MATHEMATICS

Paper 0580/11
Paper 11 (Core)

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

Candidates made good attempts at answering this paper. Candidates must read the question carefully to see what information they are given. Candidates must take notice, that, if a question asks for the answer as a fraction, a decimal will not do. On this paper, there were instructions to answer to the nearest whole dollar – this instruction was ignored by many candidates. Marks were often lost because of premature rounding or truncation – this was particularly noticeable in **Questions 17** and **18**.

Generally in those parts that carry more than 1 mark, workings need to be shown in order to access the method marks if the final answer given is incorrect. In most cases a sufficient amount of working was seen. Along with this entreaty for workings to be shown, candidates must check their work for sense and accuracy.

Most questions proved accessible to the majority of candidates. The questions (or parts) that presented least difficulty were **Questions 2, 5, 7 9, 14** and **16(c)**.
The questions that proved to be the most difficult were **8(b), 10(c), 13, 15(c)(i)** and **18(b)**.

There did not appear to be an issue with lack of time for candidates, as the parts that were left blank were mainly those at the end of questions rather than entire questions at the end of the paper.

Comments on specific questions

Question 1

This was expected to be a straightforward start to the paper but many candidates did not understand the question and this was evidenced by many writing *S* and *A* in the vector brackets. Common incorrect answers involved reversing the x- and y- components as well as the positive and negative directions. A less common incorrect response was an answer matrix made up of the inferred co-ordinates of *S* and *A*.

Answer: $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$

Question 2

Generally this question was well answered. Many candidates correctly started their workings by writing $\frac{4}{5}$ x 30 but then tried to use their answer in a fraction by giving their answer as $\frac{24}{30}$ or $\frac{120}{150}$. Sometimes candidates gave an impossible answer of 120 goals scored out of 30 penalties.

Answer: 24

Question 3

This is one of the more complex ratio questions where the method of solution is not to start by adding the two parts of the ratio to find a total. This misunderstanding of the question led to candidates giving unrealistic answers for Ben's height. Some moved the decimal point, maybe to try to give an answer that would fit the context. Many candidates wrote (9+7) x $\frac{9}{7}$ which gives 20.57…, which sometimes had the decimal point moved to give a slightly more realistic height of 2.06. Another incorrect method was to divide 9 by (9+7). Some candidates had two or three attempts at combining the figures in various ways without choosing an answer.

Answer: 1.8

Question 4

Some candidates obtained the mark for figures 16 with the decimal point in the wrong place, showing they understood how to apply the scale but their conversion from kilometres to centimetres was incorrect. Only a small number of candidates gave the correct answer of 16. Some candidates attempted to divide 50000 by 8 or to multiply the two previous figures without any attempt at using the scale. As with the previous question, some candidates tried multiple methods to solve this question.

Answers: 16

Question 5

While most candidates answered both parts of this question correctly, there were a number of incorrect answers for each part, 10 being a common incorrect answer for **part (a)**. Another incorrect answer for **part (a)** seen was 75 which is the number of squares in the bar chart. Often the correct answer for **part (b)** 'Green', was accompanied by the frequency, 8. This did not score the mark as it was not clear if the candidate knew that the mode does not refer to the frequency.

Answers*:* **(a)** 25 **(b)** Green

Question 6

This was generally well answered but many candidates' workings showed misunderstanding of how a calculator works and the need for brackets. A significant number gave the wrong answer of 13.94… from taking the square root of 45, multiplying by 5.75, dividing by 3.1 then finally adding 1.5. There were other errors that were not to do with the order of operations, for example, often the numbers in the denominator were not added correctly or the numerator was rounded rather than being written exactly as it appeared on the calculator. Some tried to do this question by estimation.

Answer: 7.5

Question 7

Candidates answered **part (a)** well although the incorrect answer of 30 was seen (from 60 x 100 ÷ 200). In **part (b)** there were two main areas of misunderstanding. Firstly, that of converting the decimal to a correct fraction, with fractions such as $\frac{36}{10}$ or $\frac{0.36}{100}$ seen. Secondly, going on to take the square root if $\frac{9}{25}$ was reached. In the last case, although the correct answer was reached it was then spoilt so it was only awarded the mark for the conversion of decimal to fraction.

Answer: **(a)** 120 **(b)** $\frac{9}{25}$

Question 8

This was a textbook question so those that knew the formula for area of a circle gained both marks in **part (a)**. The temptation to dive straight into a question without reading it carefully must be suppressed. This question might look familiar to that in previous papers but, for example, another question might have given the diameter not the radius so there was no need to divide by 2, which a few candidates did do. Instead of the correct formula, some candidates found the circumference of a circle, the area of a semi-circle or the arc length of a quarter circle. A few candidates squared π as well as the radius and others wrote π x 50 cm^2 which did not get the method mark. Also, some candidates gave 2500 (cm^2) as their answer, omitting to multiply by π. The rubric of the question paper says to use π as 3.142 or to use the calculator's π-button so the approximation $\frac{22}{7}$ will not give an acceptable answer. There were many candidates who found the area correctly but on the answer line gave only the first three figures as if this was an attempt to give a 3 significant figure answer. **Part (b)** was far less well answered by candidates as many seemed not to be able to convert square units. It was perfectly possible for candidates to get **part (b)** correct even if the previous part was incorrect by starting again and doing the conversion to metres before finding the area.

Answers: **(a)** 7850 **(b)** 0.785

Question 9

Generally this question was answered well with nearly all candidates getting **part (a)** correct. **Part (b)** caused a few problems as some candidates gave a subset of the time, in particular 2(pm) to 3(pm) or 3(pm) to 6(pm). The correct times given in 24-hour clock were accepted, although not many chose to do this. Some gave the temperatures rather than the times. In **part (c)**, the acceptable answer of –15 was seen on a few occasions.

Answers: **(a)** 15 **(b)** 2(pm), 6(pm) **(c)** 15

Question 10

'Square' or 'trapezium' were the most common incorrect answers for **part (a)** but also answers to do with triangles were seen. In **part (b)**, 'equilateral' or 'rectangle triangle' were seen as well as other non-triangular names. **Part (c)** was the least well answered. Sometimes the correct answer of 5 was seen in conjunction with 72. This qualification lost the candidate the mark as it was not clear if they were giving an explanation or that they, in fact, did not know which answer was the required one. Often wrong whole numbers were given or various amounts in degrees.

Answers: **(a)** Rectangle or Rhombus **(b)** Isosceles **(c)** 5

Question 11

Here, the clarity of working was good if not always correct. This appeared to be an improvement on what has been seen in previous sessions. Candidates were equally split over the two ways to approach this question, that of dealing with the multiplication first or the addition. Those that chose the multiplication first sometimes forgot to multiply the second fraction but in general, these candidates scored better than those who added first. Those who tried to add first sometimes came up with the incorrect answer of $\frac{3}{7}$ from putting (2 + 1) over (3 + 4). Another error in this method was to divide by a half or to multiply the numerator and denominator by a half. Some candidates wrote the correct answer without showing any correct workings implying that a calculator had been used. Questions such as this that emphasise the need for showing working will have no marks for an answer that is not supported by correct working.

Answer: $\frac{11k}{24k}$

Question 12

Many candidates used a ruler to draw the correct line required in **part (a)**, but a significant number drew an incorrect line that passed through (0, 3). In **part (b)** there were many answers of –2.8 and 0.8 which could have been from readings at –2.75 and 0.75 and then rounding up – this was an incorrect method. This was not a question about rounding, but rather reading to the nearest grid line as they were set 0.1 apart. Giving the solutions in co-ordinate form was penalised as this was not what was asked for.

Answers: **(b)** – 2.7, 0.7

Question 13

This question could be solved in various ways but those that started by finding the total number of degrees in a hexagon were generally successful. Some candidates counted up the sides getting 5 or 7 ignoring the information that the shape was a hexagon. Another common method was unfinished rather than incorrect; many candidates wrote (360 – 180) ÷ 4 = 45 and then stopped. This only finds the external angle at the diagonal lines and so the 45 must be subtracted from 180 to find the required angles.

Answer: 135

Question 14

This is another textbook question testing algebraic manipulation. In **part (a)**, many candidates multiplied out the brackets and handled the negative signs correctly, but then instead of collecting like terms, went on to put the contents from the first brackets equal to the second and solved the resulting equation. A small number treated this as two brackets to multiply out giving a quadratic expression. In **part (b)** a fair number of candidates did the multiplication correctly and then went on to spoil it by further working, for example, multiplying the two terms together giving $6x^4$ or applying the power of 3 to the constant, 2, then subtracting 3x to give an answer of 5x. Occasionally, the first term was given as $3x^3$, $2x^2$ or $3x^2$.

Answers: **(a)** $9x – 10$ **(b)** $2x^3 – 3x$

Question 15

Part (a) was the question left blank the most in the entire paper. Some candidates gave a description of the relationship between the two sets of test marks but this was not given any credit. The mean point in **part (b)** was plotted correctly in some cases but many candidates misunderstood the vertical scale so 30.3 was often plotted at 33. **Part (c)(i)**, the line of best fit, was poorly drawn with horizontal or zigzag lines seen. There were many straight lines but they were out of tolerance. Candidates did not need to draw the line through the mean point to gain the mark but **part (b)** was supposed to be of help when drawing the line. Some candidates drew a line with positive gradient that went through the origin. Candidates should not simply join the points at the extremes of the data, the ends of the axes or force their line through the origin but rather draw a straight line that follows the trend in the plots. However, most understood they had to read from their line at 45 marks for the Mathematics test in **part (c)(ii)**.

Answers: **(a)** Negative

Question 16

Part (a) was generally well answered but not many candidates annotated the diagram, so were unable to gain the method mark for angle *ABD* if they had an incorrect answer. The most common incorrect answer was 110°, In **part (b)**, the majority of candidates obtained the correct answer for *z* but far less were able to calculate *y* and hence *t*. Some gave *y* as 90° and then followed through for *t* = 0° which was impossible. Candidates must understand that some values that are possible to calculate are, in context, impossible answers. The context here is a triangle's angles where two angles of 90° is impossible.

Answers: **(a)** 70 **(b)(i)** 80 **(ii)** 40 **(iii)** 10

Question 17

The most common error in **part (a)** was to use the wrong version of Pythagoras' Theorem. Candidates added the 3^2 to 8^2 instead of subtracting. For those who added or subtracted the squares, the taking of the square root did not cause concern. Some candidates gave 7.4 as their answer so only gained two marks as the instruction in the rubric is to give inexact answers to 3 significant figures. However, some candidates did not recognise this as a question using Pythagoras' Theorem but simply multiplied 8 by 3. The question was set up so that **part (a)** and **part (b)** are independent and can be done in either order. Use of the cosine ratio did not involve the answer to **part (a)** but the use of sine or tangent needed **part (a)** to be correct to get both marks for the angle. Candidates that found the height as greater than 8 m, giving an impossible triangle, did not receive a follow through mark if they used sine or tangent in **part (b).** However, if candidates made a calculation error rather than method error so that the height of the ladder above ground was less than 8 m, a follow through mark was available. Some candidates truncated their answer or missed out a digit and so did not get the accuracy mark. A few candidates had their calculators working in radians or grads instead of degrees.

Answers: **(a)** 7.42 **(b)** 68.0

Question 18

Part (a) involved simple interest but some candidates used compound interest. Some candidates gave ($)575 as their answer. This only gained the method mark as the answer was spoilt. **Part (b)** caused problems when candidates tried to remember or use the complex interest formula. The use of the formula is unnecessary and a year by year calculation of compounded interest was what was expected. After Andy's total interest amount had been found, candidates were expected to find how much more interest he had than Lucinda. Candidates who calculated that Lucinda had a greater amount of interest should have realised that they had made an error. Some candidates did not do the subtraction and stopped after the calculation of the interest. The final answer was often spoilt by early rounding.

Answers: **(a)** 75 **(b)** 3.81

MATHEMATICS

Paper 0580/12

Paper 12 (Core)

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 were many very creditable, well written scripts. Presentation of the work was generally fairly clear and working where shown could generally be followed. However, clear presentation must always be stressed as this will enable the candidate to present a good solution and help the marker to see where method marks can be awarded even when the final answer is incorrect.

Sometimes the more straightforward questions were answered poorly, in many cases due to candidates not reading questions correctly. The attachment to diagrams, NOT TO SCALE' means that angles should not be measured or assumed to have values that they appear to be close to. However, the diagrams are such that they are a realistic representation of the lengths and angles stated. Hence, candidates should realise for instance that a clearly small obtuse angle should not be equal to an angle approaching 90°.

The 'showing all your working' instruction means that just simply working on a calculator and stating the answer will not get credit. Correctly rounding numbers to required or appropriate accuracy would have improved the marks of many candidates.

Higher marks would be gained if candidates looked at the answer they had found and thought about whether it was a sensible response to the question. For instance in **Question 15** an answer of 113 metres per second is hardly the speed of a cruise ship but is the result of a slip in dividing by 360 instead of 3600. This error could easily be rectified by considering the inappropriateness of the answer.

Comments on specific questions

Question 1

The vast majority of candidates got this question correct. The main error was to omit the negative sign, though a few candidates went 5 degrees higher.

Answer. –2

Question 2

This was the more straightforward currency conversion question since it simply required multiplication. Although some candidates divided by 0.796, the vast majority did the correct calculation. Some rather carelessly missed the decimal point out of the answer or gave 95.5 instead of the exact amount.

Answer. 95.52

Question 3

Few candidates understood what was required in this question. Of those who did understand, 34 was the usual response, which gained 1 mark. A long list was often seen but this rarely led to the correct answer. Many thought that a specific time (17 30 take away 09 00 most common) was the answer rather than a number of journeys. This question was a clear case of candidates not checking for a reasonable answer, some in the hundreds or even not integers.

Answer. 35

Question 4

Many candidates gained 1 mark on this question, usually for showing the items changed correctly to decimals. This demonstrates the value of showing working even if the answer is not quite correct. Many felt that 1.2 was the smallest since it had the least number of decimal places while 0.166 and 11.5 were often seen for 1.166 and 1.15 respectively.

Answer. $\frac{9}{8} < 115\% < 1\frac{1}{6} < 1.2$

Question 5

This standard ratio question was well answered by most candidates. Errors made were 12×8, $\frac{12}{5} \times 8$ or $8 \times \frac{5}{12}$. A few candidates worked out $12 \div 8$ without completing the question.

Answer. 7.5

Question 6

While most candidates understood cube root, there were a considerable number of responses of 9.80, the square root. Otherwise the main errors were not observing the required rounding and multiplying the calculator answer by 10 or 100.

Answer. 4.58

Question 7

Most candidates understood standard form, though there were a number of responses indicating no knowledge of it. Some omitted the decimal point. Also 734×10^6 occurred a significant number of times for part **(a)**. Quite a number of candidates rounded both these numbers to 2 significant figures.

Answers: **(a)** 7.34×10^8 **(b)** 5.87×10^{-4}

Question 8

Upper and lower bounds continues to be a topic that many candidates find difficult. Adding and subtracting many different values were seen, commonly 5, 50 or 5000. Some misunderstood the inequality symbols and gave values the wrong way round. Quite a number of responses were values not in the order of 400 000.

Answer. $399\,500 \le P < 400\,500$

Question 9

Both parts of this question were quite well done. In part **(a)** a common error was to assume that 3^0 was equal to 3. As a result an answer of 18.75 was common. Part **(b)** was done a little better than part **(a)** although dealing with a negative index caused some difficulty. Since the value was asked for, the common responses of $\frac{1}{6.25}$ and $\frac{4}{25}$ did not score the mark. An answer of –5 was occasionally seen.

Answers: **(a)** 6.25 **(b)** 0.16

Question 10

This angles question was quite poorly answered, in particular part **(b)**. The common incorrect answer in part **(a)** was 25° due to candidates ignoring the parallel line property of alternate angles, and assuming angle *BDA* is 90°. Candidates should realise that, with the first part of the question having only one mark, the information on the diagram was sufficient to find the angle required. Many answers of 70° were also offered for part **(b)**, angle y being found incorrectly from angles on a straight line with 180 – (20° + 90°).

Answer: **(a)** 20 **(b)** 65

Question 11

Forming an equation from a given situation is quite a demanding topic. Consequently many candidates struggled with this question. In many cases $5x = 75$ or an expression rather than an equation was seen in part **(a)**. Correct answers in part **(b)** were sometimes seen even when an equation was not formed in part **(a)**.

Answers: **(a)** $x + 2x + 2x + 75 = 360$ **(b)** 57

Question 12

Many candidates struggled with this fractions question. Many were seemingly confused by the incorrect response shown in the first line of the question. While the instruction to not use a calculator was not specifically given, 'show all your working' should have meant that working without a calculator was intended. However, more able candidates did use a common denominator method and made progress to at least 2 of the 3 marks available. Where working was shown, at times the addition of the common fractions was not apparent, while some added the $1\frac{3}{9}$ as well. Only a small number worked in decimals which very rarely scored any marks.

Answer. $2\frac{1}{12}$

Question 13

A considerable proportion of candidates did not know how to tackle simultaneous equation questions. Many who did the expected elimination of y gained at least the value of x. Most errors were made when both equations were multiplied to eliminate x. Very often then subtracting the y terms produced y instead of $–9y$. Candidates should realise that these questions result in solutions that are almost always integers or at worst a fraction of $\frac{1}{2}$. Very few attempted a substitution method.

