best attempted by candidates with most correctly identifying 39 as the multiple required. A small number wrote a list of multiples or gave other multiples but did not identify the one in the required range. Candidates should be encouraged to reread the question to check they have answered it correctly.

(b) (i) This part proved the most difficult for all candidates. Most showed understanding of a prime number by correctly identifying one or two, however a substantial percentage of the candidates thought 1 was a prime number and therefore lost both marks by not identifying three correct prime numbers.

(ii) Candidates were more successful in identifying a cube number from the list with the majority of correct answers identifying 27. However a large proportion of candidates believed that 9 was a cube number, showing a misunderstanding between cube and square numbers.

Both standard form questions were answered well by the best candidates. Weaker candidates understood the form required but could not correctly identify the correct power.

(c) (i) The most common error was to give a positive power instead of a negative power. A number of candidates used a negative power but started their answer with 35 instead of 3.5.

(ii) Similarly to part **(i)** candidates found it difficult to express their answer in the correct form and only the best candidates gained full marks. Many candidates used their calculators correctly to get the answer of 42000 but then were unable to express it in standard form correctly – common mistakes being 42×10^3 or 4.2×10^3. A number of candidates simply copied the answer from the calculator, e.g. 4.2E4, not showing understanding of standard form.

Answers: **(a)(i)** 1, 2, 11, 22 **(a)(ii)** 39 **(b)(i)** 2, 17, 19 **(b)(ii)** 1 or 27
(c)(i) 3.5×10^{-3} **(c)(ii)** 4.2×10^4

Question 7

This question discriminated well between candidates of differing abilities. It gave more able candidates an opportunity to demonstrate their knowledge of trigonometry but also gave less able candidates the opportunity to demonstrate their understanding of Pythagoras' theorem and area. Only the most able candidates were able to gain full marks on **part (c)**. All candidates found the questions about bearings difficult.

(a) Nearly all candidates identified the need to use Pythagoras' Theorem in this part. However a large number of weaker candidates lost potential marks by not showing a full method, or rounding incorrectly, giving 86 as their answer which is not to three significant figures. Candidates should be reminded to read the instructions on the front of the exam paper regarding the level of accuracy required. A number of candidates did not square root so left their answer as 7453 which scored no marks.

(b) Very few candidates showed understanding of bearings in this question. The majority believed they had to use their answer to part **(a)** or did not give a response. Some candidates did give an answer of 90 but failed to gain marks as it was not in the required form of a three figure bearing.

(c) (i) This question gave the more able candidates the opportunity to demonstrate their understanding of trigonometry. Of those that attempted the question most used a trigonometric ratio and the majority correctly chose the tangent ratio, however a significant number of candidates used adj/opp instead of opp/adj. A significant number of good candidates rounded their answer to 82/27 prematurely and found the angle to be 71.7.

(ii) Most candidates found the calculation of the bearing challenging. Common misunderstanding was to subtract the previous answer from 360° instead of 180°. A large proportion of candidates did not attempt this question showing a common misunderstanding of the word 'bearing'.

(d) (i) This part of the question was more accessible to all candidates, who showed a good understanding of area. Most candidates gained full marks with only a small number forgetting to half their multiplication sum.

(ii) Again well answered by all candidates who had answered part **(i)** correctly. Those candidates who made mistakes in part question were still able to gain full marks by multiplying their previous answer by 8400 in this part.

Answers: **(a)** 86.3 **(b)** 090 **(c)(i)** 71.8 **(c)(ii)** 108.2 or 108
(d)(i) 1107 **(d)(ii)** 9 298 800

Question 8

Candidates attempted most parts of this question. Weaker candidates found the ratio part difficult and many candidates were confused by the way part **(d)** was worded. All candidates showed the ability to calculate a percentage of an amount.

(a) The best candidates answered this ratio question well, however less able candidates did not divide by 7, dividing by 2 or 5 instead. A large number of candidates chose not to use their calculator for this part of the question and therefore commonly made arithmetic mistakes.

(b) This question was attempted by all candidates and most were able to calculate the correct increase of 1800 over 3 years. However a substantial proportion then did not add this on to the original amount so only gained one of the three marks available. Again candidates should be encouraged to reread the question once they have found their answer to check they have answered the question set.

(c) This part was correctly answered by most candidates.

(d) (i) Candidates generally found this question straight forward with the vast majority just giving the correct answer. However a number of weaker candidates could not follow the sentence structure and forgot to add the 600 at the end.

(ii) This part proved more difficult to the candidates with a large proportion misreading the sentence given. Many candidates read it as 100 + 4 for every 10 km, hence calculating 104 x 3200, instead of the required calculation of 100 + (4 x 3200).

Answers: **(a)** 31 200 **(b)** 16 800 **(c)** 63 **(d)(i)** 11 800 **(d)(ii)** 12 900

Question 9

Candidates found this question challenging, Especially the calculation of the gradient and forming the equation of the straight line in the form y=mx+c. Candidates were more confident calculating the missing values in the table and plotting the points and graph in part **(a)**.

(a) (i) Candidates answered this part well with the majority of candidates correctly calculating 2 of the 3 missing values. Candidates found calculating the value for x=–2 most difficult with y=–6 being a common mistake, from $-(2)^2$ instead of $(-2)^2$.

(ii) Candidates plotted their values from the table well with the majority of candidates scoring 2 or 3 marks for this. The quality of curves drawn has improved again this year with very few straight lines drawn and very few with very thick lines or broken lines drawn. Some candidates continue to draw a straight line between the bottom two points so forming a ‘flat bottom’. Candidates need to be reminded what the requirements of a smooth curve are.

(iii) The line y=10 was drawn well by most candidates. A large number of candidates still continue to draw straight line graphs free hand without a ruler and lose a mark which they should have earned.

(iv) This part of the question was the least attempted question on the whole paper, despite the majority of candidates drawing a correct curve and line.

(b) (i) Many candidates did not know the difference between gradient and y-intercept in an equation of the form y=mx+c. A large proportion of candidates gave the answer of –5 instead of 2/3.

(ii) This part proved to be the most difficult of this question. Candidates who had been unable to answer part **(i)** found this part equally difficult and many did not give a response. A number of good candidates who had shown understanding of gradient in part **(i)** missed out on a mark in this part as they omitted the y= in their answer.

(c) The question on calculating the gradient remains challenging for many candidates; however an improvement was seen from previous years. Very few candidates used coordinates and the formula for the gradient between two points and most candidates used a triangle or simply spotted the correct gradient. Those candidates who found a gradient went on to give the correct equation however some weaker candidates did gain a mark for identifying the *y*-intercept and used it correctly in an equation of the correct form. A number of candidates however did not know how to start this question and gave no response.

Answers: **(a)(i)** 2, 2, 12 **(a)(iv)** 2.6 – 2.8 **(b)(i)** $\frac{2}{3}$ **(b)(ii)** $y = \frac{2}{3}x + c$ **(c)** $2x - 3$

Question 10

This question proved to be the most difficult of the paper with only the very best candidates able to gain marks. Part **(a)** was the most difficult for all candidates as the second part could only be solved if they had correctly identified the expressions in part **(i)**. Many candidates did not use algebra to solve the problem and therefore tried many numerical methods which ultimately did not work. The simultaneous equation in part **(b)** was only solved by the best candidates.

(a) (i) This part was attempted by all candidates, however very few were able to gain full marks. Completing the table was very challenging to all candidates with most only gaining one mark for *x*-34. Many candidates read on to part **(ii)** before completing the table and therefore became confused trying to fill in the rest of the table. The candidates had all the required information in part **(i)** to complete the table.

(ii) This part proved difficult for nearly all candidates, especially those who had made mistakes in part **(i)**. The question challenged the candidates to form an equation from the information given in parts **(i)** and **(ii)**, however very few candidates did form an equation, with the majority of candidates who attempted the question attempting a numerical solution, usually trial and error, which ultimately did not work.

(b) The simultaneous equation challenged the very best candidates. The majority of candidates were able to gain one of the three marks for a partially correct solution, using the elimination method. However most made mistakes in this method and were unable to find either of the correct solutions. The best candidates used the substitution method which led most to the correct two solutions and gained full marks.

Answers: **(a)(i)** $x + 12$, $x - 34$, $x - 22$ **(a)(ii)** 39 **(b)** 8, –3

Question 11

This question was challenging for all candidates, however most were able to gain some marks. Knowledge of the area of a circle was required, which some candidates mixed up with the formula for the circumference of a circle, and the ability to apply this to a problem. Some excellent solutions and working was seen from many candidates, however a large number of candidates did not show their workings and lost out on potential method marks.

(a) Most candidates gained full marks in calculating the area of the circle. A very small number of candidates used the formula for the circumference instead of the area and some used 6 instead of 3 in the correct formula. However the vast majority of candidates were able to gain some marks on this question. The use of 3.14 was seen on a number of occasions and candidates should be reminded that they must use the π button on their calculators or 3.142.

(b) Some excellent methods and solutions were given to this question. Most candidates were able to gain some marks for the area of 6 circles or the area of the rectangle and most showed their methods clearly. However a number of candidates did not show a method and gave an incorrect answer so lost out on a potential three method marks. Candidates should be encouraged to show their workings throughout the paper. A small number of candidates chose to show their working out arithmetically instead of using a calculator which generally led to errors and therefore not gaining full marks.

Answers: **(a)** 113 **(b)** 185

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 necessary working clearly and use a suitable level of accuracy. 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 important in questions which required the use of π. Clear instructions are given on the front of the paper that candidates must use the calculator value for π or 3.142. However a number of candidates continue to use 3.14 or 22/7 which leads to inaccurate answers. Candidates should also be encouraged to fully process calculations 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.

General Comments

The paper gave the opportunity for candidates to demonstrate their knowledge and application of mathematics. The majority of the candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates answered all of the questions, with some omitting parts of a question on a particular topic. The standard of presentation and amount of working shown was generally good although candidates still lost marks for not showing their working or not giving answers to the required accuracy. The plotting and drawing of curves continues to improve with points being accurately plotted and fewer instances of joining points with straight lines. There were still a few instances of candidates rubbing out construction lines and/or working in questions, losing marks for themselves. Centres should continue to encourage candidates to show clear working in the answer space provided; the formulae used, substitutions and calculations performed are of particular value if an incorrect answer is given.

Comments on Specific Questions

Question 1

This question on probability and statistics enabled many candidates to make a good start on the paper and many were able to score full marks. In part **(a)** a small number mixed up their answers to the mean, mode and median.

(a) (i) The correct working and answer to the mean was generally seen.

(ii) The correct answer to the mode was generally seen.

(iii) The correct answer to the median was generally seen.

(iv) The correct answer to the range was generally seen although a common error was to leave the answer as 10 – 3 or 3–10.

