MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key messages

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

General comments

Candidates must check their work for sense and accuracy as there were answers in context that were unlikely, for example in **Questions 3**, **14** and **24**. Candidates must show all working to enable method marks to be awarded. This is vital in multi-step problems, in particular with algebra, where each step should be shown separately to maximise the chance of gaining marks in for example, **Questions 17**, **19**, and **24**. Candidates must take note of the form or units that are required, for example, in **Questions 2**, **7**, **14** and **19**. It is worth noting that candidates should use HB pencils and rulers for diagrams such as with **Questions 21**, **22** and **23**.

The questions that presented least difficulty were **Questions 6**, **10**, **14**, **18**, **22(a)** and **(d)**. Those that proved to be the most challenging were **Questions 12,** upper and lower bounds, **17**, re-arranging a formula, **21**, nets of solids, **23(b)**, construction and all parts of **24,** perimeter, area and volume, and these were also the questions that were most likely to be left blank. It is likely that any blank responses were due to the difficulty of the syllabus areas being tested rather than a lack of time.

Comments on specific questions

Question 1

This question was reasonably straightforward and a large majority gave the correct answer. Incorrect answers were usually missing a zero, typically, 7020. Sometimes 17 020 or 1720 were seen as candidates confused seventy with seventeen. Occasionally 720 000 was seen due to confusion of the effect of the thousands.

Answer: 70 020

Question 2

The most common incorrect answers were –125 (from -5^3), –0.15 (-5×3), 0.005 ($5 \div 10^3$) and $\frac{1}{125}$. This last, although correct, was not in the form asked for in the question and therefore did not get the mark.

Answer: 0.008

Question 3

Candidates had problems dealing with the standard form for the thickness of one sheet of paper and few checked their answer for sense in context, with negative answers, or ones that were vastly less than 1 cm or over 1 m, often 200 cm seen.

Answer: 2

Question 4

This rules of indices question was not handled very well with answers such as $5x^2$, 32 (2^5) seen and the most frequent incorrect answer was x^7.

Answer: x^{10}

Question 5

Candidates should not leave this type of question blank as there is a limited choice of what the answer could be but they should remember to only leave one answer. Translated was the most commonly chosen incorrect answer but other words not from the list, such as rotated, were seen.

Answer: Congruent

Question 6

There were two correct answers that candidates could choose. However, if candidates gave two answers they both had to be correct to get the mark. Very occasionally, candidates gave a number not on the list.

Answer: 31 or 37

Question 7

Candidates found these two parts of about equal difficulty with slightly more being successful with part **(a)**. Incorrect answers included 2345.71 (moving the decimal point to give four numbers in front of it), giving the incorrect number of significant figures or truncating the value to 23.45 With part **(b)**, the most common incorrect answer was to give the number to the nearest integer. Some looked at the right-hand end of the number, disregarding the decimal point, giving their answer as 70. Others who knew the answer was 20, gave instead, 20.0000 by putting a zero in place of each original digit.

Answers: **(a)** 23.46 **(b)** 20

Question 8

Some tried to combine the terms giving $8mn^2$ or $140mn$ showing that they had no understanding of what factorise meant and that only like terms can be combined. Some started well but made numerical errors. Some who partially factorised the expression, taking one or two factors outside the bracket, such as $2n(6n – 2m)$ or $4(3n^2 – mn)$, gained a mark. This question had a large amount of blank answer spaces.

Answer: $4n(3n – m)$

Question 9

Candidates often confuse highest common factor (HCF) with lowest common multiple (LCM) and that was the case here with 3150 or 18 900 being frequent incorrect answers. Some used a factor tree but had decimal numbers not integers on the branches. There was a mark for answers of a common factor 2 or 3. The HCF has to be lower than the original numbers (or equal to one of them).

Answer: 6

Question 10

This question was answered very well. To earn the mark in part **(a)**, Chicago had to be stated and not the temperature, –10. Some candidates chose Helsinki or Moscow, the other cities with negative temperatures. In part **(b)**, the temperature in Helsinki had got warmer by 4 °C so incorrect answers were often a combination of a 7 and a 4 with the signs incorrect, giving positive or negative 11.

Answers: **(a)** Chicago **(b)** −3

Question 11

This algebra question was answered better than **Question 8** and most errors occurred when candidates combined terms after they had correctly expanded the expression, giving answers like $22y^2x$ as their final answer or made numerical slips in the initial multiplication. What was slightly different about this question was that when the brackets were multiplied out, two of the terms cancelled ($14x$ and $-14x$).
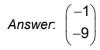
Answer: $21y + xy$

Question 12

Candidates found this the most challenging question on the paper and a large number did not attempt it. The correct approach is to work with the 'nearest 5 kg' part first, which has to be split into 2.5 kg subtracted from the elephant's mass and 2.5 kg added on.

Answer: 3567.5, 3572.5

Question 13

Some candidates read the question as **a** + **b** but many responses were correct. If the final answer was incorrect but a candidate had worked out 2**b** correctly this was worth a mark. Candidates must be aware that it is not correct to draw a horizontal line between the two components and if in doubt should follow the format given in the vectors in the question.

Answer: $\begin{pmatrix} -1 \\ -9 \end{pmatrix}$

Question 14

This was a different type of conversion question to that often seen as candidates were asked to find an exchange rate but this did not seem to cause many problems. Firstly, candidates had to recognise which exchange rate they needed – in this case how many pesos to one dollar. Next, looking at the amounts of money, Manuel has numerically more pesos than dollars so for each dollar he gets more than one peso so candidates had to divide 5000 by 336. If candidates reversed the division then the answer of 0.0672 cannot be correct in this context. The question asks for the answer to 2 decimal places so only an answer of 14.88 got both marks but 15 and 14.881 were seen.

Answer: 14.88

Question 15

By far the most common incorrect answer came from not understanding that using relative frequency is a way of getting a probability from data, so the actual number 21 was often seen. For some, the word 'estimate' caused problems. This does not mean guess but rather use the relative frequency of birthdays in the sample to predict how many have April to June birthdays in a larger population. In part **(b)**, candidates were often correct even when they were wrong in part **(a)**.

Answers: **(a)** $\dfrac{21}{50}$ **(b)** 315

Question 16

Some candidates treated the cube root as meaning multiply by 3 giving $3 \times \sqrt{512} \div 6^2 = 1.8856...$ as their answer. However, there were many that earned 1 mark for getting as far as $\dfrac{8}{36}$ but then not cancelling far enough or making arithmetical slips.

Answer: $\dfrac{2}{9}$

Question 17

Change of subject questions are often problematic for many candidates and this question was no exception. Only a few candidates gained a mark for a correct first step and many gave just an answer without any workings. The first step is to leave the r^2 on one side of the equals sign and to collect all other terms on the other side before trying to square root. It is possible to square root first but this approach often leads to errors.

Answer: $\sqrt{\dfrac{A}{4\pi}}$

Question 18

In part **(a)**, quite a number interpreted the multiplication sign as an *x* resulting in an algebraic expression. While –20 was seen a number of times (from adding 3 and 2 then multiplying by –4), most who understood this question, on order of operations, gave the correct answer. The last parts were answered very well with many using the blank space below the question to try out different positioning for the brackets.

Answers: **(a)** –5 **(b)(i)** $3 \times (5 + 2) + 2 = 23$ **(ii)** $12 \div (4 + 2) = 2$

Question 19

There were some candidates who showed complete and convincing working. A few candidates made arithmetical errors, which should have been picked up when checking. A small number worked only with the given fractions and omitted to take account of the 1 in front of the $\dfrac{2}{3}$. A few candidates arrived at the correct answer but showed spurious or no working, suggesting that they had resorted to using their calculators to arrive at the solution. The answer was asked for as a mixed number in its simplest form but many left their answer as $\dfrac{50}{21}$. Candidates should be clear that in fraction questions, a decimal answer is not acceptable.

Answer: $2\dfrac{8}{21}$

Question 20

There are various methods to solve simultaneous equations and candidates should be aware that sometimes, depending on the structure of the equations, one method might be quicker or involve less places for arithmetic slips to spoil good method. The simplest approach to these simultaneous equations was to multiply the first by 2 and add the two equations to eliminate *y*. Candidates should check their values in both equations.

Answer: $(x =)$ 2, $(y =)$ –7

Question 21

More candidates did not attempt this question than any other on the paper. Two complications were that all 3 dimensions were different and that there was limited space to draw the net. Above and below the given rectangle, others of 6 cm by 3 cm had to be drawn with a copy of the original on top. The side rectangles had to be drawn one on each side alongside a large rectangle. Often the top rectangle was missing or the smaller side rectangles were the wrong size. Candidates did not earn full marks if the net was not drawn with a ruler. Many tried to draw a 3D interpretation of the cuboid.

Question 22

CAMBRIDGE
International Examinations

For many candidates this was their best answered question as a whole. The point plotting was accurate in general in part **(a)**. Candidates generally are more comfortable with positive correlation which is shown here. Besides the incorrect negative, candidates gave other answers such as numbers, increasing, rising and single point in part **(b)**. Sometimes a question will ask candidates to describe the relationship and this is when the answer needs the connection between the two variables but that is not the case with this question. There were some excellent lines of best fit in part **(c)** but some candidates simply joined up the points. Some lines were too short and a commonly occurring misconception was for candidates to force their line to start at the 'origin' or in this case, (0, 25). Again, 'estimate' caused a problem in part **(d)**. This does not mean guess, it means 'use a mathematical method to find out' and in this case the method is reading from the line of best fit when the time is 5.5 hours.

Answers: **(b)** Positive **(d)** 33.5 to 37.5

Question 23

Many candidates did not attempt one or all parts of this question. A few candidates drew the triangle, *ABC*, and then stopped. To gain full marks in parts **(a)(i)** and **(ii)** all the construction arcs had to be visible. Some drew the arcs for the first part but then did not go on to draw the perpendicular bisector. Sometimes candidates only drew part of the circle around *C*. This whole circle is not needed to define the region but to get full marks in this part the whole circle must be seen. Occasionally, candidates drew a circle around *A* or *B* instead of *C*. To get the mark in part **(b)** candidates must indicate which is the correct region as some answers had two sets of shading that overlapped and this did not get the mark. All that was necessary was to label the single region that was their answer.

Question 24

This type of question has not got scaffolding to lead the candidate through the calculation so candidates must decide where to start and the method to be used. With parts **(a)(i)** and **(ii)**, the first step is to divide the shape into its component parts, work out the relevant perimeters and then remember to combine everything. For the square section, candidates had to remember not to include the forth side and similarly with the semicircle, not to include the diameter; often, candidates did not take account of one or other of these points. Sometimes answers included 180° for the semicircle or 222 (3 sides of the square) or 116.2 (37 × π). Either of these last two values were worth 1 mark. With the area calculation, there was less of a problem as the area of the whole square was needed and likewise with the semicircle so more candidates gained some marks here. Part **(b)** was far less complex but many candidates appeared not to realise that simply multiplying their area answer by 5 was all that was needed.

Answers: **(a)(i)** 338 **(ii)** 7630 **(b)** 38 100

MATHEMATICS

Paper 0580/12
Paper 1 (Core)

Key messages

Work to an accuracy of at least 3 significant figures unless the question specifies otherwise.

Check that answers in context questions are sensible and fit the data.

General comments

Most candidates tackled the questions with a fair level of understanding. The number of questions left not attempted was less than most previous papers but a considerable number of marks were lost by many candidates who clearly understood the topic. Mostly this was due to lack of working shown and answers given to two significant figures, rather than at least three. Confusion between volume and surface area was very evident in this paper causing many to lose significant marks since both were asked. Presentation of work and clarity of figures is still an issue for some candidates and clear working where required should always be important when preparing candidates for the examinations.

Comments on specific questions

Question 1

This question was not well answered due to three main reasons. Firstly, 0.07 was from counting from the zero after the decimal point, or simply two decimal places. Secondly, and to a lesser extent, not rounding up the second significant figure since 6 was the third figure. Then a significant number of candidates added zeros (usually two) to replace the last figures in the question.

Answer: (0).072

Question 2

The probability was answered well, although many chose to change to a fraction answer, which at times resulted in an error, such as just changing the decimal in the question to a fraction or even a denominator of 1 or 100.

Answer: (0).15

Question 3

This was a very straightforward basic use of a calculator question that almost all candidates could tackle with confidence. However, many did not gain the mark by giving their answer to 2 significant figures (or 2 decimal places) or even 1 figure. So 0.39 in particular was often seen. A few candidates did not interpret the question as three independent numbers by either including the square root of 120 with the squaring operation or including 3.8^2 as part of the square root.

Answers: (0).394

Question 4

This question was poorly answered by many candidates who misinterpreted the question. The main error was to calculate 85% of $2.03 leading to 1.72 or 1.73. With a % sign in the answer space candidates should have realised the error. Those who did a correct calculation often did not round correctly, giving 41.8 as their answer. An example of an unrealistic answer was 4187% resulting from not having common units for the data or simply forgetting the decimal point.

Answers: 41.9

Question 5

Changing square units tends to be very challenging and this question was no exception. Division by 100 leading to 62 was the most common response although 6.2 and 0.0062 were seen quite often.

Answer: (0).62

Question 6

This factorisation question was straightforward and the vast majority of candidates who knew how to factorise gained the mark. Those who did not understand the topic gave a variety of responses such as $-7xy$, $2x - 3y$ or $7x$ outside the bracket.

Answer: $7(2x - 3y)$

Question 7

(a) Nearly all candidates gained this mark but a few lost the mark by giving the temperature instead of the day. The only noticeable incorrect day was Tuesday since it was the only other negative temperature.

(b) Whilst this part was also very well answered some errors were made manipulating the directed numbers. Adding the two temperatures to give -1 was evident a number of times and some misread the days in the question.

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

Question 8

Whilst there was a good response to this ordering question, it was noticeable that those who did not show any conversion to a common form (usually decimals), rarely gained the marks. Some of those who did convert to decimals only gave 2 significant figures for $\dfrac{1}{3}$, so the same as 33%. Although most with sufficient decimals shown gained both marks, there were some who still could not order the items correctly.

Answers: 0.3 $\quad \dfrac{7}{22} \quad$ 33% $\quad \dfrac{1}{3}$

Question 9

Many gained the marks for the symmetries of a rhombus with only a few gaining 1 mark for just 1 correct line. The most common error was drawing additional lines, joining the mid-points of opposite sides.

Question 10

(a)   There were only a few who didn't score this mark although 30% and 0.3% were seen a significant number of times.

(b)   Again the vast majority gained this mark, while 0.37 was the most common error.

Answers: **(a)** 3 **(b)** $\dfrac{37}{100}$

Question 11

This question was answered well by the vast majority of candidates. The main problem for those not gaining the marks was dealing with –3 multiplied by –2 which often produced an answer of 29 from 35 – 6. Showing a full substitution of the values into the expression first usually resulted in the correct answer. A few candidates even worked out 5×7 to be 45.

Answer: 41

Question 12

Incorrect answers were rare for both p and q but those who did get them incorrect usually did not recognise that p had to be greater than 90° and q less than 90°. A few candidates reversed the two answers.

Answers: p = 110, q = 70

Question 13

This question was quite well answered but many candidates found difficulty with reaching a correct $ax = b$, with, for example, $4x = 1$ seen a number of times. Those who did reach the penultimate stage had difficulty realising that the answer could be a fraction. An answer of 6 was quite common, while of those who realised the correct answer some felt the answer had to be a decimal and often did not give sufficient accuracy, for example 0.17 or 0.166.

Answer: $\dfrac{1}{6}$

Question 14

(a)   Dealing with a decimal number in standard form proved challenging for many candidates. Apart from a value not being between 1 and 10, it was common to see $\times 10^{-3}$ or $\times 10^{2}$.

(b)   Although more was involved in this part, it was considerably better answered than part **(a)**. Similar errors were seen but candidates appear to handle positive indices more confidently. Indices of 2 and –3 were seen.

Answers: **(a)** 6.05×10^{-2} **(b)** 5.1×10^{3}

Question 15

This upper and lower bounds question was poorly answered with most candidates unable to work out that 0.05 had to be subtracted and added for the limits. Many gave 2.2 and 3.2 from adding and subtracting 0.5 while others seemed to think that 1 decimal place meant 0.1 was to be added and subtracted leading to 2.6 and 2.8. Some were close and found the lower bound but then gave 2.74 for the upper bound as they did not observe that the upper inequality sign did not include equals.

Answer: 2.65, 2.75

Question 16

This basic trigonometry question was reasonably well answered. Many seemed to realise that the required ratio was sine and gained a mark for equating sine to $\frac{4}{7}$. A significant number then were unable to complete the calculation to find the angle. Of those who did make that step, many had rounded the decimal too much and so the angle was not accurate.

Answers: 34.8

Question 17

While many candidates understood the concept of gradient, it was common to see difference in *x* ÷ difference in *y* for two points on the line, leading to an answer of $\frac{1}{3}$. Some mixed up the values of the co-ordinates. Probably more successful was the method of forming a triangle on the diagram to work out rise ÷ run, especially as the scales were the same.

Answer. 3

Question 18

This question was well answered, even though it is often one of the more demanding topics. The vast majority of candidates recognised the scale factor of 3 or $\frac{1}{3}$ but then some divided or multiplied incorrectly. Had they looked at their answers in relation to the triangles it should have been clear that 49.5 or 0.02 could not possibly be the length of *EF*. The usual error of 6.5 from 15 – 5 = 10 and then 16.5 – 10 was seen from some candidates. Unfortunately premature rounding again spoilt some solutions with 0.3 or 0.33 being used for $\frac{1}{3}$.

Answer: 5.5

Question 19

(a)   Whilst some candidates divided by 1.158, by far the majority did multiply, and correctly more often than not. Unfortunately a number lost the mark by rounding, usually to the nearest dollar, but the exact answer was needed.

(b)   This part was also answered well, although a few multiplied rather than divided by the exchange rate.

Answers: **(a)** 5674.2(0) **(b)** 2500

Question 20

(a)   Although success on this question relied on knowing there were right angles at *A* and *C*, many did get this correct. However it was common to see 42° from equal angles, and 138°. Some candidates clearly did not know how to identify a specific angle from the 3-letter notation. Very few actually wrote on the diagram with right-angle symbols or other particular angles, which could have helped. 69° was seen, presumably due to the idea that the triangle was isosceles.

(b)   Again this was well answered by many, although from a follow through from part **(a)** a number of times. Few gained the 1 mark for stating or showing the angle at *C* to be 90°, without finding the correct answer. In this part also some gave angles greater than 90°.

Answers: **(a)** 48° **(b)** 42°

Question 21

(a)   Most candidates showed sufficient correct working to gain the marks on this straightforward subtraction of fractions. Some realised a denominator of 12 could be used but did not change the numerators, producing the correct answer but no marks. Others showed the correct working but did not cancel to the simplest form.

(b)   This part was also answered quite well with many fully correct solutions. Some candidates, after correctly forming improper fractions, decided a common denominator was needed resulting in very large numbers. Then going straight to the given answer was not satisfactory for a calculation without a calculator. Working from the given answer also was seen at times which was not an acceptable approach.

Answers: **(a)** $\dfrac{1}{3}$

Question 22

(a) (i)   Many candidates were confused between pyramid and prism leading to answers of prism in this part. Two-dimensional shapes were also commonly seen answers. However, around half the candidates gained the mark.

(ii)   This part was not so well answered, partly due to the type of prism being required. A common error was to give rectangular in the description.

(b)   This part was not very well answered with many being confused between volume and surface area. Many did not know how to find the area of the trapezium cross-section, resulting in calculations such as
$14 \times 8 \times 18$ or multiplying all the numbers together. Some did find the correct area of the trapezium but then doubled it suggesting a surface area rather than a volume calculation.