Answer. $x = 3$ $y = –1$

Question 14

It was clear that very few candidates understood that relative frequency was simply the experimental probability. As a result nearly all gained just the marks for the frequency of yellow and the colour blue in part **(b)**. Strangely there were a few responses in part **(b)** that did not give the highest frequency colour.

Answers: **(a)** 13 $\frac{19}{60}$ $\frac{13}{60}$ $\frac{28}{60}$ **(b)** Blue

Question 15

Candidates struggled with this question with very few fully correct answers seen. The two processes of changing knots to kilometres per hour and then to metres per second was very demanding. Many gained a mark, usually for changing to km/h but did not get further. Many realised that they had to multiply by 1000 but then were more likely to divide by 60 or 360, or multiply by 3600 than divide by 3600.

Answer. 11.3

Question 16

Many candidates were clearly unsure about the difference between factors and multiples, resulting in many answers of 2 for part **(a)**. Part **(b)** was more successfully answered but many just found the factors 3 and 9. The answer space made it clear that a third factor was required. Although putting a factor twice was not penalised it did seem to indicate a lack of understanding of what was required. The final part was very poorly answered and only a few candidates could choose the prime number from the list of factors. Again reading the question carefully should have led to just one item and those who put 1 in addition lost the mark. Also those who put the answer as a product of primes ($3 \times 3 \times 3 \times 3$) were not answering what was asked in the question even though they showed some understanding.

Answers: **(a)** Any multiple of 56 **(b)(i)** 3, 9, 27 **(ii)** 3

Question 17

Few candidates gained full marks on this question. In part **(a)** it was more common to see $x = -2$, $y = x - 2$ or just 2 rather than the correct equation. The horizontal and vertical line equations on a grid are basic knowledge and clearly the majority of candidates did not know them. Again in part **(b)(i)** most did not know how to draw a line parallel to a given line and of those who did at least as many as drew the correct line drew a line through an incorrect point, usually (0, –2) or (2, 0).

As the equation of the given line was stated in the question it was expected that more would have given at least an equation with $3x$. Clearly equations of lines is a topic that candidates struggle with.

Answers: **(a)** $y = -2$ **(b)(ii)** $y = 3x + 2$

Question 18

Most candidates managed to work out the angle in the isosceles triangle required in part **(a)**. However, a response of 75°, seen quite often, showed complete lack of appreciation of the diagram.

The responses in part **(b)(i)** were often completely unrealistic for the number of sides of a polygon and indicated often an attempt at the sum of the angles of a polygon.

While not showing a full polygon it was expected that candidates would realise that an interior angle of the polygon was just twice 75. However, very few realised this resulting in attempts at a formula.

Answers: **(a)** 30° **(b)(i)** 12 **(ii)** 150°

Question 19

Although there were a significant number of candidates who were giving point *B* as (5, 1) most could give the correct co-ordinates. Although many did plot *D* correctly, many plotted it incorrectly, indicating that they did not understand rotational symmetry. Following an incorrect *D* it was almost certain that lines of symmetry could not be drawn. This should have indicated to candidates that an error had been made. Many lost the mark due to adding diagonal lines, presumably regarding the figure as square.

The naming of quadrilaterals is standard bookwork. However, many did not recognise a kite and the trapezium was often confused with a rhombus.

Answers: **(a)(i)** (1, 5) **(ii)** *D* at (5, 2) **(iii)** $x = 3$ and $y = 3.5$ drawn **(b)** Kite Trapezium

Question 20

The common error when identifying the mode is to give the highest frequency. It was more common however to see both Petrol and 40 which could not be awarded as it could not be determined which was the mode. Finding the angle in part **(b)** was more successful but often a percentage, rather than an angle, was found. Once again careful reading of the question was not always done.

There was generally a good response to part **(c)**, though the change to simplest form was often ignored or incorrect. Some decimal answers again showed that 'a fraction in its simplest form' was ignored.

Answers: **(a)** Petrol **(b)** 72° **(c)** $\frac{1}{10}$

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

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

Overall presentation was clear and mostly working was shown where necessary.

A general error was on approximations and conversions to decimals where candidates often lost marks by not showing a sufficient number of significant figures.

Less able candidates lacked knowledge of factorisation and some basic formulas and there were questions omitted that really should have had at least an attempt from all candidates. As usual, careful reading of what the questions asked was not always evident.

Comments on specific questions

Question 1

Most responses were correct and the main error was due to writing the answer as 25/30. Some candidates seemed not to understand expectation.

Answers: 25

Question 2

(a) Some candidates were confused by the wording of the number and the number of zeros needed caught some out. 5102 was seen a few times.

(b) If part **(a)** was correct then part **(b)** was often correct. Few candidates scored the follow through mark.

Answers: **(a)** 105 002 **(b)** 110 000

Question 3

This was well answered although $-5y$ and $17y$ were seen at times. Although quite a number of candidates gained just 1 mark it was rare to see no marks scored for this question.

Answers: $8x + 5y$

Question 4

(a) This was well answered although some candidates omitted this part.

(b) This was slightly less well answered, with some candidates putting in 2 sets of brackets.

Answers: **(a)** $7 \times (6 - 3) + 5$ **(b)** $8 - 6 \times (4 - 1)$

Question 5

Those candidates who showed the decimals generally got the 2 marks. Some attempted to change to decimals but did not use enough significant figures to distinguish. Those who scored no marks had often not shown any working. The least able candidates found this question challenging.

Answers: $\frac{11}{21}$, 52.4%, 0.525, $\frac{111}{211}$

Question 6

Many candidates scored full marks but the vast majority gained at least 1 mark. Common incorrect answers were 80 and 800, as some were confused by centilitres and millilitres. Another common incorrect answer was 13, from 12.5 rounded, by those who had incorrectly divided.

Answers: 8

Question 7

In this straightforward ratio question few errors were made. 240 ÷ 7 and 15 × 7 was seen and a few candidates clearly did not know how to tackle the question.

Answers: 112

Question 8

(a) This was generally correct. The main error was to give 213 or to give more than one answer.

(b) This was generally correct. The main error was to give more than one answer.

Answers: **(a)** 211 **(b)** 216

Question 9

Although this question was well answered some candidates misread the instructions and gave the profit instead of the selling price. A small number of candidates divided by 1.15.

Answers: 138

Question 10

This pair of simultaneous equations needed no multiplication but many were determined to eliminate y, often resulting in an error. Less able candidates struggled with this question. Several had found $y = 5$ but then substituted $x = 5$ to find the other value.

Answers: (x =) –3 (y =) 5

Question 11

Although many correct responses were seen, many candidates did not appreciate the best first step of clearing the denominator. Quite a few omitted this and others used trial and error, nearly always unsuccessfully. Another common error was to multiply the numerator by 2 as well as the right hand side.

Answers: 3.5

Question 12

(a) Provided candidates knew what standard form was, their answer was nearly always correct.

(b) This part was not so well answered with a variety of incorrect responses seen for the upper bound.

Answers: **(a)** 1.28×10^5 **(b)** 128 500

Question 13

The most accurate answers came from those candidates using the compound interest formula. Some candidates however still do not appreciate the difference between simple and compound interest, resulting in an answer of 880 seen quite often. Other errors made were such as forgetting to add the total interest on i.e. giving the answer of 82 or adding the second year's interest to 800 rather than 840.

Answers: 882

Question 14

The factorising was well done by more able candidates but some showed no idea of what was required, producing single term answers. A small number of candidates managed to earn 1 mark for extracting either the 5 or the h.

Answers: $5h(g^2 + 2j)$

Question 15

This was generally well answered although some candidates multiplied instead of divided for this currency change question. The accuracy requirement was often not observed or applied, causing a loss of a mark with 279.80 being a common answer.

Answers: 298.79

Question 16

This indices question was very well answered but quite a few candidates omitted it. Some managed to earn 1 mark for $20x^{k}$. A common incorrect answer was $9x$.

Answers: $20x^9$

Question 17

More candidates scored 1 mark than 2, usually for the figures 13. Questions with scales in this form do cause problems for many. Changing from cm to km is clearly difficult for many and some candidates divided rather than multiplied.

Answers: 130

Question 18

There was a mixture of decimals and fractions given in responses. It was intended as a fractions problem but many used decimals. That often was not complete enough for the marks. The negative indices caused problems for some. Several candidates had clearly worked out the answer using their calculators and despite the instructions "show that" and "write down all the steps of your working" in the question many did not show the necessary stages of working to earn the marks.

Question 19

(a) Most candidates managed to calculate the range even though that term was not used in the question.

(b) The calculation of the mean caused more problems due to the mixed positive and negative terms. Lack of three significant figures was very common. Candidates should always work to that level, even if the question does not specify it, regardless of what might seem a more sensible answer. In this case, with integer values, it was thought by many that 1 or 2 decimal places was sufficient, with -0.7 and -0.71 being common answers. Some didn't realise the answer was negative and omitted the negative sign.

Answers: **(a)** 5 or -5 **(b)** –0.714

Question 20

This question was well answered by some but a combined problem with two areas caused problems for less able candidates. Some used an incorrect formula for the area of the circle, often using the circumference formula, or doubling the radius. Other candidates multiplied $\pi \times 2.5^2 \times 8$ or $8^2 \times 2.5 \times \pi$.

Answers: 44.4

Question 21

(a) (i) Provided candidates interpreted the triangles as isosceles, this was well answered with few errors.

(ii) Although many correct answers were seen this was slightly less well done than part **(i)**.

(b) This was less well answered, with trapezium, rhombus, polygon and no response being seen often.

Answers: **(a) (i)** 70 **(a) (ii)** 64 **(b)** Kite

Question 22

(a) Although nearly all candidates could do the calculation, the accuracy was often not good enough to earn the mark, and less than half the candidates scored full marks. Three decimal places rather than three significant figures was common. 0.029 or 0.3 were often seen.

(b) This was better answered, but errors were often seen from changing to standard form.

Answers: **(a)** 0.0299 **(b)** 6.4×10^{13}

Question 23

(a) (i) The plotting of point *B* was almost always correct though (–5, –2) was seen at times.

(ii) Writing the vector was often correct with common incorrect answers $\begin{pmatrix} -4 \\ 10 \end{pmatrix}$, $\begin{pmatrix} -10 \\ 4 \end{pmatrix}$ and $\begin{pmatrix} 4 \\ 10 \end{pmatrix}$ seen quite often. A small number of candidates who had incorrectly plotted point *B* were able to correctly give *their* vector and earn the mark.

(b) This was generally well done with most understanding midpoint to work out point *D*. However, not all could then give the correct co-ordinates.

Answers: **(a) (i)** *B* at (5, –2) **(a) (ii)** $\begin{pmatrix} 10 \\ -4 \end{pmatrix}$ **(b)** (–1, –4)

Question 24

(a) Just over half the candidates scored full marks. Many candidates realised they needed to use Pythagoras' theorem, but usually added rather than subtracted. Of those who scored 2 marks, the final mark was often lost for poor accuracy with 9.7 being the common answer.

(b) Many candidates had attempted to use trigonometry but some used sin and $\frac{7}{12}$ rather than $\frac{7}{13}$, while others had used cos or tan.

Answers: **(a)** 9.75 **(b)** 32.6

MATHEMATICS

Paper 0580/21

Paper 21 (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

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability.

Questions 13 and **18b(ii)** proved to be good discriminators between the most able candidates. There was no evidence at all that candidates were short of time and almost all candidates attempted all of the questions.

Not giving answers to the correct degree of accuracy continues to be a problem. Examiners also reported that there was an increase in the number of candidates not showing any working. Candidates should be encouraged to show working at all times as this may be given credit in the event of an incorrect answer. Incorrect answers with no working usually score 0 marks.

Candidates should check at the start of the examination that their calculator is set in degree mode.

Particular Comments

Question 1

This was generally well answered, with only about a quarter of the candidates unable to score full marks on this question. Very few candidates wrote down any working and there was some evidence that those that didn't score were often prematurely rounding their working. The common wrong answer of 13.94 was due to using the wrong order of operations.

Answer: 7.5

Question 2

Most candidates knew what was required and did well on this question. Those candidates not gaining full marks either didn't write their answer in standard form or they rounded their answer to two significant figures.

Answer: 5.92×10^8

Question 3

This was one of the best answered questions on the paper. Those few candidates not scoring full marks often ignored the negative sign on cos 158. Some Examiners reported that candidates appeared not to have set their calculator in degree mode.

Answer: cos 38 sin 38 sin 158 cos 158

Question 4

This was very well answered by most candidates. The main issue was to understand that even more detailed working than normal is required when the answer is given.

Question 5

Part **(a)** was very well answered. A few candidates used the wrong formula, some didn't round correctly and others used $\frac{22}{7}$ for π which will give an inaccurate answer.

Part **(b)** was more challenging with only about a third of the candidates correctly dividing by 10000. Most candidates divided (or multiplied) by 100.

Answers: **(a)** 7850 **(b)** 0.785

Question 6

Candidates struggled with this question. Nearly half the candidates assumed that the internal angle of the polygon was 360° (or in some cases 540° or 1440°), rather than 720°. A few candidates treated the shape as a regular hexagon.

Answer: 135°

Question 7

Most candidates scored full marks on this question. The common wrong answer in part **(a)** was 65° from assuming that $OB = AB$.

Answer: $y = 80°$ $z = 40°$ $t = 10°$

Question 8

This variation question was better answered than in previous years. However still only about half the candidates seem to be able to extract the correct information from the first two sentences. Most candidates now understand the process but $v = k\sqrt{d}$, $v = k/d$ or even $v = k/d^2$ were common starting errors.

Answer: 2.81

Question 9

Part **(a)** was very well answered and with high quality drawings. The few candidates not scoring full marks drew a perpendicular through O. Part **(b)** was less well answered, with 90° as the common wrong answer.

Answer: 60°

Question 10

This question proved to be a good indicator of the candidate's ability. A question worth 4 marks should indicate to candidates that they should show as much working as possible. Weaker candidates often just completed parts of the tree diagram. The middle range of candidates generally understood what was required but made errors on the tree diagram. The most able tended to score full marks.

Answer: **(b)** 0.38

Question 11

This question was not as well answered as usual. There were large numbers of candidates squaring or finding the reciprocal of each term.

Answers: **(a)** $\begin{pmatrix} 8 & 5 \\ 20 & 13 \end{pmatrix}$ **(b)** $\begin{pmatrix} 1\frac{1}{2} & -\frac{1}{2} \\ -2 & 1 \end{pmatrix}$

Question 12

Part **(a)** was very poorly answered, with some candidates even giving a numerical value. The plotting of the mean was also poorly answered both in terms of quality and accuracy. Many candidates confused 30.3 with 33. For the line of best fit, many candidates just joined up two points, one of which was usually (20,50). Other candidates joined up every adjacent point. The final part was usually very well answered.

Answers: **(a)** negative **(c) (ii)** follow through from their line

Question 13

This whole question was very challenging for candidates. In part **(a)** more than half the candidates found $\overrightarrow{AC}$ instead of $\overrightarrow{OC}$. Candidates also had difficulty with negative signs and with correctly simplifying their answers.

Answers: **(a)** $\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b}$ **(b)** $-1\frac{1}{2}\mathbf{a} + 1\frac{1}{2}\mathbf{b}$

Question 14

Part **(a)** was very well answered. Almost all candidates knew what was required and the few errors were usually due to premature approximation, incorrect rounding to 3 significant figures or incorrect use of the calculator. In part **(b)** the 2π caused confusion and loss of marks for some. Many candidates ignored the term when squaring so that $T^2 = 2\pi(l/g)$ was a common first move. Another common error seen was $T - 2\pi = l/g$.

Answers: **(a)** 2.84 **(b)** $\dfrac{4\pi^2 l}{T^2}$

Question 15

This speed-time question was not as well answered as usual. Only the most able candidates scored full marks. Many candidates used only distance = speed x time. Those that knew that area was required had considerable difficulty dividing up the area and many candidates made incorrect assumptions about the vertical scale or tried to project parts of the graph down to the time axis. In the second part some candidates found the average of the two given speeds so that 11.5 was a common wrong answer.

Answers: **(a)** 156 **(b)** 12

Question 16

About half of the candidates were able to score well on this question. Those using the distance formula sometimes quoted it incorrectly. Some confused gradient with Pythagoras and some, using Pythagoras were unable to find the lengths of the sides correctly. In the second part more candidates were able to score some marks, generally for finding the gradient.

Answers: **(a)** 3.61 **(b)** $y = \frac{1}{2}x + 2\frac{1}{2}$

Question 17

Overall, this question was reasonably well answered by at least ¾ of the candidates. Some candidates however just multiplied the functions in part **(a)** after substituting for x. In part **(b)** some candidates had difficulties in dealing with the order of operations. In part **(c)** many tried to use the quadratic formula, despite the simplicity of the factorisation.

Answers: **(a)** ½ **(b)** $\sqrt[3]{(x-1)}$ **(c)** 1, 2

Question 18

Parts **(a)** and **(b)(i)** were extremely well answered. The errors seen were usually inappropriate rounding of the fraction. Conversely part **(b)(ii)** was more challenging with most candidates not recognising the sequence U_n. In part **(c)** most candidates did not compare the sequence V_n with the one in part **(a)** and tried to generate their own from first principles.

Answers: **(a)** 4324 **(b)(i)** 4, 9 **(ii)** $(n + 1)^2$ **(c)** $\frac{2}{3}n(n + 1)(2n + 1)$

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 continued to be an issue this year. 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.

There were a significant number of candidates who did not use the available working space in the answer booklet to show the necessary calculations for obtaining their answers. When there is only an incorrect answer on the answer line and no relevant working the opportunity to earn method marks is lost.