(v) The correct answer of "the mode" was generally seen although a common error was to simply state the value of 10.

(b) (i) The correct probability of 8/24 or 1/3 was generally seen.

(ii) The correct probability of 17/24 was generally seen.

(c) The correct answer of 45° was generally seen although a common error was to calculate 3/24 x 100 leading to an incorrect answer of 12.5.

Answers: **(a)(i)** 7.2 **(a)(ii)** 10 **(a)(iii)** 8 **(a)(iv)** 7 **(a)(v)** mode
(b)(i) 8/24 **(b)(ii)** 17/24 **(c)(i)** 45°

Question 2

This question involving three children and their marbles tested the use of algebra, weight calculations and ratio. The use of algebra in a problem-solving situation proved difficult for a significant number of candidates.

(a) (i) The expression "3 m" was generally correctly stated although the common errors were m+3 and m^3 with the occasional numerical value seen.

(ii) The expression "m + 4" was less successfully stated with the common errors of 3m+4, 4m, and again the occasional numerical value.

(b) (i) Fewer candidates were able to write down the correct equation although a significant number were able to score the mark on a follow through basis. A common error was to omit the "m" marbles of Shireen and giving the answer of 4m + 4 = 84.

(ii) Those candidates who had the correct equation were generally able to solve it correctly. Many others were able to score a follow through method mark.

(c) This part asking candidates to find the weight of one marble involved the use of a correct division and the conversion of units, with only about one third of the candidates able to perform both operations correctly. Common errors included 0.05, 0.5, 5 or 500 from an incorrect conversion, and 20, 2, or 2000 from an incorrect division.

(d) This part on ratio was well answered with the majority of candidates able to score full marks. The only common error was to divide the value of 84 by each part of the ratio, e.g. 84÷2=41 for Shireen.

Answers: **(a)(i)** 3m **(a)(ii)** m + 4 **(b)(i)** m + 3m + m + 4 = 84 or 5m + 4 = 84 **(b)(ii)** 16 **(c)** 50
(d) 14, 49, 21.

Question 3

This question on a number of numerical calculations proved difficult for many candidates.

(a) (i) Just under half of the candidates were able to score both marks here by giving the correct answer of 6. However a significant number failed to appreciate the functionality of the question as shown by the common errors of 6.125 or 6.1 for the maximum number of bookcases and were only able to be given the method mark. Other errors included the absence or incorrect conversion of centimetres and metres, and incorrect calculations such as 120/735, 120/7.35, and 120x7.35. These calculations often led to unrealistic answers for which a check back may have highlighted the error.

(ii) The calculation of the upper bound proved difficult for all but the best candidates with the common errors being 50, 45.5 and 47.4.

(b) (i) The majority of candidates were able to answer this part on a two way table and were able to score full marks.

(ii) Many candidates found using this table to give the required fraction difficult with the common errors being 15/70, 3/14, 40/160 and 1/4.

(c) (i) Many candidates continue to find the calculation of percentage profit very challenging. Although a good number were able to score one mark for an initial step of 6.6 – 5.5, few were able to follow this through to a correct final answer. Common errors included 1.1/6.6, 5.5/6.6 and leaving 1.1 as the final answer. A small number of candidates used other valid methods including the use of 1056 and 880.

(ii) Generally this question on currency conversion was done well although a significant number rounded the answer to 1.87 or 1.88. Other common errors were 3.52/6.60, 3.52x6.60 and 6.60-3.52.

(d) (i) A considerable number of candidates did not appreciate what rounding to one significant figure required them to do. Common errors included attempted rounding to 312, 310, 48, 47, 50.00, and 3x3x5.

(ii) Those few who stated 3x300x50 in part **(i)** were virtually all able to calculate the answer as 45000 with a small number also able to score the mark from answers in part **(i)** of 3x300x50.00 or 3x300x48. The majority gave a calculated answer rather than an estimate as asked for in the question.

Answers: **(a)(i)** 6 **(a)(ii)** 47.5 **(b)(i)** 55,70,25,90,120. **(b)(ii)** 3/8
(c)(i) 20 **(c)(ii)** 1.875 **(d)(i)** 300, 50 **(d)(ii)** 45000.

Question 4

This question again highlighted the problems many candidates have with the concept of bearings.

(a) The required measurement was generally well done with the majority able to convert their measurement to kilometres. However a common error was for example 5.8 x 10 = 50.8.

(b) The required angle measurement was not so well done with many candidates not appreciating that a bearing is measured from the (given) North line. Common errors were 143 and 323. Few candidates gave the fully correct three figure bearing but this was not penalised in this one mark question.

(c) This part also caused difficulties, mainly with the bearing as most candidates were able to plot a point 8 centimetres from the given point A to gain one of the available marks.

Answers: **(a)** 56 to 60 **(b)** 035 to 039 **(c)** correct length and bearing

Question 5

This question on constructions was generally well answered although a small number of candidates continue to erase or not show their construction arcs.

(a) (i) Most candidates made a reasonably good attempt at the construction of the required perpendicular bisector with about half of all responses able to score full marks. Common errors included using just one set of arcs usually leading to an inaccurate line, the required bisector reaching the line DE but not crossing it, bisecting the line CD, and bisecting the angle CDE. A significant number however simply drew correct or more usually incorrect arcs and had no line drawn.

(ii) Almost all candidates were able to correctly use their bisector from part **(i)** and labelled M in the correct position. Others were able to mark M correctly or on a follow through basis whilst a few were unable to answer this part and a very small number placed M inside the diagram often where their construction arcs crossed.

(iii) Most candidates made a reasonably good attempt at the construction of the required angle bisector but slightly less successful with just less than half of all responses able to score full marks. Common errors included using just one set of arcs or no arcs usually resulting in an inaccurate answer, a line not coming from C, and a series of arcs but no line drawn.

(iv) Nearly half of the candidates were able to give the correct name to the requested shape. There were a wide variety of wrong answers with most of the common polygons mentioned being rhombus, pentagon or parallelogram. The spelling of trapezium was sometimes imaginative but usually decipherable and acceptable.

(b)(i)(ii) Just under half of the candidates were able to construct the two required loci. Common errors included incomplete circles or arcs, incorrect or inaccurate radii used, with a significant number unable to attempt these two parts.

(iii) There seemed to be a fairly even split between candidates who shaded the correct region, incorrectly shaded the overlapping region between the two circles, shaded only part of the correct region, shaded a completely incorrect region or were unable to attempt this part.

Answers: **(a)(i)** correct perpendicular bisector **(a)(ii)** M correctly labelled
(a)(iii) correct angle bisector **(a)(iv)** Trapezium **(b)(i)(ii)** correct circles
(b)(iii) correct region shaded.

Question 6

This question on shape and space involving the use of Pythagoras, trigonometry and the calculation of volume and surface area proved difficult for many candidates.

(a) Nearly half of the candidates were able to gain full marks on this "show that" question and correctly used the application of Pythagoras' theorem. Common errors included the incorrect working of 1.5 x 1.2 ÷ 2, 1.8 ÷ 2, attempted use of trigonometry without justifying the angle used, and circular arguments using the value of 0.9 itself.

(b) Just over one third of candidates were able to gain full marks on this part and correctly used a trigonometrical method usually involving the use of the cosine ratio. A small but significant number lost the accuracy mark by giving their answer as 36˚ or 37˚ rather than an answer correct to one decimal place as stated in the rubric at the start of the paper. A common error was an answer of 53.1˚ coming either from using an incorrect ratio or from finding the wrong angle.

(c) About one third of the candidates were able to score full marks on this part, with a further third able to score one mark either for the correct value of 2.7 or less commonly for the correct units of m^3. A significant number did not appreciate that they should use the formula of Volume of prism = Area of cross section x Length. Common errors included use of 1.2 x 1.5 x 1.08, a variety of other incorrect formulae and incorrect units such as m^2, m, and cm^3.

(d) Most candidates struggled with this part and many were not able to score any method marks with others unable to attempt this part. Many did not appreciate that the surface area of this prism was made up of three parts; 2 triangles, 2 sloping sides and the base. Whilst a small number were able to score full marks many were unable to show any valid working although a small number were able to pick up one of the available method marks usually for part answers of 4.5 or 7.5.

Answers: **(a)** correct proof **(b)** 36.9 **(c)** 2.7 m^3 **(d)** 14.2

Question 7

Candidates are now better at drawing quadratic curves rather than joining points with straight lines. Candidates can improve by taking care when substituting negative values into formulae and reading points of intersection accurately. A greater knowledge of the form y = mx + c would be beneficial to most candidates.

(a) While many candidates correctly calculated the three missing values in the table there was a significant number who gave 6 as the first value rather than 8. This is possibly due to the omission of a bracket round the (–1) when calculating; a common problem when using modern calculators

(b) Nearly all candidates demonstrated the ability to plot coordinates accurately from their table of values, although a small number did not indicate the points clearly, often just using small dots. Consequently most candidates were able to earn at least three of the available four marks. Most candidates made a good attempt to join their points with a smooth curve but few scored the full four marks. This was either as a result of the incorrect point of (–1, 6) following through from their part **(a)** or because their curve did not dip below y=–4 at the lowest point but had a horizontal line joining (2,–4) to (3,–4).

(c) (i) This part proved more difficult and few correct coordinates were seen. Common errors included (2,–4), (3,–4) and many others with an *x*-coordinate of between 2 and 3. Few candidates seemed to appreciate that the symmetry of the curve meant that the *x*-coordinate of this minimum point had to be 2.5.

(ii) The majority of candidates were able to draw the correct line of *y*=–1. Common errors included drawing *x*=–1, or a diagonal line crossing the *x* or *y* axis at ± 1.

(iii) Just over half the candidates were able to give both answers within the range allowed and scored full marks. Common errors included incorrect values from misreading the scale, and giving answers as a pair of coordinates.

(d) Just over a third of correct answers were seen to this part involving a reflection. Common errors were the many variations of ±2 and ±5 as *x*- or *y*-coordinates. Few candidates appeared to draw the reflection on their graph and then read off the coordinate values.

(e) Many candidates continue to find the application and use of the form *y*=m*x*+c as the equation of a straight line difficult and this part was certainly challenging to all but the better candidates. Common errors included finding the gradient as difference in *x* / difference in *y*, calculation errors due to the use of negative numbers, finding the gradient as 2 and using the value of 1.5 as either the gradient or the intercept or as the final answer.

Answers: **(a)** 8,2,–2 **(b)** correct graph **(c)(i)** (2.5, –4.25) **(c)(ii)** $y = -1$ drawn
(c)(iii) 0.5 to 0.9, 4.1 to 4.5 **(d)** (–5, 2) **(e)** $y = -2x + 3$

Question 8

This linked question on a sweet shop involving the drawing and use of two different graphs was generally answered well with the majority of candidates understanding the situations described.