Answers: **(a)(i)** Pyramid **(ii)** Triangular prism **(b)** 990

Question 23

The basic calculations of the amount found in a compound interest calculation and the interest from a simple interest calculation were answered quite well. However, many candidates did not realise that one was amount and one was interest so they simply subtracted these two answers. Although use of the formula for compound interest calculations is not required, most candidates did use it, mainly successfully, although some did include 16 400 in cubing the bracket $(16\,400 \times 1.04)^3$. Those who worked out year by year did lose accuracy at times by over-rounding. With simple interest it was quite common to see 4% in the formula rather than 4, resulting in 19.68.

Answers: 79.76 or 79.77

Question 24

(a)   This was a straightforward question and was answered well, although not by all candidates. Some used the formula for circumference and a few multiplied 6 by π before squaring.

(b)   In contrast to part **(a)**, this was found very challenging by candidates. The confusion between surface area and volume was very apparent again as in **Question 22(b)** with many responses being more like a volume, rather than surface area. Many candidates did double the area found in part **(a)** but then multiplied by the length. Some did find the curved surface area but of these it was common to see the area of just one end or nothing added.

Answers: **(a)** 113 **(b)** 792

MATHEMATICS

> **Paper 0580/13**
> **Paper 13 (Core)**

© 2017

Key Messages

Answers should be given to three significant figures unless the question states otherwise.
Candidates should ensure they show their working, and check their answers.

General Comments

The vast majority of candidates could tackle all questions. Careful checking of answers would help to reduce errors; more detail is given in the comments on specific questions. Candidates should ensure they do not round or truncate answers in the middle of calculations as this can lead to a loss of accuracy in the final answer.

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

Comments on specific questions

Question 1

This was generally well answered. There were very few errors in method here although some candidates divided.

Answer: 374

Question 2

(a) Some candidates gave diameter but the majority had correctly named the radius.

(b) The term chord was less well known.

Answers: **(a)** Radius **(b)** Chord

Question 3

(a) This was well answered with the majority of candidates giving the correct answer.

(b) This was also well answered.

Answers: **(a)** [0].16 **(b)** $\dfrac{16}{100}$

Question 4

(a) This was not very well answered since most candidates did not show the small hand far enough past 3. Almost all wrote the big hand at 9. Many candidates showed the time 2.45.

(b) This was generally correct although a small number of candidates used incorrect time notation e.g. 15 45 pm.

Answer: **(b)** 15 45

© 2017

Question 5

(a)   Many candidates gave the correct answer. The most common error was 5370 from rounding to the nearest ten.

(b)   This part was also well answered. Common errors were 42.3 and 42.34780.

Answers: **(a)** 5400 **(b)** 42.348

Question 6

Many candidates didn't seem to understand what a tally was so left that column blank or had the frequency there. Those who had the frequency there often then had a probability or a percentage in the last column. There were the usual arithmetic inaccuracies also.

Answer: 5, 3, 6, 4, 7

Question 7

(a)   Most candidates were able to work out the pattern of this sequence. Possibly the hardest part was working out 4–10.

(b)   This part was less well answered with some candidates starting with 0 and giving the answers 5, 8 and 11.

Answers: **(a)** –6 **(b)** 8, 11, 14

Question 8

(a)   This question was well answered.

b)   Many correct answers were seen to this part. The most common error was to cube rather than cube root the number.

Answers: **(a)** 4913 **(b)** 9

Question 9

There were many correct answers seen but also many candidates scored just 1 mark for a partial factorisation, particularly for $2x(2x – 4y)$. A few wrote $–4xy$ as their answer.

Answer: $4x(x–2y)$

Question 10

(a)   This question was not well answered. Several candidates missed or incorrectly entered the x co-ordinate. A significant number did not attempt the question.

(b)   Many candidates had not realised the coefficient of x was the gradient from the equation given, with 4x or –6 or blank responses seen. Some tried drawing a grid with the line on and calculating the gradient.

Answers: **(a)** (0, –6) **(b)** 4

Question 11

(a) Many correct answers were seen. However several candidates gave the answer 26 from poor use of a calculator.

(b) This part was mostly correct with the most common error being 9.

(c) Most candidates had the correct answer for this part.

Answers: **(a)** 8 **(b)** −9 **(c)** $\dfrac{3}{5}$

Question 12

(a) Most candidates understood this use of algebra and 180° in a triangle was well known, although some found the angles in terms of x rather confusing and didn't understand how to tackle the question. $7x + 6x + 5x = 18x$ so $x = 18$ and $7x + 6x + 5x = 360$ were common errors.

(b) Many correct answers were seen in this part but the follow through was rarely applied as many who did not understand part **(a)** were also confused here. Almost all who got part **(a)** correct also were successful with part **(b)**.

Answers: **(a)** 10 **(b)** 70

Question 13

(a)(i) Candidates who understood vectors usually had the correct answer.

(ii) Many candidates did not know they had to change the signs. The most common error was $\begin{pmatrix} -4 \\ 6 \end{pmatrix}$.

(b) This part was generally correctly answered.

Answers: **(a)(i)** $\begin{pmatrix} 30 \\ -20 \end{pmatrix}$ **(ii)** $\begin{pmatrix} -6 \\ 4 \end{pmatrix}$ **(b)** −4

Question 14

(a) Many candidates were able to give the correct answer, although some just stated 4.1–2.7 without carrying out the calculation.

(b) Many candidates were able to give the correct answer, although some hadn't listed all ten numbers. Others made errors in the addition, with 30.87 and 30.4 being common incorrect totals.

Answers: **(a)** 1.4 **(b)** 3.42

Question 15

(a) Many candidates were able to correctly identify either of the two required answers. 81 was the most common incorrect answer.

(b) Many of those candidates who found the correct value lost marks by leaving their answer as 3×7×10 or 2×3×5×7. Others confused HCF and LCM with the answer of 3 being seen often.

Answers: **(a)** 83 or 89 **(b)** 210

Question 16

(a)   Many candidates were unable to answer this question. Some repeated 5^6 as the answer.

(b)   Many candidates did not realise that multiplication of equations was not necessary. However, many did reach the correct answers even if they did more work than necessary.

Answers: **(a)** 8 **(b)** 0.5, 5

Question 17

A significant number of candidates calculated simple interest. Many calculated the compound interest but lost the final mark through premature rounding. Some just gave the interest as their answer. Others spoilt their method having successfully found 646 by adding 600 back on or by multiplying 646 by 3.

Answer: 646

Question 18

Many candidates scored full marks on this question. Others lost out through a lack of working. Candidates must understand that when a question says 'you must show all your working' that they will not be awarded marks for the correct answer without working. Other than this, the main loss of a mark was due to not cancelling to the simplest form.

Answer: $\dfrac{5}{6}$

Question 19

(a)   Many candidates were able to correctly plot the points. Errors were largely due to incorrect use of the scale.

(b)   The answer to this part was generally correct.

(c)   The majority of candidates were able to draw a line within the allowed tolerance. There were some candidates who thought the line of best fit had to go through the origin.

(d)   Many candidates were able to use their line of best fit. Errors were as in part **(a)** due to incorrect reading of the scale.

Answers: **(b)** Positive **(d)** 80 to 92

Question 20

(a)   Many candidates had realised the need to use Pythagoras' theorem and could apply it successfully. A significant number of candidates lost a mark for giving the answer 8.9 rather than 8.91.

(b)   Those who realised that trigonometry was needed usually gave the correct answer. A small number used cosine or tangent rather than sine.

Answers: **(a)** 8.91 **(b)** 13.5

Question 21

(a)   This part was not well answered with 6*w* being the most common error. Other incorrect answers
were 1 and 0.

(b)   Few correct answers were seen to this part, with 2*x* or 2x^0 or even x^3(5–3) given as the answer.

(c)   This part was correct more often than parts **(a)** and **(b)**. However a large number of candidates
were not able to calculate the indices and several scored 1 mark for 15y^k, while others ignored the
indices and gave 15 as the answer.

Answers: **(a)** 6 **(b)** 2x^3 **(c)** 15y^4

MATHEMATICS

<div style="border:1px solid">

Paper 0580/21
Paper 21 Extended

</div>

Key messages

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

General comments

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

Candidates showed very good number work in **Questions 2**, **4** and **7**, and a good understanding of simplifying indices and simple factorising in **Questions 1** and **5**.

Candidates particularly struggled with the volume scale factor in **Question 11**, the co-ordinates problem in **Question 12**, the Venn diagram in **Question 17** and the area problem in **Question 19**.

Comments on specific questions

Question 1

The majority of candidates obtained the correct answer to this question. Where an incorrect answer was given, it was usually x^7.

Answer: x^{10}

Question 2

The vast majority of candidates gave the correct answer to this question. Sometimes errors stemmed from the conversion of the standard form into ordinary form and some left their answer as 2000×10^{-3}.

Answer: 2

Question 3

The majority of candidates correctly rounded to the required accuracy in both parts of this question. Where errors were seen in part **(a)** these often appeared to stem from confusion between significant figures and decimal places. The answer 23.45 was also an error in part **(a)**, and in part **(b)**, answers of 23 and 23.5 were common incorrect ones. Candidates should remember not to include trailing zeros on a rounding question as this caused a large number to lose the marks in one or both parts of the question.

Answers: **(a)** 23.46 **(b)** 20

Question 4

There were very few incorrect answers seen to this question. In part **(a)**, −10 was occasionally seen alone or Moscow was selected. If part **(b)** was incorrect, it was usually −11.

Answers: **(a)** Chicago **(b)** −3

Question 5

The majority of candidates gained both marks on this question. Some only partially factorised, with $2n$ being the most common factor and so only gained 1 mark.

Answer: $4n(3n - m)$

Question 6

The majority of candidates were able to correctly identify the indices, with part **(b)** proving slightly more challenging. The most common incorrect answer in part **(a)** was $\frac{1}{4}$, alongside 4, $\frac{1}{8}$, and ±8. In part **(b)**, the most common incorrect answers were ±5 along with a range of decimal answers.

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

Question 7

Candidates were skilled in this fraction addition and showed all the necessary steps required. The most common loss of marks was because the answer was not given correctly as a mixed number where $\frac{50}{21}$ and $1\frac{29}{21}$ were often seen.

Answer: $2\frac{8}{21}$

Question 8

The most able candidates were successful in their interpretation of the information and could go on to give the correct expressions. The majority were able to give rt for the top row, with the amount of success then falling in turn for the next two expressions. It was fairly common to see candidates introducing their own variables, s and b for square and blue and using these within the expressions.

Answer: rt, $(1 - r)t$, $(1 - r)(1 - t)$

Question 9

Those candidates who set up a correct proportionality equation usually went on to gain full marks in this question. Some gained part marks as they subsequently made errors in either rearranging or forgetting to square root one of the values. Those who did not gain any marks were usually unable to set up a correct proportionality relationship or the one they set up used inverse proportion, omitted the square root or used the square rather than square root.

Answer: 7.65

Question 10

The majority of candidates scored at least one mark on this question but there was obvious confusion over what was required. There were many candidates who left more than one region unshaded and did not label their region R. Candidates could gain part marks if an incorrect region was identified, as it demonstrated some understanding of each inequality. A common incorrect region given was the one to the left of the correct region or to leave the whole of $1 \leqslant y \leqslant 2$ unshaded.

Question 11

This was a topic which was not well understood, proving to be one of the most challenging questions on the paper. The majority of candidates simply used a linear scale factor resulting in an answer of 56.25. Others who misinterpreted the question were using the formula for the volume of a cylinder to find the radius. Those who recognised the need for a volume scale factor generally went on to get the correct answer.

Answer: 76.9

Question 12

Candidates struggled with this problem solving question and many were not able to make a correct start. It was common to see calculations and equations using the numbers from the question in an incorrect way. The most common and most successful approach was to write down a calculation for the gradient of the line using the points given in the question and equate this to 5. Many gained part marks for a correct start and then made subsequent errors in rearrangement or simplifying. Where candidates chose to consider the gradient calculation, it was common to see $\dfrac{23 - 8}{k - x}$ not equated to 5 which did not gain any marks. A common error in this approach was to write $5 = \dfrac{k - x}{23 - 8}$. A less common approach was to write down two equations based upon the information given in the question and then solve these simultaneously. Some of these attempts led to full marks being awarded. However there were again errors in algebraic rearrangement which meant that only part marks were gained.

Answer: $k - 3$

Question 13

Those who identified the correct angle generally went on to score 3 marks by using $\sin x = \dfrac{5}{13}$. Some unnecessarily calculated *EG* as 12 but then used cos or tan or the cosine rule correctly to get the correct solution. Other unnecessary uses of Pythagoras' theorem generally led to the incorrect answer as it usually involved finding the incorrect angle, commonly *AGH*, *EGH* or, after identifying the correct triangle, *EAG*. This was one of the few questions on the paper where candidates occasionally lost the final mark due to premature rounding of their sine value.

Answer: 22.6

Question 14

The majority of candidates approached this by calculating the interior angles of the octagon and triangle and subtracting them from 360. Very few realised that adding the exterior angles of the octagon and triangle would give *x*. The majority of incorrect answers stemmed from the confusion between interior and exterior angles of the octagon, with the interior angle often labelled as 45. Other misconceptions were to label the interior angle of the octagon as 120 or to assume a line of symmetry, taking *x* as equal to the interior angle of the octagon.

Answer: 165

Question 15

Many candidates were able to correctly find the acceleration in part **(a)**. The most common error was to perform the calculation in reverse and other answers came from using incorrect values from the graph, most commonly 12 and 100. There were a good proportion of candidates gaining full marks for the total distance travelled in part **(b)**, with the majority understanding that they needed to find the area under the graph. There were a variety of approaches to dividing up the area under the graph; candidates should think about the most suitable strategy in questions like this. Where candidates divided up the area under the graph into separate sections they were generally able to gain 1 mark for a correct area. Common errors seen included dividing the graph into unsuitable sections which required further calculation to find a length, and identifying an incorrect length when trying to find the area of a triangle or trapezium. There were many instances of forgetting to halve the base × height when finding the area of a triangle.

Answers: **(a)** 0.8 **(b)** 1180

Question 16

The four different parts to this question were answered with very varied success rates. Almost all candidates gained the marks in parts **(a)** and **(d)** but far fewer in the other two parts of the question. Although the majority did state 'positive' in part **(b)**, there were a great number who did not know how to describe correlation, and answers such as directly/inversely proportional, linear, increasing or a sentence describing the relationship were commonly seen, alongside a fairy high proportion of blank answer spaces. In part **(c)**, the majority produced a good line of best fit but there was also a large proportion who did not gain this mark because they either joined the points, started the line at 0 hours, drew a curve or obviously drew a freehand line.

Answer: **(b)** Positive **(d)** 33.5 to 37.5

Question 17

This set notation question appeared to be challenging for many candidates. The vast majority made an attempt at part **(a)**, but with a fairly low success rate, even among the more able candidates. The main confusion appeared to be between $\cup$ and $\cap$ with many shading $F \cap G'$. The shading of G' was also commonly seen. There was a better understanding of part **(b)** with some fully correct diagrams and more partially correct for 1 mark. The most common error was not recognising 1 as a square number and placing it in $A \cap B' \cap C'$. Some misplaced 2 and 8 or omitted them altogether. Many candidates gave the most popular correct value 36 for part **(b)(ii)** with 9 being the most common incorrect value.

Question 18

The majority of candidates were able to give the correct answer in part **(a)** but there were many who gave incorrect multiples of **a** or **b**, most commonly 3**a** + 2**b** ($\overrightarrow{OE}$), or 3**a** + **b**. Equivalent vectors such as $\overrightarrow{AF}$ were also seen. Part **(b)** was the most successful part of the question and part **(c)** the most challenging with a whole variety of responses, the incorrect ones usually involving just one point, such as *F* and *G*.

Answers: **(a)** 2**a** + **b** **(b)** *D* **(c)** $\overrightarrow{CF}$ and $\overrightarrow{BG}$

Question 19

The most able candidates did well on this question, showing a well reasoned and well presented solution. Some lost the accuracy mark here due to premature rounding within multiple calculations. The majority of candidates scored 0 or 1 for this question, the latter usually for $\frac{40}{360} \times \pi \times 10^2$. Most did not appreciate that $\frac{1}{2} ab \sin C$ could be used for the area of the triangle and often attempted to split *ADC* into two, followed by Pythagoras' theorem or trigonometry to attempt to calculate the lengths of the base and height. This is the type of question where candidates should be encouraged to spend some time considering the most efficient methods available to them before leaping in to calculations. A significant number of candidates did not feel able to make any attempt at the question.

Answer: 5.53 or 5.54

Question 20

Any errors in part **(a)** appeared to come from candidates looking for patterns in the table. Otherwise it was well answered with the vast majority filling in the correct values. The majority also found the most likely score in part **(b),** with the most likely score of 3 on each spinner being the source of some errors. The word 'total' in the question appeared to prompt a number of candidates into adding up various rows and columns of the table. Most candidates found the correct probability in part **(c)(i)** or gained 1 mark for a correct denominator if the numerator was incorrect. A common incorrect denominator was 36, no doubt due to the values on the spinner ranging from 1 to 6. The majority were also able to gain the mark in part **(c)(ii)**.

Answer: **(b)** 7 **(c)(i)** $\dfrac{7}{25}$ **(ii)** 0

Question 21

Part **(a)** was carried out successfully with many gaining full marks. The value of *u* was generally found correctly and sometimes a mark was awarded for labelling another relevant angle on the diagram. Part **(b)** involved a circle theorem which slightly fewer were familiar with. Many gained a mark for making a first correct step of writing angle *FOG* as 150. This often led to the answer that *p* was also 150. Some candidates made incorrect assumptions about the diagram, often adding a right angle where it looked remotely like one.

Answer: **(a)** 35, 110 **(b)** 75

Question 22

The final question on the paper was well attempted and most candidates demonstrated some competence in dealing with the algebraic fractions. In part **(a)** many scored 1 mark for factorising the numerator to $x(x - 3)$ even if they did not spot the difference of two squares in the denominator. Those who did not score were generally 'cancelling' the x^2 from the numerator and denominator of the fraction, leading to an answer of $\dfrac{x}{3}$.

Again, in part **(b)**, the majority were able to apply the correct method to combine the fractions. It was fairly common to gain 2 marks if the process was completely correct but then errors were made in multiplying out the brackets or combining the terms. There was sometimes confusion over what should be multiplied, for example, multiplying each fraction by 2 or 3 from the numerators, or finding the correct denominator but not multiplying the numerators.

Answers: **(a)** $\dfrac{x}{x + 3}$ **(b)** $\dfrac{8x + 7}{(x - 4)(2x + 5)}$

MATHEMATICS

```
Paper 0580/22
Paper 22 (Extended)
```

Key messages

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

General comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates showed evidence of good basic skills with particular success in **Questions 2**, **7**, **8**, **9** and **14**. Candidates were very good this year at showing their working; there were few candidates showing just the answers and more method marks were awarded as a consequence. There is still a need to work to an appropriate accuracy; some lost marks due to rounding or truncating within the working or giving answers to less than three significant figures. Candidates found the interpretation of Venn diagrams, **Question 23**, and finding an expression for the area of the triangle in **Question 24(c)** particularly challenging.

Comments on specific questions

Question 1

More than a third of candidates found rounding to 2 significant figures challenging. An incorrect answer here had implications throughout the paper for further lost marks where answers were required to 3 significant figures. Common errors included giving the answer to 2 decimal places i.e. 0.07; writing two figures rather than ignoring the 0s as not significant i.e. 0.1; truncation to 0.071 and leaving in trailing zeros i.e. 0.07200. Other incorrect answers were 0.7, 0.72 and 72.