Comments on particular questions

Question 1

This was one of the least well answered questions on the paper with the majority of candidates only scoring one of the two available marks for the incorrect answer of 34. Some candidates chose to list all of the bus times which must have wasted valuable time.

Answer: 35

Question 2

This question was well answered by the majority of candidates. Some candidates only partially factorised the expression and hence only earned one of the two available marks. A common incorrect answer was $a(x+y)b(x+y)$.

Answer: $(a+b)(x+y)$

Question 3

This was the best answered question on the paper.

In part **(a)**, a few candidates wrote $3^0 = 0$, hence giving an incorrect final answer of 0. Some candidates also didn't convert their improper fraction of $\frac{25}{4}$ to a mixed number.

Part **(b)** caused very few problems to candidates, although a small number chose to leave their answer as $\frac{1}{6.25}$ which did not earn the mark.

Answers: **(a)** 6.25 **(b)** 0.16

Question 4

The responses to this question were mixed. The numbers 27.5 and 28.5 were observed on the majority of scripts. Some candidates, however, then proceeded to multiply the numbers by 445 and 455. The candidates who did not use the correct figures of 27.5 and 28.5 usually used 27.5 and 28.4. Some candidates did not read the answer line carefully and gave their answers in reverse order.

Answers: 12375, 12825

Question 5

The responses to this question were mixed. Some candidates appeared to be trying to show that Jiwan was correct. Some candidates simply produced a correct answer for the sum without showing any method and hence scored zero marks since the question clearly stated that the correct working must be shown.

Answer: $2\frac{1}{12}$ with correct working

Question 6

This was well answered by the majority of the candidates. The most common error was to use direct proportion instead of inverse proportion.

Answers: 37.5

Question 7

The responses to this question were mixed. Some candidates tried to guess the answers and were usually unsuccessful. Some candidates tried to set up the two simultaneous equations but this was often spoilt by careless errors. A common incorrect answer was $a = 4$.

Answer: $a = -3, b = 4$

Question 8

Most candidates scored one mark for 22×1.852, but a significant number were unable to then multiply by $\frac{1000}{3600}$. The most common error was to multiply by $\frac{3600}{1000}$.

Answer: 11.3

Question 9

Candidates were generally more successful in part **(b)** of this question. Common incorrect answers in part **(a)** were $\sqrt{n+2}$ and $2n-1$. Some candidates wrote $\sqrt{2n}-1$ or $\sqrt{2n}-\sqrt{1}$ which are incorrect.

Answers: **(a)** $\sqrt{2n-1}$ **(b)** $\sqrt{57}$ or 7.55

Question 10

The majority of candidates made a good attempt at this question and understood what was required. A correct answer then incorrectly simplified was quite common. A common error was to miss out a step by incorrectly writing $3x+12-x+10$ and not showing $3(x+4)-(x+10)$ as the first line of working, thus losing the **M1** mark.

Answers: $\dfrac{2x+2}{(x+10)(x+4)}$

Question 11

Candidates were usually more successful with part **(a)** than with part **(b)**. The most common errors that were seen in part **(b)** were $2^{4n}\times 2^{2n}=4^{6n}$ and $2^{4n}\times 2^{2n}=2^{4n\times 2n}$.

Answer: **(a) −**3 **(b)** 1.5

Question 12

The majority of candidates demonstrated an understanding of the need to calculate areas under the graph. Many scored **M2** for a correct area for one of the cars, usually for 280. The most common fully correct answer came from calculating $\frac{1}{2}(10+4)\times 40-\frac{1}{2}\times 10\times 40=280-200=80$, with relatively few using the most efficient method of $\frac{1}{2}\times 4\times 40=80$. Of those who attempted to use the constant acceleration equations method, almost all scored zero marks.

Answer: 80

Question 13

Candidates were generally more successful in part **(a)** of this question, with the majority of candidates earning at least one mark for indicating on the diagram that angle *OCT* was a right angle.

Part **(b)** was one of the least well answered questions on the paper. The most common incorrect answer was $180+52=232$.

Answers: **(a)** 52 **(b)** 322

Question 14

This question was generally well answered in comparison to previous years. Candidates were usually able to identify the boundary lines for the region but were then sometimes unable to use the correct inequality signs. Some candidates confused the horizontal and vertical lines and gave an incorrect answer of $x\le 5,\ y\ge 2,\ y\ge x$.

Answers: $y\le 5,\ x\ge 2,\ y\ge x$

Question 15

Part **(a)** was generally well answered. The most common error was to use $\left(\frac{5-1}{2}, \frac{5-2}{2}\right)$ or $\left(\frac{5+2}{2}, \frac{5+1}{2}\right)$.

Part **(b)** was not as successful. Common incorrect answers were $\begin{pmatrix} 3 \\ 4 \end{pmatrix}$ and $\begin{pmatrix} 1 & 5 \\ 2 & 5 \end{pmatrix}$.

Part **(c)** was generally well answered with the majority of candidates producing an accurate construction. Only a small number of candidates did not show the necessary construction arcs and hence only earned one of the two available marks for their correct line.

Answers: **(a)** $\left(3, 3\frac{1}{2}\right)$ **(b)** $\begin{pmatrix} 4 \\ 3 \end{pmatrix}$ **(c)** perpendicular bisector of line AB

Question 16

In part **(a)**, indecision about what was the mode led to many candidates offering both Petrol and 40 on the answer line.

Part **(b)** was generally well answered. The most common error was to calculate $\frac{12}{60} \times 100$.

Part **(c)** was one of the best answered questions on the paper although some did not give the fraction in its simplest form. A common error was to write $\frac{6}{60} = \frac{1}{6}$.

Answers: **(a)** Petrol **(b)** 72 **(c)** $\frac{1}{10}$

Question 17

This was one of the least well answered questions on the paper.

In part **(a)(i)** many candidates either didn't simplify their – **a** + **c** + 4**a** or incorrectly simplified it to 5**a** + **c**.

In part **(a)(ii)** the position vector of *M* was often incorrectly stated to be ½ of part **(a)(i)**.

In part **(b)** a number of candidates offered no response. Whilst many indicated *D* was on *CB*, some did not appreciate it was ¾ *CB*.

Answers: **(a)(i)** 3**a** + **c** **(ii)** $2\frac{1}{2}$**a** + $\frac{1}{2}$**c** **(b)** *D* marked $\frac{3}{4}$ way along *CB*

Question 18

Many candidates made a good response to part **(a)** of this question. For those who did not provide the answer in the correct format, it was common to see 250000 in the answer space. Many who did not progress this far, gained credit through part values. However a number of incorrect answers were presented which gave no evidence as to where the candidate's figures came from.

Part **(b)** was not as well answered as part **(a)**. Many candidates tried to perform multiple steps in one line and thus couldn't earn method marks when they had made an error. Some candidates gave their answer in an unfinished format i.e. $\frac{\frac{1}{w^2}}{L}$ which lost them the third mark.

Answers: **(a)** 2.5×10^5 **(b)** $C = \frac{1}{Lw^2}$

Question 19

Part **(a)** was well answered by the majority of candidates. Only a few didn't show the correct construction arcs.

In part **(b)** many candidates could determine the gradient of the line *BC* and use $y = mx + c$ but many found difficulty when determining the value of c.

Part **(c)** was not as well answered as the first two parts of the question. Many of the candidates did not use the fact that the triangle was right angled and isosceles and could progress no further than writing down 6.5 = ½ x base x height. Occasionally an answer of 3.6 was seen with no working and thus scored zero marks.

Answers: **(a)** correct bisector through $\left(3\tfrac{1}{2}, 3\tfrac{1}{2}\right)$ **(b)** $y = 1\tfrac{1}{2}x - 5$ **(c)** 3.61

MATHEMATICS

Paper 0580/23
Paper 2 (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

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 are showing evidence of good work in ratio, percentages, standard form and simultaneous equations. Candidates particularly struggled this year with their algebraic manipulation namely factorising, rearranging formulae and adding algebraic fractions (**Questions 11**, **15** and **18** respectively).

Not showing clear working and in some cases any working remains a problem. 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 were giving their answers to the correct degree of accuracy than in previous years, although this was still an issue with some candidates. Premature rounding part way through calculations caused problems when it came to final accuracy marks, particularly in **Questions 8**, **19**, **21** and **22**. It is important to work to at least 4 significant figures in interim working in order to obtain the final answer correct to 3 significant figures.

Candidates should check their answers are sensible. In particular in **Questions 6**, **12**, **13** and **23** there were a number of numerical answers given that made no sense in the given context.

Comments on specific questions

Question 1

This was generally a well answered question by nearly all candidates. A small minority of candidates found the amount Martha saved, consequently the incorrect answer 128 was occasionally seen.

Answer: 112

Question 2

This was well answered by most candidates. A common incorrect answer in part **(a)** was 213. Candidates should remember their divisibility tests when trying to identify primes. Successful candidates checked to see if the sum of the digits was divisible by 3 thus avoiding this error. In part **(b)** candidates occasionally lost a mark for an answer of 6^3, since the question had asked them to choose from the given list of numbers.

Answers: **(a)** 211 **(b)** 216

Question 3

This was one of the best answered questions on the paper. The most success came from those who subtracted the second equation from the first to eliminate x, since the number of x was the same in both equations. Some candidates preferred to eliminate y, by multiplying both equations through by constants first. These candidates tended to have more errors in their working. Some candidates used substitution methods to varying degrees of success. Candidates who made x the subject were more successful than those who made y the subject.

Answer: $x = -3 \;\; y = 5$

Question 4

The most successful candidates where those who worked in stages showing their knowledge of laws of indices clearly, rather than treat this as a calculator question, giving their answer as a fraction. Using the first stage of $\left(\frac{8}{27}\right)^{\frac{4}{3}}$ was a good starting point followed by $\left(\frac{\sqrt[3]{8}}{\sqrt[3]{27}}\right)^4$. There was evidence that candidates were trying to deal with the numerator and denominator separately i.e. $\frac{27^{\frac{-4}{3}}}{8^{\frac{-4}{3}}}$ followed by $\frac{0.0123}{0.0625}$, was commonly seen.

Answer: $\frac{16}{81}$

Question 5

Most candidates had a sound knowledge of standard form and upper bound. Occasionally in part **(a)** the incorrect answer 128×10^3 was seen arising from the common misconception that the number of zeros determines the power of 10. Also 1.28×10^{-5} was occasionally seen. In part **(b)** a common incorrect answer was 128000.5 (sometimes the 5 appeared in the units or tens column). A few candidates used an inequality sign which is unnecessary when quoting a single bound.

Answers: **(a)** 1.28×10^5 **(b)** 128 500

Question 6

Candidates performed well on this question with the most success from those using 800×1.05^2 for their method. Occasionally just the interest was given as the answer, or simple interest was calculated. In a few cases candidates demonstrated a lack of understanding of the word interest, for example 800×0.95^2 was sometimes seen. Candidates should check their answers are sensible. There were a few very large answers or very small answers which made no sense given the context of the question. For example $800^2 \times 1.05 = 672000$ or $800 \times 0.05^2 = 2$ demonstrate clearly implausible answers that were occasionally seen.

Answer: 882

Question 7

The candidates with the most success were those who used their knowledge of indices and fractions to do this question rather than using a calculator. 'Show that' questions such are these are not generally shown clearly by using a calculator. If decimals were used, this was condoned only if candidates worked to at least 4 figures of accuracy which was often not the case. Also when working in decimals it was common for candidates to miss a stage of the working out which happened less when working in fractions.

Question 8

This was well answered by many and usually answers were given to the appropriate level of accuracy (3 significant figures). The problems dealing with this question fell into three categories. Firstly, those who showed no working and rounded their answer to less than 3 significant figures or typed something wrongly into their calculator. These candidates missed the opportunity to gain a method mark by not writing down the value of the numerator and denominator. The second issue was being unable to work out the numerator. Interim working often showed $\sqrt[3]{17.1} - 1.89$ had been calculated. The third issue was that of premature rounding e.g. $\frac{2.5}{13.3} = 0.188$ or $\frac{2.48}{13.3} = 0.19$. In both cases method marks could not be awarded since it is important in interim work to use at least 4 figures in order to obtain the final answer correct to 3 figures.

Answer: 0.186

Question 9

Part **(a)** was very well answered with the occasional incorrect answer of 4 seen most often. In part **(b)** the most common errors were to confuse mean, median and mode, not rounding answers to the appropriate degree of accuracy or omitting the minus sign.

Answers: **(a)** 5 **(b)** – 0.714

Question 10

This question was generally answered well with few candidates not scoring. The best working showed the interim stage of 9.2 hours being calculated. The common misconception that 9.2 hours was the same as 9 hours 20 minutes was often seen. Those who omitted the 9.2 hours in their working, simply writing 9 hours 20 minutes on the answer line, were unable to score any method marks.

Answer: 9 h 12 min

Question 11

Approximately half of candidates scored 1 mark on this question. This was for recognising x as a factor and showing $x(p^2 - 4q^2)$ in their working or as a final answer, thus not factorising completely. Of those that recognised that further factorisation was required, the most common error, in dealing with the difference of two squares, was to write $x(p-2q)^2$.

Answer: $x(p-2q)(p+2q)$

Question 12

This question was well answered by many candidates. A common incorrect answer was 226 arising from using the first exchange rate twice. Another common incorrect answer was 795 arising from not subtracting the spent dollars. In the second case re-reading the question and checking their answer was sensible would have helped.

Answer: 225

Question 13

Approximately two thirds of candidates scored full marks on this question, recognising they needed to divide the given mass by 0.98. Some candidates did not check their answer was sensible, giving an answer smaller than 67.13 kg. The most common incorrect method was 67.13 x 1.02.

Answer: 68.5

Question 14

There was almost an even split between 0, 1, 2 and 3 marks on this question. Candidates with the most success tackled the entire question algebraically, correctly cancelling out the πr^3 appearing in both expressions. A significant number of candidates were unable to round 66.6666... correctly to 3 significant figures. It was common to see the final answers: 66, 67, or 66.6. Many candidates were not sure how to approach this problem without a numerical value for *r*. They went on to substitute their own chosen value for *r* showing the answer for that case. Some candidates were unable to write down the correct expression for the volume of a cylinder. Examples of incorrect expressions that were seen are $2\pi rh$ (curved surface area of a cylinder) and $\frac{1}{3}\pi r^2 h$ (volume of a cone). Some candidates found the percentage of the cylinder not occupied by the sphere.

Answer: 66.7

Question 15

This question proved to be a good discriminator with many candidates unsure how to deal with the fact that *p* appeared twice in the expression. Those candidates with the most success began by subtracting *px* and then factorising the expression to ensure that *p* only appeared once. Those with the alternative starting point of dividing through by *p* first had less success. Approximately half of the candidates scored no marks at all, with many of these having expressions with *p* on both sides still. The most common wrong method was to subtract *c* then divide by *x* giving $p = \frac{ap - c}{x}$

Answer: $p = \frac{c}{a - x}$

Question 16

This was generally well answered by many candidates, with the most success arising from the starting point $t = k\sqrt{l}$, then going on to find the value of *k*. Some candidates wrote the answer to part **(a)** as $t = k\sqrt{l}$ with *k*=2 only evaluated during the working in part **(b)**. The most common errors were to use inverse variation or the square of its length instead of the square root of its length. Most candidates were then able to correctly use their formula from part **(a)**.

Answers: **(a)** $t = 2\sqrt{l}$ **(b)** 3

Question 17

Part **(a) (i)** was the best answered in this question with many understanding the notation n(R $\cap$ F). Finding n(R' $\cap$ F) was less well done. For some there was evidence of the correct figure of 4 in the correct place in the Venn diagram. These candidates had clearly not understood the notation R' $\cap$ F. Answers of 7 for **(a) (i)** and 4 for **(a) (ii)** were sometimes interchanged. Part **(b)** was not as well answered. Candidates should check values are less than 1 for probability answers. Candidates who wrote their probability answers as fractions instead of as decimals or percentages generally did better as there were no rounding issues.

Answers: **(a) (i)** 7 **(a) (ii)** 4 **(b)** $\frac{7}{13}$

Question 18

This question proved to be a good discriminator. Many candidates understood the need for a common denominator and this was the most common method mark awarded. The most frequent problems arose from dealing with the numerator. Essential brackets were regularly omitted. $(1 - x)\ (1 - 2x)\ -x(2 + x)$ appeared as $1 - x \times (1 - 2x) - x \times 2 + x$ and was consequently incorrectly expanded. Sign errors were also common and $(1 - x)\ (1 - 2x)$ was often expanded incorrectly to $1 - x - 2x - 2x^2$. Similarly $-x(2 + x)$ was often expanded to $-2x + x^2$. Incorrect cancelling between numerator and denominator was also apparent. Some candidates are unaware that cancelling can only take place between common factors on numerators and denominators.

Answer: $\frac{1 - 5x + x^2}{x(1 - 2x)}$

Question 19

The majority of candidates scored one mark or more on this question. The most successful used $\frac{1}{2}r^2\sin\theta$ for the area of the triangle and $\frac{\theta}{360}\pi r^2$ for the sector area, rounding these answers to 4 or more significant figures before subtracting. Premature rounding was the most common cause of losing the final accuracy mark. Other problems arose from not using $\frac{1}{2}r^2\sin\theta$ for the area of the triangle. Many candidates split the isosceles triangle into two right-angled triangles and used trigonometry to find heights and lengths and then used $\frac{1}{2}bh$. The majority who did this prematurely rounded these values, compounding errors in subsequent calculations. Additionally candidates using $\frac{1}{2}bh$ often did not show working clearly and it was difficult to follow methods.