(a) Although candidates generally understood that there was a division involving time and distance to be performed only just over a quarter were able to score full marks. Common errors include 40/4, 4/40, 4/50, 4/1410, 4/1450, incorrect units such as not converting the minutes into a fraction of an hour, and premature rounding to 0.6 or 0.7. It was very rare to see candidates use a ratio method along the lines of 4km in 40 minutes, 1km in 10 minutes, 6 km in 60 minutes hence speed of 6 km/hr

(b) (i) This graph was generally well done with the majority able to score both marks or at least one mark usually for the first part of the horizontal line. The common errors in the second part of the graph included continuing moving away from home, drawing lines that would meet the axis outside the given time and it was not uncommon for candidates to assume that the sloping line would end at 1540 without any obvious attempt to calculate the time taken.

(ii) Most candidates were able to give the correct answer or a correct answer following through from their graph.

(c) (i) Most candidates were able to plot all four points or at least three correctly in this scatter graph.

(ii) The correlation was correctly identified by many of the candidates although a number of variations, often none mathematical, were seen.

(iii) Just over half the candidates were able to draw an acceptable line of best fit. Some drew their line through the bottom or top limits of the points rather than in the midst of the points. There was a requirement for the line to demonstrate some understanding of going through the spread of the points to earn the mark. Some improvement was seen in this respect this year although a small number continue to join the bottom left corner of the grid to the top right corner of the grid, whilst others continue to join all points together to create a zig-zag pattern.

(iv) The majority of candidates were able to interpret their graph to give a correct answer.

Answers: **(a)** 6 **(b)(i)** correct graph **(b)(ii)** 1530 **(c)(i)** 4 points correctly plotted
(c)(ii) positive **(c)(iii)** correct ruled line **(c)(iv)** 12 < answer < 16

Question 9

This linked question on cycles involving a varied number of calculations proved challenging for a significant number of candidates.

(a) (i) This question required organisation and careful interpretation of the table to earn marks, although the arithmetic skills required were straight forward. Most candidates using a complete method were able to reach the correct answer. Many candidates understood that there were two sets of calculations to be performed i.e. large and small bikes and many earned a method mark for partially completing the calculation. The most common part marks earned were for correctly calculating the cost of the first hour for both sets of bikes i.e. \$12 and \$12.80, or for correctly calculating the cost of the first hour and five (should have been four) hours i.e. \$60.80. Other common errors were calculating the total cost for either one adult and one child, or for two adults and two children.

(ii) Most candidates were able to calculate 85% of their total from part **(i)**. Common errors included calculating 15% but omitting to subtract from their total, simply subtracting 0.15 or 0.85, and rounding an exact money answer.

(b) (i) This part on finding the circumference of a circle was generally well done with just over half the candidates scoring full marks. Common errors included the use of an area formula, using a value of 16 or 32 for the diameter, or using an inaccurate value for π. Clear instructions are given on the front of the paper that candidates must use the calculator value for π or 3.142. However a number of candidates continue to use 3.14 or 22/7 which leads to inaccurate answers.

(ii) This part proved more challenging for candidates. Although most realised that a division was required it was frequently inverted. Most also realised that consistent units were required but again this was not always done correctly. Other common errors included 24 x 2.01, use of 360, and giving the final answer as 11.9 or 12 indicating a lack of awareness of the functionality of the question.

(c) The majority of candidates were able to attempt this part but again it proved challenging and only the better candidates were able to score full marks. Common errors included 360/29, use of 80 spokes, use of 9 spokes, 9 x 29, incorrect or no units conversion, and the incorrect use of 201 or 2.01 from **part (b)(i)**.

Answers: **(a)(i)** 53.20 **(a)(ii)** 45.22 **(b)(i)** 201 **(b)(ii)** 11 **(c)** 11.6

Question 10

This question on a variety of arithmetic and algebraic topics was generally well done.

(a) (i) This part on finding the highest common factor was generally well done although there was some obvious confusion as to whether a multiple or a factor was required. Common errors were 6, 4, 3,2,72 and 144.

(ii) Many candidates were able to factorise the expression but commonly left the partial answers of $2(12x + 18y)$, $3(8x + 12y)$, $4(6x + 9y)$ or $6(4x + 6y)$. A number had possibly spotted the link with the previous part and where a factor other than 12 had been stated that was generally used here.

(b) (i) The majority of candidates were able to score full marks or at least one mark for either $10k$ or $-4w$. Common errors included $10k + 4w$, $-6k – 4w$, $6w – 10k$ and $6kw$.

(ii) Correct and incorrect answers to this part on indices were almost equally split. Common errors included x^9, x^1, $20x$, $9x$ and 20.

(c) This part was more successfully answered than in previous years with a significant number able to give the n^{th} term of the given sequence in a correct form. Common errors included 23, +4, $n + 4$, and $8n + 1$.

(d) This question on simultaneous equations was generally answered well with roughly half the candidates able to score full marks. Others were able to use either the elimination method or the substitution method to partial completion earning a method mark, but then making a mistake mainly related to understanding that methods required consistent addition or subtraction.

Answers: **(a)(i)** 12 **(a)(ii)** $12(2x + 3y)$ **(b)(i)** $10k – 4w$ **(b)(ii)** x^{20}
(c) $4n + 3$ **(d)** $x=2.5$, $y=0.5$

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 necessary working clearly and use a suitable level of accuracy.

General comments

The paper gave the opportunity for candidates to demonstrate their knowledge and application of mathematics. The majority of the candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates answered all of the questions with some omitting parts of a question on a particular topic. The standard of presentation and amount of working shown was generally good although candidates still lost marks for not showing their working or not giving answers to the required accuracy. The plotting and drawing of curves continues to improve with points being accurately plotted and fewer instances of joining points with straight lines. There were still a few instances of candidates rubbing out construction lines and/or working in questions losing marks for themselves. Centres should continue to encourage candidates to show clear working in the answer space provided; the formulae used, substitutions and calculations performed are of particular value if an incorrect answer is given.

Comments on specific questions

Question 1

Candidates generally showed an improvement in answering a "show that" type question, however, understanding of percentages and fractions could be improved.

(a) Candidates generally understood the method for showing the result. Some candidates used 14% rather than 0.14 or 14/100, so did not show how to convert a percentage into a fraction or decimal. A few candidates stopped after 14/100 × 900 = 126 so only scored the first mark. Only a very small number of candidates worked back from 774 or found 14% of 774 which is a circular argument so did not score any marks.

(b) Most candidates gave the correct answer.

(c) Most candidates gave the correct answer. Those who gave an incorrect answer, few scored any marks, the most common error was to calculate 480/9.

(d) Few candidates gave the correct answer. Many appeared to know how to calculate one number as a percentage of another, but often omitted subtraction of the rent or used 270 rather than 480. Common errors were 774/900 = 86%, 480/900, 774/100 = 7.74% or (774 – 172 – 270)/774 = 42% or 270/774 = 34.8%

Answers: **(b)** $172, **(c)** $270, **(d)** 15.8

Question 2

Candidates can improve by having a better understanding of the difference between mathematical terms such as lowest common multiple and lowest factor which will enable them to calculate them correctly.

(a) Generally candidates answered this reasonably well, though errors were seen in all parts, with almost all numbers appearing as answers to each part at some time. Most confusion occurred with lowest common multiple, where factors were seen rather than multiples and $\sqrt{6.25}$ was often seen as irrational.

(b) Some candidates appeared to use numbers from the list in part **(a)**. Consequently fewer gave the answer 3 in **(i)** than would be expected, with 11 being a common answer.

In the second part many candidates gave common wrong answers of numbers which did not multiply to give 2013 or the cube root of 2013.

Answers: **(a)(i)** 11, **(ii)** 144 or 4 or 0.25, **(iii)** 0.25, **(iv)** $\sqrt{12}$, **(v)** 40, **(vi)** 2, **(b)(i)** 3, **(ii)** 3, 11, 61

Question 3

Candidates showed an understanding of transformations. There is a continued improvement in only giving one transformation as an answer. They could improve further by considering how to draw enlargements, understanding what rotational symmetry means and by appreciating the difference between x= 0 and the x axis.

(a) Many candidates appeared not to know what was meant by rotational symmetry or gave an incorrect answer.

(b) Candidates often stated reflection on its own without stating the line of reflection. If a line of reflection was stated some gave the correct answer, but many candidates gave an answer of y = -1 or x axis. Few gave more than one transformation, although rotation was not uncommon.

(c) Candidates understood what a translation was, as correct shapes were seen but many were in the wrong place. Candidates either inverted the translation vector or miscounted the number of squares to move.

The rotation was similar with many correct answers but many also rotated about the wrong point.

(d) Many candidates found the drawing of an enlargement difficult although most could find the area of the triangles. Some candidates drew an enlargement anywhere on the grid whilst others drew a "2 times" enlargement. Most candidates gave the correct value for the base in part **(ii)** though there was some confusion seen about the height with the value of the sloping side being seen frequently. However, there were many follow through correct answers for the area. When a wrong answer was given for the smaller triangle many candidates used the formula again to work out the area of the larger triangle. Only a few candidates used the square of the scale factor. A few candidates found the perimeter instead of the area.

Answers: **(a)** 2, **(b)** reflection in x=–1, **(d)(ii)** 3, 2, **(iii)** 3, **(iv)** 27

Question 4

Candidates can now draw curves rather than joining point with straight lines. Candidates can improve by taking care when substituting negative values into formulae and reading points of intersection accurately.

(a) Most candidates could substitute positive values of x correctly, but more errors were seen in substituting the negative value, where –2 was often seen in place of 7. Most candidates could plot their points correctly and those who had the 8 correct points usually joined them with a smooth curve. Few ruled line segments were seen.

(b) Candidates found it difficult to give the equation of the line, with answers of 1 or y = 1 common.

(c) Candidates did not answer this part well. The most common answer in **(i)** was to see the coordinates (–2, 7) and (4, 7). Those who did attempt to find values on the line were often incorrect. However, some candidates drew the correct line for **(ii)** and tried to read values off it for **(i)**. Many candidates did not attempt the last part, **(iii)**. Those that did give an answer generally scored marks for reading off the correct solutions of their line and curve. A few candidates attempted to solve the equation analytically but without success.

Answers: **(a) (i)** 7, –1, 2, **(b)** x=1

Question 5

Candidates showed an understanding of how to convert values from a scale drawing. However, to improve candidates need to show all their working and constructions.

(a) Some candidates gave the correct answers when measuring the bearing, although some measured the incorrect angle giving for example 53 (90 – 37) or 143 (180 – 37). Some gave the answer 10 in **(i)** from measuring the line rather than the angle. Most answered 120 correctly in **(ii)** with measurements very accurate. Most candidates knew that they needed to calculate distance/time in **(iii)** and there were many correct answers, although some confusion was seen using for example 90 or 1.3 instead of 1.5 for the time.