Answer: 0.072

Question 2

This question was generally well answered by all and by far the most common answer was the correct answer of 0.15. Occasionally, equivalent answers as fractions were seen, usually $\frac{15}{100}$ or $\frac{3}{20}$ and sometimes 15%. Incorrect answers seen were 0.85, $\frac{1}{0.85}$ and sometimes 0.75. Infrequently there were clear arithmetic slips with 1 – 0.85 in the working followed by 0.25 on the answer line.

Answer: 0.15

Question 3

The majority of candidates recognised that they needed to divide. Many divided by the correct value, 100^2. There were a number who did not show understanding that they were dealing with area conversion and used the linear scale factor of 100 to give an answer of 62. Some candidates multiplied by a power of 10. A few left their answer in incorrect standard form e.g. 62×10^{-2}.

Answer: 0.62

Question 4

Most candidates were able to do this calculation correctly, offering a solution with at least 3 significant figures. The most common error was for the answer to be given to only 1 or 2 significant figures with no more accurate answer offered in the working.

Answer: 0.394

Question 5

This question was often correctly answered. A few candidates did not convert so that both amounts of money were the same units and some candidates did not give their answer correct to 3 significant figures. An answer of 42 with no more accurate answer seen was quite common as was truncating to 41. A small minority had totally incorrect working and answers, the most common being $\frac{85}{100} \times 2 \cdot 03 = 1 \cdot 73$.

Answer: 41.9

Question 6

The majority of candidates were able to correctly factorise the expression and therefore gained the mark. Some had $2x - 3y$ only and omitted the factor 7. There were a small number of incorrect answers, blank answers or answers that were just a copy of the question where candidates felt there were no common factors.

Answer: $7(2x - 3y)$

Question 7

Very few did not achieve 2 marks here. Nearly all showed their substitutions clearly. Those who did not gain both marks invariably made an error with evaluating $-3(-2)$ incorrectly to reach $35 - 6$; consequently a common incorrect answer was 29.

Answer: 41

Question 8

This was very well answered with most candidates correctly applying angles on a straight line to give p = 110 and many going on to also correctly find q as 70. The most common errors in this question were reversed answers on the answer line or 110 as the answer for both p and q.

Answer: 110, 70

Question 9

Most candidates were able to show full and correct working to reach $\frac{1}{3}$ gaining 2 marks. The most popular and most successful method was $\frac{5}{6} - \frac{3}{6}$ followed by correct cancellation of $\frac{2}{6}$. Use of a common factor of 12 for the denominator was also often seen and this was more likely to lead to an answer that was not fully cancelled. If candidates scored 0 marks it was usually because they were not showing a method or they attempted the question in decimals using a calculator. There was very occasional addition and also, more frequently, incorrect cancellation or forgetting to give the answer in its simplest form.

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

Question 10

This was a well answered question and candidates demonstrated a good understanding of algebraic manipulation. Work was generally well presented with all steps shown. The majority of candidates left their answer in fraction form and those who converted to decimals were generally accurate and gave answers appropriately to 3 significant figures. Occasionally marks were lost for an answer of 0.16 or 0.17 when a more accurate answer was not clear in the working. Any errors were usually made in the first steps of the rearrangement with sign errors resulting in answers of $\frac{1}{4}$, $\frac{3}{4}$ or $\frac{1}{2}$. In a small number of cases, $6x = 1$ was followed by $x = 6$.

Answer: $\frac{1}{6}$

Question 11

Many fully correct answers to this question were seen. In part **(a)** some candidates gave an answer to only 2 significant figures and others gave a positive rather than a negative power. Other errors seen in part **(a)** were incorrect attempts at standard form such as 60.5×10^{-3} and 605×10^{-4}. In part **(b)** the most common error was for the answer to be left as 5100, rather than being given in standard form. 51×10^2 was also a common incorrect answer.

Answers: **(a)** 6.05×10^{-2} **(b)** 5.1×10^3

Question 12

Most candidates correctly started with the statement $\sin x = \frac{4}{7}$. Errors generally occurred due to premature rounding when the decimal equivalent of $\frac{4}{7}$ was rounded or truncated e.g. to 0.57 or 0.6. The final answer should have been left with at least 1 decimal place but was often rounded to the integer 35, or truncated to 34, sometimes without a more accurate answer seen. An incorrect trigonometric ratio was sometimes seen with $\cos x = \frac{4}{7}$ being more common than $\tan x = \frac{4}{7}$. Some candidates used a less efficient method of the sine rule; this was usually correctly attempted but more frequently followed by incorrect work than the more efficient method. An even smaller number of candidates used Pythagoras' theorem and the cosine rule.

Answer: 34.8

Question 13

The most successful candidates rearranged to keep the terms in *n* positive i.e. $18 - 11 > 5n - 3n$. Many candidates gained 1 mark for a correct rearrangement. It was reasonably common to see sign errors in collecting terms and then 0 marks was inevitable. The two most common reasons for the loss of the final mark were not giving the final answer as the inequality i.e. 3.5 alone or $n = 3.5$ on the answer line or due to dealing with division by negatives and forgetting to reverse the inequality sign. Some listed integers 1, 2 and 3 as their answer.

Answer: $n < 3.5$

Question 14

Access to a calculator meant that the majority of candidates went straight to the correct answers in both parts. The most common incorrect answer in part **(a)** was 5208.3 resulting from $\frac{125^2}{3}$ and in part **(b)**, $\frac{1}{9}$.

Answers: **(a)** 25 **(b)** 9

Question 15

With two steps involved, candidates should be encouraged to clearly show them separately in order to be sure of gaining the method marks on offer. There were some who gained no marks by trying to do the two steps at once, getting one wrong but not providing opportunity to gain credit for the correct step. The most common incorrect starting point was $\sqrt{p} = 2q$, followed by $q = \dfrac{\sqrt{p}}{2}$ for M1. Also common was a problem with the length of the $\sqrt{}$ sign. This was occasionally not long enough, so although the candidate meant $\sqrt{\dfrac{p}{2}}$ it looked like $\dfrac{\sqrt{p}}{2}$. Occasionally seen was $q^2 = p - 2$ as an incorrect first step, as was $q^2 = \dfrac{2}{p}$. A small number of candidates tried, and mostly succeeded, to rationalise the denominator after getting the correct answer.

Answer: $\sqrt{\dfrac{p}{2}}$

Question 16

In part **(a)** most candidates demonstrated a good knowledge of compass and ruler constructions, showing the correct arcs to construct the angle bisector. Those that did not use a compass were usually able to show a correct line within the tolerance given, showing an understanding of the bisector terminology. Accuracy was quite varied with a fair number using arcs with an inappropriately small radius leading to bisectors which were only just in tolerance. Where candidates received 1 mark in part **(a)** it was usually for a correct bisector with no arcs or incorrect arcs. Some realised that arcs were needed and drew them in freehand, indicating they may not have been in possession of a pair of compasses, or they drew incorrect arcs. Some incorrect working seen was to join *A* to the midpoint of *BC*. Other occasional misunderstandings included candidates bisecting the wrong angle in the triangle or constructing perpendicular bisectors of one of the sides.
In part **(b)** the majority were able to shade the correct area; rarely candidates shaded the opposite area. A few candidates lost the mark by not fully extending their line in part **(a)** to reach side *BC*. A few instances were seen where candidates started their construction with a single arc stretching from *AB* to *AC* and then only shading up to this arc and below their line of bisection.

Question 17

This was a well answered question where candidates demonstrated a sound knowledge of the use of the sine rule. The majority gave the correct answer with well-presented work. The most common loss of marks was due to accuracy, with candidates truncating to 4.33 or 4.3 or prematurely rounding part way through their work. Candidates should be encouraged to enter values such as sin 110 directly into calculators rather than using the truncated decimal value which in turn leads to an inaccurate answer. There was some evidence of confusion in the application of the sine rule, for example writing the ratios without the use of sine or using sine with the length rather than the angle. Occasionally the cosine rule was attempted or the triangle was treated as if angle *A* was 90° and sin 30 = $\dfrac{AC}{8.15}$ was seen.

Answer: 4.34

Question 18

Many candidates answered this question well with a significant proportion realising that their final answers should not be rounded as bounds should be given as exact. The most common error seen was for candidates to round their fully accurate answers to 5, 4 or 3 significant figures, thus producing an incorrect final statement. A few candidates wrote their answers the wrong way around in the answer spaces. A significant number of less able candidates multiplied 62 by 47 first and then subtracted and added 0.5 to the result of that calculation, giving answers of 2913.5 and 2914.5. Some others subtracted and added 0.05 rather than 0.5 to the original lengths. A few candidates correctly subtracted and added 0.5, but then multiplied the lower bound of the length by the upper bound of the width and vice versa.

Answers: 2859.75   2968.75

Question 19

Most solutions to this question started with $17 = \frac{1}{2} \times 8 \times 7 \times \sin Q$ which lead to $\sin Q = \frac{17}{28}$ and the first answer of 37.4° so 2 marks was a very common score. Only a few candidates appeared to know that 180 – 37·4 is the second answer and the special case was rarely seen. This second angle was either left blank or sometimes an answer such as −37·4 was provided or a second version of 37.4 e.g. 37.4 and 37.38. Just a few alternative solutions were seen, where a height of the triangle was calculated using the formula area $= \frac{1}{2} \times$ base $\times$ height and then an appropriate trigonometric formula was used. This generally provided just one of the two possible angles as before, often with a loss of accuracy. Common errors included missing the $\frac{1}{2}$ and using cos in place of sin. A small number of candidates used bounds for the length of the sides of the triangle in an attempt to get two answers.

Answer: 37.4, 142.6

Question 20

A significant number of candidates were able to obtain all 3 marks on this question; if not, 1 or 2 marks were also extremely common. Most candidates achieved at least one mark by finding the common denominator. The denominator was expressed as 3(x + 1) or 3x + 3 in equal proportions. A few candidates expanded the denominator 3(x + 1) to get 3x + 1 instead, or followed 3(x + 1) by 3x – 3 occasionally too. (2x – 1)(x + 1) – 6 was often seen but then sometimes the expansion of the brackets resulted in only 3 out of 4 terms correct or the correct terms were incorrectly simplified. A few candidates multiplied 2x by x and got 3x when expanding the brackets. The most common mistake was in adding – x and + 2x to give – x consequently leading to $\frac{2x^2 - x - 7}{3(x+3)}$. A few candidates began with the correct expression $\frac{(2x-1)(x+1)-6}{3(x+1)}$ then incorrectly cancelled the (x + 1) brackets in the numerator and denominator leading to a common incorrect answer of $\frac{2x-7}{3}$. A significant number of candidates missed off one pair of essential brackets and it was extremely common to see e.g. 2x – 1(x + 1) – 6 followed by 2x – x – 1 – 6.

Answer: $\dfrac{2x^2 + x - 7}{3(x + 1)}$

Question 21

This was generally a well answered question with many candidates scoring 2 or 3 marks. The most successful candidates began with $y = \frac{k}{\sqrt{1+x}}$ and showed full clear working throughout. A common error was to use direct proportion i.e. $y = k\sqrt{1+x}$. Other common errors included using x instead of $\sqrt{1+x}$; numerical slips such as $\sqrt{1+8} = 9$; following $2 = \frac{k}{3}$ with $k = \frac{2}{3}$ or not fully processing the answer and leaving the answer as $\frac{6}{4}$. Some candidates forgot the constant and began with $y = \frac{1}{\sqrt{1+x}}$ and this was rarely recovered from.

Answer: 1.5

Question 22

Many recognised part **(a)** as the difference of squares and went straight to the correct answer. The most common answers for 1 mark were $(3t - u)^2$, $(9t + u)(t - u)$, $(3t + u)^2$, $(9t + u)(9t - u)$. Other common incorrect answers included $(9t - u)^2$ and $9(t + u)(t - u)$. Several attempts started with $(3t)^2 - (u)^2$ but went no further. A minority seemed to be unsure what was expected and either did not attempt the question or gave up after a few jottings. Some candidates were able to correct errors due to checking their answer by expanding it. Part **(b)** was a little more challenging for candidates than part **(a)** but there were many correct answers. Most attempts that successfully completed the M1 stage went on to score both marks. The most common errors involved an incorrect sign inside a bracket either in the answer or in the method stage, such as $(2d + c)(2 - p)$, $2(c - 2d) - p(c + 2d)$ and $c(2 - p) + 2d(2 - p)$. Many candidates did not write a subtraction sign between the two parts of the expression, e.g. $2(c - 2d) \, p(c - 2d)$ was quite common, causing them to lose the M1 mark if their final answer was incorrect.

Answers: **(a)** $(3t + u)(3t - u)$ **(b)** $(c - 2d)(2 - p)$

Question 23

This question was the most challenging question on the paper for many candidates, with most getting at least one part of this question incorrect or several parts incorrect. Part **(a)(i)** was often incorrect with the most common wrong answer being 13, where candidates omitted to include the candidates studying both subjects. 11 was also seen quite often. Some candidates wrote this as a fraction, e.g. $\frac{13}{31}$.

Part **(a)(ii)** was correct more often than the other parts of the question but the wrong answers of 12, 16 and 24 were all quite common.

Part **(a)(iii)** was fairly well answered but there were still about half of the candidates who got an incorrect answer. The numerator was quite often correct; the problems occurred in finding the correct denominator, the most common wrong answers were $\frac{7}{13}$, $\frac{7}{24}$ and $\frac{7}{31}$. It was also common for the answer to not be a probability e.g. 7.

Part **(b)** also proved quite challenging for candidates. Those who got all the previous parts correct usually got this correct too. It was also sometimes the only correctly answered part of the question. The most common error was missing out the intersection or shading $(D \cup E)'$.

Answers: **(a)(i)** 24 **(ii)** 5 **(iii)** $\frac{7}{12}$

Question 24

Most candidates gave the required word in part **(a)**. The most common incorrect answers were those such as double and bigger. Among others commonly given were congruent, proportional, parallel and opposite. Virtually all candidates identified the scale factor of 2 in part **(b)** and for many this led to the correct answer. The most common error was to give an answer of 4, thinking that AX corresponded to CX. Part **(c)** was a challenging question for many candidates. Those who used $\frac{y}{x} = \left(\frac{8}{4}\right)^2$ were generally successful in their outcome. Others who showed understanding of the need to square the linear scale factor sometimes got the triangles confused and the response $4y$ was often seen. Expressions involving y^2 or $\sqrt{y}$ were sometimes given. Many used the linear scale factor and the answer $\frac{y}{2}$ was more common than the correct answer. $2y$ was also often seen. Some attempted to work out the areas of the triangles and gave a variety of numeric answers rather than an expression that was asked for in the question.

Answers: **(a)** Similar **(b)** 5.6 **(c)** $\frac{y}{4}$

Question 25

In part **(a)** more able candidates scored well. Those that did not score full marks often either got the correct power of x or the correct coefficient. A few candidates did not simplify sufficiently, leaving brackets in their final answer or leaving the coefficient as 2^3.
In part **(b)** a common error was for the calculation to be done in the wrong order, with candidates finding the cube root of the square of 54 before finally dividing by 2. Therefore 7.14 was a common wrong answer. Many that began correctly by dividing both sides by 2 often went on to find the correct value of p. However there were also a significant number of candidates who simply multiplied 27 by $\frac{2}{3}$ to reach another common incorrect answer of 18. It was also common to see $27^{\frac{3}{2}} = 140.3$ instead of $27^{\frac{2}{3}}$.

Answers: **(a)** $8x^{12}$ **(b)** 9

Question 26

This question was well answered by a large proportion of candidates with 0 marks being very rare. Working was generally shown on the diagram, which was often credited with marks when the answer was wrong. It was harder to award part marks in the working as candidates did not always label the angles that they were calculating. Many candidates made unjustified assumptions about the diagram and the angles. These included assuming that lines *AC* and *BD* were at right angles or assuming triangles *AED* or *DCB* were isosceles. Those who wrote down their answers and showed no working could have possibly gained an extra few marks for intermediate steps or angles shown on the diagram.

Answers: $w = 40$, $x = 95$, $y = 45$

Question 27

There were many candidates who scored full marks in part **(a)** and a reasonable number who gained 2 marks, commonly for $y = 2x + c$ or $y = mx + 4$. The most successful candidates wrote 4 and –2 on the axes at the intercept points and found the gradient from the diagram. Less successful were the candidates attempting to find the gradient through a formula approach. This often ended up with inconsistent subtraction or the fraction inverted. Candidates who ended up with a negative gradient usually did not realise this was inconsistent with the diagram. The y-intercept seemed more elusive to candidates than attempting the gradient, despite the fact that the point *B* was given to them. Most gave an equation in a correct format, usually $y = ...$ although sometimes the answer was just $2x + 4$.
Part **(b)** differentiated between candidates well. Candidates found this significantly more demanding than part **(a)**. Although there were many fully correct answers, there were also many which were awarded few or no marks. The most successful candidates began by finding the midpoint which was then substituted into $y = -\frac{1}{2}x + c$ to find c. Sometimes the gradient was incorrect e.g. 2, –2 or $\frac{1}{2}$. However there were still 2 marks available when the gradient was not correct and many candidates scored these marks. A large number of candidates made a sign error in their attempt to find the midpoint of *AB* or did not attempt to find it and instead used a given endpoint substituted into their $y = -\frac{1}{2}x + c$. Some candidates found the midpoint correctly for 1 mark but either progressed no further or had problems identifying the perpendicular gradient, sometimes resorting to re-calculation rather than use of the product of gradients being –1 for perpendicular lines. A number of candidates left this question blank. Others attempted using Pythagoras' theorem to find the length of *AB*.

Answers: **(a)** $y = 2x + 4$ **(b)** $y = -\frac{1}{2}x + \frac{3}{2}$

CAMBRIDGE
International Examinations

MATHEMATICS

Key messages

Always keep the number of figures in the working to more figures than the answer requires, so if a question requires an answer correct to three significant figures, then always keep at least four figures in your working.

General comments

The questions on algebra were usually answered well; some errors were made in simplifying expressions especially those involving brackets. Some candidates lost credit because they did not give their answer in the form or to the accuracy asked for, for example **Questions 14** and **19** asked for all the working to be shown and there were some who did not show their working. **Question 24** asked for the answer to three significant figures and many did not give it to this accuracy. In geometry it is important to identify the correct information which the question is asking for, either the correct length, the correct angle or the correct shape. A labelled diagram always helps to select the appropriate method to solve the question and very few candidates produced one when it was needed.

Comments on specific questions

Question 1

A few candidates calculated the square root of 0.5 and then multiplied by the bracketed term. The most common error was to give a truncated answer of 0.406 or to round to 2 significant figures, 0.41, or even to 1 significant figure, 0.4 and show no other working.

Answer. 0.407

Question 2

This was answered very well. Some candidates did not factorise it completely and they left the final answer with an incomplete common factor e.g. $4(x^2 - 2xy)$ or $2x(2x - 4y)$.

Answer. $4x(x - 2y)$

Question 3

Most candidates answered this question correctly and, if not, a correct prime factor list for either 20 or 24 was given. The few incorrect answers were often attempts at a common factor such as 2 or 4.

Answer. 120

Question 4

There were two distinct types of error seen in this question. Firstly, the equation was manipulated incorrectly to give $\sqrt{a} = y - x$ and secondly, instead of squaring both sides to remove the square root, the square root of both sides was taken.