Answer: 4.32

Question 20

Part **(a)** of this question was one of the least successfully answered in the paper. In **(a) (i)** the question asked for the order of matrix **NP**. However some candidates calculated the matrix **NP** instead. Other common incorrect answers were 1 × 2, 2 × 1 and 1 × 1. For **(a) (ii)** some candidates did not take into account that the answer is a 1 × 1 matrix and consequently the essential brackets were often omitted. Other common incorrect answers were (19) or the matrix **NP** or the statement that **PN** could not be found. Part **(b)** was generally answered with more success with most candidates gaining at least 1 mark for either the determinant correctly used or the adjugate of **M** correctly found. For those who had some idea where to start, the most common cause of lost marks were due to arithmetic slips in calculating the determinant or errors in writing the adjoint matrix.

Answers: **(a) (i)** 2 × 2 **(a) (ii)** (20) **(b)** $\frac{1}{2}\begin{pmatrix} 4 & -3 \\ -2 & 2 \end{pmatrix}$

Question 21

Candidates were more successful in part **(b)** of this question than part **(a)** with about two thirds correctly able to demonstrate an understanding of bearings. Candidates with the most success in part **(a)** were those using the version of the cosine formula with cos$C$ the subject. Many candidates had not learned the cosine formula or not realised this was required. Even more candidates had learned the version of the formula commonly used to find side lengths namely, $c^2=a^2+b^2-2ab\cos C$. After substituting in the numerical values many were then unable to correctly rearrange this to make cos$C$ the subject and common errors seen were $c^2=(a^2+b^2-2ab)\cos C$ or $c^2=(a^2+b^2-2ab)+\cos C$ rearranged. Candidates are advised to either learn how to rearrange this correctly or learn both versions of the formula. A small number of candidates measured angles with a protractor, ignoring that the diagram was ‘not to scale’. Some candidates stated that they had measured or made up a value for part **(a)** specifically to answer part **(b)** showing an astute understanding of the presence of follow through marks on mark schemes. This was another question where premature rounding caused problems, for example, cos$C$=0.1 followed by C=84.3 was sometimes seen. Some candidates had correctly quoted the cosine formula but demonstrated a lack of understanding of what sides went with the appropriate letters.

Answers: **(a)** 84.0 **(b)** 136

Question 22

A wide variety of explanations were seen in part **(a)**, with the most common incorrect ones being because triangles were similar or that angles in a cyclic quadrilateral are equal. The most successful candidates in part **(b)** worked out the ratio between side lengths and used this unrounded figure correctly (squaring this ratio in **(b) (ii)**.) Premature rounding caused problems, since many candidates used 2.14 as the ratio giving incorrect final answers of 8.22 and 24.8 (to 3 significant figures). Even using 4 significant figure accuracy on the ratio gives an incorrect final 3 significant figure answer for *CX*. Candidates are advised to use the exact ratio in their calculations. Calculator memory and 'Ans' functions are useful here. Part **(b) (i)** was generally answered better than **(b) (ii)** as some forgot to square the ratio when dealing with area or attempted to use a trigonometry approach wrongly or $\frac{1}{2}bh$ wrongly.

Answers: **(a)** Angles in the same segment **(b) (i)** 8.20 **(b) (ii)** 24.7

Question 23

Candidates answered this question reasonably well with many scoring at least 1 mark in part **(a)**. The majority of candidates knew that the gradient gave the acceleration. Some were unable to deal with, or did not notice, the mismatched units. Looking out for words in bold would have helped here. Consequently the most common incorrect answer was 8 arising from 40/5. Some candidates realised they needed to convert this figure to m/s^2 and wrongly multiplied this answer of 8 by 60 giving an incorrect answer of 480 m/s^2. Considering whether this answer was sensible or not could have helped here. Another common incorrect answer was 0.13. Reading the general rubric at the beginning of the paper and the accuracy requirements required throughout would help here. Part **(b)** was also reasonably well answered with many realising they needed to calculate the area under the graph for the total distance and that this needed to be divided by the total time. Most chose to use the area of the triangle plus the area of the rectangle rather than finding the area of the trapezium. There were continuing issues with the units, with $\frac{500}{15\times 60}$ being the most common incorrect method seen.

Answers: **(a)** 0.133 **(b)** 33.3

MATHEMATICS

Paper 0580/31

Paper 31 (Core)

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

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 all questions. Very few candidates omitted part or whole questions. The standard of presentation was generally good. There were occasions when candidates did not show clear workings and so did not gain the marks available. This was particularly important in the two questions that required candidates to "show that", where explicit workings were required to earn full marks. Candidates should be encouraged 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. 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 the correct equipment should be emphasised, and, when constructions are involved, candidates need to understand the requirement to leave clear construction lines visible to score full marks

Comments on specific questions

Question 1

This question was generally well answered by candidates of all abilities. Most candidates were able to attempt all parts.

(a) This was generally correct although some candidates gave varying numbers of zeros after the figures "25".

(b) This was well answered. The two that were sometimes in the wrong order were the 65% and $\frac{2}{3}$ where there was no evidence of the candidate converting to a decimal.

(c) Many candidates scored full marks. A common error was to divide 50 by 200 giving 25%. 80% was also sometimes given as a solution.

(d) (i) This was very well answered.

(ii) This was also very well answered. Many candidates gained at least 1 mark for "120" as the size of the required sector either in their working or on the diagram.

Answers: **(a)** 25 000 000 **(b)** $0.6 < 65\% < \frac{2}{3}$ **(c)** 20% **(d) (i)** 30 **(ii)** 40

Question 2

This question discriminated well between candidates of differing abilities.

(a) This was well answered. Common incorrect answers were 15×10^1, 0.15×10^3 or the answer given in words.

(b) This was generally correct. A common error was dividing 150 by 90 giving 1.6…, the speed in km/min.

(c) This was also generally correct.

(d) Many candidates calculated 2.5 hours correctly, but common errors were to then add on 2 hrs 50 mins or to add on 2.15.

(e) There was some confusion by candidates with some giving correct answers, but reversed. Answers of 140 and 160, 140.5 and 150.5, 149.5 and 150.4 were seen.

Answers: **(a)** 1.5×10^2 **(b)** 100 **(c)** 2 hours 15 mins **(d)** 16:25 **(e)** $145 \le d < 155$

Question 3

This was generally well answered, but some candidates were uncertain as to the definition of which numbers were required in each part. The most common error was in distinguishing between "even" and "prime", and "mean" and "median". Candidates should be clear on mathematical definitions. The statistical questions showed improvement on previous sessions.

(a) (i) The definition of "even" was not understood by some.

(ii) This was well answered, although some candidates seemed to think that "prime" means "odd".

(iii) This was very well answered. A few candidates gave the answer 6 or 6^2.

(iv) This was also very well answered with most solutions coming from the given list.

(b) (i) The mean was generally calculated accurately with many showing clear workings.

(ii) The median was well attempted with many candidates showing an ordered list. A common incorrect answer was 45, being the centre value from the given list.

(iii) Many candidates understood the concept of range but left their answer as "45 – 10".

(c)(i) This was generally well answered. Those candidates who converted their answer into a decimal or percentage did not always give sufficient decimal places. There were not many who gave their answers as ratios, but some who attempted a percentage did not give the "%" sign.

(ii) This was generally well answered, as above.

Answers: **(a)(i)** 36,10 **(ii)** 29,41,13 (any 2) **(iii)** 36 **(iv)** 45,15,10 (any 2) **(b)(i)** 27 **(ii)** 29 **(iii)** 35
(c)(i) $\frac{2}{7}$ **(ii)** $\frac{3}{7}$

Question 4

This question proved challenging for many candidates, There was a requirement for accuracy and full workings to demonstrate understanding. Candidates should be encouraged to show unambiguous working i.e. explicit use of multiplication and division signs.

(a) (i) This was generally well done. The most common error was dividing 100 by 0.70.

(ii) This was less well done. Candidates often gave 1.1(0) but did not show sufficient working to gain method marks. Other common errors resulted from multiplying instead of dividing.

(b)(i) Candidates generally understood what was required, but some gave the answer as CHF 15.60 instead of $15.

(ii) This required candidates to show an explicit method to demonstrate the "show that". The method demanded two clear steps of a multiplication and a subtraction (in either order) with clear evidence of where the commission figure came from if it was not the $15 from the previous part. Many candidates gained a mark for an implied multiplication, but did not show it explicitly.

(c) This proved challenging. Many did not start from the CHF1544.40 given in the previous question – CHF1560 was a common starting point. Some added back the commission instead of deducting it. Many candidates earned a mark for an implied or explicit division by 1.04.

Answers: **(a)(i)** 70 **(ii)** 1.11 **(b)(i)** 15 **(ii)** (1500 – 15) x 1.04 **(c)** 561.92

Question 5

This question considered straight-line graphs.

(a) Candidates often had some idea how to find the gradient, but were confused as to how to do it exactly. The mark scheme allowed for some indication of y step/x step, but candidates did not always make it clear which values of x and y they were considering, and there were often inconsistencies e.g. $(y_2 - y_1)/(x_1 - x_2)$. Some candidates managed to get to a correct numerical answer but gave it as positive instead of negative. Difficulty reading the scale on the axes was also seen.

(b)(i) This was generally well done with many correct tables seen.

(ii) Candidates gained marks for the three points from their table plotted correctly. Those with the correct line often just joined those three points in the first quadrant. This meant that in the next part they did not have a point of intersection to read from the graph. Candidates should take note of the range provided in the question and understand the concept of continuity of graphs.

(c) Many candidates did not understand the link between the graph and this part of the question. Many attempted to solve the simultaneous equations algebraically, with varying degrees of success. Those who had not drawn the line long enough in the part above still sometimes managed to get this correct.

Answers: **(a)** $\frac{-4}{3}$ **(b)(i)** 3,2,6 **(c)** x = -2, y= 4

Question 6

This construction question challenged many candidates. They should be encouraged to leave in all construction lines. There was confusion between angle bisector and perpendicular bisector. Many diagrams were within the accuracy tolerances.

(a)(i) This was generally well done by those who attempted the diagram. Candidates who did not leave in the construction arcs could not score full marks.

(ii) Candidates were able to measure an angle accurately, but some gave *ABC* instead of *BAC*. Misreading the protractor as 133 was a common error.

(iii) This was quite well done by those who understood the term angle bisector.

(iv) Candidates were able to measure the length *AT*, but some did not understand where *T* should be placed.

(v) Again this was well done by those who understood the term perpendicular bisector.

(vi) This was not well done. Candidates shaded various regions, sometimes including the correct one. However if they did not clearly identify which region they were identifying they did not earn the mark.

(b) (i) This part of the question proved challenging. Candidates were able to draw line *PQ* as 8 cm but the angle was often incorrect. A common error was drawing the line on a bearing of 050º.

(ii) Again candidates could draw *QR* as 6 cm but its orientation was often not correct, sometimes due to inaccurate measurement but often because it was drawn in completely the wrong direction e.g. up above *Q*.

(iii) Candidates who understood the context of the question seemed able to measure *PR* and apply the scale factor. The most common error was 40 + 30 = 70, with no concept of direction.

(iv) There were very few candidates who gained this mark. Those who attempted it generally gave an answer of less than 180º. Understanding of bearings seemed lacking in many cases.

Answers: **(a)(ii)** 47^{o} **(iv)** 4 **(b)(iii)** 35 –37 **(iv)** 264 - 268

Question 7

The first three parts of this algebra question were generally well done. The “show that” part required explicit clear working which was often missing.

(a) Many candidates scored a mark for expanding a bracket correctly. Those that did not go on to score full marks found the manipulation challenging, particularly regarding negative values, in particular 2x – 3x.

(b) This was reasonably well done. Those who did not score often subtracted “a” instead of dividing by it.

(c) This was well answered, often without working. Some took the cube root of 54 before dividing by 2, and others cubed 2 and then divided 54 by 8.

(d) (i) A number of candidates did not seem to understand what was expected of them. They worked backwards from 6x – 10, or missed out stages. Some candidates drew the rectangle, put on the expressions but did not go on to show how they added together to get the perimeter.

(ii) A number of candidates did not start from the 6x – 10 in the previous part, so did not get to the correct answer. A large number simply calculated 50 divided by 4 to get the answer 12.5.

Answers: **(a)** –6 www **(b)** $\frac{3-b}{a}$ **(c)** 3 **(d)(ii)** 10

Question 8

This transformation question proved challenging for many candidates.

(a) Most candidates understood that only a single transformation should be given, but a large number did not give the correct answer of “translation”. “Translocation” is not acceptable, and reflection was a common incorrect answer. Of those candidates who did identify translation, many did not give a correct vector, either giving no answer, co-ordinates, or incorrect numbers.

(b) Many candidates drew the line correctly. Those that did not drew y = 2, lines that were too short, or dotted. A line defined by an equation should be continuous.

(c) (i) Candidates could generally draw a correct reflected shape but often did not locate it correctly.

(ii) Candidates could draw the shape the correct size but again did not always locate it correctly. A number reflected it as well as enlarging it and some used the scale factor “-2” or just turned it upside down.

Answers: **(a)** Translation $\begin{pmatrix} 0 \\ -6 \end{pmatrix}$

Question 9

Candidates made a good attempt at this question.

(a) This was generally well done. Most common errors were to combine the elements to give the answer $15x^2$ or to partially factorise, such as $3(x^2 + 4x)$ and score part marks.

(b) This was generally well done. A common incorrect answer was –4 from 8–12. Many candidates who showed working scored a mark for $2^3 = 8$, but some had difficulty squaring -2.

(c) This was generally well done. Common incorrect answers were $5x^7$ and 6x.

Answers: **(a)** $3x(x+4)$ **(b)** 20 **(c)** $6x^7$

Question 10

This question on area and volume challenged those who did not read the question carefully and who did not understand the difference between area and volume.

(a) Most candidates recognised that they needed to use Pythagoras' theorem, and very few tried other methods. The most common error was to calculate 25–4 = 21, and then take the square root. Many candidates would then gain the mark for giving their answer to 1 decimal place. Many candidates who applied Pythagoras' theorem correctly left their answer as 5.39 so did not earn the last mark.

(b) The area of the triangle was often calculated correctly, but then candidates would go on to add it to or multiply it by another number – often 2, presumably relating to each end of the prism. Sometimes the volume of the prism was found in this part. Those that showed working gained some credit for showing how to calculate the area of a triangle.

(c) Many candidates followed through correctly from their **part (b)**, although some did start again and calculated 10 x 5 x 2. Some candidates calculated it from the beginning and picked up marks even if they had not earned marks in **part** (**b)**.

(d) This question was challenging. Many candidates did not add together five faces, or did not use their answers in **parts (a)** and **(b)**. Some multiplied together all the dimensions and others added them. Those who showed workings generally earned one mark for three faces added together. The most common face to be omitted was 2x10, and other errors included 3 x (10 x 5.4) or 3 x (10 x 5). Candidates that worked through the faces individually seemed to get the correct answer more often.

(e) This was generally well done with candidates taking their answer from **part (d)** and multiplying it by 2.25. The most common error was to divide by 2.25, and the most common incorrect answer was 5 (faces) x 2.25 giving 11.25.

Answers: **(a)** 5.4 **(b)** 5 **(c)** 50 **(d)** 134 **(e)** 301.50

Question 11

The first three parts of this sequence question were well answered. The second three parts involving the algebra proved more challenging for candidates.

(a) The diagram was generally correctly drawn.

(b) The table was generally correctly completed.

(c) Most candidates answered this correctly.

(d) This was not so well answered. Many gave $n + 5$ or $n = 5n + 1$.

(e) Candidates often gained this mark either by following from their answer in **part (d)** or by starting again, although 500 was a common incorrect answer.

(f) This was well answered even by candidates who did not score in **part (d)**. As the number was quite low, candidates followed the sequence to reach 66. Not many followed through from **part (d)** to use an incorrect formula to solve the equation.

Answers: **(b)** 16,21,26 **(c)** 41 **(d)** 5n + 1 **(e)** 501 **(f)** 13

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key Messages

To succeed in this paper candidates need to have completed full syllabus coverage, apply correct methods, 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. The standard of presentation and amount of working shown was generally good. In particular candidates showed improvement in their drawing of curves. However there were occasions when candidates did not show clear working and so did not gain the method marks available. This was also particularly important in **Question 2b** that required candidates to “show that”, where explicit working was required to earn full marks. Candidates should be encouraged 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. 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 to answer the question set. The use of the correct equipment should be emphasised, and, when constructions are involved, candidates need to understand the requirement to leave clear construction lines visible to score full marks.

Comments on specific questions

Question 1

All candidates attempted this question with many scoring well. However candidates do need to be aware of the difference between a time of 15 35 and a time interval of 15 hours 35 minutes.

(a) (i) This was generally correct although common errors were 15 75 (from the incorrect 16 20 – 45), and the aforementioned 15 hr 35 mins.

(ii) Although the majority of candidates were able to reach 4 20 a significant number could not be awarded the mark due to the common error of omitting the pm and/or writing 4 hr 20 mins.

(b) (i) This was generally well answered.

(ii) This was well answered although the common error was in using an incorrect number of adults and/or children. A number of unrealistic answers were seen.

Answers: **(a)(i)** 15 35 **(a)(ii)** 4 20 pm **(b)(i)** 16 **(b)(ii)** 96

Question 2

This question tested the knowledge and use of percentages, fractions and decimals.

(a) This was generally well answered although common errors were incorrect rounding, and the incorrect use of 23000/11000. A common incorrect answer was 47.8%. Three figure accuracy was required.