(b) Many candidates constructed the angle bisector, usually accurately. However, some did not show all the arcs. Some candidates assumed the two lines were the same length and used the ends to produce just one set of arcs to create an angle bisector.

(c) In general candidates understood the direction of the bearing but many failed to give an accurate answer or marked E without drawing the line to represent the journey.

(d) Many candidates did not show clear working for this part. They needed to show the measurement they had taken from their diagram, but many converted to km without having shown the value they were converting. Some then showed the division by 55 followed by a decimal. Often the decimal was incorrectly converted to hours and minutes by assuming 100 minutes in an hour. A large number of candidates just gave an answer.

(e) Almost half the candidates did not answer this part. Of those that did few gave the correct locus, a few just marked the point on the line where the boundary for the speed limit would be.

Answers: **(a) (i)** 37, **(ii)** 120, **(iii)** 80 **(d)** 1 hour 22 minutes

Question 6

Nearly all candidates found this a difficult question. In order to improve candidates need to understand the difference between terms such as frequency, relative frequency and cumulative frequency as well as how to calculate ranges, means, modes and medians.

(a) A large number of candidates did not complete the extra 10 results in the tally table. Those that did add the extra tallies usually did it correctly. Almost all candidates gave the frequency instead of the relative frequency.

(b) Few candidates gave correct answers in this part. Candidates did not appear to understand the difference between each of mode, median, mean and range.

Many different errors were seen in finding the mean but the common ones were dividing the cumulative frequency by 11. 70/11 was also a common error.

(c) Almost all candidates correctly completed the table. However, very few could give an acceptable reason in **(ii)** with answers such as "7 is not on the dice" being seen.

Answers: **(a)(ii)** $\frac{3}{70}$, **(b)(i)** 6, **(ii)** 10, **(iii)** 6, **(iv)** 6.43

Question 7

Candidates showed a general understanding of trigonometry but made errors in their answers. They can improve by reading the question carefully and giving the answers required.

(a) Most candidates identified the shape as a trapezium although rhombus was a common error seen.

There were many uses of correct trigonometry in **(ii)** seen, although some candidates failed to show an answer to more accuracy than the given 5.2 so did not demonstrate the rounding principle required. A few candidates could not rearrange correctly from sin 70 = h/5.5.

Many candidates did not use the formula for the area of a trapezium in **(iii)** and attempted to split the shape into a rectangle and two triangles, and often involved the use of Pythagoras. Even if a complete calculation was seen, the final answer was often inaccurate due to premature rounding of values. Some candidates who used the correct area formula used 5.5 instead of 5.2 for the height.

In **(iv)** many candidates did not realise that they could multiply their area by the length to get the volume, and started new calculations here. Few candidates noted the need to give an answer correct to 2 significant figures.

(b) Some candidates gave completely correct answers, but some candidates having found w incorrectly, correctly followed through to get x.

In **(ii)** it was common for candidates to think that $y = z$. An answer of 108 was also common from assuming that it was a regular pentagon. The other common error was to subtract all 6 marked angles from 540 to find z, rather than realising that w was not one of the vertices of the pentagon.

Answers: **(a)(i)** trapezium, **(iii)** 54.3, **(iv)** 370 **(b)(i)** 64, 21, 116, **(ii)** 154

Question 8

Candidates scored well on this question although simple mistakes were made. Candidates can improve by being careful when using negative values.

(a) Candidates commonly gave the correct answers. Common errors were a result of incorrect subtractions such as $8e+10f$. A few candidates did not simply correctly leaving their answers unresolved, for example $(3\text{-}5\text{+}6)m$ for part **(i)** and $(5\text{-}3)e\text{-}(4\text{+}6)f$ for part **(ii)**.

(b) Most candidates answered part **(i)** correctly, although some showed the substitution but could not evaluate it correctly.

Fewer candidates could rearrange the formula correctly, and many candidates gave a numerical answer, having substituted values into the formula. Various errors were seen in those who did try to rearrange, the most common being $at=u\text{-}s$.

(c) Many candidates gave correct solutions to the equations. A common error was to multiply the second equation by 2 and then subtract rather than add, so arriving at $3x = 18$.

Answers: **(a)(i)** $4m$, **(ii)** $2e–10f$, **(b)(i)** –3, **(ii)** $\frac{s-u}{a}$, **(c)** x=2, y=–3

Question 9

Candidates can find next terms in simple sequences but continue to have difficulty finding n^{th} terms or giving an explanation as to how the next term is derived.

(a) Many candidates could correctly find the next term of each sequence, but had more problems with finding the rules. In particular it was fairly common for candidates to give a position to term rule, in terms of n, rather than a term to term rule. Candidates often stated the rule for **(ii)** as add an odd number rather than being specific enough and stating ‘add the next odd number’ In **(iv)** candidates struggled to explain how the sign changed.

(b) Nearly all candidates could continue the sequence, but very few of them could state the rule for the n^{th} term. They usually recognised it was something to do with 8, but $n + 8$ was more common than the correct $8n - 3$.

Some candidates arrived at the correct answer in **(iii)** without having had the correct n^{th} term rule, but also it was fairly common for candidates to follow through correctly from their incorrect rule.

Answers: **(a)(i)** 243, multiply by 3, **(ii)** 27, add next odd number, **(iii)** 0.25,divide by 2, **(iv)** 80, multiply by –2, **(b)(i)** 37, 45, **(ii)** $8n–3$, **(iii)** 797

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

General comments

Some scripts demonstrated a lack of working, or had presentation of work that was often haphazard and difficult to follow, making it difficult to award method marks when the answer was incorrect.

As a general point, some candidates are working in pencil and then overwriting in pen. This makes the responses difficult to read, and may be taking up the candidates' time.

There was no evidence to suggest that candidates were short of time on this paper although weaker candidates made no attempt at some questions.

Comments on specific questions

Question 1

In more than one part of this question on time and travel the working shown was often insufficient to gain credit, as the operators of arithmetic were often left out and replaced by tables or ratios. In 'show that' questions it is essential that candidates clearly show the steps required to obtain the answer.

(a) (i) A large majority gave the correct time. A few added on 27 minutes to the starting time to obtain 07 75 but then failed to convert to the correct time.

(ii) A majority earned both marks by showing a calculation to find the walking speed. Some struggled with the units and got no further than 1.8 ÷ 27.

(b) (i) The combination of this question and part **(ii)** caused a lot of confusion for candidates. A significant number had working reversed in the two parts. A minority obtained the correct answer. Some picked up a mark for a partial method or for calculating the cycling speed as a percentage of the walking speed, ignoring the increase. Another common error was calculating as a percentage of the wrong speed.

(ii) Candidates were least successful on this part of the question. Some had correct methods but lost the final mark because of inaccurate answers. A significant number picked up a mark for calculating the cycling time as a percentage of the walking time, ignoring any decrease.

(iii) Many correct answers were seen. Apart from the occasional rounding error by approximating 100 ÷ 36 the most common error was 0.36 × 9.

Answers: **(a)(i)** 08 15 **(ii)** $\frac{1.8}{27} \times 60$ **(b)(i)** 275 **(ii)** 73.3 **(iii)** 25

Question 2

(a) The large majority of candidates earned all three marks in this part-question on substituting values into a function. Any loss of marks resulted from giving 0.3 in the table and slips with one or more values.

(b) Most candidates were able to pick up some marks on this question. Plotting points caused the most difficultly, especially for the exponential curve. Although a large majority attempted a curve, too many used line segments throughout or between the extreme points.

(c) (i) About half of candidates obtained an answer within an acceptable range. The most common mistake was calculating f(0) = 3.

(ii) A similar comment to **(i)** with some candidates attempting to calculate g(4) and with others giving answers outside of an acceptable range.

(iii) A similar comment to the two previous parts although candidates fared less well on this part.

(d) The quality of the tangents was generally poor, sometimes with gaps between the tangent and curve, sometimes crossing over the curve, often at points other than $x = 0.5$ and sometimes applied to the wrong curve. Some candidates with a correct tangent showed no working for the gradient and possibly lost a method mark when their gradient was incorrect. Candidates would be well advised to show the coordinates of the points they are using to find the gradient.

Answers: **(a)** 3, 0.33, 1 **(c)(i)** $1.2 < x < 4$ **(ii)** $1.2 < x < 1.35$ **(iii)** $0.55 < x < 0.7$ **(d)** $-2.5 < x < -1.5$

Question 3

This question on cumulative frequency was generally well answered. In **(a)**, the most common error involved misreading of the scale. Many candidates did not mark up their graphs when attempting to read off values.

(a) (i) A large majority earned this mark.

(ii) Candidates were slightly less successful in this part.

(ii) A small majority earned this mark.

(iv) A large majority earned this mark. Common errors included giving the number of candidates with estimates of 7g or more.

(b) (i) Many candidates completed the table correctly. There were occasional slips with the arithmetic but the most common error was giving the cumulative frequencies.

(ii) This proved more of a challenge and discriminated between the candidates as less able candidates struggled to obtain a frequency from the given probability. Some obtained a frequency of 60 but failed to realise that 60 candidates estimated greater than *M*. Consequently 2.4 was a common wrong answer.

Answers: **(a)(i)** 3.2 **(ii)** 4.2 **(iii)** 4.6 **(iv)** 196 **(b)(i)** 100, 46, 12 **(ii)** 4

Question 4

(a) There was an even spread of all the marks available in this transformations question, with slightly more earning three than any the other mark. It was common to see the centre omitted and when given it was usually quoted as the origin. If an incorrect transformation was given it was usually stretch or shear.

(b) (i) Many candidates coped well and earned both marks. Common errors included the wrong translation $\begin{pmatrix} 4 \\ 5 \end{pmatrix}$ or a slip in one of the two components.

(ii) Candidates fared slightly better with this reflection. Common errors included reflection in a vertical line other than $x = 2$, quite often the y-axis and sometimes the line $y = 2$.

(iii) Candidates at all levels fared less well with the stretch with a significant number making no attempt. When a stretch was attempted the invariant line used varied, most commonly the y-axis and the line $y = 1$.

(iv) Candidates who were successful in the previous part were more likely to earn these marks although a small number had obviously learned the format. A small number attempted to set up simultaneous equations but these were rarely successful.

(c) Most who found reflection also had the correct mirror line but there was a great variety of transformations. Rotation was the most common mistake along with answers such as 'inverse' or 'identity'.