Answer. $(x - y)^2$

Question 5

The two most common errors were squaring the radius rather than cubing it and working out the volume of a sphere, and not a hemisphere, by not dividing by 2.

Answer. 68.6

Question 6

This was well answered but some candidates gave the decimal equivalent of $\frac{2}{5}$, 0.4, as the answer, whilst others added rather than multiplied so getting $\frac{4}{5}$ or 0.8 as the answer.

Answer. $\frac{4}{25}$

Question 7

This question was answered well with the majority of candidates reaching the correct answer of $\frac{32}{x^2}$. A small number of candidates, having written $y = \frac{k}{x^2}$ then successfully found $k = 32$, but then made errors in writing the answer in terms of y, such as $\frac{32}{x}$ or $\frac{k}{x^2}$. Some thought it was direct proportionality and started with $y = kx^2$.

Answer. $\frac{32}{x^2}$

Question 8

Most candidates gave the correct answer although $2a^4$ was seen when the two parts were done separately and then combined incorrectly. For the numerator, $8^{\frac{1}{3}}$ and 2.67 from $8 \div 3$ were seen.

Answer. $\frac{2}{a^4}$

Question 9

Part **(a)(i)** was answered very well but occasionally the negative sign was omitted. In part **(a)(ii)** a few gave the answer $\begin{pmatrix} -4 \\ 6 \end{pmatrix}$ by exchanging the two elements. In part **(b)** most gave the correct answer. The most common incorrect answer was 4.

Answer. **(a)(i)** $\begin{pmatrix} 30 \\ -20 \end{pmatrix}$ **(ii)** $\begin{pmatrix} -6 \\ 4 \end{pmatrix}$ **(b)** -4

Question 10

(a)   Those candidates who used the fact that the angles of a triangle add to 180° always gave the correct answer. The common error was to use 360° for the angle sum and this always led to an answer of 20. In part **(b)** almost everyone multiplied their answer to part **(a)** by 7; a few gave the answer as $7x$.

Answer. **(a)** 10 **(b)** 70

Question 11

Most of the shadings were incomplete in that a number of regions were left unshaded but then the candidates chose the correct region and it was correctly indicated with an R. Those that indicated the wrong region usually indicated a region close to the correct answer. Some, however, did not indicate any region so it was left to interpret their shadings which often included incorrect regions.

Question 12

Part **(a)** was usually correct with a common error being 3(3 + 4x) or 9 + 12x. In part **(b)** the common error was to attempt 6(3 + 4x) + 7 by getting the order of the functions the wrong way round.

Answer. **(a)** $3 + 12x$ **(b)** $24x + 31$

Question 13

The common incorrect approach was to start with $\dfrac{0.512}{1} = \dfrac{96}{x}$ and this led to an answer of 187.5. The correct approach involved the cube root of the left-hand side and then squaring it to get the correct scale factor to use.

Answer. 150

Question 14

The most successful candidates used the method 0.6363.. × 100 − 0.6363... to obtain 99x = 63 or 0.6363.. × 10 000 − 0.6363.... × 100 to obtain 9900x = 6300. The other successful method was 0.6363.. × 100 = 63 + x leading to x × 100 = 63 + x and then 99x = 63. Some at this stage did not simplify their fraction. There were some who just wrote down the correct answer with no working and a few who thought it was 0.63 so gave the answer $\dfrac{63}{100}$.

Answer. $\dfrac{7}{11}$

Question 15

This was usually well answered. A small number of candidates wrote the sine rule but then substituted the angles and lengths in the wrong places. Some wrote the correct sine rule but then could not rearrange the equation correctly. Some did not get an accurate answer because they rounded prematurely and this often led to sin x = 0.58 and hence x = 35.5.

Answer. 35.8

Question 16

(a) The two main errors were that the sign was not changed when dividing both sides by –2, e.g. –2x ⩾ –6 leading to x ⩾ 3 and a sign error e.g. 2x ⩽ –6 and therefore x ⩽ –3 is written after the inequality is rearranged.

(b) Most candidates gave the correct answer; a few just wrote a single number such as 2.

Answer. **(a)** $x \leqslant 3$ **(b)** 1, 2, 3

© 2017

Question 17

The first error was that candidates didn't understand the idea of a position vector so many gave $\overrightarrow{PZ}$ or $\overrightarrow{QZ}$ as their answer. Some struggled to find a correct expression for $\overrightarrow{PQ}$, usually writing it as **p** – **q**. It was often correctly recognised that $\overrightarrow{PZ} = \frac{5}{7}\overrightarrow{PQ}$ or $\overrightarrow{QZ} = \frac{2}{7}\overrightarrow{QP}$. Some wrote a correct expression for $\overrightarrow{OZ}$ but they made algebraic errors in simplifying their expression.

Answer. $\frac{2}{7}$**p** + $\frac{5}{7}$**q**

Question 18

There was a good response to this question with most choosing to split the shape into triangles and rectangles before calculating the total distance. Common errors here were not dividing the area of a triangle by 2 or using an incorrect length for the rectangle.

Answer. 3000

Question 19

There was a high success rate with this question. Some candidates just wrote down the result of $\frac{3}{4} - \frac{2}{3}$ as $\frac{1}{12}$ without showing any working at all. A few converted their correct answer to a decimal.

Answer. $\frac{5}{6}$

Question 20

(a) The main incorrect responses for this part were 6*w* and 1.

(b) This was usually correct but some did not completely simplify it, writing their answer as $(5 - 3)x^3$.

(c) There were a lot of correct answers, but some added the numbers to get 8 rather than 15 and others multiplied the powers to get −12 rather than adding them.

Answer. **(a)** 6 **(b)** $2x^3$ **(c)** $15y^4$

Question 21

Most candidates knew how to answer this question but many didn't produce the correct answers because of an incomplete or incorrect quadratic formula, such as using a short fraction line, making errors in simplifying the expression generated by the formula, leaving the final answers in surd form (the question asked for the answers to be given correct to 2 decimal places) and writing the answers to 3 significant figures.

Answer. −0.23 and −1.77

Question 22

Most candidates obtained the length of *AC* or *AG* or both. Those who could see the correct triangle and who identified the correct angle usually reached the correct answer. Most of the other candidates did not attempt to find the correct angle, often leaving either *AC* or *AG* as their answer or calculating the wrong angle such as angle *GAB*. Some lost accuracy by truncating or rounding figures too early in the calculations. A 2-dimensional diagram would have helped candidates to find the correct method to use.

Answer. 35.3

Question 23

(a) Most candidates did give one of the two acceptable versions of the answer. The main errors were an answer of 4(x + 6), incorrectly multiplying out 4(x – 6) and multiplying out the numerator, rather than cancelling.

(b) This was well answered again but common errors included incorrectly multiplying out $(x + 4)^2$, usually to x^2 + 16 and simplifying 8x + 15x to just 23.

Answer. **(a)** $4(x - 6)$ or $4x - 24$ **(b)** $x^2 + 23x + 26$

Question 24

Most candidates worked out the total simple interest as \$120. However many added this to \$2500 rather than to \$2000. Many candidates were able to produce the correct expression for the compound interest but equated it to 2500 + 120. There were some who followed the correct method but rounded or truncated their figures to 1 significant figure and produced an answer of 2% despite the question asking for 3 significant figure accuracy.

Answer. 1.96

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time. Few candidates omitted part or whole questions. Candidates generally showed their workings and gained method marks. However many candidates were unable to gain marks in the 'show' questions (**1(a)(i)** and **4(b)**) if they used the value they had to show from the beginning. Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed and emphasise that in show questions candidates must not start with the value they are being asked to show.

Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. This was particularly evident in **Question 4(vi)(a)** and **(b)** where answers were often given to 2 significant figures only with no working out shown. These candidates gained no marks as answers need to be to at least 3 significant figures and with no working out no method marks could be awarded either.

The standard of presentation was generally good; however candidates should be reminded to write their digits clearly and to make clear differences in certain figures. Similarly many candidates overwrite their initial answer with a corrected answer. This is often very difficult to read and is not clear what the candidates' final answer is. Candidates should be reminded to re-write rather than overwrite.

There was evidence that most candidates were using the correct equipment.

Areas which proved to be important in gaining good marks on this paper were; using ratios, finding fraction and percentages of an amount, forming and solving linear equations, transformations, calculating averages from a frequency table, calculating angles and drawing a pie chart, identifying parts of a circle and use of circle theorems, using Pythagoras' theorem and trigonometry to find missing lengths of a right-angled triangle, accurate plotting of co-ordinates and points on graphs, calculating the gradient of a straight line, use of time in 24-hour format, calculate speed and time, find and use the expression for the nth term of a sequence, measure and draw bearings on a scale diagram, calculate using money and compound interest. Although this does not cover all areas examined on this paper, these are the areas that successful candidates gained marks on.

Comments on specific questions

Question 1

(a) (i) Candidates were generally successful at answering this 'show that' question if they recognised that they had to use the $78 given in the question to show that the total cost was $364. Good solutions showed all working out, generally calculating the kit and travel costs separately and then adding to the membership cost to reach the total of $364. However a very large proportion of candidates started with the $364. The most common incorrect method was $3 + 5 + 6 = 14$, $364 \div 14 = 26$, kit $= 26 \times 5 = 130$ and travel $= 6 \times 26 = 156$. Total cost $= 78 + 130 + 156 = 364$. This method demonstrates the importance of not using the value you are being asked to show in the calculation.

(ii) Candidates were more successful at finding the cost of the kit and travel because most had already worked out these values in part **(i)**. Candidates who found the correct cost for kit and travel using the $364 in part **(i)** were not penalised again and most candidates simply copied their values from part **(i)** in the answer space. The most common incorrect answers were 15.6 and 13 from dividing 78 by 5 and 6 respectively.

(b) Candidates attempted this fraction question in a variety of ways. Successful solutions found $\frac{10}{13}$ of 364 by dividing and multiplying and then subtracting their value from 364. Many more able candidates showed good understanding of fractions and found $\frac{3}{13}$ of 364. A large number of candidates attempted to use percentages to solve this question. This was successful if candidates did not round their percentage value but often candidates rounded it to 76.9% or 77% and when calculating these percentages of 364 and then subtracting, their answers were not exact and therefore lost the accuracy mark. Candidates should be reminded not to round values prematurely within their working and to use the value from the calculator exactly.

(c) Candidates were similarly successful in calculating the total cost of Camilla's brother joining the soccer team. Again a variety of methods were seen with the most common calculating the 12% first and then subtracting this from 364. More able candidates often showed their understanding of percentages and calculated 88% of 364. A large proportion of candidates rounded their final answer to $320 or $320.30 which did not gain full marks as the answer was an exact value and only $320.32 gained full marks. Many less able candidates subtracted 12 or 0.12 from 364.

(d) (i) This part was well answered with a variety of acceptable equations seen. The most common correct answer was $W + 6 + L = 24$. However many rearrangements were seen including $W + L = 18$ and $W = 18 - L$ which both gained full marks. Less able candidates often did not form an equation with answers such as $24W + 6L$ often seen.

(ii) Candidates found this the most challenging part of the question. Many incorrect equations were seen through confusion that W represented the number of points gained from the winning games rather than the number of games won. Therefore $W + 6 = 54$ was a common wrong answer, along with $18W = 54$ and $3W = 54$.

(iii) Candidates were more successful in calculating the value of W and L, even if they had formed the wrong equation in part **(ii)**. Many candidates calculated the correct values for W and L without using an equation. Many candidates gained a follow through mark if they incorrectly found a value for W but then used this to find L by subtracting their value for W from 18.

Answers: **(a)(ii)** 130, 156 **(b)** 84 **(c)** 320.32 **(d)(i)** $W + 6 + L = 24$ **(ii)** $3W + 6 = 54$ **(iii)** 16, 2

Question 2

(a)   Few candidates correctly identified the shape as a quadrilateral with many candidates incorrectly trying to name it as a type of quadrilateral, trapezium, trapezoid and tetragon being the most common wrong answers.

(b)   Good answers contained all three parts to describe an enlargement, including scale factor and centre of enlargement. The most common error was to omit the centre of enlargement. Less able candidates could correctly identify the transformation as enlargement but did not include the centre or gave the wrong scale factor. Very few double transformations were seen.

(c)   Good solutions in this part contained the correct transformation, translation, and a correct vector to describe the translation. Few candidates described the translation in words but those that did often got it correct. The most common error was omitting the minus sign from the vector or writing the vector as a co-ordinate.

(d)   Most candidates reflected the shape however not all in the correct line. The most common error was reflecting the shape in the *y*-axis rather than in the line *x* = 2. Diagrams were generally well drawn, although most were without a ruler. Candidates however should be reminded to always draw diagrams with a pencil as errors made in pen were difficult to correct and often led to answers which were particularly difficult to assess as corners of the shape were difficult to see.

(e)   Most candidates were able to rotate the shape through 90° anti-clockwise however not using the origin as the centre of rotation. Candidates who used a different centre of rotation were able to gain one mark. Similarly to part **(d)** most diagrams were drawn freehand without a ruler.

Answers: **(a)** Quadrilateral **(b)** Enlargement, (scale factor) 3, (centre) (–3,–1) **(c)** Translation, $\begin{pmatrix} 10 \\ -7 \end{pmatrix}$

Question 3

(a) (i)   More able candidates generally identified 4 as the mode from the frequency table. The most common error, 6, showed misunderstanding of a frequency table, as 6 is the most common number seen in the bottom row of the table. An equally common error was 9 as this was the largest number in the table.

(ii)   Candidates again found interpreting the frequency table to find the median difficult. A large proportion of candidates wrote a list of 30 figures from the table to find the median successfully. However a significant number used the top row of the table and gave the answer of 2.5 or 5 from the median of the bottom row.

(iii)   Finding the mean from the table proved equally challenging. A large proportion of candidates found the mean of all 12 values in the table ($\frac{45}{12}$ = 3.75) or the bottom row ($\frac{30}{6}$ = 5). Some candidates made a correct start by adding all 30 values but then divided by 6 which gained one method mark.

(iv)   Completing the bar chart was more successful. Bars were generally drawn with a ruler accurately with the vertical scale correctly completed. The most common error was not reading the question fully and not writing any values on the vertical scale. Candidates should be reminded to reread the question after completing it to check they have done everything asked for.

(b)   Most candidates successfully completed the table. Very few wrong answers were seen and these candidates generally gained one mark for 3, 4 or 5 correct values.

(c) (i) Calculating the sector angle proved challenging for less able candidates with a large proportion choosing not to answer this part. Successful solutions used $\frac{30}{75} \times 360$ from the table rather than using the 120° given in the question for ages 4 and younger.

(ii) Candidates were more successful at gaining this mark as most were able to as a follow through mark from their incorrect answer to part **(i)**. Candidates understood that their answers to **(i)** and **(ii)** had to add to 240° and used this successfully to gain the follow through mark.

(d) Candidates showed good use of a protractor with most candidates correctly drawing an angle of 144° or 96°. Very few candidates did not use a ruler and many using a pencil. Candidates should be encouraged to draw all diagrams in pencil so that any mistakes can be rubbed out and corrected rather than scribbled out if a pen is used.

Answers: **(a)(i)** 4 **(ii)** 2 **(iii)** 2.5 **(b)** 14, 16, 39, 14, 11, 25 **(c)(i)** 144 **(ii)** 96

Question 4

(a) (i) Candidates found identifying the radius from the diagram challenging. Common wrong answers were ratio, radio, diameter and chord.

(ii) Giving a reason why angle *ABO* is 90° proved to be one of the most challenging questions on the whole paper. Many less able candidates drew attention to the square drawn at *B*, or that the triangle was a right-angled triangle, and that this showed the angle was a right angle rather than giving a reason why it was 90°. Very few candidates were able to give a complete correct answer that included the two critical words of tangent and radius.

(iii) Finding the angle *AOB* was the most successfully answered part of this question. The vast majority of candidates correctly showed their understanding that the angles in a triangle add up to 180 to find the missing angle. The most common wrong answer was 49, incorrectly identifying triangle *ABO* as isosceles.

(iv) Identifying the angles *ADC* and *AOB* as corresponding angles was challenging for most candidates. More able candidates tried to give a reason using enlargement and similar triangles but few were able to use the correct terms as required. Candidates should be reminded of the key words to use when describing angles on parallel lines, as F-angles is not accepted as a correct answer.

(v) Many candidates believed that the two triangles were equal or congruent rather than similar. Often candidates wrote the same answer to both parts **(iv)** and **(v)**. A large number of candidates wrote that the triangles were enlargements or in proportion without using the correct term, similar.

(vi)(a) Many candidates did not gain full marks on this question due to rounding their answers to less than 3 significant figures. Good solutions with clear and correct use of trigonometry did not gain full marks because the answer was given as 6.2 instead of 6.21. Candidates should be reminded of the clear instructions given on the front page of the paper which directs candidates to give answers to 3 significant figures. Other common wrong answers were 5.4 cm, from treating the triangle as isosceles, or 3.5 cm from using cos instead of tan.

(vi)(b) Candidates were slightly more successful in finding the length of side *OA*. The majority of more able candidates identified that they needed to use Pythagoras' theorem to find the hypotenuse of the triangle and many were able to gain full marks on a follow through even if part **(a)** was answered incorrectly. Again a very common error was to round answers to 2 significant figures instead of 3; 8.2 was seen often. Many candidates missed out on possible follow through marks by not showing any working out and rounding their solution to 2 significant figures. Without working no marks were awarded for a follow through unless it is correct to 3 significant figures.

(vi)(c) Candidates demonstrated that they knew the formula for the area of a triangle and generally were able to earn full marks as a follow through from an incorrect answer in part **(a)**. The most common error was forgetting to halve after multiplying.

(b) A large proportion of candidates chose not to attempt this part of the question. This was another 'show that' question and a significant number of candidates used the 900° given in the question to show that the sum of the interior angles of the polygon is 900° ($\frac{900}{7}$ = 128.571… × 7 = 900).

Candidates should be reminded that if asked to show a value, not to use it in their answer. Despite the diagram, many wrong answers attempted to find the interior angles of a regular heptagon rather than the diagram shown.

Answers: **(a)(i)** Radius **(ii)** (Angle between) tangent (and) radius **(iii)** 41 **(iv)** Corresponding (angles) **(v)** Similar **(vi)(a)** 6.21 **(vi)(b)** 8.23 **(vi)(c)** 16.8 **(b)** 5 × 180

Question 5

(a) Identifying the missing values in the table was well answered by the majority of candidates. Most candidates correctly identified the y-coordinates for x = –4, 2 and 3. However a common wrong answer was y = –4 when x = –1.

(b) There was good plotting of points seen. The follow through from part **(a)(i)** was seen often. Very few straight lines joining points was seen and even fewer thick or feathered curves drawn.

(c) (i) Candidates found drawing the line of symmetry more challenging. A large proportion of candidates chose not to attempt this part of the question. Successful candidates used a ruler and drew the line the full length of the grid. However a number of candidates lost the mark because they drew the line freehand.

(ii) Again this part was not attempted by a large proportion of candidates because they had not drawn a line in part **(i)**. Candidates who had drawn the correct line in part **(i)** generally gave the correct equation for the line.

(d) (i) Most candidates were able to gain full marks by correctly plotting the points and joining with a straight line. The most common error was plotting (0, 3) instead of (0, –3).

(ii) Candidates were less successful at identifying the x-coordinate of each point of intersection of the curve and their straight line. This was mainly due to reading the negative part of the x-axis incorrectly. Many candidates gave the correct figures but did not include the minus sign or read their values from left to right across the x-axis instead of from right to left, e.g. –1.5 given instead of –0.5 or –4.5 given instead of –3.5.