(b) This required candidates to show an explicit method to demonstrate the "show that". The method demanded two clear steps of a percentage calculation and a subtraction with clear evidence of where the figures came from. The alternative method of (100 – 32) / 100 x 11000 was rarely seen.

(c) Many candidates were able to score full marks by succinct use of the correct formula. Full marks were also scored by those using a year on year method but sometimes marks were lost by premature rounding, giving the interest payable only ($813.21), or giving just the third year's interest ($280.45). A significant number used simple interest only.

(d) (i) This was generally well answered.

(ii) This was also generally well answered.

(iii) This was generally well answered particularly on a follow through basis.

(e) Very few correct ratios in simplest form were seen. However the majority of candidates were able to score the method mark by writing a correct ratio though not in its simplest form, often 2/5:9/20:3/20. A small number started again with 4400:4950:1650 but again rarely were able to give the simplest form. A significant number simply changed the order to 0.15:0.4:0.45.

Answers: **(a)** 52.2 **(c)** 8293.21 **(d) (i)** 4400 **(ii)** 4950 **(iii)** 1650 **(e)** 8 : 9 : 3

Question 3

Candidates demonstrated a good understanding of transformations. Candidates could improve by recognising how many pieces of information are required to fully describe a particular transformation. Candidates were less successful on the use of vectors in part **(a)**, with a small yet significant number unable to attempt this part.

(a) (i) This was generally well done although errors arose with the use of directed numbers, multiplication rather than addition, and giving the answer as a 2x2 matrix.

(ii) This was less successful even on a follow through basis. (+/- 5, +/- 6) were common incorrect answers.

(iii) Few candidates appeared to appreciate that the required answer was the inverse vector to the one given in part **(i)**. A further common error was to repeat the co-ordinates from part **(ii)** as a vector.

(b) (i) The majority of candidates were able to correctly identify the transformation as an enlargement but were less successful in stating the necessary scale factor and centre of enlargement.

(ii) This was generally correct although a common error was to reflect in the line y = 0.

(iii) This was generally correct although common errors were to rotate about 90 degrees or to rotate about a different centre of rotation.

(iv) Candidates were generally able to identify the required transformation as a reflection but often omitted or incorrectly named the line of reflection. Follow through marks were awarded in this part. There would appear to be some confusion over the terms y=0, x=0, x-axis and y-axis.

Answers: **(a)(i)** $\begin{pmatrix} -2 \\ -4 \end{pmatrix}$ **(ii)** (1, -2) **(iii)** $\begin{pmatrix} 2 \\ 4 \end{pmatrix}$ **(b)(i)** Enlargement, scale factor 3, centre (0,0)
(iv) Reflection in y = 0

Question 4

This question tested the use of algebraic techniques and was generally answered well although a significant number did not appreciate the terms used, with less able candidates often appearing to attempt to solve equations.

(a) Generally candidates were able to correctly expand at least one of the brackets and were able to gain a method mark if clearly shown in their working. However the correct collecting of like terms proved more of a problem for a significant number. Other common errors included $3 \times 2x = 5x$, $6xy - 5xy$, $11x + 8y$, $11x - 8y$ and $11x = 2y$.

(b) Candidates appeared to struggle more with this expansion. Common errors included $3x^2 - 2x^2y$, $3x^3 - 2xy$, and $3x^3 = 2xy$. A significant number spoiled a correct expansion by attempting to collect like terms together.

(c) This was generally well answered although a number only gave a partial factorisation. Common errors included $2y(2y-10x)$, $6xy$, $6xy^3$, and $2y=5x$.

(d)(i) This was also generally well answered although common errors included -12, $-3^2 = -9$, $4 \times -3^2 = -12^2$, and $4(-3)^2 = 4 - 3^2$.

(ii) Changing the subject of the formula given proved more challenging although more able candidates were able to score full marks by showing clearly the 3 required operations. A significant number substituted a value for y, usually 12. Less able candidates simply swapped the *x* and *y* terms. A number were able to demonstrate some understanding of the process but made errors such as $4x^2 = 3y$ leading to $x^2 = 3y - 4$. Incorrect positioning of the square root sign led to a number losing the final method mark.

Answers: **(a)** $11x - 2y$ **(b)** $3x^3 - 2x^2y$ **(c)** $2y(2y - 5x)$ **(d)(i)** 12 **(ii)** $x = \sqrt{(3y / 4)}$

Question 5

This question proved challenging to many candidates. Candidates need to recognise the use of trigonometrical methods and understand how to calculate angles in geometric situations. Some candidates did not provide answers to all or some parts of the question.

(a) Those candidates who recognised the application of the tangent ratio were generally successful although some were unable to proceed further than $\tan 22 = h/140$ whilst a small number used the sine or cosine ratio in error. Common incorrect methods included the application of Pythagoras' theorem with the values of 22 and 140, and simply 140 +/- 22.

(b) The majority of candidates applied the correct formula of S = D/T but many were unable to give the correct answer in the required units of km/ h. Common errors were 1850/3.3, 1850/210, 1850/330, and a time value/1850.

(c)(i) This part was not answered well with many candidates not appreciating that all that was required was 12000 m – 8300 m. A common error was to take the height of 12000 as the distance *AB* and to apply Pythagoras' theorem to find *BC*.

(ii) This part was also not answered well with many candidates not appreciating that use of the sine ratio was required. Common errors included the use of the cosine or tangent ratio, Pythagoras' theorem, and 180 – 37.

Answers: **(a)** 56.6 **(b)** 529 **(c)(i)** 3700 **(ii)** 14.3°

Question 6

This question proved challenging to a number of candidates. Candidates need to recognise the use of formulae and understand how to calculate lengths, areas and volumes in geometric situations. Candidates also need to appreciate the follow through nature of such questions as this. Some candidates did not provide answers to some parts of the question.

(a) (i) This was generally answered well although the common error was to use 16 x 30 rather than ½ x 16 x 30. Other common errors included 16 + 30, 16 x 30 x 24 and the attempted use of Pythagoras' theorem.

(ii) Many candidates did not appreciate the use of **part (i)** in calculating the volume of this prism and consequently (their **part (i)**) x 24 was rarely seen. Common errors included 16x30x24 and 16+30+24.

(b) (i) This was generally answered well with the use of Pythagoras' theorem recognised by the majority of candidates. However common errors were $16^2 + 30^2$, and omitting to take the square root.

(ii) Many candidates did not appreciate what was required in this part and very few fully correct solutions were seen. Clear working was needed to show the calculation of the circumference of the coin, the division of their length *BF* from **part (i)** by this value, and the truncation of this value to give the correct integer value for the number of complete turns as required. Common errors included division by the radius, diameter or area, 34 x/+/- 1.6, and leaving their answer as a decimal number.

(c) A significant number of candidates appeared unfamiliar with the concept of a net and were unable to answer this part. Of the three marks available the mark for the triangular face was earned the most followed by the mark for the smallest rectangular face. Many drew the face *BCEF* the same size as the base of the prism, even in cases when *BF* had been calculated correctly. Some candidates simply omitted this face when drawing the net. There were a small number of disjointed faces and also a few cases of all triangular faces drawn.

(d) Many candidates did not appreciate that the net drawn in **part (c)** could be used to find the surface area of the wedge. Few fully correct answers were seen. Many incorrect answers simply based their answers on the perimeter of the net or the perimeters of the individual faces of the wedge. Other common errors included treating the wedge as a cuboid and using 16 x 24 x 30, calculating the triangles by 16 x 30, and not using the scale of the grid when using a "counting squares" method.

Answers: **(a)(i)** 240 **(ii)** 5760 **(b)(i)** 34 **(ii)** 6 **(d)** 2400

Question 7

Candidates in general understood how to complete tables and draw and use graphs. The standard of drawing was very good with few straight line or thick curves observed. A small minority of candidates plotted points but did not join them. This caused problems in answering later parts of the question.

(a) (i) The table was generally completed accurately.

(ii) This was generally answered well with the majority of candidates able to produce correct and carefully drawn curves. Common errors were in plotting (-4,-4.5) and (4,4.5).

(iii) This was generally answered well although a number of candidates did not use their graph and made calculation errors, commonly 3.6, 90 or -90. Common errors from using the graph included 3.6, -4.4 ("wrong side" of -4), and -3.8 (wrong scale).

(b) (i) This was generally answered well although a few errors appeared by miscalculating the y-value when x=-3.

(ii) This was generally answered well although common errors included drawing a freehand line, and only drawing two line segments crossing the curve. A small yet significant number were unable to attempt this part.

(iii) This was generally answered well although answers in this part often highlighted candidates who were misreading the scales on the axes, omitting negative signs, and reversing the co-ordinates.

Answers: **(a)(i)** -3, -6, 9, 6, 2 **(iii)** -3.7 to -3.5 **(b)(i)** -3, 9
(iii) (2.2 to 2.5, 7.5 to 7.8), (-4.0 to -3.7, -4.8 to -4.5)

Question 8

This question on the use and application of statistics was generally well answered although a number of candidates were confused between mean, median and mode.

(a) This was generally answered well although a number of candidates did not attempt this part.

(b) (i) Those candidates who calculated the mean of the rainfall usually did so correctly although common errors of incorrect addition, incomplete addition, incorrect rounding, incorrect method involving **(**18 x 67 + 18 x 48 + ……)/ 1018 were seen.

(ii) Those candidates who calculated the median of the rainfall usually did so correctly although common errors of not ordering the data, incorrect or incomplete ordering, and incorrect rounding were seen.

(c) (i) The scatter diagram was generally answered well with the majority of candidates able to correctly plot all the given points. A small number had problems with the scale resulting in a couple of the points being incorrectly plotted.

(ii) The line of best fit was generally drawn well with the majority able to draw a correct line with a ruler, long enough and within the bounds accepted. However a significant number joined point to point or drew freehand lines or curves.

(iii) The correct “negative” response was given by most candidates although a full range of incorrect terms, names and expressions were seen.

Answers: **(a)** heights drawn at 11,13,15,16 **(b)(i)** 84.8 **(ii)** 81.5 **(c)(iii)** negative

Question 9

Candidates showed some understanding of construction. They could improve their answers by showing all of their construction lines and arcs clearly and visibly.

(a) This was generally answered well with the constructed line within the bounds of accuracy required. However a number drew the line by measurement rather than construction. To obtain full marks the four construction arcs needed to be clearly visible and correctly placed.

(**b) (i)** The construction of the required locus was not so well done with a number of candidates not appreciating that the perpendicular bisector of *BC* was required. A common error was to join points *B* and *C* to *L* or simply join *B* to *C*. To obtain full marks the four construction arcs needed to be clearly visible and correctly placed. The point *P* was not always marked or understood.

(ii) It was rare to see an answer to the distance *AP* within the required range possibly due to the lack of understanding or significance of the point *P*.

(iii) This was generally well answered on a follow through basis although common errors included their *AP* from **part (ii)** x10, x100 or ÷3.

(iv) Again this was poorly answered due to the problems previously mentioned. Many responses were in fact acute angles.

(c) (i) This was generally well answered if attempted although common errors included incomplete circles, circles with an incorrect radius and circles with an incorrect centre. Circles should be drawn with a pair of compasses and need to be clearly visible.

(ii) Few correct answers within range were seen, again possibly due to problems encountered earlier in the question.

Answers: **(b)(ii)** 10.8 to 11.2 **(iii)** 32.4 to 33.6 **(iv)** 155 to 165° **(c)(ii)** 41 to 44

Question 10

The concept of sequences was well understood by the vast majority of candidates. Working out the value of lower position terms in a sequence was seen as straightforward. However, the ability to determine and use n^{th} term formulae was less evident.

(a) (i) This was generally well answered.

(ii) This was generally well answered although a common error was 59 coming from 51 + 8.

(iii) This was generally well answered although a common error was 19 coming from 14 + 5 and not recognising the incremental differences.

(iv) This was generally well answered although common errors were 1/6 and 0.

(v) This was generally well answered although common errors were 30 and 24.

(b) (i) This was generally well answered.

(ii) Many candidates were not able to write down an expression for the n^{th} term for this sequence. Candidates would benefit by understanding the ways in which n^{th} terms are generated. Common errors were +7, n + 7 and a variety of numerical answers.

(c) Many candidates recognised the need to substitute the value of 50 into the given expression but a significant number made a calculator error of 2500 + 150/2 = 2575. Other common errors included using an incorrect value for n, often 20, and making numerical slips particularly when attempting to calculate all 50 terms.

(d) This was generally well answered although common errors included 12^2 = 144, 2 x 12 = 24, 1024, 2048 and 8192. Efficient use of a calculator may have avoided some of these errors.

Answers: **(a)(i)** 30 **(ii)** 43 **(iii)** 20 **(iv)** 0.125 **(v)** 32 **(b)(i)** 65 **(ii)** 7n – 5 **(c)** 1325 **(d)** 4096

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. In particular candidates showed improvement in their drawing of curves. Few instances of joining points with straight lines were evident. There were still a few instances of candidates rubbing out construction lines and/or working in questions, losing marks for themselves. Candidates should be encouraged 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. Candidates need to be aware of the correct way to convert answers from, for example, grams to kilograms.

Comments on specific questions

Question 1

All candidates attempted this question with many scoring well.

(a) This part was generally well answered with most of the candidates scoring full marks. Occasionally a candidate lost marks due to giving answers to two significant figures instead of three.

(b) (i) Candidates understood that they had to add their five values and many correct answers were seen.

(ii) Although candidates understood that they had to subtract their previous answer from 10, several lost the mark because they just gave an answer of 0.5 or 0.50 instead of 0.53.

(c) (i) This was generally well answered. The most common error was to assume that there are 100 minutes in an hour.

(ii) This was also generally well answered with the majority of candidates understanding the required ratio. However, a common error was to not express it in its simplest form with many leaving it as 18:45.

(d) Many candidates gave the correct answer. Working would have been useful here as a number of candidates just gave the rounded answer of 35 with no working to show where it had come from.

Answers: **(a)** 1.64, 3.60, 1.68 **(b)(i)** 9.47 **(ii)** 0.53 **(c)(i)** 10 31 **(ii)** 2:5 **(d)** 34.9

Question 2

The majority of candidates had a good understanding of statistics. There is some confusion over the methods for calculating mean, mode and median with many candidates losing marks for interchanging, for example, the calculations for the mean and the mode.

(a) (i) The range was generally well found. The most common error was to write 9 - 20 instead of 11. A few candidates wrote down 3 or 12 – 15 which appears to be an attempt at the range of the middle two numbers.

(ii) Although a large majority of candidates gave the correct answer, many others calculated the median instead.

(iii) This part was not answered quite as well as the previous part. Common errors included finding the median without ordering the data or rounding the answer to a whole number.

(iv) Many candidates gave the correct answer. A common error was to miss out one of the terms when adding, or incorrectly adding. If candidates showed working they could gain part marks.

(b) (i) The table was generally completed accurately.

(ii) The majority of candidates understood how to interpret data as a pie chart. When a pie chart was drawn most of the candidates labelled the sectors correctly. In a few cases incorrect angles were drawn.

(c) Although a clear majority of candidates scored full marks there was a sizeable minority who did not answer this part. A common error was to not give the answer in its lowest terms. Common incorrect answers seen were 3/12 and 3/5.

Answers: **(a)(i)** 11 **(ii)** 15 **(iii)** 14.5 **(iv)** 14 **(b)(i)** 3, 2 **(c)** $\frac{5}{6}$

Question 3

Candidates showed that they can draw and interpret travel graphs. However, they would benefit from reading the question carefully to identify what distances are required and to show their working especially in part **(c)**.

(a) Most candidates gave the correct answer.

(b) Again most candidates gave the correct answer. Half of those who did not, gave the distance from Bruce's home at 09 20.

(c) Candidates understood the need to divide the distance by the time. However, the majority of them did not carry out one or other of the necessary conversions in the distance (metres to kilometres) and/or in the time (minutes to hours).

(d) Many candidates drew the correct graph. Those that did not draw the correct graph, the majority made a mistake in the line representing the journey from the park to Bruce's home with many finishing at the end of the graph (10 15 instead of 10 10).

Answers: **(a)** 5 **(b)** 150 **(c)** 1.8

Question 4

Candidates demonstrated a good understanding of transformations. Candidates could improve by recognising how many pieces of information are required to fully describe a particular transformation.

(a) (i) Many candidates gave the correct answer. A few reflected the shape in the wrong line.

(ii) Again many candidates gave the correct answer. Some candidates gave answers where they rotated clockwise about *C* and others rotated anticlockwise or clockwise about the reflection of *C*.

(b) (i) Some candidates gave the full correct answer. A greater number made a mistake in the column vector, the common error being mistakes in the signs.

(ii) Few candidates scored full marks with the vast majority only giving two of the three pieces of information needed to describe an enlargement. Common incorrect answers seen for the scale factor were 2 and $-\frac{1}{2}$.

Answers: **(b)(i)** Translation $\begin{pmatrix} -9 \\ -1 \end{pmatrix}$ **(ii)** Enlargement, centre (0,0) scale factor $\frac{1}{2}$

Question 5

This question proved challenging for many candidates. Candidates need to understand how to calculate angles in geometric shapes and the relationship between different angles in such shapes. Some candidates did not provide answers to all or some parts of the question.

(a) (i) Many candidates gave the correct answer. A common error was to find the interior rather than exterior angle.

(ii) About half the candidates recognised that the lines were parallel. Of these a small majority could give the correct reason. There was a large number of candidates who gave an incorrect statement such as perpendicular or similar, or did not provide an answer.