Answers: **(a)** Enlargement, (–3, 4), factor 3 **(b)(i)** Image at (1, 5), (4, 5), (4, 6), (1, 7)
(ii) Image at (5, 1), (8, 1), (8, 3), (5, 2) **(iii)** Image at (–4, 3), (–1, 3), (–1, 6), (–4, 9)
(iv) $\begin{pmatrix} 1 & 0 \\ 0 & 3 \end{pmatrix}$ **(ii)** Reflection, $y = x$

Question 5

(a) The hint in this question on data handling helped many to make progress and a majority were able to obtain the correct mean. Common errors included the mean of the mid-interval values and occasionally a division of a correct total by 4.

(b) A majority obtained the correct interval but $165 < h \le 180$ and occasionally $150 < h \le 160$ were the common errors.

(c) Most attempts involved bars with the correct widths. The last bar was usually correct as candidates often used the scale as frequency for the bars.

Answers: **(a)** 171.25 **(b)** $160 \le h \le 165$ **(c)** Blocks with heights 1.8, 1.2, 1 and correct widths

Question 6

(a) Almost all candidates attempted this question on angles with the majority obtaining all three marks. A few obtained an implicit statement for BC but were unable to rearrange this into an explicit form. The majority of the rest often used incorrect trigonometry and in some cases Pythagoras' Theorem.

(b) A majority were able to make a good start in this trigonometry question but lost out on the final mark by failing to obtain an answer (48.573) that rounded to 48.57. Most of these just gave the given answer. Some attempted to use the answer to show that terms in the sine rule were equal but this could not earn full marks. Many of the rest failed to make any progress either by using incorrect trigonometry or by using Pythagoras' Theorem.

(c) (i) Although many candidates gained both marks, almost as many lost marks by rounding prematurely and not obtaining an answer that rounded to 40.6.

(ii) Stronger candidates were able to apply the cosine rule correctly. A few lost the final accuracy mark by rounding numbers prematurely. Of the rest many struggled with the method, evaluating the terms out of sequence and often treating the triangle as right angled and so the use of Pythagoras' Theorem and simple trigonometry were common.

(d) Another question that proved to be a good a discriminator of the candidates. Many simply made no attempt but for others there were errors in applying the area formula. Some preferred to use ½bh but rarely showed any method for calculation of the perpendicular heights. In most cases no marks could be awarded for an incorrect answer as the method was incomplete.

Answers: **(a)** 31.4 **(b)** working and 48.573 **(c)(i)** working and 40.57
(ii) 15.3 or 15.27 to 15.28 **(d)** 466 or 466.34 to 466.5

Question 7

This question on algebra and probability challenged most candidates.

(a) Many struggled to make a start on this part of the question. Many calculated the angles but in general this did not help. Some replaced the sine value by a decimal, usually rounded, which allowed the candidates to pick up some early marks but to lose out on the accuracy mark. Many of the rest went straight to Pythagoras' Theorem which allowed them to pick up some marks if correctly applied. Many introduced a second variable by using the sine formula or used x for the length of BC which spoiled their equations. A third starting point was to use 9 and 16 as the sides, especially for the weaker candidates, and this allowed them to pick up one mark if used correctly.

(b) (i) The information given in the equation generated a lot of confusion amongst candidates. Weaker candidates attempted to solve the problem using trial and improvement, sometimes successfully. For those that attempted to write two equations, W + R = 114.5 and R = 2.5W were common errors. Those that obtained two simultaneous equations were able to eliminate one variable and earn some credit. Equations in one variable were very rare.

(ii)(a) Fraction work proved a challenge to many, even with a calculator. Candidates obtained the correct individual probabilities but often omitted the arithmetic operation, making it difficult to award marks when the answer was incorrect.

(ii)(b) The symmetry of the "one white and one red" selection was missed by candidates, even those that had the first part correct. The reverse combination rarely appeared and $\frac{35}{132}$ was a common answer. Incorrect denominators were common, often 142 and 121.

Answers: **(a)** 6.61 **(b)(i)** W = 8.5, R = 11 **(ii)(a)** $\frac{42}{132}$ **(ii)(b)** $\frac{70}{132}$

Question 8

This question on shapes and angles proved challenging, with only the strongest candidates scoring well.

(a) (i) Surprisingly, a large minority of candidates did not know that the sum of the angles in a pentagon was 540 nor did they show any attempts to work it out. Most used 360 as the total. Those that knew of 540 usually obtained the correct answer.

(ii) Candidates were more familiar with angles in an isosceles triangle and a majority were able to earn this mark, either for the correct answer of for a correct follow through from their wrong answer.

(iii) Candidates were less successful than in previous parts. Many did not earn the follow through mark as answers were often greater than 84

(b) This proved to be the most challenging question on the paper with correct answers very rare. This was evidenced by the high number of candidates making no attempt at all. In the vast majority of cases there was no reference to any of the circle theorems. Common misconceptions included that opposite angles of quadrilateral OABC add to 360, or add to 180 or are equal. Something a little closer to the correct approach was to give $3y = 2(4y + 4)$. Those that appreciated that the reflex angle at O was the angle at the centre generally went on to obtain a correct answer. A small number of candidates drew an angle in the opposite segment and used opposite angles in a cyclic quadrilateral successfully.

(c) (i) It was common to see references to angles adding to 180, sometimes related to a triangle, sometimes a line, but it was rare to see a mention of opposite angles. Many candidates made no attempt.

(ii) Many candidates were able to obtain a value of 168 using the ratio. That said, there were a significant number of candidates who simply made both parts 51º. Most then struggled to see the connection between angle PQS and angle PRS and in many cases PQS was given as 78º. Again many candidates made no attempt.

(d) Although many candidates attempted this part many of them simply worked with linear scale factors giving 4.79 as the most common answer. Some appreciated the need for different factors but then cubed the volume factor to obtain a 'linear factor'.

Answers: **(a)(i)** 118 **(ii)** 31 **(iii)** 22 **(b)** 32 **(c)(i)** opposite angles add to 180 **(ii)** 68 **(d)** 5.75

Question 9

(a) Almost all of the stronger candidates earned all four marks in this question on functions. Less able candidates tended to make more errors with the substitution or the presentation of their formula. Commonly $-b$ was written separately from the rest of the formula. Some were able to recover. Slips with the arithmetic led to some obtaining incorrect solutions and in other cases solutions were not given to the required degree of accuracy.

(b) A minority earned all three marks for finding p, q and r. Others would pick up one or two marks for a correct substitution or for a correct expansion of the square term. A common error involved attempts to simplify $p(2x + 7)^2 + q(2x + 7) + r$ or $f(x).g(x)$. A significant number made no attempt.

(c) Candidates generally were more successful finding the inverse function and many earned both marks. Common errors included leaving answers in terms of y, or slips in the rearrangement following a correct start.

(d) A majority were able to find the correct value of x. The most common error was to calculate h(2).

(e) All levels of ability found this a more challenging end to the question and many weaker candidates struggled to make any progress. Some candidates laid out calculations step by step and were usually successful. Others were confused by the order of operations and answers based on 6^{27}, 8^{27} were seen. Others worked on $2^3 = 8$ then cubed 8 followed by the cube of 512. A significant number made no attempt to correct their answer to four significant figures.

Answers: **(a)** –2.30 and 1.30 **(b)** 4, 30, 53 **(c)** $\frac{x-7}{2}$ **(d)** –2 **(e)** 1.158×10^{77}

Question 10

(a) This was well answered by most candidates. Some candidates were caught out by the jump from Star 5 to Star 7 and 60, 61 were often seen. A majority were able to find the algebraic expressions but weaker candidates experienced more difficulty with answers such n and $10 + n$.

(b) (i) A large majority of candidates were able to find the correct number of dots with the occasional arithmetic slip for some others.

(ii) Most of the more able candidates could obtain the correct formula. However, weaker candidates struggled, tending to give numerical values for the number of dots. Other candidates started off correctly but often made slips with the simplification.

(iii) A similar comment to that of part **(ii)**, although overall candidates were slightly less successful.

(c) (i) Candidates fared better on this part and many earned both marks. A number of candidates evaluated the given expression but then did not show the number of dots to be correct by using an alternative approach.

(ii) Yet again, most candidates were able to calculate the correct number of dots.

(d) A good discriminator of candidates. It was nice to see some well laid out solutions starting from $5n^2 + 6n + 10(n + 1) + 1$ and working through appropriate steps to reach $5(n + 1)^2 + 6(n + 1)$. Unfortunately they were given by a minority of candidates. Others attempted to work from both ends and work towards the middle but this required the separate expressions equated or linked with a conclusion for full marks. Some others picked up one or two marks for working towards a solution. Re-arrangement of the terms seemed beyond all but the most able. Many weaker candidates gave no response at all.

Answers: **(a)** 50, 70 10n, 51, 71, 10n + 1 **(b)(i)** 212 **(ii)** 20n + 12 **(iii)** 20n + 152
(c)(i) 5 × 32 + 6 × 3 = 63, 11 + 21 + 31 = 63 **(ii)** 560

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key Message

It is important that candidates are fully aware of and experienced with the whole syllabus as there is no choice of questions. Certain formulae need to be learned and these include the quadratic equation formulae and trigonometric formulae. When answering questions candidates should include clear working and use appropriate levels of accuracy. Candidates should also possess the ability to succeed in multi-step and contextual questions. Accuracy in graph drawing and in geometrical constructions is also important and candidates should possess basic geometrical instruments in good condition.

General comments

Almost all candidates were well prepared for this level of paper and were able to attempt all questions in the allotted time. Many candidates attained high scores. Omissions were due to difficulty with the content rather than lack of time.

One important point to make is that the papers are designed to leave ample working space for all questions and candidates should only use supplementary sheets if they have a genuine need for more space. This should only be when some working needs to be replaced or when a longer than anticipated method has been chosen. Candidates are better placed if they only have the question booklet and do not think that they need to use a supplementary sheet for rough working.

In the examination itself, most candidates set out the work clearly and usually showed sufficient working in the questions which required proof that a given value was correct. Good calculator skills were demonstrated by many but the most common loss of marks in this exam was a tendency among many candidates to round off or even truncate answers in the course of their calculations, leading to an inaccurate final answer. When this was combined with a reluctance to write down all of the method steps, it could lead to a significantly lower mark on the question concerned. Examiners will not imply method marks from values that are not correct to at least 3 significant figures.

Candidates do need to be aware of the need to work to more than 3 significant figures and not to round off during calculations. When several steps of the working can be done on a calculator candidates should write down any methods used, not necessarily with answers, and not take the high risk of losing many marks by only giving answers. There is the responsibility of communicating any methods used and this is becoming more important when some calculators can give answers from simple input. Another rounding issue is when a question asks for a value to be calculated and to show that it rounds to a given value. In such cases candidates need to provide an answer to a greater accuracy than the given value. **Questions 4**, **6** and **11** required this approach.