(iii) Finding the gradient of their straight line was one of the most challenging questions on the whole paper with a large proportion of candidates choosing not to attempt it. A number of more able candidates correctly identified the gradient as –2 but then wrote their answer as the equation of the straight line. Candidates should be reminded to check they have answered the question in the form asked for. A common error was to not take into account the fact that the scales on both axes were not equal. A common wrong answer of –1 was seen from $\frac{-10}{10}$ rather than $\frac{-10}{5}$.

Answers: **(a)** 7, –2, 7, 14 **(c)(ii)** x = –1 **(d)(ii)** –3.3 to –3.5, –0.5 to –0.7 **(iii)** –2

Question 6

(a)   This question was attempted by nearly all candidates with the majority correctly giving the time.
Common errors were to include pm in their answer, i.e. 17 35 pm, or 18 35.

(b) (i)   Most candidates successfully added 16 minutes to their time in part **(a)**. The most common wrong
answer was 17 47, which was the time the bus left the railway station.

   (ii)   Candidates found reading the table more challenging with fewer candidates correctly identifying the
next bus arriving at the theatre at 18 40. More commonly candidates gave the time for the first bus
18 05 or the last bus 19 12.

   (iii) The correct answer of 4 minutes was often seen. However this sometimes came from wrong
working. Many candidates found finding the length of each journey difficult and often 72 and 76
minutes were given as the journey times instead of 32 and 36 minutes. Many candidates are
subtracting times as a column sum and not taking into account that there are 60 minutes in an hour
and not 100.

   (iv)   Calculating the speed of the bus was the most challenging part of this question. Good solutions
showed all working out, including the formula for speed, correct conversion of times from minutes
to hours, division and correct rounding to 1 decimal place. A large number of candidates missed
out on the chance of a mark by not showing their answer to more than 1 decimal place before
rounding. This did not affect candidates who had the correct answer but candidates who had the
wrong journey time or those that divided incorrectly could have gained a mark if they had shown
the answer on their calculator and then rounded their answer to 1 decimal place. Candidates
should be reminded to show all their working out, including any formulas used.

Answers: **(a)** 17 35 **(b)(i)** 17 51 **(ii)** 18 40 **(iii)** 4 **(iv)** 14.2

Question 7

(a)   Giving the order of rotational symmetry of diagram 1 was challenging to most candidates with the
correct answer of 2 only seen from more able candidates. Common wrong answers were 4 or 180°
and some did not attempt this question.

(b)   The vast majority of candidates gained full marks on this question by correctly completing diagram
4.

(c)   Candidates were equally as successful at completing the table. The number of crosses and dots for
diagram 4 was correctly identified by nearly all candidates. The most common wrong answer was
26 dots for diagram 5, adding 8 to 18 instead of 10.

(d) (i)   Writing a worded description of the rule for continuing the sequence was challenging for most
candidates. A common wrong answer was to write the nth term given in part **(ii)** in words. Many
candidates showed they understood how the sequence continued but found describing it in words
difficult, the key part that the amount added on each time went up by 2 was not described with
enough detail.

   (ii)   Candidates successfully substituted 12 into the formula for Diagram n. Common errors following
correct substitution was to subtract 12 instead of adding and writing $12^2 = 24$ instead of 144.

(e) (i)   A large proportion of less able candidates did not attempt both parts of part **(e)**. However those that
attempted part **(i)** usually gained marks for a correct answer or a part mark for $2n$ or $+2$. Some
answers of $n + 2$ were seen.

   (ii)   Candidates who correctly answered part **(i)** generally gained full marks for finding n. The most
common error was substituting 100 into their expression in part **(i)** instead of making their
expression equal to 100 and then solving.

Answers: **(a)** 2 **(c)** 18, 28, 10, 12 **(d)(i)** Add two more each time **(ii)** 154 **(e)(i)** $2n + 2$ **(ii)** 49

Question 8

(a) (i) Most candidates were able to measure the line *BQ* to the nearest mm.

(ii) Candidates who measured the line *BQ* accurately in part **(i)** gave the actual distance by multiplying their measurement by 150.

(iii) Candidates found measuring the bearing very challenging. The majority of candidates showed little understanding of bearings with the most common answers being a measurement of length rather than an angle or 40° which was the angle from south measured in a clockwise direction or 140˚, which was the angle from North measured in an anti-clockwise direction. Some evidence of correct measuring was seen. However few candidates showed the ability to use a protractor accurately when measuring a bearing.

(b) Candidates showed a better understanding of bearings and scale drawing in part **(b)** than in part **(a)**. The majority of candidates scored at least 1 mark, with the majority scoring 2 marks for a line 14 cm long. The length was more successful than the angle. Some candidates did not mark the point with a cross or dot. These candidates often just wrote the letter *M*. This is unacceptable as an answer as it is not clear where to measure to. Candidates must make their position clear by using a dot, cross or a line joining their position of *M* to *Q*.

(c) (i) The majority of candidates gained 1 mark for this question by correctly dividing distance by speed to calculate time. However rounding again caused most candidates difficulty with the correct value 3.818181… often rounded to 3.81 or 3.8. Understanding of time and converting time from decimal time to hours and minutes caused most difficulty as many candidates attempted to change 3.81 or 3.82 to 4.21 or 4.22 in this part.

(ii) Candidates who had already attempted to change their time from 3.81 to 4.21 often then wrote their times as 4 h 21 minutes in part **(ii)** and similarly for other times. Very few correct conversions from decimal time to hours and minutes were seen.

Answers: **(a)(i)** 4.4 **(ii)** 660 **(iii)** 220 **(c)(i)** 3.82 **(ii)** 3 (h) 49 (min)

Question 9

(a) (i) Working with money proved to be one of the most successfully answered question of the whole paper. The vast majority of candidates were able to multiply 400 by 12 correctly and reach the answer of 4800.

(ii) Similar to part **(i)** candidates successfully found the amount spent on furniture with very few errors seen.

(iii) Candidates who had correctly answered parts **(i)** and **(ii)** were able to calculate the amount of money remaining. The only common error was not including the $800 for office equipment in their subtraction, leading to the incorrect answer of $1008.

(iv) Candidates showed good understanding of working with money by correctly dividing their answer to part **(iii)** by the cost of one box of paper. The vast majority of candidates were then able to correctly interpret their decimal answer and give the correct number of boxes. Very few candidates left their answer as a decimal although these candidates gained one mark for the correct method.

(b) Compound interest continues to be a challenging topic for many candidates. Good solutions generally came from using the formula $(2000 \times (1 + 0.05)^3)$. However a number of fully correct solutions were seen where candidates had calculated the amount at the end of each of the three years. Many candidates were able to quote the formula and substitute correctly but made errors in using their calculator. Less able candidates often calculated simple interest instead of compound interest which gained no marks.

Answers: **(a)(i)** 4800 **(ii)** 192 **(iii)** 208 **(iv)** 42 **(b)** 2315.25

CAMBRIDGE
International Examinations

© 2017

MATHEMATICS

```
Paper 0580/32
Paper 32
```

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of Mathematics. Most candidates completed the paper making an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. When candidates change their minds and give a revised answer it is much better to rewrite their answer completely and not to attempt to overwrite their previous answer. Candidates should also be reminded to write digits clearly and distinctly.

Comments on specific questions

Question 1

(a) This part was generally well answered with the majority of candidates able to interpret the given menu and perform the required numerical operations correctly. A small number of arithmetic errors and choosing the wrong price/item were seen. As the answer was an exact value it should not have been rounded to $15.

(b) This part was generally well answered with the majority of candidates able to interpret the given practical situation and apply the correct numerical operations. A common error was not rounding the quotient value down to 4 and leaving the first answer as 4.18 or rounding to 5.

(c) This part on percentage increase was generally well answered. Few instances of the single calculation of $7.60 \cdot 1.15$ were seen with the majority of candidates finding the 15% and then adding it on. Common errors were just finding the 15% and giving the answer as $1.14, and $7.60 + 0.15 = 7.75$.

(d) This part on using a given ratio was well answered with the majority of candidates able to give the correct answer. Common errors included dividing by 3 to get 32, and the answer of 24.

(e) (i) This part proved more demanding for candidates with many unable to correctly work out the opening hours for Saturday and Sunday.

(ii) This part proved very challenging for many candidates. The significance of "the café needs three people on duty" was generally not appreciated. The expected method of $(60 \cdot 3) \div 36$ was rarely seen. Common errors included $3 + 3 = 6$, $36 \div 3 = 12$, $36 \cdot 3$ and $60 \div 36$. There were also a significant number of candidates who were unable to attempt this part.

(f)   This part was generally well answered. Common errors included 464 (omitting the required $\cdot$ 12), 169360 (incorrectly $\cdot$ 365) and the use of 72.5^2.

Answers: **(a)** 14.90 **(b)** 4, 3.40 **(c)** 8.74 **(d)** 72 **(e)(i)** 60 **(ii)** 5 **(f)** 5568

Question 2

(a)   This part on simplifying a given algebraic expression was generally well answered. Common errors included $11a$, $11a - a$, $(5 + 6 - 1)\,a$, 11, 10, $10a^2$ and $10a^3$.

(b)   This part on finding the perimeter of the given rectangle proved to be a good discriminator and the full range of marks was seen. Common errors included finding the semi-perimeter resulting in $8f - 2g$; using the area formula and attempting $(5f + 2g) \cdot (3f - 4g)$; incorrect simplification in the addition of the four correct terms; and incorrectly changing a correct answer to $4f - g$.

(c) (i)   This part was generally answered well although common incorrect answers of $35 + 90$, $35x + 90y$ were seen.

   (ii)   This part was generally answered well although common errors of $(4 \cdot 5)^2$, $4 \cdot 3^2$, and $pr = 35$ were seen.

(d)   This part on solving a given equation was generally well answered with many candidates clearly showing in their working the three required steps. Method marks could often be awarded for a correct first or second step. Common errors included the incorrect expansion of the bracket to $15x - 6 = 75$, and the incorrect second step of $15x = 75 - 30$.

(e) (i)   This part on writing algebraic expressions was generally well answered. Common errors included $x - 6$, $6 - 4x$, and $x + 4 - 6$ for the last term.

   (ii)   This part proved more demanding with a significant number not appreciating the importance of "write down an equation" and "show that" in the wording of the question. This meant that "$x + x - 5 + x + 4 + 4x + 4x - 6 = 125$" had to be seen for the mark to be awarded. A number solved the equation given at this stage.

   (iii)   This part on solving a given equation was generally well done with many candidates clearly showing in their working the two required steps. Method marks could often be awarded for a correct first step. Common errors included $11x = 125 - 7$ and $x - 7 = \dfrac{125}{11}$.

Answers: **(a)** $10a$ **(b)** $16f - 4g$ or $4(4f - g)$ **(c)(i)** 125 **(ii)** 85 **(d)** 7 **(e)(i)** $x + 4$, $4x$, $4x - 6$ **(iii)** 12

Question 3

(a) (i)   The correct answer was reached by the vast majority of candidates.

   (ii)   This part on using the given table to write down probabilities was generally well done although an incorrect total from the table was sometimes used for the denominator. A small but significant number of candidates gave their answers as decimals or percentages but often not to three significant figure accuracy. Common errors included $\dfrac{17}{38}$, $\dfrac{17}{210}$, 17, $\dfrac{1}{17}$ for part **(a)**, $\dfrac{21}{210}$, $\dfrac{21}{126}$, $\dfrac{1}{21}$, 21 for part **(b)**, and $\dfrac{1}{164}$, 164, 84 for part **(c)**.

   (iii)   This part on finding the median was generally well answered especially by those candidates who rewrote the given list into numerical order first. Common errors included 42, 45, 42 and 45, 38 (from using 16 and 60 as the middle figures), 44 (from the mean) and 63 (from using the range).

(b)   This part on finding the mean from a grouped frequency table caused problems although some excellent answers with full working were seen. Common method errors included $50 \div 6$, $50 \div 21$, $21 \div 6$, $172 \div 6$ and $172 \div 21$.

(c) (i) The majority of candidates were able to plot the four pairs of values onto the scatter diagram correctly although a number of inaccuracies were seen.

(ii) This part was generally answered well with the point (10, 35) correctly identified although occasionally the point (14, 11) was also identified.

(iii) The correct correlation for the scatter diagram was stated by the majority of candidates although negative, none and test scores were seen.

(iv) Drawing a line of best fit caused problems for many candidates often because of the insistence of drawing from the origin. The joining of points with a series of straight lines was seen.

(v) This question was generally well answered with the majority of candidates giving an answer within the acceptable range.

Answers: **(a)(i)** 62 **(ii)(a)** $\dfrac{17}{84}$ **(ii)(b)** $\dfrac{21}{38}$ **(ii)(c)** $\dfrac{164}{210}$ **(iii)** 43.5 **(b)** 3.44 **(c)(ii)** (10,35) indicated
(iii) positive **(v)** 28 to 32

Question 4

(a) (i) The great majority of candidates were able to recognise that 36 was the only multiple of 12 in the given list. Those that did not usually offered the answer as 4, no doubt getting confused with factors of 12.

(ii) The great majority of candidates were able to recognise that 4 was the only factor of 8 in the given list. Those that did not usually offered the answer as 32 or 40, no doubt getting confused with multiples of 8.

(iii) The great majority of candidates were able to recognise that 11 was the only prime number in the given list. Those that did not usually offered the answer as 27.

(iv) The great majority of candidates were able to recognise that either 36 or 4, or sometimes both, were the possible square numbers in the given list. Those that did not usually offered the answer as 10, 20 or 27.

(v) The great majority of candidates were able to recognise that 27 was the only possible cube number in the given list. Those that did not usually offered the answer as 10 or 36.

(b) Many candidates were able to find the lowest common multiple (LCM) of 32 and 80 although a small yet significant number gave the highest common factor (HCF) of 16, with factors of 2, 4 and 8 or multiples of 320, 2560 or 5120, being other common errors. Many candidates were able to score the available method mark for the correct prime factors of 32 or 80 or both. These were often set out neatly in a ladder/table format or more successfully by using factor trees.

(c) (i) The correct answer was reached by the vast majority of candidates.

(ii) The correct answer was reached by the majority of candidates. Common errors included $3 \cdot \sqrt{19683} = 420.89$, $\sqrt{19683} = 140.3$ and $(\sqrt{19683})^3 = 2761448.44$.

Answers: **(a)(i)** 36 **(ii)** 4 **(iii)** 11 **(iv)** 36 or 4 **(v)** 27 **(b)** 160 **(c)(i)** 8.3 **(ii)** 27

Question 5

(a)   The majority of candidates were able to identify the given transformation as a rotation but not all were able to correctly state the three required components that were needed for a full description. The identification of the centre of rotation proved the more difficult with a significant number omitting this part. A small number gave a double transformation, usually rotation and translation which results in no marks.

(b)   Similarly the majority of candidates were able to identify the given transformation as an enlargement but not all were able to correctly state the three required components. The identification of the centre of enlargement proved the more difficult with a significant number omitting this part, and (0, 0), (2, 0) and 2 being common errors.

(c) (i)   The majority of candidates were able to correctly draw the required reflection although common errors included reflections in the *y*-axis or *x* = 1 or *x* = –1.

    (ii)   Although many were able to correctly draw the required translation, this part proved to be challenging for some candidates. Common errors included drawing a translation with one of the vertices at the point (–2, 3), or a triangle with only one of the vector components correct.

    (iii)   The majority of candidates were able to correctly draw the required rotation. Common errors included drawing a rotation with one of the vertices at the point (0, 0), or a triangle with a different centre of rotation.

Answers: **(a)** Rotation, 90° anticlockwise, centre (0,0) **(b)** Enlargement, sf = 2, centre (0, 2)

Question 6

(a)   The majority of candidates were able to construct the triangle accurately using compasses, clearly showing the pair of construction arcs and joining the sides with a ruler. Common errors included omission of the required arcs, drawing an isosceles triangle with one side of the correct length, inaccuracies in arcs/lengths, and a half-scale triangle.

(b)   This part proved more demanding for the majority of candidates with a number of blank answers seen. Many candidates did not appreciate that the required constructions were the bisector of angle *S* and the perpendicular bisector of side *SR*. Common errors included lines that were too short, bisectors of incorrect lines or angles, lines parallel to *SR* or *PS*, or more commonly random lines and/or arcs drawn.

Question 7

(a) (i)   The concept and definition of bearings caused problems for all but the more able candidates. Many did not seem to appreciate that the information given of "port *M* and port *P* are due west of port *R*" would give them the answer without the need for calculation or measurement. Common errors included 90°, 62°, 28° and west.

    (ii)   The calculation of the required bearing again caused many problems with a significant number of candidates seemingly unaware of which angle was the actual bearing. There are a number of valid methods but the expected three stage method of 180 – 118 = 62, 180 – 90 – 62 = 28, 180 – 28 was rarely seen in its entirety. 130° was a common error as this is the bearing obtained by measuring with a protractor despite the diagram being stated as "not to scale".

    (iii)   This part was generally well answered with the majority of candidates recognising the need to apply Pythagoras' theorem. Common errors included $\sqrt{(117^2 + 45^2)}$, 117 ± 45 and 117 ÷ 45. Those few candidates who attempted to use a long trigonometrical method tended to use incorrect lengths, angles or ratios and were largely unsuccessful.

(b)   Candidates found this part on finding the number of sides of a polygon quite demanding. Those who found the exterior angle first tended to be more successful. Those who attempted the sum of the interior angles were less successful and tended to start with the incorrect formula of $(n-2) \cdot 180 = 171$. Other common errors included 9, $180 \div 9$, $180 \div 171$, $360 \div 171$ and $180n = 171$.

Answers: **(a)(i)** 270 **(ii)** 152 **(iii)** 108 **(b)** 40

Question 8

(a)   The table was generally completed well with the vast majority of candidates giving six correct values for full marks.

(b)   This reciprocal graph was generally plotted well. The majority were able to draw the two correct smooth curves although a small yet significant number plotted some points inaccurately mainly due to the misreading of the vertical scale.

(c)   The majority of candidates were able to correctly solve the given equation either by using the graph as instructed or possibly solving algebraically. Common errors included 2, 0.53 and 120.

Answers: **(a)** –3, –5, –7.5, 7.5, 3.75, 3 **(c)** $1.8 \leqslant x < 2$

Question 9

(a) (i)   This part on continuing a given sequence was generally answered very well with the majority of candidates able to recognise the differences of 6 and thus write down the next two terms correctly.

(ii)   This part on continuing a given sequence was generally answered very well with the majority of candidates able to recognise the differences of –2, –3, –4 … and thus write down the next two terms correctly.

(b)   This part was reasonably well answered with a number of candidates able to give the more complex generalised rule of $11n + 3$. Common errors included $n + 11$, $11n$, $n = 11$, +11, 58 and a range of numerical answers.

(c)   This part on using a given nth term was often misinterpreted with a significant number of candidates not appreciating that to find the second term meant to use $n = 2$ in the given expression. Common errors included $15 - 10n$, $n = 1.5$ and 5.

(d) (i)   This part proved challenging for all but the most able candidates with many not appreciating the significance of the given sequence 1, 4, 9, 16. The most common error was to give the next term in the sequence as 26. Other common errors included $n + 1$, $2n + 1$, $2n^2$, although a wide variety of other numerical, linear and quadratic expressions were seen.

(ii)   This part again proved challenging for all but the most able candidates with many not appreciating the significance of the given sequence 1, 4, 9, 16. The most common error was to give the next term in the sequence as 75. Other common errors included $3n$, $6n + 3$, n^3, n^6, although a wide variety of other numerical and algebraic expressions were seen.