(b) The correct answer was often seen. Candidates could improve by recognising that a tangent and radius form a right angle.

(c) Again the correct answer was often seen. A common incorrect answer was 9.

Answers: **(a)** 104 **(a) (ii)** Parallel, correct reason **(b)** 36 **(c)** 18

Question 6

Candidates in general understood how to complete tables and draw and use graphs. The standard of drawing was very good with few straight line or thick curves observed. A small minority of candidates plotted points but did not join them. This caused problems in answering later parts of the question.

(a) Many candidates completed the table correctly. The most common error was to give y=4 at x= -2.

(b) This was generally well drawn.

(c) (i) Most candidates understood the concept of line of symmetry.

(ii) If a line had been drawn in the previous part the correct answer was often seen. The common incorrect answer seen was y=1.

(d) Candidates understood how to use a graph to solve an equation. In some cases candidates attempted to use the quadratic formula when they had not drawn a graph. The most common error was to misread the scale.

Answers: **(a)** -4, ... 4, ... 4,... -4 **(c)(i)** x=1 drawn **(ii)** x=1 **(d)** -1.4 to -1.1, 3.1 to 3.4

Question 7

Candidates showed an ability to read a bar chart but could improve their answers if they showed working when calculating the mean.

(a) Almost every candidate completed the table correctly.

(b) Generally correct answers were given.

(c) Few candidates gave the correct answer. Some candidates lost marks because they did not show any working. The most common error was to calculate the mean shoe size ignoring the frequency giving an answer of 4.75.

Answers: **(a)** 5, 8, 7, 6, 4, 5 **(b)** 40 **(c)** 4.538

Question 8

Candidates showed some understanding of construction. They could improve their answers by showing all of their construction lines clearly and differentiating them from the sides of the triangle, angle bisector etc. Some candidates drew the triangle *ABC* and did not complete any other parts of the question.

(**a)** This was generally well done. Some candidates only used very short arcs in their construction which were difficult to see against the lines drawn for the sides of the triangle.

(b) (i) A small majority of candidates gave the correct construction. The most common error was to draw the angle bisector using a protractor.

(ii) Candidates who had drawn an angle bisector measured a length although some were inaccurate.

(c)(i) Nearly all candidates performed the same in this construction as in the previous one in **part (b)(i)**.

(ii) Although many candidates measured the correct angle even more measured the acute angle instead of the obtuse angle or left the answer blank.

(d) Some candidates did show that they understood how to find the region. This was the least successful part of the question with many just shading any part of the triangle, and on occasions, almost hiding answers to other parts of the question.

Answers: **(b)(ii)** 4.2 **(c)(ii)** 130^0

Question 9

Generally candidates showed a reasonable understanding of volumes. They were less able to demonstrate an understanding of the surface area of a 3D shape. Candidates could improve their answers by thinking carefully about how many faces a 3D shape has and how to convert from one set of units to another.

(a) (i) Many correct answers were seen. The common incorrect answer seen was 1500.

(ii) Candidates understood the necessary calculation and many gave the correct answer. The most common errors were to divide by the density and/or incorrectly converting from grams to kilograms.

(b) (i) A good majority of candidates showed this by using Pythagoras' theorem. Some candidates attempted to use trigonometry but tended to make mistakes and to make premature approximations.

(ii) This part proved challenging for many candidates. The most common error was to not include all of the five surface areas. However, many successfully obtained the total cost for their surface area.

Answers: **(a)(i)** 750 **(ii)** 0.72 **(b)(ii)** 64.80

Question 10

Candidates clearly demonstrated an understanding of the concepts required in this question. However, they could improve their answers by reading the question carefully and taking full account of the wording, especially those words in bold.

(a) (i) Many correct answers were seen.

(ii) Although some candidates gave the correct answer the majority gave pw as the answer, missing the fact that the total distance was required.

(iii) This part proved more challenging. Candidates understood that they needed to divide a distance by a time but did not recognise that the total time was required.

(b) (i) Many candidates gave the correct answer.

(ii) The correct answer was often seen. The most common error was to incorrectly re-arrange the formula.

Answers: **(a)(i)** 1200 **(ii)** $1200 + pw$ **(iii)** $\frac{1200 + pw}{15 + p}$ **(b)(i)** 96 **(ii)** 7

Question 11

The concept of sequences was well understood by the vast majority of candidates. Working out the value of lower position terms in a sequence was seen as straightforward. However, the ability to determine and use n^{th} term formulae was less evident.

(a) The vast majority of candidates gave the correct next term in all four sequences.

(b) Many candidates were not able to write down an expression for the n^{th} term in either sequence. Candidates would benefit by understanding the ways in which n^{th} terms are generated.

(c) (i) Many candidates gave the correct answer.

(ii) Many candidates gave the correct answer. A common error was to substitute 592 for n instead of making the n^{th} term equal to 592.

(iii) The correct answers were sometimes seen. Many candidates did not see the correct pattern of terms in the entire sequence but used a pattern from a few consecutive terms to give answers.

Answers: **(a)** 36, 48, 25, 24 **(b)(i)** n^2 **(ii)** n^2 -1 **(c)(i)** 25 **(ii)** 85 **(d)** 8192, 2097152

MATHEMATICS

Paper 0580/41
Paper 41 (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

Overall this paper proved to be accessible to most of the candidates. Most candidates were able to at least attempt all questions and solutions were usually well-structured with clear methods shown using the working space provided on the question paper. The questions/parts of questions on arithmetic (percentages, ratio etc.), drawing and interpreting cumulative frequency graphs and calculating an estimate of the mean, and drawing graphs of functions were very well attempted. The parts of questions involving percentage depreciation, surface areas and volumes of frustums, general trigonometry in a context, transformations and use of upper and lower bounds in calculations proved to be the more challenging areas.

Candidates appeared to have sufficient time to complete the paper and omissions were due to difficulty with the questions rather than lack of time. The use of at least three significant figure accuracy unless specified was noted by most candidates with only a few approximating answers early, mainly in parts of questions 1, 2 and 6 involving % loss, the use of the quadratic formula and general trigonometry. It should be noted that any answers or figures in working given to two significant figures will not result in method marks being awarded unless a clear correct method is also shown.

Candidates generally followed the rubric instructions in respect to the values to use for π although a few used $\frac{22}{7}$ or 3.14 in **Questions 4** and **9(c)** which could result in final answers that are outside the required accuracy.

Comments on specific questions

Question 1

The first part of this question was well answered on the whole by the majority.

(a) (i) Most candidates were successful in working out Jasmine's share of the cost of the car as $4950. A few gave answers of $4050 by calculating 45%.

(ii) Many were successful in reducing the ratio of the payments to its simplest form. Some gave a reversed ratio however and others only partially simplified. Those starting from 45 and 55 were more successful in reaching the simplest form than those starting from 4050 and 4950.

(b) The ratio question was very well answered and candidates usually scored all three marks. There were occasional misreads of the amount of money, $2256, to be divided and only a few that did not understand the proportional division method required and incorrectly attempted $2256 ÷ 8, $2256 ÷ 3 and $2256.

(c) (i) Many candidates were well prepared for this part, and a few recognised that the depreciation could be calculated using a multiplier of 0.77 to the power 3. The majority however chose a three stage calculation and most of those using this method were successful with only a few losing accuracy.
The most common misunderstanding was to find 69% of $15000 and then to subtract it from $15000.

(ii) This part discriminated achievement and rewarded candidates who showed a clear method to find the percentage loss. Those that had incorrectly answered the previous part were given full credit for answers that followed from their value of the truck in part **(c)(i)** provided there was no ambiguity shown in the working. Many formed a correct fraction and were able to show the conversion to a percentage. Some did not give the percentage loss but gave the percentage of the value of the truck e.g. 45.7% instead of 54.3%. There were a substantial number of candidates who did not show sufficient working for this part. This was particularly the case for some of those who intended to divide their answer to part **(c)(i)** by $15 000. A typical example is as follows:
15 000 –100
6850 –*x*
If this is followed by the correct figures such as 45.65 then the method could be implied and the candidate awarded two marks in this case. However if the answer is given as 45 or 45.6, for example, then no marks are earned whereas if the candidate had written down $\frac{6850}{15000}$ = 45 (or 45.6) then a method mark is earned. It is important for candidates to understand that a clear, explicit step must be given if method marks are to be earned. Examiners will not imply method marks for the candidate from figures given to less than three significant figures.

Answers: **(a)(i)** 4950 **(ii)** 9: 11 **(b)** 1504, 564, 188 **(c)(i)** 6847.99 **(ii)** 54.3

Question 2

This question proved challenging to some, with only a few candidates fully successful in all four parts.

(a) Most attempted an algebraic solution to the inequality and many arrived at $-1 < x \le 3.5$. Many appeared not to understand that this was not the required answer as the question asked for integer solutions to the inequality. There were occasional errors in the algebra with either the lower or upper limit of the inequality.

(b) This produced a range of responses with a number of candidates arriving at the simplified answer and showing a clear method with the numerator and denominator correctly factorised before cancelling the common factors. Some attempted to factorise but made sign errors e.g. $(x - 5)(x - 5)$ was a common error for the denominator. Weaker candidates attempted to cancel the terms in x^2 without factorising.

(c) (i) A full range of responses was seen to the verification of the quadratic equation, $3x^2 - 13x - 8 = 0$. Most attempted to find a common denominator for the fractions $\frac{5}{x-3} + \frac{2}{x+1}$ and were able to show this successfully. Some lost the equation aspect at this stage and focused entirely on the left hand side of the equation arriving at $\frac{7x-1}{(x-3)(x+1)}$. The majority reaching this stage retained the right hand side of the equation and then multiplied by the denominator to remove the fraction and were able to expand the brackets correctly and reach the required equation without any errors seen.

(ii) The use of the quadratic formula was recognised by many in this part. Most were able to recall the formula correctly with only a few choosing to use the completing the square method. Some were very clear in their working ensuring all signs were shown carefully and the full division line in the fraction was shown. This was not always the case however and candidates should note that care needs to be taken with the substitution of the correct coefficients including the correct signs, and the division needs to be clearly shown as a numerator all over a denominator. Credit is given for correct answers but as these can be obtained entirely from a calculator, it is important that candidates also show complete correct working to score full marks. Common errors included the evaluation of $(-13)^2$ within the discriminant and a short division line used in the formula.
Many candidates were able to obtain the correct solutions but fewer of them rounded correctly to 2 decimal places as required and answers of 4.88 and –0.546 or 4.87 and -0.54 were common errors.

Answers: **(a)** 0, 1, 2, 3 **(b)** $\frac{x-2}{x-5}$ **(c)(ii)** 4.88 and – 0.55

Question 3

This question was generally well answered on the whole.

(a) (i) The majority understood the term 'modal class' and were able to express the answer correctly. A few gave incorrect answers of 1.65 (the mid-interval value of the modal class) or 45 (the frequency).

(ii) This part was very well answered by the majority who were well prepared for an estimated mean question and showed clear use of the products of the frequencies with the mid-interval values and then division by the sum of the frequencies.
Some common misunderstandings were using the upper or lower class boundaries instead of the mid-interval value for the calculation. Others found $\sum fx$ correctly but then divided by 6 which was the number of intervals instead of the total frequency. A few found the sum of the mid-interval values and then divided by 6.

(b) (i) This was answered very well and all candidates used either a fraction, decimal or a percentage to record the answer.

(ii) This was much more challenging and although many candidates showed a correct probability in their working for the first girl being 1.8 metres tall or less, the probability that the second girl chosen was 1.8 metres tall or less was often incorrect, with errors such as $\frac{114}{120}$, $\frac{113}{120}$ or $\frac{114}{119}$. Many recognised the need to multiply the two probabilities although others chose to add. Some candidates worked with the probabilities as decimals and in those cases, it is important to show at least three significant figure accuracy to score both method and accuracy marks.

(c) (i) This was well answered. Most candidates were able to complete the cumulative frequency table correctly. A small number appeared to make arithmetic errors in the addition e.g. 85 instead of 95.

(ii) The cumulative frequency graph was invariably drawn well with correct plots and either a curve or ruled sections between the points. There were a few incomplete curves with either the first or last sections omitted.

(d) (i) This was also very well answered. Almost all candidates recognised the median as the 60th value and were able to read it accurately from the graph.

(ii) This was less well answered. Those that recognised the 30th percentile as the 36th reading on the cumulative frequency were accurate with the reading. Many candidates read from the 30th value on the cumulative frequency however.

Answers: **(a)(i)** $1.6 < h \le 1.7$ **(ii)** 1.62 **(b)(i)** $\frac{6}{120}$ **(ii)** $\frac{2147}{2380}$ **(c)(i)** 95, 120 **(d)(i)** 1.61 to 1.63
(ii) 1.555 to 1.57

Question 4

Candidates generally found this question challenging, and this along with **Question 6**, was the least well answered question on this paper.

(a) (i) This was answered well by only a few. Most did not recognise the similar cones, using the heights 12 cm and 20 cm to obtain the radius of the larger cone. Many others attempted a similarity calculation but with 8 cm and 20 cm. Some incorrectly used a circular argument, for example using 4.5 cm to calculate the slant height of the large cone as 20.5 and then reversing the calculation to give 4.5 cm.

(ii) A number recognised that the volume of two cones should be calculated with the volume of the smaller cone to be subtracted from the volume of the larger one. A common error was to use a height of 8 cm for the smaller cone however or to confuse the radius of 2.7 cm with 4.5 cm. Many were able to score a method mark for calculating the volume of the larger cone but this was often the only mark earned. The most common error was to treat the frustum as a cone and to calculate $\frac{1}{3}\times\pi\times4.5^2\times8$.

Candidates should also note the instruction on the rubric for values of π and use either the calculator value or 3.142.

(b) (i) There were a range of methods shown to justify the slant height, *s*, as 8.2 cm. The most common ones included using Pythagoras' theorem with 8 cm and 1.8 cm or using Pythagoras' theorem to find the slant heights of the larger and smaller cones before subtracting. Some found the slant height of the larger cone as 20.5 cm and then applied a scale factor of 0.4. In questions like this, where the solution is given, it is very important that candidates show every step of their working. Some who chose Pythagoras' theorem lost marks by not explicitly showing the square root stage of the calculation. There were some errors with some of the dimensions seen e.g. 8 cm was used with 2.7 cm on occasions which resulted in an answer greater than 8.2 but was then 'rounded down'.

(ii) There were a few excellent answers finding the curved surface areas of both cones before subtracting. Candidates found this part very challenging generally however. Some attempted to find the curved surface areas of the cones but used the vertical heights of 20 cm and 12 cm and not the slant heights. The most common error was similar to part **(a)(ii)** where the frustum was treated as a cone with an attempt to find the curved surface area using a slant height of 8.2 cm or even 8 cm.

A few calculated the entire surface area of the cone rather than the curved surface area.

Answers: **(a)(ii)** 332.3 to 332.6 **(b)(ii)** 185.45 to 185.51

Question 5

(a) Over half of the candidates were able to find all three values correctly. The first value was sometimes given as 5.5, –1 or –3 and the final value was occasionally given as –3.5 or 5.5.

(b) The majority were able to plot the points correctly. The common errors included omitting a point around the maximum or minimum area, or misplotting (0, –1) at (0, 1) or the origin. The majority of graphs were good curves but a minority still clearly use a ruler to join pairs of points together for which the curve mark is not awarded.

(c) (i) Many were successful at reading the *x* – values at three intersections of their graph with the line $y = 0.5$ although a few chose the wrong horizontal line such as $y = 1$ or $y = –0.5$ from which to read the *x* - values.

(ii) Only the most able candidates realised the *y* - values above and below the maximum and minimum points of their graphs corresponded to the *k* values for the function to have one solution only. A generous range was allowed for those that may make a slight misreading of the graph and a follow through was allowed from an incorrect curve. Some were successful with one of the inequalities required but for the majority the values appeared to be guesswork.

(d) (i) The drawing of the straight line produced a range of responses. The most successful candidates appeared to select two or three points to calculate then plot and join them with a ruled line. Some used the fact that the *y*- intercept of the line was the point (0, –2) and that the gradient of the line was 3. These candidates were in the minority however. Many candidates attempted to work out multiple points using the *x*-values from the table in part **(a)**. There were often one or two values incorrectly calculated resulting in a non-straight line when plotted. This should have alerted candidates that an error had been made but many demonstrated a lack of understanding of the nature of the graph of the form $y = mx + c$.

(ii) There were some excellent solutions where candidates showed the transformation of the equation to the required form and made no errors. The most common error for those attempting this part was to only multiply the right hand side of the equation by 2 when removing the fraction and to ignore the terms '–3*x* – 1' on the left hand side.

(iii) This part rewarded those that recognised the solution was the intersection of f(x) and the line $y = 3x - 2$ and had drawn accurate graphs in both parts **(b)** and **(d)(i)**. Accuracy of the lines did affect a number of candidates who gave answers outside the required range.

Answers: **(a)** 1, -1, 3.5 **(c)(i)** – 2.2 to – 2.1, – 0.65 to – 0.45, 2.5 to 2.7
(ii) (k <) –4 to –3.7 and (k >) 1.7 to 2 **(d)(ii)** – 12, 2 **(iii)** 0.1 to 0.2 and 3.3 to 3.4

Question 6

This question using trigonometry was well done in some parts by some candidates but many found the question challenging.