The questions involving ratio, fractions, percentages, bounds, transformations, graphs, trigonometry, simultaneous equations, probability and matrices were well answered. More challenging questions involved a tangent from a point to a curve and solving an equation related to a drawn curve, finding the length of an arc, explaining why two triangles were congruent, setting up and solving a quadratic equation, mensuration involving surface area, algebraic fractions and an investigation.

Comments on specific questions

Question 1

This question provided opportunities for candidates to demonstrate their knowledge of some of the general number topics.

(a) (i) This was very well answered with the majority of candidates understanding how to show that $\frac{6}{14} \times 560 = 240$. Some used the reverse argument starting from 240 and working back to 560 which was perfectly acceptable. A few were vague as to how to use the 6 and 14.

(ii) Very well answered with most candidates giving the value 120.

(b) The vast majority of candidates were successful, giving an answer of 90. A few calculated five eighths of 240 and did not subtract it from 240. A few confused the men, women and children in their calculations.

(c) (i) Most reached $96120. Only a few then rounded to $96100 and so did not gain full marks. Exact money amounts should not be rounded to 3 significant figures. Once again, the only real method error was confusion between women and children and the prices they paid. When men, women and children were all calculated separately, the total did not always reach 560.

(ii) Candidates generally found this part more challenging although many identified the correct method and scored full marks. The most common error was to calculate 5.6% of $198 and subtract this from $198. A few candidates found 105.6% of $198. A few candidates obtained $187.5 and then gave their final answer as $188. Candidates should be aware that the answer to a question involving currency where the answer is exact should not be rounded unless instructions are given in the question to give the answer to a specific accuracy.

(d) Candidates who took all the information in the question correctly found the question straightforward. There were different types of errors which could have been avoided by more careful thinking. One error was to compare the cost price of 36 tennis balls with the selling price of one ball. Another error was to find the selling price as a percentage of the cost price, overlooking the wording about profit. The final error worth mentioning is the finding of the profit as a percentage of the selling price. These errors indicate a need for more practice with percentage change questions.

(e) Mixed answers were seen in this part. Many were correct although upper and lower bounds were occasionally reversed. Many found the correct bounds for the lengths but then multiplied to get areas instead of perimeters. Some found the perimeter (or half the perimeter) and tried to apply the limits at this point, usually without success.

Adding 4 × 0.5 rather than 4 × 0.05 was a common error for those who were not successful here.

Answer: **(a)(i)** $\frac{6}{14} \times 560$, **(ii)** 120; **(b)** 90; **(c)(i)** 96120, **(ii)** 187.50; **(d)** 184; **(e)** 69.4 and 69.

Question 2

This question on transformations was generally well answered.

(a) (i) The majority of candidates identified the transformation as a translation but a significant number were unsure of the correct term and used similar incorrect terms such as transition or translocation. The most frequently given incorrect response was rotation. Candidates generally then used a vector to define the translation with problems arising from incorrect signs and counting from the top of shape P to the bottom of shape Q. Some candidates lost this mark by using a row instead of a column vector.

(ii) This reflection was very well done by the vast majority of candidates. The occasional error seen was a reflection in the line $x = -1$ instead of in $y = -1$ or reflection in the axes.

(iii) Many fully correct transformations were seen here, usually from candidates that had learnt that the matrix $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ produces a rotation of 90° anticlockwise about (0, 0). Some candidates also achieved the correct solution by using the matrix multiplication $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 2 & 2 & 4 & 4 \\ -7 & -4 & -5 & -7 \end{pmatrix}$. From unsuccessful candidates it was common to see an attempt at the incorrect product $\begin{pmatrix} 2 & 2 & 4 & 4 \\ -7 & -4 & -5 & -7 \end{pmatrix}\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ which was then often abandoned in confusion.

(b) (i) Many candidates correctly identified 'Shear' and also the scale factor 2. Candidates must be more rigorous in their descriptions of the invariant line. Descriptions such as '*x* line invariant' or '*x* invariant' are ambiguous and do not score. The required description is '*x*-**axis** invariant' or equivalently '*y* = 0 invariant'. The description 'parallel to the *x*-axis' does not score. Some candidates confused a Shear with a Stretch and/or gave scale factor 8, presumably because the top vertices of the rectangle moved across 8 to the right.

(ii) The candidates that plotted the centre of enlargement correctly and drew some 'ray' lines usually gave the correct rectangle. A few used (0, 5) for the centre and there were a large number of rectangles of the correct dimensions but in the wrong position which were given partial credit.

Answer: **(a)(i)** Translation $\begin{pmatrix} -5 \\ 8 \end{pmatrix}$; **(b)(i)** Shear, *x*-axis invariant, factor 2.

Question 3

This graph question was very accessible in parts **(a)** and **(b)** but presented challenges in the remaining parts.

(a) Almost all candidates scored full marks on this part.

(b) Many candidates scored full marks by plotting all 8 points correctly and drawing a good quality curve. There were a large number who plotted all 8 points correctly but drew a curve that had a straight section between $x = 2.5$ and $x = 3$ and they did not realise that the graph had a turning point. A few drew a curve that was too thick or that had more than one line between two points and there were also a small number of candidates whose curve did not pass close enough to one, or more, of their plotted points. There were very few incorrectly plotted points and some candidates omitted to plot one of the 8 points. It was very rare for a candidate to score less than 2 marks.

(c) This part of the question proved to be challenging for many candidates. Most did not understand that the suitable line referred to in the question was the line $y = -1$. Often no line was drawn at all or the line $y = 1$. Candidates were expected to draw the line $y = -1$ and accurately read the x values from their curve at the points of intersection with the line.

Some credit was given to candidates who found accurate solutions to the equation by methods such as using the quadratic formula or by drawing the curve $y = 11x - 2x^2 - 11$, but this was a weaker area generally.

(d) (i) Many candidates did not understand that the required tangent with equation $y = mx + 2$ would pass through the point (0, 2). Those candidates that did begin their line at (0, 2), usually drew excellent tangents to the curve and read the required co-ordinates correctly. A few candidates allowed daylight to be seen between their tangent and the curve so did not achieve full marks. Many tangents were seen but commonly ones that touched the curve at (2, 2) or a horizontal line touching at the maximum point.

(ii) Candidates who made a good attempt at the tangent in part **(d)(i)** usually went on to find the gradient of their tangent correctly, showing a good understanding of rise/run. Some candidates used the equation $y = mx + 2$, and their x and y values from part **(d)(i)**, with equal success. Only a few candidates misinterpreted rise/run by counting squares instead of using the given scales and very few mistakenly used run/rise.

Answer: **(a)** 0, 2, 0, –3; **(c)** 1.3 to 1.4 and 4.1 to 4.2; **(d)(i)** Tangent drawn from (0, 2) and (2.5 to 2.75, 3 to 3.4), **(ii)** 0.4 to 0.48.

Question 4

There was a mixed response to this question with candidates finding parts **(d)** and **(e)** challenging.

(a) This was usually answered correctly with most candidates giving an answer of 227 or 226.98. Some candidates were not awarded the accuracy mark giving an answer of 226.9 which is from either truncating the accurate answer obtained on the calculator, or using an inappropriate value for π such as 3.14 or $\frac{22}{7}$. A small number of candidates used the formula for the circumference of a circle.

(b) Almost all candidates found the length of MB to be 5.35. A few made numerical errors when halving 10.7 to get for example 5.45 or gave the inaccurate answer 5.4 without showing a more accurate value.

(c) Many candidates understood to use $\sin(MOB) = \frac{5.35}{8.5}$ but from here jumped straight to the conclusion that angle $MOB = 39°$ to the nearest degree. To *show* that the angle rounds to 39° the more accurate value of 39.0(...)° to at least one decimal place must be stated. Some candidates chose to use less efficient methods such as the cosine rule in triangle AOB but often lost accuracy during the process. Some incorrect methods were seen from candidates who used OM as a radius of 8.5 and thus stated for example $\tan(MOB) = \frac{5.35}{8.5}$.

(d) Many candidates had learnt the formula, arc length = $\frac{\theta}{360} \times \pi \times d$ and so many candidates were awarded a method mark for stating $\frac{\theta}{360} \times \pi$ x 2 x 8.5 and using θ as any value between 0° and 360°. Few candidates went on to achieve full marks from using θ as 360° – 4 x 39°. Some candidates found the minor arc AC instead of the major arc. Others did not appreciate the congruency of the four triangles that create the angle 4θ or chose to use the angle as 2θ instead. Some candidates attempted to find the chord AC instead of the arc.

(e) A formal proof of congruency was not required but only a few candidates were able to give the 3 pairs of sides exclusively. The succinct explanation that triangle ATB is congruent to triangle CTB because $AT = TC$, $AB = BC$ and TB is common to both triangles was rarely seen. Pairs of angles were often included and often only one or two pairs of sides were given. The challenge on this question was to only use elements of the two triangles and not to use pairs of elements which depended on the triangles being congruent.

Answer: **(a)** 227; **(b)** 5 35; **(c)** 39.0 to 39.01; **(d)** 30.2 or 30.3.

Question 5

Many candidates found this algebra question challenging although most found **(d)** and **(e)** more familiar.

(a) This question proved to be a challenge for many candidates. A variety of incorrect answers were seen including $27x$, $x = 27$, $\frac{x}{27}$ and attempts to write an inequality. Some candidates who were thinking along the right lines spoilt their answer by writing $x = \frac{27}{x}$.

(b) Again candidates found this part a challenge with similar misunderstandings to part **(a)**. Poor notation from a few candidates was also seen, so $25 \div x - 2$ for example, did not score.

(c) Most did attempt to follow through their answers from parts **(a)** and **(b)** but unfortunately with little success. When the '4' was used, often an expression was multiplied by 4 rather than added or subtracted.

After the first method mark for a correct algebraic statement the second method mark was generally the one earned for dealing with the fractional denominators correctly. Candidates seemed to have a good understanding of multiplying to 'clear' the denominator. The common error was found in multiplying out the brackets and in particular the two negatives. A few candidates did not use brackets at all.

Occasionally when candidates did manage a fully correct method the omission of the 'equals 0' meant that the final mark was lost.

(d) The solving of the quadratic equation was more successful, with many overlooking the possibility of factorising in favour of using the formula. Many candidates either omitted part **(c)** or could not do part **(c)** but went on to successfully solve the equation in part **(d)**.

(e) Candidates should expect to a solution from an equation to be used in the context of the original question. This part simply required the positive root from part **(d)** to be divided into 27. Nevertheless this part was still often omitted.

Answer: **(a)** $\frac{27}{x}$; **(b)** $\frac{25}{x-2}$; **(d)** 4.5, –3; **(e)** 6.