Answers: **(a)(i)** 32, 38 **(ii)** –2, –8 **(b)** $11n + 3$ **(c)** –5 **(d)(i)** $n^2 + 1$ **(ii)** $3n^2$

MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key Messages

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

General Comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of Mathematics. Most candidates completed the paper making an attempt at most questions. The standard of presentation and amount of working shown was generally good. However, some candidates just provided answers or did not carry out calculations to sufficient accuracy and consequently lost marks. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be paid to the degree of accuracy required and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. Centres should encourage candidates to read the front cover of the examination paper carefully and to use the correct value for π, either 3.142 or the value in their calculator. When candidates change their minds and give a revised answer it is much better to rewrite their answer completely and not to attempt to overwrite their previous answer. Candidates should also be reminded to write digits clearly and distinctly.

Comments on Specific Questions

Question 1

(a) A number of candidates did not appreciate the connection between "8 children" and "72°", which would have led them to the required operations of $\frac{72}{8}$ and then $\frac{360}{9}$ or the proportion method of 72, 8 then 9, 1 and 360, 40. Common errors included 5, 41, and 162.

(b) This part was answered slightly better with the independent method of $\frac{126}{72} \times 8$ being preferred to the follow through method of $\frac{126}{360} \times$ their 40.

(c) Candidates who calculated the angles correctly generally completed the pie chart accurately. It was common to see angles of 81 and 81 as the fact that "strawberry" should be double "banana" was not always appreciated. Another common error was to use 90° for one of the sectors.

(d) The majority of candidates were able to correctly identify "vanilla" as the modal flavour although "strawberry" was a common error.

Answers: **(a)** 40 **(b)** 14 **(d)** Vanilla

Question 2

(a)   This part on converting kilometres to metres was generally answered well although common errors of 127.56 and 1 275 600 were seen.

(b)   Most candidates were able to apply the correct formula and calculate the time as 3840 hours correctly. However the conversion from hours to days was often omitted or incorrectly converted by dividing by 60 or 365.

(c)   This part on converting a large number into standard form proved challenging for a significant number of candidates. Those who wrote 149.6 million correctly as 149 600 000 first tended to be more successful. Common errors included 1.496×10^2, 149.6×10^6 and rounding to 1.5 or 1.50×10^k.

(d) (i)   This part was generally answered well with most candidates understanding that a decimal value was required although the common errors of 0.001 and 1000 were seen.

(ii)   This part was generally answered well with most candidates able to convert correctly to millimetres although the common errors of 0.0000001 (division by 1000) and 0.01 (multiplication by 100) were seen.

Answers: **(a)** 12 756 000 **(b)** 160 **(c)** 1.496×10^8 **(d)(i)** 0.0001 **(ii)** 0.1

Question 3

(a) (i)   This part was reasonably well answered with correct answers of 25 or answers of 11 commonly seen. The full method of $\dfrac{510 - (6 \times 18 + 8 \times 20)}{22} + 6 + 8$ was usually done in stages and when shown in the working enabled 1 or 2 of the available method marks to be earned. Some candidates used just one row with 18 and one with 20, leading to $\dfrac{(510 - 18 - 20)}{22}$ and an answer of 21 or 22. Other candidates subtracted 18, 20 and 22 from 510 and then attempted a calculation with the remaining 450 seats. A small number of candidates thought that this was a question involving sequences.

(ii)   This part on finding a percentage was generally answered well.

(b)   This part on monetary calculations was generally answered well. However there were also arithmetic errors seen, particularly in 7.95×2 and 5.95×2. Some candidates reached the 3.80 but felt that this difference needed to be shared between the 4 people, so divided by 4. A small number of candidates just used one adult and one child ticket in their calculation.

(c)   Candidates who were able to convert 116 minutes to 1 hour 56 minutes by subtracting 60 were generally able to reach the correct answer. Candidates who divided 116 by 60 leading to 1.93 often were unable to proceed correctly from here as this was often treated as 1 hour 93 minutes. Some candidates gave an answer of 15 31 resulting from 14 15 + 116 on a calculator.

(d)   Candidates were often confused in this part about which calculations were required for a comparison. Those who divided to find cost per gram were often able to compare correctly and decide that "small" was the best value. Those who divided to find grams per cent or grams per dollar often gave an answer of "large" as they did not appreciate that the largest value represented best value in this case. Many candidates using correct methods lost marks as they did not give sufficient accuracy in their results to allow comparison. A large number of candidates attempted various multiplication or subtraction methods, which did not lead to any values suitable for comparison.

Answers: **(a)(i)** 25 **(ii)** 357 **(b)** 3.80 **(c)** 16 11 **(d)** Small

Question 4

(a) A significant number of candidates did not appear to know the definition of a reflex angle as although there was evidence of correct measurement, few correct answers were seen. Common errors included 32, 148, 122, 68 and 320.

(b) The majority of candidates were able to give the angle as 68°, but few gave the correct reason as corresponding angles. Vague answers such as the lines are parallel were common and some gave the reason as alternate angles or opposite angles. A small number gave an answer of 112° for the angle.

(c) A reasonable number of candidates were able to give all three angles correctly and score full marks, with others able to score one or two marks particularly on a follow through basis. An answer of 144 was a common error for the value of c, where candidates had omitted to divide by 2 to find one base angle. Candidates often did not appreciate that the values of c and e were equal and it was reasonably common to see the same value given for d and e.

(d) Candidates who calculated the exterior angle as 15° and then subtracted from 180 to find the interior angle were usually more successful and gave the correct answer. Candidates who attempted to use $\dfrac{(n-2)180}{n}$ often made errors in the formula such as $(n-1)$ or 360 in place of 180.

(e) This part on drawing a bearing was generally well answered with many candidates able to draw a neat and accurate diagram to score full marks. Many others were able to score one mark usually for a correct distance.

(f) (i) Candidates found this part very challenging, with an answer of trapezium or parallelogram far more common than the correct answer of rhombus. Only a small number of candidates attempted a sketch to help with their decision.

(ii) Again candidates found this part very challenging, and few correct answers were seen. The most common error was isosceles triangle, but many other quadrilaterals were given as answers.

Answers: **(a)** 328 **(b)** 68, corresponding **(c)** 72, 108, 72 **(d)** 165 **(f)(i)** rhombus **(ii)** kite

Question 5

(a) (i) This part on simplifying a ratio was generally well answered. Common errors included the unsimplified ratios of 35:40:45 and $\dfrac{7}{24}:\dfrac{1}{3}:\dfrac{3}{8}$ (where candidates had divided all values by 600 and then written these values as fractions in their simplest form), and the incorrect ratio of $\dfrac{24}{7}:3:\dfrac{8}{3}$ (where candidates had divided 600 by each of the three values).

(ii) This part on using a given ratio was generally well answered with many able to score full marks.

(b) (i) This part on volume was generally answered well. The two required components were to show the correct use of $V=\pi r^2 h$ by $V=\pi\times10^2\times5$ and an answer between 1570 and 1571. Common errors included the use of an incorrect formula, omitting the accurate answer, and attempting to work backwards from 1600.

(ii) This part on finding the length given the volume of a different tin was less successful and proved challenging for all but the more able candidates. Many did not appreciate that the starting position was $(V=)\ L^2 \times 4 = 1600$. Common errors included 400 (from $L \times 4 = 1600$), 200 (from $2L \times 4 = 1600$), 100 (from $L \times 4 \times 4 = 1600$), 40 (from $L^2 =1600$), 11.7 (from $L^3 = 1600$), and a variety of incorrect formulas used.

(c) This part on bounds was answered reasonably well. There was evidence of understanding this concept but it did appear that a significant number of candidates did not read the question carefully and assumed that the values were correct to the nearest 10 g or 1 g rather than 20 g. Common errors included 1335 and 1345, 1339.5 and 1340.5, 1320 and 1360, and 1300 and 1400.

(d) (i) This part proved to be challenging for many candidates with the significance of the fraction given in the question not appreciated, resulting in the single required calculation of $1290 \div 3$ being rarely seen. Common errors included $1290 \div 12 = 107.5$, $1290 \div 4 = 322.5$, $1290 \times 4 = 5160$ and $1290 \times 12 = 15480$.

(ii) This part on finding a percentage was more successful with a good number of candidates understanding that they could follow through from their previous answer. However $2000 \div 100 = 20$ was a common error.

Answers: **(a)(i)** $7 : 8 : 9$ **(ii)** $300, 225, 75$ **(b)(ii)** 20 **(c)** $1330, 1350$ **(d)(i)** 430 **(ii)** 21.5

Question 6

(a) (i) The table was generally answered well with the majority of candidates giving four correct values for full marks. Common errors were values of $y = -4$ from $x = -2$, and $y = -6$ from $x = -1$.

(ii) This quadratic graph was generally plotted well. The majority were able to draw a correct smooth curve with very few instances of candidates joining points with ruled line segments although a small yet significant number had a point rather than a curve at the minimum point.

(b) (i) The majority of candidates were able to draw the line $y = 5$ correctly with a ruler and covering the full width of the graph paper.

(ii) A good number of candidates were able to correctly solve the given equation by using the graph as instructed. Common errors included using the intersection of the graph with the x-axis, omitting the negative sign and attempting to solve the equation algebraically which was rarely successful.

(c) Many candidates found this explanation challenging and difficult to explain in mathematical language. Those who appreciated the connection with their work in part **(b)** often were able to identify that the graph did not pass through $y = -9$.

(d) (i) Candidates continue to find writing down the equation of the line of symmetry difficult and few correct answers were seen. Those who drew the line of symmetry onto their graph tended to be more successful. Many candidates were unable to state the equation of a line parallel to the y-axis. Common errors included 1, $y = 1$, $2x^2 - 4x - 6 = 1$, and attempting to find an equation in the form $y = mx + c$ which was seldom successful.

(ii) The majority of candidates did not appear to appreciate how the symmetry of the graph could be used to complete the given statement ($x = 7$, $x = 1$ so $x = -5$) and only a small number of correct answers were seen.

Answers: **(a)(i)** $10, 0, -8, 10$ **(b)(ii)** $3.5, -1.5$ **(c)** -9 is below -8 **(d)(i)** $x = 1$ **(ii)** -5

Question 7

(a) (i) This part on interpreting the given travel graph was generally well answered although the common errors of 25 and 10 were seen.

(ii) This part was also generally well answered although the common errors of 11 50 and 12 00 were seen.

(iii) This part on speed conversion was found challenging, although many candidates were able to convert to metres per hour by multiplying by 1000. Common errors included multiplying by 10 or 100, dividing by 60 and multiplying by either 60 or 3600.

(b) This part on completing the travel graph was generally well answered. Most candidates drew the correct horizontal line, but then often joined to 13 00 rather than calculating the time for the remainder of the journey as 15 minutes

(c) (i) This part was also generally well answered although common errors of starting at (11 00,0) or finishing at (12 30,36) were seen.

(ii) The majority of candidates were able to read their point of intersection correctly.

(iii) The majority of candidates were again able to read their point of intersection correctly although the common error of 23 was often seen.

(d) (i) This part on probability was generally well answered although common errors of 0.2, 0.4, 9.6 and 99.6 were seen.

(ii) This part was also generally well answered although common errors of 85, 51 and 510 were seen.

(e) (i) This part on time was reasonably well answered although common errors of 7 + 8 = 15, 8 + 9 = 17, 32 + 9 = 41 and 14 + 13 = 27 were seen.

(ii) Many errors were seen in this part, with confusion about how many hours were paid at $18 and how many at the overtime rate. Many candidates thought that the whole of the day with overtime was paid at that rate. Others used 25% as the overtime rate rather than 125% as the overtime rate. Most candidates managed to gain at least one mark, usually for either 25% of 18 or 125% of 18 correctly evaluated.

Answers: **(a)(i)** 20 **(ii)** 11 55 **(iii)** 26.7 **(c)(ii)** 12 09 **(iii)** 9 **(d)(i)** 0.6 **(ii)** 34 **(e)(i)** 39 **(ii)** 715.50

Question 8

(a) The majority of candidates were able to correctly identify the given shape as a trapezium.

(b) (i) Candidates who realised that they needed to take a measurement from the diagram, namely *AB* as 7 cm, usually gave the correct answer. Common errors included 2, 7, 28, 10 or 100.

(ii) This part on finding the area proved very demanding for all but the more able candidates and the correct answer was seldom seen. The multi-step method of taking measurements, converting to scale, and then using the correct formula to find the area was not always appreciated, and the full method of ½ × (32 + 48) × 28 was rarely seen. The majority of candidates did the work in individual stages and many were able to score part marks for a correct stage. A number of incorrect formulas were used, often with the half missing for the trapezium or triangle.

(c) This part on constructions was generally well answered and many accurate and well-drawn bisectors with clear arcs were seen. Common errors included omission of arcs, short bisectors that did not cover the whole field and incorrect sides and/or angles used.

(d) (i) Many candidates realised that an arc was required here, and it was usually of the correct radius. Some candidates did not shade any area and others shaded an incorrect area. A small number of candidates drew a square for the area.

(ii) This part proved very demanding with a significant number of candidates not appreciating what was required and few correct answers were seen. Those that attempted it seldom used a correct formula for the area of a circle.

Answers: **(a)** Trapezium **(b)(i)** 4 **(ii)** 1120 **(d)(ii)** 201

Question 9

(a) (i) The majority of candidates were able to identify the given transformation as a reflection but either omitted the equation of the line of reflection, gave an incorrect line, or mentioned a centre of reflection. A small number gave a double transformation, usually reflection and translation, which results in no marks.

(ii) Similarly the majority of candidates were able to identify the given transformation as a translation but the vector, if given, was often incorrect with one or both of the negatives omitted or given as co-ordinates.

(b) (i) The majority of candidates were able to correctly draw the required rotation. Common errors included drawing a rotation of 90° clockwise, 180° or a triangle with a different centre of rotation.

(ii) Although many were able to correctly draw the required enlargement, this part proved to be challenging for some, possibly because the centre of enlargement was not the origin. Common errors included drawing an enlargement with one of the vertices at the point (4, 7), or a triangle from a different centre of enlargement, often the origin.

Answers: **(a)(i)** Reflection in $x = 1$ **(ii)** Translation of $\begin{pmatrix} -10 \\ -5 \end{pmatrix}$

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key messages

To score well in this paper, candidates needed to have a good understanding and knowledge of all of the topics on the extended syllabus.

Candidates need to ensure that they read the questions carefully and answer the questions to the required level of accuracy. This is to at least 3 significant figures unless directed otherwise. In addition π should be used from the calculator or as 3.142. Using 3.14 or $\dfrac{22}{7}$ will not in general give the required accuracy.

All diagrams should be completed in pencil and a ruler should be used when appropriate.

In questions that require showing working or have the word 'show' in them, candidates should show all steps in their working. In addition, in 'show' questions, candidates should work towards the result rather than using the given result.

General comments

Most candidates demonstrated that they had a clear understanding across many of the topics examined. The majority of candidates attempted every question on the paper and they were able to show that they had understood the concepts and were able to apply their knowledge to problem solving. Most candidates reached the end of the paper and when candidates were stuck on a particular part they were able to confidently carry on with subsequent parts.

Whilst most candidates followed the instructions in the rubric there were some marks lost due to inaccuracy of answers. These were generally from rounding within the middle of a calculation, using an inaccurate value of π, giving answers to the nearest dollar instead of the nearest cent, or not giving answers to at least 3 significant figures.

Candidates should be particularly careful regarding units whether it be changing litres to cm^3 in **Question 5** or working in cents or dollars in **Question 1**.

The questions involving algebra, transformations, statistics, volumes and money were completed particularly well. Weaker topics included interpretation of graphs and perpendicular lines, matrices, bearings and finding a quadratic formula.

CAMBRIDGE
International Examinations

Comments on specific questions

Question 1

(a) (i)   Many candidates were unable to deal with the fact that some values were in cents whilst others were in dollars. The majority of candidates correctly worked out the total cost in cents but many did not convert their answer to dollars, and some divided by 10 instead of 100. A small number only included one day's fixed charge instead of 90 days.

(ii)   Only a minority gave the correct answer with many writing $32.02 as their answer. This common error came from calculating 176.11 ÷ 5.5. There were a few who calculated 90 × 24.5 in cents correctly and then attempted to subtract the result from 198.16. Again there were some who did not appreciate the need to find 90 × 24.5 so only subtracted one lot of 24.5 and others simply calculated 198.16 ÷ 5.5 or 198.16 ÷ 90.

(b)   A large number wrote a concise method leading to a correct answer. Many others gave the correct answer but it was evident that they calculated the interest one year at a time. Often in these cases inaccuracies arose from rounding the intermediate totals which lead to wrong final answers. There were also many who calculated the simple interest instead of the compound interest.

(c) (i)   There were many correct answers but answers of 1.4 and 140 were frequently seen. A significant number of candidates had the calculation the wrong way round, finding 2.2 as a percentage of 7.7. There were also quite a number who assumed an exponential increase, which was the requirement for the next part.

(ii)   More able candidates had no problem in reaching the correct answer, and many others earned one method mark. Errors occurred when candidates needed to convert the answer they got from finding $^{3}\sqrt{1.4}$ to a correct percentage. A common incorrect answer was 12% which in many cases came from trials which were seen, but it may also have come from candidates rounding their cube root to 1.12 without showing a more accurate answer. Less able candidates just divided their answer to part **(c)(i)** by 3.

(d)   The vast majority had no problem in reaching the correct answer, with a small number making a slip but picking up a method mark for 390 ÷ 13.

(e)   Many candidates correctly divided by 1.033, but the common error of finding 3.3% of $258.25 and either adding or subtracting it from $258.25 was seen very frequently.

Answers: **(a)(i)** 275.31 **(ii)** 3202 **(b)** 17.0 **(c)(i)** 40 **(ii)** 11.9 **(d)** 150 **(e)** 250

Question 2

(a)   Most candidates correctly identified the modal group although a number gave $72 < t \leqslant 73$ or $70 < t \leqslant 75$.

(b)   The majority of candidates found the mean correctly. Some candidates made slips in arithmetic but they were often able to be awarded method marks. Others wrote down the mid-points correctly but did not multiply by the frequencies.

(c) (i)   It was rare to see errors in the table. However the most common error was to simply restate the frequencies instead of working out the cumulative frequencies.

(ii)   The great majority correctly plotted their points at the upper boundaries and the curves or polygons were well drawn. A few candidates wrongly drew bar charts.

(iii)   Most candidates answered this question, even if they had not drawn a cumulative frequency graph. Those who had a correct increasing graph usually gave an answer in range. Those whose graphs were not correct were unlikely to gain a mark, although occasionally a candidate used linear interpolation successfully. Many simply wrote 72.5 as their answer.

(iv) This was less well answered. Using the values on the axes, particularly the vertical axis, proved a problem for some. This meant that some of the values read from the graph were slightly out of range. Many quoted only one of the quartiles but did not identify which one. Again, less able candidates simply wrote down 72.5 again.

(d) There were not many fully correct answers seen, with many errors arising in the conversion of units of time or the use of the wrong boundary. The more able candidates correctly used 74.5 seconds without resorting to decimal equivalents in hours and so successfully reached 50 m/s, although some then didn't go on and convert this to km/h. Of those who worked with the correct boundaries, errors of accuracy arose because they converted seconds to hours before the division. Most candidates scored one mark for dividing a distance by a time but used the wrong or no boundary, and many also scored a mark for multiplying by 3.6, although usually as an equivalent division by a decimal time in hours.