(a) The majority recognised the use of cosine rule to show that the length *AC* was 135 m.
Most recalled the explicit version of the formula for finding sides accurately while a few gave the angle version of the cosine rule. The angle version of the formula does present difficulties for candidates in that they then have to rearrange the terms correctly to find the required side.
Although most were able to earn the method marks by correctly substituting the lengths 95 m and 120 m and the angle 77° into the cosine formula, fewer were able to earn both of the accuracy marks for the question as they went straight to the answer 135 m without giving a more accurate value e.g. 135.26.. . This more accurate value was required as candidates were asked to justify the answer given to the nearest kilometre. In questions where the answer is given, it is important that candidates show every step of their working including a more accurate value than the answer provided to ensure full marks.

(b) This was started well with the clear use of the sine rule which was usually correctly rearranged to find the acute angle *ABC*. Accuracy was often good here with only a few candidates rounding the decimal before finding the inverse sine. It is recommended that each step is shown in working to ensure that method marks can be awarded where there is premature rounding affecting the answer. Many, having obtained the acute angle as 48.5°, struggled to relate this to the obtuse angle required in the question. A common error was to subtract 26° and 48.5° from 180°, others subtracted from 360°. A few weaker candidates did not use trigonometry and used 180° – 77° presumably falsely regarding the shape as a cyclic quadrilateral. There were a small number of fully correct solutions.

(c) This proved to be the most challenging part of the question. Many recognised that the straight path would form a right angled triangle with the nearest point on the road *AC.* The common error for many was to see triangle *ABC* as isosceles and to use the length 67.5 m as the base of the right angled triangle before attempting a Pythagoras' theorem calculation. Some incorrectly used the angle 26° with the length 79 m. Some having found the acute angle only in the previous part used this to obtain the angle *BAC* as 105.5° and then attempted to use right angled trigonometry and did not appreciate that a right angled triangle was not possible with this angle for *BAC*. There were a few excellent answers however that found angle *BAC* using the answer to part **(b)** and then used the sine ratio with the length 79 m to calculate the length of the path.

(d) There were a number of excellent solutions where candidates calculated the area of the triangle *ACD* using the trig area formula or an equivalent method, before dividing this area by 180 and truncating the answer to an integer. The best solutions showed every step in working including accurate answers to the division before truncating. A common error was seen in calculating the area of the triangle where ½ base times slant height was sometimes used. Another error was in interpreting the answer to the division by 180 correctly where some candidates rounded their answer to the nearest integer rather than truncating given the context of the question.

Answers: **(b)** 131 **(c)** 30.2 to 30.5 **(d)** 30

Question 7

This question on transformations produced a full range of responses and use of the appropriate terminology varied.

(a) (i) The majority of candidates were able to describe the transformation as a reflection and although most recognised the mirror line as a horizontal line midway between shapes *A* and *B* there was difficulty for some in using the correct equation to describe it. Many were successful but a number gave the equation as $x = -2$ and a number did not attempt to give the mirror line. In each of parts

(a)(i), **(ii)** and **(iii)**, it should be noted that if candidates give more than one transformation when they are asked to describe a **single** transformation then no marks will be awarded.

(ii) Most used the term enlargement but some incorrectly used a term such as a ‘reduction’. The scale factor was more often given as –2 or 2. Most attempted to find the centre of enlargement but some made errors by drawing inaccurate ‘ray’ lines through the corresponding vertices and gave a coordinate close to the correct one of (1, 4). Some gave excellent answers and checked the centre by counting squares from the centre to the object and image shapes.

(iii) This was usually correctly described as a rotation and many gave the rotation as 90° clockwise. A few did not give a direction or incorrectly gave the direction as anticlockwise. The centre of rotation was obtained by some using either trial and improvement or by construction. Many were unable to find the correct centre of rotation or overlooked it.

(b)(i) There were mixed responses to this part. A number recognised the meaning of the term translation but did not understand the vector notation used. Others tried to use the vector $\begin{pmatrix} -5 \\ 2 \end{pmatrix}$ correctly but counted the small graph squares rather than interpreting the scales on the axes for the translation.

(ii) There were a number of candidates that drew the correct transformation often without any working shown. They appeared to recognise the matrix as a stretch. Others attempted a matrix multiplication with the coordinates but sometimes the method shown was incorrect with the matrix used incorrectly.

(c) This part was quite well answered. A number recognised the matrix and were able to give a full description. Some used shear rather than stretch but were able to correctly describe the factor and the invariant line. The most common error was to describe the transformation as a translation or enlargement usually following an incorrect part **(b)(ii)**.

Answers: **(a)(i)** reflection in $y = -2$ **(ii)** enlargement, scale factor ½, centre (1, 4) **(iii)** rotation 90° clockwise, around (1, – 3) **(c)** stretch, factor 2 with x-axis invariant

Question 8

All candidates were able to score some marks on this question but few answered it fully correctly.

(a)(i) This was generally well answered with good answers linking the inequality given with the maximum of 5 large coaches.

(ii) Fewer candidates were successful here. The best solutions gave an inequality in symbolic form $50x + 30y \geq 300$ before describing how division by 10 gave the required inequality. Most candidates attempted a word description which was often vague or only partially correct. Some candidates incorrectly referred to the 5 large coaches as the $5x$ part of the required inequality and the 30 candidates in each small coach as the 30 given in the required inequality.

(b) There were many successful answers showing all three lines correctly and the correct identification of the region. Most candidates were able to draw the lines $x = 5$ and $x + y = 10$ correctly, but fewer were successful with the line $5x + 3y = 30$. Common errors for that line were to draw a line joining the points (0, 3) to (5, 0) or to attempt a line through the origin through the point (3, 5) or (5, 3).

(c)(i) Answers varied here and some were successful without referring to the graph by an intuitive approach maximising the large coaches available. The most common error was to give the value 3 for large coaches and 5 for small coaches and there was little evidence that candidates had tested other points in the correct region to find a smaller cost.

(ii) The majority were able to correctly calculate the minimum cost for their number of large coaches and small coaches given in the previous part and were awarded a follow through mark here.

Answers: **(a)(i)** there are up to 5 large coaches, **(ii)** $50x + 30y \geq 300$ **(c)(i)** 5, 2 **(ii)** 2950

Question 9

The final question provided an opportunity for all to score and for the most able to demonstrate their knowledge and skills in parts **(b)** and **(c)**.

(a) (i) This was very well answered and most were able to express the correct prime factors as a product.

(ii) Many gave a common factor such as 2, 3 or 9 but fewer gave the highest common factor and a few confused the terms highest common factor and lowest common multiple, reversing their answers to **(ii)** and **(iii)**.

(iii) This was the weakest answered of part **(a)**. Some gave the product of 72 and 126 as the lowest common multiple without taking into account the common factors of the two numbers. Those attempting to use the prime factors of the two values were often successful. A few gave answers that were factors of 72 and 126 and did not understand the term lowest common multiple.

(b) Most candidates were able to score one or two marks here for an attempt to divide the circumference of the pizza by the diameter and for identifying one of the correct bounds to use which was usually 104.5 for the circumference of the pizza. Only a very small number of candidates recognised the correct combination of bounds to use for the division to obtain the lower bound for the estimate of the value of π. The majority used both lower bounds for the circumference and the diameter.

(c) There were some excellent attempts beginning with the statement $\pi r^2 h = 550$ and then proceeding correctly to find *r* from this equation. Many candidates showed a very good understanding of how to solve their equation to find *r* for which three marks were available. As in part **(b)** there was limited understanding shown of which combination of bounds should be used for the height and volume of the cylinder and only a small number selected the upper bound of the volume with the lower bound of the height to find the upper bound of the radius. Others had difficulty in obtaining the correct bound and 550.5 was a common error for the upper bound of the volume of the cylinder.
A number of candidates were unsure of the volume formula for a cylinder and began with incorrect formulae such as $\frac{1}{3}\pi r^2 h$ or $2\pi r^2 h$ or even the volume of a sphere formula for example.

Answers: **(a)(i)** 2 × 3 × 3 × 7 **(ii)** 18 **(iii)** 504 **(b)** 3.028 or 3.029 **(c)** 3.919

MATHEMATICS

Paper 0580/42

Paper 42 (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

This paper proved to be accessible to the majority of candidates. Almost all candidates were able to attempt all the questions. Well-structured answers with clear methods were shown in many cases.

As in the past, the questions/parts of questions on arithmetic (percentages, ratio etc.), interpreting cumulative frequency graphs and calculating an estimate of the mean, general trigonometry and drawing graphs of functions were very well attempted. The questions involving functions, matrix transformations, similarity, time calculations, areas and solving equations from graphs proved to be the more challenging aspects.

Candidates appeared to have sufficient time to complete the paper and omissions were due to difficulty with the questions rather than lack of time. The use of at least 3 significant figure accuracy unless specified was noted by many candidates but many candidates approximated to 2 significant figures in their working and this resulted in loss of marks. Some candidates gave all answers correct to 3 significant figures, even when the answer was exact with four figures or the accuracy required was specified in the question. Candidates should be encouraged to use all the figures in their calculator and correct to the required accuracy at the end of the calculation.

Words printed in bold, e.g. **similar** in **Question 6 (b)(i)** are intended to help candidates to think of the efficient method for that question. This was ignored in many cases and alternative methods rather than properties of similarity were attempted often unsuccessfully.

Comments on specific questions

Question 1

This was very well answered by the majority of candidates with many of the more able candidates gaining full marks.

(a) (i) The common error in this part was giving the answer as \$14.6 which scored only 2 marks since the **exact** answer was \$14.62. Some candidates evaluated 0.85 x 20 and ignored the discount.

(ii) Many candidates did not realise that \$16.40 was 82% of the original amount and found 118% or 84% of \$16.40.

(iii) There were many correct answers but the common error was to divide by 9 and multiply by 4 or 5.

(b) This part proved to be a discriminator at the higher grades as many were unable to write down the required equations. Some confused *c* and *d* and others seemed to invent new data for the question as their working had values that did not appear in the question. Some merely divided 27.10 by 4 and 34.30 by 7.

(c) The usual error was in finding the time interval with 8.56 or 15.13 often being used. Of those who did correctly find 07 30, many changed this to 7.3 for their calculation.

(d) This part was often correct. Some candidates spoiled their method by subtracting or adding \$540 to the amount they found from correctly using $P(1 + R/100)^n$.

Answers: **(a)(i)** 14.62 **(ii)** 20 **(iii)** 135 **(b)** $c = 17.50$, $d = 2.40$ **(c)** 36 **(d)** 606.74

Question 2

This question was very challenging for a significant number of candidates who were unfamiliar with the function of a function notation but well answered by those who understood it.

(a) (i) Common errors were to evaluate fh(2) or f(2) × h(2). Some candidates used $(4x - 2)^2 + 3$ but then made errors in expanding the quadratic rather than substituting $x = 2$ into this.

(ii) Many candidates had $4(\frac{2}{x} + 1) - 2$ as the correct first step. This became $\frac{8}{4x} + 4 - 2$ in many cases. The product $(4x - 2)(\frac{2}{x} + 1)$ was used by those who did not understand the notation.

(b) Many candidates substituted correctly to begin with $\frac{2}{x} + 1 = 0.2$. This often became $\frac{3}{x} = 0.2$. Some of those who correctly obtained $\frac{2}{x} = -0.8$ proceeded to spoil their solution by reaching $x = \frac{-0.8}{2}$ or -0.8×2. By far the most common error was to evaluate $\frac{2}{0.2} + 1$.

(c) This question was generally well answered. A few candidates prematurely approximated $\frac{5}{3}$ as 1.67 which gave an answer of 2.198.

(d)(i) There were many correct verifications seen. There were also elementary errors in multiplying by x to eliminate the fraction from the equation and this was the usual cause for the loss of the mark. The most successful candidates were those whose first step was to isolate the $\frac{2}{x}$ term.

(ii) This was generally well answered but the common error of omitting brackets led to $-3^2 = -9$. In some cases the division line in the formula was too short and this resulted in incorrect solutions. A number of candidates gave the answers correct to three significant figures rather than two decimal places as required.

Answers: **(a)(i)** 39 **(ii)** $\frac{8}{x} + 2$ **(b)** -2.5 **(c)** 2.2 **(d)(ii)** 1.18, -0.43

Question 3

Responses varied greatly for this question. Some candidates had problems with simple drawing of a rotation, a reflection and an enlargement, whereas others struggled with the shear and matrix transformations.

(a) This part was usually correct. Some candidates gave $y = -1$ as the mirror line.

(b) (i) Most candidates rotated correctly with only a few clockwise answers.

(ii) This was often correct but some reflected in $y = x$ and others in the x - axis.

(iii) There were a number of candidates who enlarged the triangle with the correct scale factor 1.5 but did not use the correct centre of enlargement.

(c) Some candidates answered both parts extremely well, either by the correct matrix product or by recognition of the given matrix as a shear. Other candidates had little idea of what to do in either part, showing a lack of experience with this topic.

(d) A few candidates gained full marks. Some had a correct column or row but there were many blank answers. A common error was to find the matrix for *T* onto *B*.

Answers: **(a)** Reflection in $x = -1$ **(c)(ii)** Shear, y-axis invariant with factor 1 **(d)** $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

Question 4

There were rather varied responses to this multi-topic question.

(a) (i) This was usually correctly answered. Some candidates used the total mass of the ingredients.

(ii) This was usually correct or correctly followed through from an incorrect answer in part **(i)**.

(b) This was generally well answered. For some, premature approximation led to inaccuracies. Dealing with 4/3 and π was problematic for some and occasionally the square root was found even when the cube root was written in the working.

(c) (i) This part was not well answered as candidates did not apply the practicality of the problem. The common error was to divide the volume of the cuboid by the volume of one biscuit.

(ii) This part was not well answered. Candidates went on to make further errors of using the volume of a sphere for the cylindrical biscuit or the area of their total biscuits and subtracting this from 1080.

Answers: **(a)(i)** 28 **(ii)** 420 **(b)** 6.36 **(c)(i)** 24 **(ii)** 232

Question 5

Most candidates scored well in this question.

(a) Many candidates demonstrated their knowledge of calculating a mean from continuous data. Only the weaker candidates did not use the mid-interval values. Few scripts were seen with the solution as the sum of the mid-intervals or frequencies divided by 8.

(b) (i) Almost all candidates completed the table correctly.

(ii) The graph was often correct with curves and polygons being equally popular. The errors in plotting were (80, 167) at (80, 157) or (60, 75) at (60, 70) or the omission of (90, 195).

(c) (i) The median was usually correct.

(ii) The lower quartile was usually correct.

(iii) The inter-quartile range was usually correct.

(iv) This was often correct. Some candidates did not subtract the two appropriate frequencies.

(v) This was usually correct with only a few candidates not subtracting their reading from 200.

Answers: **(a)** 63.45 **(b)(i)** 75, 117, 195, 200 **(c)(i)** 65 to 67 **(ii)** 52 to 55 **(iii)** 21 to 24 **(iv)** 44 to 52
(v) 200 – reading at 45 secs

Question 6

Some candidates left this question completely or almost completely blank. More experience in this type of mensuration question with compound shapes is required. Most candidates were successful in parts of the question with only a few gaining full marks. Efficient short methods were not seen in many cases and premature approximation, using 2 significant figures throughout, resulted in loss of marks.

(a) (i) Despite the required formula being given in the question, some candidates used an incorrect one. Common errors were to substitute r = 9 or 3.

(ii) This was well answered by most candidates who used Pythagoras' theorem. A few used the perpendicular height as the hypotenuse and others again had r = 9 or 3. A significant number of candidates wasted time by using the longer methods involving trigonometry and others tried unsuccessfully to use the volume or surface area of the cone.

(b) (i) Many realised that the efficient method was to divide their answer to part **(a)(ii)** by 3 and gained full marks even when part **(a)(ii)** was incorrect. Others were not prompted by the word **similar** being printed in bold in the question and tried to use Pythagoras' theorem again, often with the slant height as 5 instead of 10/3.

(ii) Very few candidates used the most efficient method of dividing their answer to part **(a)(i)** by 9. Many used πrl with r = 1.5 and l = 10/3 or $\sqrt{their(b)(i)^2 + 1.5^2}$. A significant number of candidates used l = 3.3 without supporting this by 10/3 and since 2 significant figures in working or as an answer is insufficient to imply the method marks, they scored 0.

(c) This very challenging part of the question was answered correctly by few candidates. Most were unable to identify the four required areas or to organise their work to find some of them. The volume of the cylinder instead of the curved surface area was often found and one or both circles were omitted. The formula πrl with r = 4.5 and l = 6.666…was sometimes used for the curved surface area of the frustum instead of their answer to part **(a)(i)** – their answer to part **(b)(ii)**. Premature approximation resulted in answers that were out of the required range.

Answers: **(a)(i)** 141 **(ii)** 8.93 **(b)(i)** 2.98 **(ii)** 15.7 **(c)** 535

Question 7

This question tested some of the more difficult concepts of solving equations from graphs and consequently only the more able candidates were able to score marks after parts **(a)** and **(b)**.

(a) The table was usually completed correctly. There were also some unexpected errors with all three values, including 8.6, – 9.9 and 10.01.

(b) The points were often plotted correctly and the standard of curve drawing was high. A number of candidates thought the left hand branch of the curve would be a similar shape to the branch already drawn and plotted the first two points with negative y-coordinates. Others misread the scale on the x-axis and plotted the points (– 0.5, – 1.8) and (– 0.3, – 3.2) at (– 0.25, – 1.8) and (–0.15, –3.2) respectively.

(c) More able candidates drew an accurate tangent. A few were not steep enough to give the gradient in the required range. Candidates need to carefully interpret the scales on both the x-axis and the y-axis to ensure that the correct values are used in their calculation.