Question 6

(a) (i) Candidates are very well prepared for the use of trigonometrical formulae and this question proved to be no exception. This was the cosine formula to find an angle and most candidates wrote down a correct cosine formula statement, whether it be explicit or implicit. Those who started with the implicit formula (i.e. for the square of a side) were more likely to make numerical errors. A small number of candidates displayed the need to have a better knowledge of the formulae. The answer was given to 3 significant figures and so a four or more significant figure answer was required for full marks. If this was not seen then a value of the cosine of the angle could earn an accuracy mark. A number of candidates therefore only scored 2 of the 4 marks by only showing the formula with values and then only giving the 3 figure answer quoted in the question.

(ii) The area of the triangle was usually correctly calculated with most candidates using the value from part **(a)(i)**. In fact candidates are encouraged to realise that whenever a value is asked for in part of a question, it is likely to be used in a later part. A few candidates found longer methods such as using base and height or two sides with a different included angle but these candidates often had answers outside the acceptable accuracy range because of rounding issues within the method.

(b) This was done quite well. Apart from the need to find the third angle of a triangle this question was a straightforward sine rule calculation. Many found the 55° angle correctly and then used the implicit form of the sine rule. Some candidates did not write down the explicit form but substituted decimal values for trig functions too soon and so found it difficult to demonstrate their method. Premature approximations of trig values sometimes led to an inaccurate answer.

Answer: **(a)(i)** 44.41 to 44.42, **(ii)** 88.2; **(b)** 7.74.

Question 7

Overall most candidates performed reasonably well on this question, showing that they had a good understanding of the topic of matrix manipulation.

(a) (i) Most candidates were able to correctly multiply a 2 by 1 matrix by a scalar.

(ii) This part was the matrix calculation that was not possible and many candidates clearly knew that this was the case, but there was little evidence of other candidates writing down the order of vectors/matrices to check compatibility.

(iii) This product of matrices gave a 1 by 1 matrix which caused some confusion amongst some candidates. The answer was often a 2 by 2 matrix, a 2 by 1 matrix or a 1 by 1 matrix without brackets or even "not possible". Parts **(ii)** and **(iii)** suggested a need for more experience with dimensions of matrices when multiplying.

(iv) The addition of two matrices proved to be very straightforward.

(v) The squaring of a 2 by 2 matrix was a more discriminating question. Many candidates correctly multiplied the matrix by itself, indicating a good grasp of matrix calculations. Others squared each element of the matrix.

(b) The inverse of the matrix was usually correctly calculated and incorrect answers were often due to arithmetical slips rather than misunderstandings. A few candidates omitted the multiplication by the reciprocal of the determinant and a few showed some confusion over the re-arrangement of the 2 by 2 matrix.

Answer: **(a)(i)** $\begin{pmatrix} 15 \\ 21 \end{pmatrix}$, **(ii)** not possible, **(iii)** (2), **(iv)** $\begin{pmatrix} 4 & 13 \\ 0 & 0 \end{pmatrix}$, **(v)** $\begin{pmatrix} -5 & -9 \\ 1 & 0 \end{pmatrix}$; **(b)** $\frac{1}{2}\begin{pmatrix} 3 & -4 \\ -1 & 2 \end{pmatrix}$.

Question 8

In all parts of this probability question candidates understood the rubric, giving answers in fractions. Decimals or other notations were seen very rarely.

(a) The tree diagram was accurately completed by most candidates. The few incorrect ones were from candidates clearly in need of more work on basic probability and interpreting worded problems.

(b) (i) Most candidates found the two relevant probabilities from the diagram and multiplied them correctly, a concept which needs to be understood at this level.

(ii) As with part **(b)(i)**, the candidates knew the correct process for answering this question.

(iii) The greater challenge in this part was to recognise two products and to add them. This part was also generally successful, although a little more confusion between multiplying and adding was seen here. Some candidates found all 4 products on the tree diagram and placed them at the ends of the branches. They were then able to look down and decide which ones were needed for all three parts of part **(b)**.

(c) This part brought a third probability into the situation and was a more demanding question. It also required the subtraction of one product of three probabilities from 1. This was therefore an opportunity for stronger candidates to demonstrate a very good understanding of probability. A few candidates found the wording a little difficult.

Answer: **(a)** $\frac{5}{8}$, $\frac{3}{8}$, $\frac{2}{3}$, $\frac{1}{3}$, $\frac{1}{6}$, $\frac{5}{6}$; **(b)(i)** $\frac{15}{48}$, **(ii)** $\frac{5}{24}$, **(iii)** $\frac{13}{48}$; **(c)** $\frac{170}{240}$.

Question 9

Many candidates found this a difficult question, with only part marks being scored by the majority of candidates.

(a) The total surface area of a hexagonal prism proved to be more challenging than might have been expected. Candidates should realise that the total surface area includes two ends as well as the six rectangles. The area of the regular hexagon was demanding but should have been possible by a suitable division into simpler shapes. Those who used 6 identical equilateral triangles together with $\frac{1}{2}ab\sin C$ found more success than those who used two trapezia or two triangles and a rectangle. Candidates should also remember the need for holding accurate values for each area, otherwise the final accuracy mark will be lost. The absence of any trigonometry or Pythagoras in the working of some candidates showed the need for more experience with this type of area. Most candidates did earn the mark for the area of the six rectangles.

(b) (i) This part required the division of a volume by the area of a circle together with changing litres into cm^3. Many candidates did not see the problem as simply as this, presumably because of the context. Rate of flow through cylindrical pipes was certainly a challenge for many. There were a number that were able to correctly find the area of the cross-section of the pipe or to find the volume delivered per minute and they gained partial credit.

(ii) This part required the equating of the volume of a cylinder of an unknown radius but given height to a given volume. Again there was the added complication of change of units. This seems to be a fairly accessible problem but many candidates demonstrated the need for a greater understanding or more practice. The given height of the cylinder was 5 mm which needed to be changed to cm and put into $\pi r^2 h$ and then made equal to the 12 litres changed into cm^3. A surprising misunderstanding was to add the 5 mm to the 12 litres or 12000 cm^3. Candidates are urged to look through other mensuration questions of recent papers to have a fuller experience with this part of the syllabus.

Answer: **(a)** 371; **(b)(i)** 1740, **(ii)** 87.

Question 10

Answers were generally mixed and parts of this question proved to be discriminatory.

(a) (i) This subtraction of two algebraic fractions with numerical denominators was well answered. A small number of candidates did not find a common denominator and several had a correct answer but then spoiled it by some incorrect cancelling.

(ii) This question involved the same rules as part **(a)(i)**, but now one denominator was linear and one numerator was linear. This proved to be a much more demanding question as two pairs of brackets had to be expanded and then added, leading to some sign errors. As in part **(a)(i)** some correct answers were spoiled by incorrect cancelling.

(b) Most candidates demonstrated the ability to solve simultaneous equations. There was quite a large number who did not deal with the fraction $\frac{2}{3}$ correctly. A common answer was 0.67 and this often led to an inaccurate value of the other variable. More careful work with the fraction answer would have given candidates 3 marks out of 3 instead of just 1 mark. The substitution method was less successful than the elimination method.

(c) This algebraic fraction question involved factorising a numerator and a denominator and then cancelling common factors. This was successfully done by many candidates. To factorise $2x^2 + 9x + 9$ some candidates used the quadratic equation formula. Many were successful with this but some gave a factor as $x + \frac{3}{2}$ instead of $2x + 3$, which proved to be quite a costly misunderstanding. Some candidates cancelled parts which were not factors and clearly needed to be more aware of the fact that only factors can be cancelled.

Answer: **(a)(i)** $\dfrac{25-8x}{20}$, **(ii)** $\dfrac{2x^2+5x+9}{3(x+3)}$; **(b)** $\frac{2}{3}$, –3; **(c)** $\dfrac{7}{2x+3}$.

Question 11

This question on an investigation into triangles proved to be a very challenging final question for the majority of candidates and there were a large number of omissions.

(a) Almost all candidates demonstrated that $3^2 + 1^2$ gave 10 or better equivalent statements.

(b) (i) This part required the use of $\sqrt{10}$ being kept in its exact form, which appeared to be a difficult concept for some candidates who gave decimal answers.

(ii) This part also required an exact value although this time it was rational, which appeared to be a little more accessible. Many used Pythagoras' Theorem for this part rather than using the ratios from similar triangles. This was not a problem, although ratio was a more appropriate method for part **(c)**.

(c) There were a few excellent solutions shown by the most able candidates who were more successful when using a ratio than using Pythagoras'. A common error was to assume that the base of the triangle remained constant. Another error was to assume that the side lengths formed an arithmetic progression. Only the best candidates worked in surds and then gave an exact answer.

Some candidates used a very neat method using similar triangles to find the required side, but others used similar triangles to find the bases then Pythagoras' theorem. Such a complicated approach invariably led to errors in calculations and loss of accuracy.

(d) (i) Most candidates used trigonometry to calculate the given angle. Some did not give a more accurate value than the 18.4° given in the question and could only earn the method mark.

(ii) This was a one mark question to test that the corresponding angles of the similar triangles would be equal. A large number of candidates tried to connect the angles by using the ratios of sides seen in earlier questions.

(iii) This part required candidates to simply divide 360° by 18.4° and then to interpret the overlapping situation in this part of the investigation. The stronger candidates were able to do this successfully to earn at least 2 of the 3 marks, even if there was some confusion over the $n - 1$ and the n. A large number of candidates did not attempt this part, perhaps because of the suffix notation being used.

Answer: **(b)(i)** $\frac{\sqrt{10}}{3}$, **(ii)** $\frac{10}{3}$; **(c)** $\frac{100}{27}$; **(d)(ii)** 18.4, **(iii)** 20.

MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key Messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus.

The accurate statement and application of formulae in varying situations is always required.

Work should be clearly and concisely expressed with an appropriate level of accuracy.

All working should be in ink and in the working space provided.

Candidates need to be aware that in geometrical constructions all arcs should be clearly visible so Examiners can give credit when appropriate.

Straight lines in graphs should be accurately ruled with the correct intercepts on the axes.

Candidates should be aware that it is inappropriate to leave an answer as a multiple of π or as a surd in a practical situation.

General Comments

This paper proved to be accessible to the majority of candidates. Most were able to attempt all the questions and solutions were usually well-structured with clear methods shown in the answer space provided on the question paper.

There were many excellent scripts. A few candidates were inappropriately entered at extended tier.

Candidates appeared to have 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.

Graphs were often well drawn and the readings taken from them were to the required accuracy. Some candidates still confuse the lines $x = 5$ and $y = 11$ with $y = 5$ and $x = 11$ respectively. Many candidates did not draw an accurate tangent to the curve in **Question 5(e)**. Care is needed to ensure that the point of contact is the required one.