Answers: **(a)** $71 < t \leqslant 72$ **(b)** 72.3 **(c)(i)** 41, 62, 80, 90 **(iii)** 72.1 to 72.4 **(iv)** 1.9 to 2.2 **(d)** 180

Question 3

(a) (i) Throughout part **(a)**, there were many diagrams drawn freehand and some very poorly. Work was often done in ink and then crossed out and attempted again; these answers were very difficult to mark. Those correctly using the mirror line $x = 4$ usually gave a clear and accurate triangle. The most common error was a reflection in the y-axis ($x = 0$). There were only a few who chose to reflect in $y = 4$ or in any other $x = k$.

(ii) Most correctly rotated by 90° anticlockwise but some candidates used the incorrect centre, usually a vertex of the triangle. There were also some that used a clockwise rotation and others did not maintain the shape/size of the triangle. The majority of those who chose to use construction lines for their rotation often 'missed' the correct vertices by up to a quarter square or lost the triangle size and shape in the process, scoring no marks.

(iii) The translation seemed to be the most challenging for the candidates. A correct translation or a wrong translation of $\begin{pmatrix} -5 \\ +1 \end{pmatrix}$ were seen in equal quantity. The one mark for a correct x or a correct y translation was rarely given.

(b) Very few completely correct descriptions were given. Enlargement was usually seen, but 'grows' 'minimises' 'shrinks' 'dilation' and occasionally 'negative enlargement' were not accepted. A centre of enlargement was attempted, but only a few obtained the (5, 5). The most common error in the scale factor was $\frac{1}{2}$ or 2 instead of the negative $\frac{1}{2}$. Completely incorrect answers included multiple transformations and properties and not single transformations, as required by the question. Many were describing an enlargement with a rotation and a translation, indicating that the candidate did not understand the concept of the centre of enlargement being the key to the movement of the shape, and the negative scale factor producing the rotation.

(c) There were indications that candidates did not know how to construct a matrix from a described transformation. Matrix calculations were set up with the vertices of the triangle *A* and their answer to part **(a)(ii)**, which may not have been correct. So those who performed a clockwise rotation in part **(a)(ii)** went on to find that matrix. There were also incorrect answers such as the identity matrix or 2×3 matrices from co-ordinates.

(d)(i) Although mostly correct answers were seen, a correct setting up of the matrix **G** with the position vector of the point P was rare to see. Often candidates wrongly used the co-ordinates as a 1×2 matrix, and followed this with the matrix **G**, which gave the correct answer from a wrong method.

(ii) Those correctly setting up matrices and vectors did find the correct answer and the product of the matrices **GF** was often seen. The errors came from setting up the matrices incorrectly and/or performing the transformations individually.

(iii) Only a few candidates showed evidence that they recognised that an inverse matrix was required. Hence the calculation of the determinant and statements referring to the inverse were not seen.

Correct answers came from using an algebraic approach, namely, multiplying matrix **G** by $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$

and solving for a, b, c and d. The most common wrong approach was to set up a matrix with 4 unknowns and form equations to solve. In this method candidates found that the matrix **GQ** was the identity matrix and gave this as their answer for **Q**.

Answers: **(b)** Enlargement, (5, 5), sf –0.5 **(c)** $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ **(d)(i)** (4, 2) **(ii)** (–4, 2) **(iii)** $\begin{pmatrix} 1 & 0 \\ 0 & 0.5 \end{pmatrix}$

Question 4

(a) Many candidates got this correct. The most common error was 0.4 from $y = 1$ rather than $x = 1$. Poor reading of the scale led to answers of −0.8 (8 squares below) or −1.8. A response of 1 was seen a few times and some gave a range. Together with a lot of candidates who missed this question out, this clearly showed that many did not understand the notation used in the question.

(b) This part was answered correctly by more candidates. A common incorrect answer was $x = 0.5$ and again quite a lot did not understand the notation and gave a range.

(c) Many, particularly less able candidates, struggled with this and there was a great variety of incorrect responses. Of those who had more understanding, −3.8 or −3.9 were often seen instead of −4. The more able candidates gave a value −4 and a range to 10 with the best candidates using correct inequality signs in their answers.

(d) The solution to the equation was poorly done, apart from by the most able candidates. Many did not draw a line and of those who did, many drew $y = 5$ or read the scale wrongly, often resulting in a line through (−1, −7) and (1, 3).

(e) Many less able candidates did not attempt a tangent. Some put the tangent in the wrong place, often at (0.5, 1) but nearly all who drew it in the correct place were awarded the mark for it. Tangents were required to be ruled and touch the curve. Tangents that were chords or that did not touch the curve were not accepted. Poor reading of the scale, omission of the negative sign and run/rise prevented many who gained the mark for drawing the tangent achieving all of the other marks.

Answers: **(a)** −1.6 to −1.4 **(b)** −0.5 **(c)** $k > -4$ **(d)** −2.3 to −2.1, −1.2 to −1.1, 1.3 to 1.4 **(e)** −6 to −4

Question 5

(a) (i) This was completed mainly correctly with 50 893.8 and 50 900.4 (from 3.142) being the most common correct answers. Candidates giving 50 868 (from 3.14) or 50914 (from $\frac{22}{7}$) were only awarded one mark as these answers didn't use values of π as given in the rubric. Only a few candidates did not quote an unrounded answer before giving 50 900. A few candidates were unable to perform the calculation with 2×18 or $(\pi 18)^2$ seen.

(ii) This part was well attempted by most candidates with only a few forgetting to do the subtraction to get the height of space left rather than the height of the coffee. The main errors came from candidates being unable to convert 30 litres into cm^3 or an inaccurate value for π used. Whilst most candidates used the method of dividing volume by area, a few candidates successfully used a correct proportion method.

(iii) The 30 litres was a problem here again. More common however was not recognising that the cup was a hemisphere, so the answer of 167 was seen. There were a few misunderstandings of process such as litres $\times$ volume rather than divided. Some candidates introduced rounding errors (particularly with the $\frac{1}{3}$ and the π) that resulted in an incorrect answer.

(b) (i) This part was answered well by most candidates, understanding that they needed to solve an equation with r and the 95. The use of π did cause some errors, but those who continued to use their calculator display usually obtained the answer of 3.28(6...). There were a few attempts at working backwards from 3.3 which was not given credit.

(ii) The majority understood the concept of 'slant height' and successfully used Pythagoras' theorem with the formula. The most common error was to use the vertical height of 8.4 instead.

Answers: **(a)(i)** 50890 **(ii)** 20.5 **(iii)** 334 **(b)(i)** 3.28(6..) **(ii)** 93.1 to 93.6

Question 6

(a) (i) A large majority answered this correctly. Those who did not score 2 marks nearly always scored 1 mark for $8x + 20$ or better. The most common wrong answer was $-7x - 15$. This was usually from the expansion of the second bracket as $-15x - 35$.

(ii) Mostly correct answers were seen in this part. The common wrong answer was $x^2 - 49$. Some spoiled the correct expansion by going further to factorise again as $(x - 7)(x - 7)$. A few candidates found the constant term to be $+14$ rather than $+49$.

(b) (i) There were many correct answers seen but many candidates only scored 1 mark for this question. The first step caused the problem. Many tried to multiply throughout by 3 first but did not multiply the 5 as part of this step, resulting in $2x + 5 = -21$. Most did earn a follow through mark for solving $2x = -26$. Another (less common) error was to add 5 to -7 rather than subtract 5 from -7. Again, a follow through mark was usually earned for solving $2x = -6$.

(ii) Nearly all candidates expanded the brackets correctly. Those who did not score full marks nearly always made errors with the signs when rearranging terms resulting in $-2x = 30$ or $\pm 2x = 12$.

(iii) Many candidates correctly rearranged the equation to $3x^2 = 75$. Some continued correctly scoring full marks or 2 marks for $+5$ with no negative solution or $+5$ and $\sqrt{25}$. A common error occurred when candidates followed the wrong order of operations resulting in $3x = \sqrt{75}$. Many candidates tried to solve the equation using the quadratic formula. Whilst some were successful most rearranged the equation to $3x^2 - 1 - 74 = 0$ and used -1 as the coefficient of x and -74 as the constant. A few candidates used the difference of two squares as their approach and some were successful.

Answers: **(a)(i)** $-7x + 55$ **(ii)** $x^2 - 14x + 49$ **(b)(i)** -18 **(ii)** 15 **(iii)** 5, -5

Question 7

(a)   Many correct answers were seen. However, there was some confusion seen with candidates subtracting the *x* and *y* co-ordinates as though they were finding the gradient.

(b)   Many correct answers were again seen. Common errors included inverting the fraction resulting in the gradient being $-\frac{1}{2}$ rather than –2 or in adding the co-ordinates in both the numerator and denominator giving $\frac{6}{-1}$ or errors arising from slips with signs. However, from all these errors, 1 follow through mark was often awarded for the correct substitution of the co-ordinates of *A* or *B* into their *y* = *mx* + *c*.

(c)   This was answered well with the majority of candidates scoring 2 marks for the correct equation or correct follow through equation. Most others scored 1 mark usually for a follow through for their gradient with *k* incorrect or sometimes for *y* = *kx* + 7. The SC mark for the omission of *y* was occasionally awarded.

(d)   This part of the question caused most problems. The format of the answer *ax* + *by* + *c* = 0 proved to be an obstacle for many of those who had reached $y = \frac{1}{2}x + 4\frac{1}{2}$. Most candidates made a good attempt to find the perpendicular gradient, often stating –2 × *m* = –1 or similar, as a starting point and many were successful. Of the two steps required, common errors were made in either changing the sign or forgetting to invert the fraction. Some candidates just swapped *a* and *b* for 1 and 5 from the given point (1, 5) in *ax* + *by* + *c* = 0 and had no notion of what the question required. A significant number of candidates did not answer this question.

Answers: **(a)** (−0.5, 3) **(b)** −2*x* + 2 **(c)** *y* = −2*x* + 7 **(d)** *x* − 2*y* + 9 = 0

Question 8

(a) (i)   This was very poorly answered with many angles clearly not representing a possible bearing. Those who did gain the marks usually found the 70° and subtracted from 360°. A common incorrect answer was 70°.

(ii)   Continuing down the north line and supposing a 90° angle with *BC* was very common. The diagram was not to scale and candidates should not assume that *CB* was a West to East line. This often spoilt the question and many gained just one mark for angle *ABC* equal to 10˚ (or occasionally their angle if allowable). Many, although mostly more able candidates, did avoid that trap and realised the sine rule was needed. This was generally successful.

(iii) Again this part was not answered well, partly due to the incorrect earlier parts but mainly because candidates did not realise that the shortest distance had to be a perpendicular. Those who did realise a perpendicular was needed, and did not use the error of extending the north line, did succeed here. Some just found *BC* using the cosine rule and a few gained the SC mark, after losing marks earlier.

(b) (i)   While this mark was gained by many candidates, there was a tendency to start with the expansion or not make it clear that *x*(*x* – 25) was an expression for the area before putting the expansion equal to 2200. Many just wrote the expansion and assumed that transferring the 2200 to the right hand side would be enough. Some thought that a calculation was needed and wasted much time on what was a 1 mark part.

(ii)   Most of those who knew the formula for quadratic equations had at least some success in this part. However errors were often made in the signs in both parts of the formula. Other candidates had remembered the formula incorrectly. Quite a number rounded to 2 significant figures rather than 2 decimal places. To obtain full marks, clear and accurate working demonstrating a correct method was required.

Answers: **(a)(i)** 290 **(ii)** 156.8 **(iii)** 8.68 **(b)(i)** *x*(*x* – 25) = 2200 **(ii)** −36.04, 61.04

Question 9

(a) (i) This straightforward part was answered correctly by most candidates. However, a few candidates either gave –3 and 5 or 13 and 21 as their answers. Others did not know it was as simple as the substitution of 1 and 2 and thought it had to be more complicated.

(ii) Most candidates managed to gain the marks from either writing down the equation $8n - 3 = 203$ and working out $n = 25.75$ or from showing evidence of substituting and evaluating $8n - 3$ for $n = 25$ and 26. Although many candidates started off correctly, errors were unfortunately shown in arithmetic.

(b) (i) While the expression for the nth term was done well, there were a considerable number of candidates who did not read the question and who gave the next term, 37, rather than the nth term. Some gave $n + 6$ or $7n + 6$ and a few gave an incorrect constant term.

(ii) This was not as well done as part **(b)(i)** but many gained at least 1 mark from either a quadratic expression or finding a second difference of 2. Many others gave a linear expression or did not attempt the question. This was a question that in general only the more able candidates succeeded in gaining the 2 marks.

(c) Many candidates gave the correct answers, often with no working. Many showed a lot of disconnected workings much of which did not seem to be leading anywhere. However, quite a lot of those cases ended up with at least one of the answers correct.

Answers: **(a)(i)** 5, 13 **(b)(i)** $6n + 7$ **(ii)** $n^2 + n + 2$ **(c)** 10, 14

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key messages

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

Work should be clearly and concisely expressed with answers written to an appropriate accuracy.

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

General comments

Although a few question parts proved to be a challenge to many candidates, most were able to attempt almost all of the questions reasonably well. Solutions were usually well-structured with clear methods shown in the space provided on the question paper, but a number of candidates did not show full working on the questions that asked for this requirement and scored only partial marks as a consequence.

There were very many excellent scripts with a large number of candidates demonstrating an expertise with the content and showing excellent skills in application to problem solving questions. Only a small number of candidates did not have the mathematical skills to cope with the demand of this paper.

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

Most candidates followed the rubric instructions with respect to the values for π although a few used $\frac{22}{7}$ or 3.14 giving final answers outside the range required. There were a number of candidates losing unnecessary accuracy marks by either approximating values in the middle of a calculation or by not giving their answers correct to at least three significant figures, in **Questions 5** and **8** for example.

The topics that proved to be accessible were ratio, compound interest, expressing one value as a percentage of another, translation, rotation and enlargement, inverse matrices, finding the mean from a grouped frequency table, drawing histograms, drawing and interpreting cumulative frequency diagrams, drawing graphs and tangents, probability, creating and solving linear and quadratic equations and using functions including composite and inverse functions.

More challenging topics included percentage reduction and repeated percentage change, describing a transformation represented by a matrix, matrix multiplication, finding the gradient of a tangent, interpreting inequalities with graphs, cones, sectors and segments, solving algebraic fraction equations, 3D trigonometry, conversions of units of time, speed and acceleration, and distance travelled as area under a speed-time graph.

Comments on specific questions

Question 1

(a) (i) This was answered well generally. Candidates were required to show every stage in the working and most did this in one calculation, multiplying 600 by $\frac{11}{20}$. Some methods were seen in several stages. A few doing this missed out a key step, usually dividing by 20.

(ii) Nearly all candidates obtained the correct result, either by subtracting 330 from 600 or by a ratio calculation.

(b) (i) Most candidates correctly used the formula although a few used a year by year method, risking a loss of accuracy. A number of candidates ignored the instruction however to give their answer correct to the nearest dollar. A few spoiled their method by adding $330 to their answer and some incorrectly used $300 as the initial investment.

(ii) This part was answered well by many although sometimes they used the answer to part **(b)(i)** rather than the interest only. Occasionally 372 or 300 were used in the denominator of the fraction and not 330.

(c) (i) Many wrote $\frac{24.75}{70}$ and were unable to continue. Some rounded or truncated the numerator in an attempt to simplify the numbers involved, and decimal answers were also given.

(ii) The majority of candidates did very well with this reverse percentage question although there were some who found 10% of $24.75 and added it on.

(d) (i) Many candidates had very little idea of how to proceed here, with a very common approach being the addition of 20% and 15%. Of those who did use a suitable method, some stopped on reaching the value 0.68.

(ii) For many candidates, the obvious, but incorrect, method was to subtract 35 from 40.84. There were few successful candidates and they used a variety of methods, some not always clearly expressed, to obtain the answer.

Answers: **(a)(ii)** 270 **(b)(i)** 372 **(ii)** 12.6 or 12.7 **(c)(i)** $\frac{99}{280}$ **(ii)** 27.50 **(d)(i)** 32 **(ii)** 13

Question 2

(a) (i) The majority of candidates drew a correct translation of the triangle.

(ii) Many answered this correctly but there were some candidates who drew a clockwise rotation of 90°.

(iii) There were many correct enlargements but a number of candidates used an incorrect centre for the enlargement including the point (0, 10).

(b) Many candidates correctly stated that this transformation was a reflection although the mirror line was not always correct with $y = x$ a common error. Some marks were not scored for the mention of other conditions such as "centre (0, 0)" or for those that gave more than one transformation. The most common incorrect answer was rotation 180° about the origin.

(c) (i)(a) There were many answers with matrices of the correct order, although sometimes an arithmetic error made one or other of the elements wrong. A number of candidates gave a 2 × 2 matrix for their answer, usually $\begin{pmatrix} 4 & 9 \\ 4 & 12 \end{pmatrix}$.

(b) Some candidates declared that the product could not be evaluated or gave answers such as $\begin{pmatrix} 2 \\ 15 \end{pmatrix}$ or (17). Those who gave the answer as a 2 × 2 matrix generally had all the elements correct.

(c) In general, the inverse matrix was given correctly even by less able candidates.

(ii) **MP** was the common answer given here, with many candidates correctly explaining why the product could not be evaluated. **NM** was also seen. The candidates who had not succeeded in finding an answer to part **(c)(i)(b)** often gave **NP**.

Answers: **(b)** Reflection in $y = -x$ **(c)(i)(a)** $\begin{pmatrix} 13 \\ 16 \end{pmatrix}$ **(i)(b)** $\begin{pmatrix} 2 & 10 \\ 3 & 15 \end{pmatrix}$ **(i)(c)** $\frac{1}{2}\begin{pmatrix} 4 & -3 \\ -2 & 2 \end{pmatrix}$ **(ii)** **NM** or **MP**

Question 3

(a) (i) Candidates generally scored well here. Most showed full working and although there was the occasional slip in figures, method marks were usually earned. There were two common errors in the method seen, the first of which was to use the interval widths with the frequencies instead of the mid-interval values and the other was to find the mean of the mid-values themselves.

(ii) Most candidates were able to draw a correct histogram. The issue for a few candidates was the quality of the drawings. Some candidates ruled their lines in pencil and were precise with the heights of the bars; others drew freehand lines, often in pen, and often lost marks through poor accuracy even when they had the correct intention for the heights and widths of the bars.

(b) (i) Most candidates plotted the five points correctly and the majority joined these plots with a suitable curve or with ruled segments. However, there were a number drawing 'grouped bar charts' instead of a cumulative frequency graph and this error led to problems then in the final parts of the question. For some, there was inaccuracy in the vertical positioning of the plots with candidates not using the scale correctly.

(ii)(a) This part was not answered particularly well. Candidates had first to find 65% of 200 and then take an accurate reading of the mass at that cumulative frequency and many gave answers that were outside the required range.

(b) This part was answered better than part **(b)(ii)(a)** with most candidates reading the cumulative frequency at 75 g of mass and remembering to subtract this reading from 200. A few candidates looked at a cumulative frequency of 75 and read the mass at that point.

Answers: **(a)(i)** 175.5 **(b)(ii)(a)** 170 to 175 **(ii)(b)** 152 to 158

Question 4

(a) Most candidates gave correct readings from the graph. Some candidates calculated the values rather than use the graph.

(b) (i) The tangent was usually well drawn and nearly always ruled. The steepness of the curve at this point of contact was perhaps more challenging than usual and a number of candidates had an incorrect point of contact, often where $x = -3.25$. A small number of candidates either omitted this part or drew a line intersecting the curve.

(ii) Most candidates who had a correct tangent or a close attempt at the tangent gave a correct gradient. The main errors were the omission of the negative sign or the misreading of the scales on the axes.