(d) Only the most able candidates scored the mark here. Many did not understand what was required and gave a single value, a range of values of x or an incorrect inequality.

(e) (i) The line was usually correctly drawn by those who attempted this part. Occasionally the line was not drawn across the full domain.

(ii) Those who succeeded in part **(e)(i)** often gained the mark here. Incorrect answers came from misreading the scale on the x-axis.

(f) This discriminated well at the higher grades as only the most able candidates made an attempt at both parts and there were few correct solutions. Many candidates omitted this question and most of those who made an attempt did not see the need to divide the given equation by x.

Answers: **(a)** 8.7, – 3.2, – 10 **(c)** 3.4 to 4 **(d)** $k > 1.85$ **(e)(ii)** – 1.9 to – 1.75 **(f)(i)** $\frac{1}{x} + x^2 = x + 2$

(ii) $y = x + 2$

Question 8

Many candidates gave clear, concise and accurate calculations throughout this question.

(a) (i) Many scripts had the correct cosine rule and calculation clearly showing the length with at least 4 figures which rounded to the required value.

(ii) This was usually answered correctly by using either the sine rule or the cosine rule. Premature approximation lost marks for some candidates.

(b) (i) Most candidates had the correct answer. Some candidates misunderstood the diagram and gave the answer as 52^o or 64^o.

(ii) Many candidates knew to use 0.5 *ab*sin*C* in at least one of the triangles. Some assumed the quadrilateral was a trapezium and others assumed triangle *ABC* was right angled.

(c) The successful candidates were invariably the ones who used $\cos^{-1}(2/3)$ as this immediately gave the answer to the required accuracy. The longer methods of calculating the hypotenuse and then using another trig ratio or the sine rule or the cosine rule usually lost the accuracy mark due to premature approximation.

Answers: **(a)(ii)** 36.3 **(b)(i)** 76 **(ii)** 17.4; **(c)** 48.2

Question 9

Responses were varied with many candidates needing more experience with probability particularly when there is non replacement. Some candidates wasted time with lengthy calculations of combinations in part **(a)** and as they did not understand efficient methods with probabilities were unable to attempt part **(b)**.

(a) (i) This was often correct. The common errors were to have 8 as the denominator in all three fractions or to add the three fractions.

(ii) Again all the denominators were often 8. A common error here from the more able candidates was to evaluate the probability of only one of the three possible alternatives.

(b) (i) Candidates who were strong with both algebra and probability showed their true ability with this question with some excellent solutions showing each step clearly. This challenging question was often omitted or the given equation was solved rather than obtained.

(ii) Candidates who had achieved little so far in this question could earn a few marks here. However for a number of candidates the factorisation proved to be more challenging than expected.

(iii) This was often answered correctly, in many cases by starting again and using the quadratic formula rather than from the factors in part **(ii)**.

(iv) Again this was often answered correctly. Some gave the positive root from part **(iii)** and others over complicated the question by giving a probability.

Answers: **(a)(i)** $\frac{120}{336}$ **(ii)** $\frac{180}{336}$ **(b)(ii)** $(x + 6)(x – 7)$ **(iii)** – 6, 7 **(iv)** 18

MATHEMATICS

Paper 0580/43
Paper 43 (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 were many excellent scripts demonstrating the knowledge and ability of the candidates. The scripts were well presented and appropriate working was shown. Candidates struggled more with some topics: geometry in **Question 3**, transformations in **Question 4**, probability in **Question 9**, and the vectors in **Question 11**.

Candidates appeared to have sufficient time to complete the paper and omissions were due to difficulty with the questions rather than lack of time. The use of at least three significant figure accuracy unless specified was noted by most candidates with only a few approximating answers early mainly in parts of **Question 1** and **6** involving mensuration and general trigonometry. It should be noted that any answers or figures in the working given to two significant figures will not result in method marks being awarded unless a clear correct method is also shown.

Candidates generally followed the rubric instructions in respect to the values to use for π although a few used $\frac{22}{7}$ or 3.14 in **Question 1** which could result in final answers that are outside the required accuracy.

Comments on specific questions

Question 1

(a) This part was well answered. A few candidates involved the cylinder, which was not necessary at this stage. A few did not like the decimal dimensions of the tank and so changed the units; this introduced difficulties in this part and the rest of **Question 1**. A few thought that 1.6 mins was 1 min 6 sec.

(b) Some candidates missed the practical fact that the contents of the tank would occupy the bottom part of the cylinder. They involved the whole tank and sometimes calculated 1.2 *d*, confusing the volumes of the two parts of the cylinder. In a calculation such as ($0.48 \div \pi \times 0.4^2$), candidates should not evaluate $\pi \times 0.4^2$ as 0.5027 and then prematurely approximate the value to 0.5 for example, as this leads to an inaccurate answer and the loss of a mark.

(c) This was well answered and full marks were earned by the majority. A number lost marks by missing "open at the top" or by not assuming the base was painted or by not knowing $2\pi rh$ for the area of the curved surface.

Answers: **(a)** 1 m 36s **(b)** 0.955 **(c)** 8.09

Question 2

(a) and (b) The table was almost always correct and the graph was very well drawn. The quality of the curve was often excellent and very few used straight line joins. The only notable and rare error was made by those who saw that $x = -2, -1$ were negative and so plotted $y = -0.25, -0.5$ even when these values were positive in their table.

(c) (i) Candidates had no problem producing the required line.

(ii) The favoured method here was to substitute the co-ordinates of a point on the line, say (3, 8), into $y = mx + 2$ and solve for m. Those who used a right angled triangle with sides 6 and 3 or 4 and 2 etc. also scored the mark.

(ii) Many read off the x-coordinate of the intersection but carelessly forgot the minus sign.

(d) This part was very well done by the majority and tangents were well drawn. Some did not use the scales correctly and counted small squares giving, for example, 17 over 24 = 0.7, but the scales gave 3.4 over 2.4 = 1.4. Gradients between 1.2 and 1.6 were accepted as decimals or fractions but fractions such as 0.7/0.5 or 2/1.5 did not get the mark without evaluation. Just a few did not know what a tangent was.

Answers: **(a)** 0.5, 4 **(c)(iii)** −0.8 to −0.6 **(d)** 1.2 to 1.6

Question 3

(a) (i) The geometry to go from angle *DAB* to angle *ABD* to angle *DBC* to the answer was well known and most candidates were successful. Candidates should take care with the arithmetic e.g. 180 – 40 = 160 causes serious loss of marks.

(ii) The more able candidates could see that either of two pairs of alternate angles were not equal or two pairs of co-interior angles were not supplementary and they scored by giving a satisfactory reason. Some did not explain themselves sufficiently well; 50° ≠ 30° was not acceptable as there are two angles of 50°; “alternate angles are not equal” was also not acceptable as the Examiner has to assume that the candidate knows what alternate angles are; “angle *DCB* ≠ angle *CBE*” is an example of what was needed.

(b) Candidates struggled with this part. It seemed that many did not know the sum of the exterior angles of a polygon. Many who did know wrote incorrectly $\frac{5n}{2} = 360$. A significant minority decided to use interior angles and produced $180 - \frac{5n}{2} = (n-2)\frac{180}{n}$; quite correct but there was much more scope for slips in the algebra.

(c) The first move was usually to find angle *CAB* = 25°. The rest of the response depended on their second move. Those who saw that angle *OAC* was 25° had a good chance of full marks with angle *OBA* = 50°, angle *BOC* = 50°, angle *OBC* = 65°.

Answers: **(a)(i)** 50 **(b)** 12 **(c)** 65

Question 4

(a) This was very well answered. Almost everyone drew the line $y = x$ and the reflection was well constructed.

(b) Again this shape was drawn well; just a little confusion in the x-shift −2 or −3, in the y-shift +1 or −1, and sometimes x and y shifts reversed.

(c) (i) Again an excellent set of responses was seen. Just a few candidates did not make the direction of rotation clear and a few quoted the wrong centre.

(ii) Some candidates could produce this matrix but the majority could not.

(d) Again, a minority of candidates could describe this stretch. "x-axis invariant" is an essential part of the description, not vague phrases such as "from the x-axis", "x invariant" etc.

Answers: **(c)(i)** rotation, 90 clockwise, centre (0, 0) **(ii)** $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ **(d)** stretch, factor 2, x-axis invariant

Question 5

(a) There was some confusion between $j = w + 5$ and $j = w - 5$. There was also some confusion between cents and dollars. The successful candidates were in two main groups:- those who produced a correct equation such as $3x + 6\ (x + 5) = 525$ and those who took a short cut and argued "the 6 bottles of juice cost an extra 30c therefore we have in effect 9 bottles of water costing 495c, 55 each". There were some inelegant solutions which relied on $525 \div 9 = 58.3$ leading to 55 and 60 being guessed and checked but the correct solutions were achieved.

(b) (i) The majority of candidates had little idea or they tried to fit the given quadratic equation to the given information. The essential question the candidate must ask is "how many biscuits can be bought for 72c?". If the expression $\frac{72}{x}$ can be found then progress can be made.

(ii) Many could factorise the quadratic but many, daunted by having to factorise 108, used the formula. The formula did not always lead to the correct roots. Slips were made along the way and sometimes it was incorrectly quoted.

(iii) Many used a positive root, k say, from part **(ii)** to gain a mark for evaluating $3k + 3$.

Answers: **(a)** 55 **(b)(ii)** −12, 9 **(iii)** 30

Question 6

(a) (i) Those who found $\sqrt{3^2 + 4^2 + 12^2}$ or found $BP = 5$ and then $\sqrt{5^2 + 12^2}$ usually went on to score full marks. Those who first calculated $AC = \sqrt{4^2 + 12^2} = \sqrt{160}$ had more difficulty by evaluating this as 12.65 or 12.6. Some did not recover from this premature approximation and didn't reach AP = 13.

(ii) Many candidates could identify the correct angle of elevation in this drawing. They then used the correct trigonometry to find its value. A common error was to find angle *PAB*.

(b) (i) This was a simple calculation, but on a 3-D figure, the angle and the trig-ratio had to be correctly found. It was very well answered by the majority of candidates.

(ii) Many candidates found *XC* successfully, but some were confused. In order to see what was happening in triangle *BPC* and to see what was being asked for, it was most advisable for the candidate to draw a separate diagram of the triangle *PBC*. The information could be put on this drawing and the triangle *XCB* seen to be not right angled so that the sine rule could be used.

Answers: **(a)(i)** 13 **(ii)** 13.3 **(b)(i)** 36.9 **(ii)** 2.77

Question 7

(a) The correct class interval was almost always identified.

(b) The majority of candidates knew what was required and produced the estimated mean well. Although the result is an estimate, it is not usual to round off the frequencies to the nearest 10; that is a further degrading of the statistic. Some did not use the mid-interval values, but there were some marks available if any values on each interval were used. A few took *x* to be the interval width. A few did not know the method and just found the mean of the four frequencies.

(c) (i) Most candidates converted the frequencies to cumulative form correctly.

(ii) The plotting of the four points was generally good and they were joined by straight lines or by curves, both acceptable. A significant minority produced a bar chart either with the frequency polygon or instead of it. The bar chart only scored the plotting marks if the plots were clearly seen in their correct positions.

(iii) Most candidates knew where to look for these statistics and they were generally successful.

Answers: **(a)** $3 < t \le 4$ **(b)** 3.31 **(c)(i)** 92, 164 **(iii)** $3 \le m \le 3.2$, $2.4 \le lq \le 2.7$, $0.9 \le iqr \le 1.5$

Question 8

(a) Many candidates were unsure how to deal with the function hg. Some had difficulty evaluating 1 – 2 (−2). Many did not know how to do this question and were unsuccessful.

(b) Many knew a method for finding the inverse function. There were many sign slips in the algebra. $y = 1 - 2x$ therefore $y - 1 = 2x$ was very common. Many used a flow-chart method which was fine but that was also marred by sign slips: $(x-1) \div -2 = \dfrac{x-1}{2}$ for example.

(c) This was a straightforward test of the quadratic formula and it was well answered by most. The most common error was to not give the two decimal places asked for. The two correct answers have 2 and 3 significant figures respectively which may have caused problems for some. Less able candidates, in spite of all the clues, tried to factorise.

(d) Responses varied to this problem. There was a mark for producing $(1 - 2x)^2 + 1 - 2x - 1$, and many scored this. There was an independent mark for expanding $(1 - 2x)^2$, but many did not score this; commonly seen were:- $1 - 4x^2$, $1 - 2x - 2x + 4x$, $1 - 4x - 2x^2$.

(e) Very few candidates scored this single mark. h(x) maps a value in one set onto a specific value in a second set; $h^{-1}(x)$ reverses the process and maps the second value back onto the first. So if $h^{-1}(x) = 2$, the "2" has come from $h(2) = 9$. The function $h^{-1}(x)$ need not be considered.

Answers: **(a)** 243 **(b)** $\dfrac{1-x}{2}$ **(c)** – 1.62, 0.62 **(d)** $4x^2 - 6x + 1$ **(e)** 9

Question 9

(a) (i) This was usually correct. Occasionally set A was taken to be the full set of nine cards giving the result $\dfrac{2}{9}$.

(ii) This was usually correct. The answer $\dfrac{25}{100}$ was not accepted. There was a follow through mark for 22 after $\dfrac{2}{9}$ in part **(a)(i)**.

(b) This was well answered, but a common error was $\dfrac{1}{4} \times \dfrac{1}{3} = \dfrac{1}{12}$.

(c) This also was well answered with $\frac{1}{4}\times\frac{4}{5}+\frac{1}{5}\times\frac{3}{4}$ being the favoured method, but there were several others.

(d) Successful candidates used $\frac{3}{5}\times\frac{2}{4}\times\frac{1}{3}$ to solve this problem and many managed it well.

Answers: **(a)(i)** $\frac{1}{4}$ **(ii)** 25 **(b)** $\frac{1}{6}$ **(c)** $\frac{7}{20}$ **(d)** $\frac{1}{10}$

Question 10

(a) A few candidates did not produce the terms 20x and 10y and so could not score this mark.

(b) Many found these three inequalities. Occasionally some used an incorrect symbol and some occasionally confused x and y.

(c) All four inequalities were generally converted to the appropriate lines on the grid and there were some excellent attempts. Most candidates scored some of the six marks available for the graphs.

(d) Having correctly identified the region, candidates picked out the point that gave optimum economy. With an incorrect region there was still a mark available for picking any point in their region and correctly converting it to a cost.

Answers: **(a)** $20x + 10y \geq 200$ **(b)** $x + y \leq 15$, $y \geq 3$, $y \leq x$ **(d)(i)** 47 **(ii)** 7, 6

Question 11

(a)(i) and (ii) Most candidates knew how to get these two answers but some did not notice the scales on the given grid; line PQ was often $\begin{pmatrix}16\\2\end{pmatrix}$ and R was marked at (4, 3).

(iii) Candidates did use the scales properly in this part giving the correct position vector of P even though they may have misread the scales in the previous part.

(b) Not many candidates were successful with this part. It would help candidates if they firstly establish the vector route from L to K and from O to M.

(i) $LK = LU + UK$ was given a mark and there were further marks for writing LU and UK in terms of $\mathbf{u}$ and $\mathbf{v}$; $\frac{1}{4}\mathbf{u}$ and $\frac{2}{3}(\mathbf{v} - \mathbf{u})$ scored two more marks.

(ii) $OM = OL + LM$ was given a mark and then all that was needed was to simplify $\frac{3}{4}\mathbf{u} + \frac{1}{2}$(their part **(i)**).

Answers: **(a)(i)** $\begin{pmatrix}8\\1\end{pmatrix}$ **(ii)** (3, 4) **(iii)** $\begin{pmatrix}-3\\1\end{pmatrix}$ **(b)(i)** $\frac{2}{3}\mathbf{v} - \frac{5}{12}\mathbf{u}$ **(ii)** $\frac{13}{24}\mathbf{u} + \frac{1}{3}\mathbf{v}$

Question 12

Many candidates were quite confident working with these two sequences; others weren't so confident and could not understand the idea of an n^{th} term, nor the suffix notation.

(a) (i) Many did this correctly. They understood that $n = 3$ gives the term 3×4.

(ii) This was not well answered. To replace n by $n + 1$ in the expression seems an easy task, but many candidates had not the confidence to do this. Few candidates achieved $(n + 1)(n + 2)$.

Some were successful using other methods to analyse the succession; $n(n + 2) + (n + 2)$ and $n(n + 1) + 2(n + 1)$ are correct but much more difficult to find.

(iii) Without understanding part **(ii)** and getting it correct, this part was not easy.

(iv) Many candidates achieved the correct answer to this problem, even after not scoring in part **(iii)**. They must have recognised that the terms were increasing by $2(n + 1)$ each time and $2(n + 1) = 140$ providing the solution.

(b) (i) Candidates needed to understand the build-up of this sequence so they could write $u_4 = 2u_2 + u_3$. Some candidates complicated matters by expanding u_3 to $2u_1 + u_2$.

(ii) Many candidates could not manage to equate u_5 to $2u_3 + u_4$.

(iii) Candidates who were still persevering at this stage could see that the next term was 2 × 3413 + 6827 and 2 × the previous term + 3413 = 6827. Very well answered by the many who saw these relationships and solved them.

Answers: **(a)(i)** 12, 30 **(ii)** $(n + 1)(n + 2)$ **(iii)** $p = q = 2$ **(iv)** 69, 70 **(b)(i)** 2 × 3 + 7 **(ii)** 27 **(iii)** 1707, 13653