Most candidates followed the rubric instructions with respect to the values for π and since there was a decrease in the use of $\frac{22}{7}$ or 3.14, answers were more accurate this time.

It was extremely encouraging to see so many varied solutions to **Question 10(b)**. The thinking candidates were rewarded for their concise solutions that used two of a possible six simultaneous equations which were solved efficiently.

Comments on Specific Questions

Question 1

(a) There were few incorrect solutions to this question on ratio. A few calculated only Ben’s share of $469. The usual error was to divide by 6 instead of by 5.

(b) Despite the calculation giving an exact answer, many candidates corrected this value to three significant figures.

(c)(i) Methods using 330 × (1 – 15%) or 330 × 85% were more common than the acceptable forms of 330 × (1 – 0.15) or 330 × 0.85. Again the usual error was to correct the exact answer to three significant figures.

(ii) This question on reverse percentages was generally well answered. A significant number of candidates divided by 1.12 and others multiplied by 0.88 or 1.12 as they did not recognise this as a reverse percentage problem.

(d) The formula for the amount obtained under compound interest was usually correctly stated. The difficulty was converting 2.3% to the correct decimal in the calculation. Some candidates preferred to use a year on year approach and this work was often to the required accuracy with only a small minority reaching an inaccurate final answer due to earlier premature rounding.

(e) Many candidates spoiled their accurate working by giving the answer correct to the nearest whole number. A few forgot to subtract 76.9% from 100% to give the loss. It was surprising how many candidates evaluated $\frac{75}{250} \times 100$.

Answer: **(a)** 2814; **(b)** 257.95; **(c)(i)** 280.50, **(ii)** 375; **(d)** 1605.89; **(e)** 23.1.

Question 2

(a) (i) Construction arcs were used in the vast majority of cases in this question on loci but some were so faint that they were almost invisible. Very often, after gaining full marks for the construction of the boundaries, candidates shaded an incorrect region. Weaker candidates often constructed several perpendicular and angle bisectors.

(ii) There were many correct solutions. Weaker candidates gave the obtuse angle and others gave the bearing of P from S.

(b) (i) This question was often answered correctly. A few candidates used the circumference formula and a small number used π = 3.14 to give an inaccurate final answer. Candidates need to be aware that it was inappropriate to leave the answer as 2025π in this practical situation.

(ii) Again this question was often answered correctly. A few candidates calculated the unfenced length and some of these recovered by subtracting this from the circumference. Some again used π = 3.14 and others inappropriately gave the answer as 52.5π.

Answer: **(a)(ii)** 219^{o}; **(b)(i)** 6360, **(ii)** 165.

Question 3

(a) (i) This question was often answered correctly. A few candidates used a strict inequality and others gave $x < 5$ or simply *x*5.

(ii) This question was often answered correctly. Those who used a strict inequality in part **(i)** were not penalised again.

(iii) This question was often answered correctly.

(b) Few candidates gained the mark here as they failed to explain why their correct inequality of $4x + 8y \leq 160$ reduced to the given one.

(c) (i) A significant number of candidates confused the lines $x = 5$ and $y = 11$ with $y = 5$ and $x = 11$. Others drew $y = 11$ at $y = 10.5$. The inclined lines were usually correctly ruled but slight inaccuracies at (0, 20) and (0, 40) often lost marks. The shading of the unwanted region was sometimes untidy and unclear as 'shading' did not reach the boundaries. Those who shaded fully or along the correct side of each boundary line usually gained full marks.

(ii) Many candidates gave the correct answer despite an inaccurate or incorrect region in part **(i)**. Those who gave an answer other than 29 often failed to provide evidence of how this was obtained and consequently the method mark could not be awarded.

Answer: **(a)(i)** $x \geq 5$, **(ii)** $y \geq 11$, **(iii)** $x + y \geq 20$; **(b)** $4x + 8y \leq 160$ and divide by 4; **(c)(ii)** 29.

Question 4

(a) This mensuration question was often answered correctly. Several candidates used $\frac{1}{3}$ instead of $\frac{1}{2}$ in their calculation and it was unclear whether this was because they considered the solid to be a pyramid. Others omitted to use the area of the cross–section multiplied by the length and found the volume of a cuboid.

(b) This question was often answered correctly. Many candidates obtained the correct solution by calculating the length of the diagonal of one face first but premature rounding of this value, e.g. 23.086… = 23, led to an inaccurate final answer. A significant number of candidates inappropriately gave the answer in surd form.

(c) Many candidates calculated the wrong angle by a variety of trigonometry methods which included the sine and cosine rules rather than the more efficient right angled triangle ratios. By far the most common incorrect angle found was *FGE*.

(d) Despite the formula for the volume of a sphere being stated in the question, some candidates evaluated $\frac{4}{3}\pi \times 1.5^2$. Others reached 217.8… but then did not consider the practical situation and rounded this to 218 or gave the decimal as the final answer. Many candidates earned the method marks when their answer to part **(a)** was incorrect.

(e) (i) By far the most common error was to use 11.5 instead of 11.05 as the upper bound for 11.0. When the correct values and formula were used the answer was often rounded to 3 or 4 significant figures. A large number of candidates multiplied the correct values of 4.55 and 11.05 but forgot to halve this.

(ii) It was impossible for many candidates to earn this mark as their answer to part **(i)** was given to 3 or 4 significant figures.

Answer: **(a)** 3080; **(b)** 46.2; **(c)** 8.7°; **(d)** 217; **(e)(i)** 25.13875, **(ii)** 25.14.

Question 5

(a) This question on substituting values into a function was often answered correctly. The common error was – 4.95 as the first value.

(b) The plotting of points was accurate in the vast majority of scripts. Plotting errors were usually at $x = \pm 0.1$ instead of at $x = \pm 0.2$. Few candidates gained full marks for the curve as their maximum point was not above $y = -2$. It was encouraging to see that so few candidates joined their branches or their points with straight lines.

(c) This question was often answered correctly.

(d) The line $y = 2x - 2$ was often correctly ruled and accurate values of x obtained from its intersection with the graph. A few candidates gave the values of y.

(e) Weaker candidates did not draw an accurate tangent at $x = -2$ as their point of contact was more than 2 squares to the left or right. Many used accurately read points on their tangent to evaluate the gradient but a few misread the scale on the y-axis and a small minority evaluated difference in x ÷ difference in y.

Answer: **(a)** – 5.04, 1.75, 0; **(c)** –1.6 to –1.5, –0.4 to –0.3, 1.8 to 1.9; **(d)** –2.6 to –2.5, –0.4 to –0.3, 1;
(e) 3.25 to 4.24 with correct tangent.

Question 6

(a) This question on probability was often answered correctly. Occasionally candidates confused the second pair of branches but the more common error was to treat the situation as one with replacement.

(b) The vast majority of candidates earned full marks for this question. Those who had an incorrect tree diagram in part **(a)**, usually earned method marks by following through from their previous values.

Answer: **(a)** $\frac{3}{10}$, $\frac{6}{9}$ and $\frac{3}{9}$, $\frac{7}{9}$ and $\frac{2}{9}$; **(b)** $\frac{42}{90}$.

Question 7

(a) (i) Candidates were often less successful with drawing this stretch than in previous times. A very common solution was the triangle with the same base as A and vertex at (1, 7). This illustrated the concept of a stretch, factor 3, and consequently earned SC1. Many others also had a triangle with the same base as A but with vertex at (1, 9) and this demonstrated none of the features of the required stretch.

(ii) Candidates had more success with this question as the format of the required matrix was well known. The common alternative to the correct answer was $\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$.

(b) (i) This question was often answered correctly. Some candidates omitted to state that the x-axis was invariant and others thought the y-axis was the invariant line. The vast majority of candidates gave the correct factor but a significant number thought this was also a stretch.

(ii) The better candidates gave the correct answer with no working. Others worked out the required matrix by solving two pairs of simultaneous equations. Candidates who gave the wrong scale factor in part **(i)** were able to earn full marks here and many of them did so.

Answer: **(a)(ii)** $\begin{pmatrix} 1 & 0 \\ 0 & 3 \end{pmatrix}$; **(b)(ii)** $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$.

Question 8

(a) (i) This question on circle theorems was often answered correctly.

(ii) This question was often answered correctly.

(iii) The answer of 126° was as popular as the correct one.

(b) (i) This question was often answered correctly. Very few candidates incorrectly combined the elements of the cosine rule.

(ii) Most candidates correctly used ½ ab sinC but others found the height of the triangle first and then used this to calculate length LM.

(iii) Only the very best candidates realised that corresponding sides were of lengths 32 and 16 and consequently the scale factor for area was $(½)^2$. Some candidates used ½ *ab* sinC with *b* as ½ of their answer to part **(ii)** but premature approximation often led to an inaccurate answer here. A large number of candidates simply divided 324 by 2.

Answer: **(a)(i)** 27°, **(ii)** 54°, **(iii)** 153°; **(b)(i)** 59.6, **(ii)** 22.0, **(iii)** 81.

Question 9

(a) This question on reading from a cumulative frequency graph was often answered correctly.

(b) This question on probability was often answered correctly.

(c) This question was often answered correctly.

(d) There were many correct solutions to this question on estimated mean. The most common error was to use 17.5 instead of 22.5 as the mid-value of the third interval. A significant number of candidates used values such as 4, 12, 23, 34, 46 instead of working out the mid-intervals. Those candidates who made an error in part **(c)** often used the correct method here with their frequencies.

(e) This question on drawing a histogram was often answered correctly. Weaker candidates drew each block with widths of 10 which demonstrated a lack of appreciation that the interval width varied for the first two blocks. Most candidates scored marks for the last two blocks.

Answer: **(a)(i)** 14, **(ii)** 8, **(iii)** 22; **(b)** $\frac{11}{80}$; **(c)** 16, 4; **(d)** 18.0625.

Question 10

(a) (i) This question on algebra was often answered correctly. The most common error was in expanding $2(3x - 7)$ as $6x - 7$. A significant number of candidates left their answer as either 27/6 or 9/2.

(ii) Many candidates lost marks because they ignored the instruction to use factors and used the quadratic equation formula to find the solutions.

(iii) Again the inability to expand a bracket correctly lost marks for many candidates. Multiplying by the common denominator to clear the fractions from the equations varied from efficient to confused with many candidates omitting brackets where necessary.

(b) This question was extremely well answered by the majority of candidates. The selection of the simultaneous equations used was very varied and these were often solved in an efficient way. The candidates who approximated the value of *a* as a decimal often lost accuracy when they then used this to evaluate *b*. Some candidates risked losing many marks by not showing any working.

Answer: **(a)(i)** 4.5, **(ii)** 1 and 6, **(iii)** 6 **(b)** $a = \frac{1}{3}$, $b = \frac{1}{2}$.