(c) (i)   The table was almost always correctly completed.

(ii)   The curve was generally well drawn. A few candidates used a ruler for some or all sections of the curve and there were occasional errors in the plotting of points.

(d) (i)   Many candidates gave the *x*-coordinates of the points of intersection correctly. A few made errors with the negative intersection particularly.

(ii)   The inequality from the answers to part **(d)(i)** was challenging to candidates and proved to be a discriminating question. Correct answers were rarely seen and some candidates who clearly understood the question used incorrect inequality signs. Many gave the difference between the answers to part **(d)(i)** and many omitted this part.

(e) (i)   The three values were often correct and the rate of success was higher from the candidates who gave the answers as fractions. Those who gave decimal answers occasionally gave an answer to only two significant figures or made errors with the third value since it was very small.

(ii)   This question was set as a challenge to interpret the values in part **(e)(i)** which led to a limit. Many candidates gave the correct limit while others either gave an incorrect limit or simply stated that the values were decreasing.

Answers: **(a)** -1.75 to -1.7 and 1.7 to 1.75 **(b)(ii)** -7 to -5 **(c)(i)** 1 **(d)(i)** -0.95 to -0.8 and 1.1 to 1.45
(ii) -0.95 to $-0.8 < x < 1.1$ to 1.45 **(e)(i)** 0.125, 0.03125 and 0.000977 **(ii)** 0

Question 5

(a) (i)   With the formula given, almost all candidates correctly found the curved surface area of the cone. A few found the total surface area however.

(ii)   The perpendicular height of the cone was usually calculated correctly. The two main errors were to take this height as the hypotenuse of the triangle or to give the answer to only two significant figures.

(iii)   The volume of the cone, with the formula given, was usually correctly found.

(b)   This part was more challenging with the need to decide on an appropriate strategy, which could have been using the length of an arc or the area of a sector. The area method was the preferred choice as the answer to part **(a)(i)** could be used. The candidates who realised that the radius of the sector was equal to the slant height of the cone usually went on to succeed in finding the angle of the sector. A number of candidates used the radius of the base of the cone for the radius of the sector.

(c)   This part also proved to be a good discriminator. The more able candidates showed clear straightforward working of the difference between the sector area and the triangle area. The candidates who used the correct radius in part **(b)** gained marks in this question. Longer methods were often seen, such as finding the base and height of the triangle or finding the area of the sector, overlooking that this was the answer to part **(a)(i)**.

Answers: **(a)(i)** 94.2 **(ii)** 9.54 **(iii)** 89.9 **(b)** 108 **(c)** 46.6 to 46.8

Question 6

(a)   The completion of the tree diagram was almost always correctly done.

(b)   This single product of two probabilities was usually found to be straightforward. A few added the probabilities.

(c) (i)   This combination of events was more challenging, being the sum of two products. However, it was generally well answered. A number of candidates only gave one of the products.

(ii)   The expected value was usually correctly calculated, even by candidates who could follow through from an incorrect answer to part **(c)(i)**.

(d) This was a much more challenging question requiring a product of five probabilities as well as multiplying this by 5, for the number of days. The more able candidates either gave a fully correct answer or overlooked the number of days. Many candidates did not have a product of five probabilities, for example, one probability multiplied by 5, leading to an answer greater than 1. A number of candidates omitted this part.

Answers: **(a)** $\frac{1}{3}, \frac{6}{7}, \frac{4}{7}, \frac{3}{7}$ **(b)** $\frac{2}{21}$ **(c)(i)** $\frac{15}{21}$ **(ii)** 50 **(d)** $\frac{10}{243}$

Question 7

(a) (i) Most candidates began with a correct equation using either the perimeters of each shape or the sum of two sides. Many continued and solved the resulting linear equation without error. Some errors were made in the algebraic simplification, the most common being to reach $4x = 10$ instead of $4x = 18$ after a correct previous step.

(ii) The majority of candidates started with the correct equation involving two products. Occasionally $(3x - 1)^2$ was then equated with $(3x - 1)(3x + 1)$ but many did expand the brackets correctly. The most common errors in expanding the brackets were $(3x)^2 = 3x^2$ and/or $(2x)^2 = 2x^2$ and/or $1^2 = 2$. The subsequent reduction to a three term quadratic equation was generally well done with the occasional slip in collecting terms. There was a high success rate in solving the equation with most showing correct substitution into the formula and reaching the required positive value of *x*. A few did not show full working for solving their quadratic equation and were unable to score method marks as a result.

(b) (i) This question was usually answered correctly. The most common incorrect answer was $(x + 1)(x - 5)$.

(ii) There were many correct solutions but a significant number of candidates made errors in the initial stages of the working. Most successfully wrote the left hand side over the correct common denominator, but $5(x + 1)$ then became $5x + 1$ and/or $x(x + 1)$ became $x^2 + 1$. A number of candidates who reached $x^2 + 4x - 5 = 0$ did not link it with part **(b)(i)** and used the quadratic formula to solve the equation.

Answers: **(a)(i)** 4.5 **(ii)** 4.24 **(b)(i)** $(x + 5)(x - 1)$ **(ii)** −5 and 1

Question 8

(a) Most candidates used $MN = 4$ and found $\tan^{-1}\left(\frac{9}{4}\right)$ to give the correct answer. The most common false assumption was angle $MBN = 90°$ which usually resulted in $MN = \sqrt{5^2 + 3^2}$ by using $BM = 5$ from part **(b)**. Longer methods involving finding PN or PB were occasionally seen and were sometimes successful where accuracy had been maintained throughout each step.

(b) A correct verification was produced by many candidates. The common errors were the omission of the square root or division by 2 when 6 and 8 were used in Pythagoras' theorem.

(c) Some candidates thought that the required angle was the same as in part **(a)** while a smaller number thought it was angle PBC. However a large proportion did know angle PBM was the required angle and went on to use $\tan^{-1}\left(\frac{9}{5}\right)$ or a less direct route which involved finding PB and using $\sin^{-1}\left(\frac{9}{PB}\right)$.

(d)   It was very common to see the length of *PC* found as the first step by using Pythagoras' theorem in triangle *PMC*. At this stage little or no further progress was made by many candidates. Many candidates made false assumptions, the most common of which were angle *BXC* = 90° and angle *PCB* = angle *PBM*. Only the more able candidates could find angle *PCB* and then use the cosine rule in triangle *BXC* or find angle *BPC* and use the cosine rule in triangle *PBX* to give the correct solution.

Answers: **(a)** 66.0 **(c)** 60.9 **(d)** 5.83 or 5.84

Question 9

(a) (i)   This question was usually answered correctly with only a few candidates using 30 as the time instead of $\frac{1}{2}$.

(ii)   Many candidates knew that the distance divided by the time interval was required but had difficulty with the units of time, using 2.1, 2.16, 2.2 etc. It was also common to see $\frac{200}{130}$ and some who wrote $200 \div 2\frac{1}{6}$ were unable to calculate this correctly. Some candidates attempted to find the speeds in each section of the journey and find the average of these whilst others tried to find the area under the graph divided by the time interval.

(b) (i)   Many candidates knew that the area under the graph was the required distance travelled. Some didn't change the time intervals into hours and arrived at $25V = 100$. A number did reach the correct solution from $\frac{5V}{12}$ = 100 but some correct methods were spoiled by a further stage where 100 was divided by $\frac{1}{2}$.

(ii)   The conversion of km/h into m/s proved challenging for most candidates and was often overlooked. It was common to see the value of *V* divided by 5 or 300. In cases where attempts were made to convert the units, changing kilometres to metres was generally done correctly but it was less common to see division by 3600 for the change from hours to seconds.

Answers: **(a)(i)** 100 **(ii)** 92.3 **(b)(i)** 240 **(ii)** $\frac{2}{9}$

Question 10

(a)   Almost all candidates answered this correctly.

(b)   The majority of candidates found the value of *x* correctly, although some obtained an answer of 55 from incorrectly substituting *x* = 19 into f(*x*).

(c)   Candidates generally dealt well with the composition of functions and most found the solution without difficulty. The most common method was to break the problem down into two stages, a method more popular than substituting directly into the composed function, fh(2) = 3(3^2) –2. Some candidates confused 3 × 3^2 with (3 × 3)^2.

(d)   Many candidates obtained the correct simplified expression but it was more common to see errors. These included incorrect expansion of (3*x* – 2)^2, where one or more of the *x*^{2}, *x* and constant term were incorrect; 3*x*^{2}, –6*x* and –4 were common errors. There were also cases of incorrect collection of terms after a correct expansion and also incorrect attempts at gf(*x*) including x^{3x-2} + 3*x* – 2 + x or 3*x*^{2} – 2 + 3*x* – 2 + *x*.

(e) This was well answered by candidates overall. However, the final answer was sometimes given with y in place of x, and errors in rearrangement occasionally resulted in an answer of $\dfrac{x-2}{3}$. A few candidates gave the inverse as $\dfrac{1}{3x-2}$.

Answers: **(a)** -11 **(b)** 7 **(c)** 25 **(d)** $9x^2 - 8x + 2$ **(e)** $\dfrac{x+2}{3}$

MATHEMATICS

> **Paper 0580/43**
> **Paper 43 (Extended)**

Key messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus. The accurate statement and application of formulae in varying situations is always required. Work should be clearly and concisely expressed with intermediate values written to at least four significant figures and only the final answer rounded to the appropriate level of accuracy.

General comments

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

Most candidates followed the rubric instructions but there continue to be a significant number of candidates losing unnecessary accuracy marks by either making premature approximations in the middle of a calculation or by not giving answers correct to at least three significant figures.

The topics that proved to be more accessible were percentages, statistical measures for discrete and grouped data, drawing graphs, the cosine rule, sequences, simultaneous equations and angle work.

The more challenging topics were interpretation of graphs, probability of combined events, angle of elevation, map scales and set notation.

Comments on specific questions

Question 1

(a) (i) This part was almost always correct. The most frequently seen incorrect answers were 9599.5 and 9595, although various others, not to the nearest hundred, were seen.

(ii) Many correct answers were seen. Some candidates were unsure of the correct lower bound, some gave the lower bound of the profit only, and some multiplied profit by number of cars sold, and then tried to find the lower bound of this.

(iii) Most candidates were successful, but quite a few just wrote down the first four digits without the trailing zeros.

(iv) Most converted to standard form correctly. Common incorrect answers included 2316×10^3 and 2.316×10^{-7}.

(b) Most candidates realised that 546 was 105% of the March value and so divided 546 by 1.05. Some tried, incorrectly, to subtract 5% of 546, or to find 95% of it. The actual notation wasn't always expressed correctly. It should not be written as $1 + 5\%$, but as 105% or 1.05.

(c) Most candidates understood the meaning of exponential growth and so found $3000 \times (1.03)^4$. There were very few errors in this calculation. A few erroneously thought this was the same as $3000 \times (1 + 4 \times 0.03)$, taking the increase to be the same each year. As in the previous part, the use of incorrect notation $(1 + 3\%)$ was seen.

Answers: **(a)(i)** 9550 **(ii)** 23 158 750 **(iii)** 23 160 000 **(iv)** 2.316×10^7 **(b)** 520 **(c)** 3380

Question 2

(a) The vast majority of candidates gained full marks on this question. The value of *x* was correct in virtually all cases. A few thought that *y* was equal to *z*. Others gave an incorrect value of *y* but gained a follow through mark for their *z* = 180 – their *y*.

(b) Although many correct answers were seen, candidates found this more demanding than part **(a)**. Some found angle *ADB* = 42 but could go no further. Most errors arose from making incorrect assumptions about the geometrical properties of the diagram. These included the assumptions that *AD* and *BC* were parallel, or that triangles *ADX*, *BCX* were isosceles, or that angle *CAB* was 90. However, they were given credit for realising that *C* and *D* were equal angles.

(c) Most candidates opted to calculate angle *QPS* = 73 before using opposite angles of a cyclic quadrilateral. Less common was the calculation to find the reflex angle at the centre before using angle at the centre property. Many of those with an incorrect answer treated *OQRS* as a cyclic quadrilateral.

Answers: **(a)** 38, 118, 62 **(b)** 69 **(c)** 107

Question 3

(a) The table was almost always completed correctly. A common error was the incorrect value of 0.75 when *x* = 0.5 as well as a few values that could not have been correct as they were off the scale of the diagram.

(b) Although many correct graphs were seen, it was common to see the points at *x* = –2.2 and *x* = 0.8 plotted incorrectly. Most attempted to draw a smooth curve and straight line segments were rare. A few candidates calculated extra values of *y* and were able to draw the cubic with the maximum turning point in the correct position.

(c) A majority misinterpreted the demand of the question and gave the correct solution of the equation rather than the number of solutions. Less than half of all candidates were successful.

(d)(i) Although many correct equations were seen, the incorrect answer of *y* = 1 was seen frequently.

(ii) Many candidates were able to draw the line from part **(d)(i)** and give the correct values of *x* at the points of intersection with the curve. A small number of candidates misread the scale, for example, instead of *x* = –0.42 giving *x* = –0.58.

(e) A significant number of candidates did not understand the requirements of the question and a variety of incorrect answers were seen. A small majority were able to give a correct range from their graph, many taking the maximum point to be at *x* = –1.5. Some accurately calculated the answer by calculus.

Answers: **(a)** 0, 2.25, 2, 1.25 **(c)** 1 **(d)(i)** $x + 1$ **(ii)** –2.2 to –2.1, –0.45 to –0.4, 0.51 to 0.6
(e) $-1.33 < k < 0$

© 2017

Question 4

(a) (i) Many candidates realised the key to finding the solution depended on finding the height of *E* above *CD* by using the right-angled triangle with hypotenuse 4 and base side 2. Most found this correctly as $\sqrt{12}$, although some thought this was $\sqrt{(4^2 + 2^2)}$. A significant number of incorrect assumptions were made; some candidates thought that *AE* was equal to *AB*, *AE* was $\frac{1}{2}$ *BC* and *BED* was a straight line. Even though the area of *ABCDE* was asked for there were a few who tried to find the total surface area. The required area was most easily found by the area of the rectangle, 7×2, plus that of the triangle, $\frac{1}{2} \times 2 \times \sqrt{12}$.

(ii) The simple solution was to multiply their previous answer by 8 and many did. However, several candidates restarted, but not always successfully.

(b) (i) Most candidates earned all three marks. The loss of marks usually resulted from using an incorrect formula for the volume of a cylinder or by answers that were outside the acceptable range. The lack of accuracy frequently resulted from calculations done in stages, such as $280 \div 13 = 21.5$ followed by $\sqrt{(21.5 \div \pi)} = 2.616$.

(ii) Yet again, many correct answers were seen. For a few, approximating values too early in the calculation led to the inaccurate answer of 10%. A volume of 14^2 was sometimes seen instead of 14^3. A few didn't read the question carefully enough and found the volume of the box not occupied by the cylinder.

Answers: **(a)(i)** 17.5 **(ii)** 140 **(b)(i)** 2.62 **(ii)** 10.2

Question 5

(a) (i) The vast majority of candidates completed the table correctly. A few did not allow for the different widths of the 20–25 and 30–50 bars and gave 66 and 10 respectively.

(ii) Many fully correct solutions with clear working were seen. In cases where the answer was incorrect it was common to see class widths used rather than mid-points and to a lesser extent end-points were used. Some errors were seen with the mid-points of the intervals 20–25 and 25–30 and a few used a different total to that of the given 200.

(b) (i) Many correct answers were seen as fractions with only a small number converting to a decimal or percentage. A common error involved treating it as if it was with replacement and answers of $\frac{4}{25}$. Some found the probability that both parcels were small while a few added the probabilities.

(ii) This proved more challenging than the previous part and only a small majority were successful. Many only considered one of the two possible combinations of small/large and large/small and obtained an answer of $\frac{9}{35}$. Others used replacement and reached $\frac{12}{25}$. Only a few candidates attempted to solve the problem by using 1 – prob(both large) – prob(both small).

(c) Almost all candidates were successful with this part.

Answers: **(a)(i)** 80, 33, 20 **(ii)** 17.3 **(b)(i)** $\frac{1}{7}$ **(ii)** $\frac{18}{35}$ **(c)** 150

Question 6

(a) (i)   A majority of correct descriptions of the translation were seen. Common errors often included terms such as translocation, transition and transfer, none of which are acceptable. Most candidates used a column vector to describe the translation and some opted to describe it in words. Where words were used, 'move' was often the only indication of the transformation. Some reversed the vector components, some gave them as co-ordinates and some made a slip in one of the components.

(ii)   Rotation was the common incorrect transformation given along with quoting both rotation and enlargement, even though the question asked for a single transformation. The co-ordinates of the centre were sometimes reversed as (–4, 0). The scale factor proved more of a challenge and answers of $\frac{1}{2}$ or –2 were frequently seen.

(b)   Many candidates earned full marks for the rotation. A small number rotated the given shape in a clockwise direction with still fewer rotating about the wrong centre.

(c)   Candidates were generally more successful with the reflection than the rotation. A small number of candidates were awarded one mark for a correct reflection in one of the acceptable incorrect lines.

(d)   Almost all candidates earned some or all of the marks in this part. Many gave the correct transformation, although some gave two despite the request for a single transformation. Some slipped up with the scale factor, giving a ratio rather than a single number. Most were able to give the centre correctly.

Answers: **(a)(i)** Translation, $\begin{pmatrix} 3 \\ -13 \end{pmatrix}$ **(ii)** Enlargement, sf = $-\frac{1}{2}$, centre (0, –4)

(d) Enlargement, sf = 3, centre (0, 0)

Question 7

(a)   This was very well answered, with a large majority obtaining full marks. The few errors were caused by inaccuracies in either the multiplication or the subtraction/addition of the equations. A significant number of candidates chose the substitution method and were often successful. A small number subtracted the equations to obtain $x – 8y = – 61$, using this as a substitution into one of the original equations.

(b)   This proved more of a challenge and far fewer candidates were successful. The expansion of $(x + b)^2$ was usually successful and candidates were then able to equate the coefficients of x and the constant a. However, although many got as far as stating the expansion correctly as $x^2 + 2bx + b^2$, some got no further and complicated their working with equations in a, b and x, which did not produce solutions. Only a small number of candidates attempted to complete the square for the expression on the left, usually without much success. A few candidates obtained correct answers without showing much working, presumably by trial substitutions.

(c)   This part also caused problems, although fewer than the previous part. Quite often, the products of the expressions were incorrect due to the lack of brackets in one or more of the terms. So the numerator became $x^2 – x + 2x – 5(3x + 2) = x^2 – x + 2x – 15x – 10$, etc. On the whole, though, candidates knew what they were supposed to do and earned some of the marks, if not completely correct.

Answers: **(a)** –5, 7 **(b)** 36, –6 **(c)** $\dfrac{7x^2 - 12x - 10}{(2x - 5)(x - 1)}$

Question 8

(a) (i) Most candidates plotted the four points correctly. The most common error was plotting a point on an adjacent grid line. Some less able candidates simply joined the six given points or drew a line of best fit.

(ii) Many gave the correct answer, sometimes with strong or weak added. Incorrect answers included line graph, linear, increasing, proportional or a reference to mathematics and physics marks.

(b) Many correct responses were seen for the mean, with working clearly set out. A common slip was to write 0×2 as 2. For less able candidates, adding the frequencies and dividing by 6 was a common incorrect method. Candidates were less successful with the median, some ignoring the frequency of each mark in the table and giving an answer of 2.5. Some attempted to find the median of the frequencies which gave rise to an answer of 5. The mode was almost always correct although a few gave an answer of 8, the frequency of the mode. Many understood the idea of range, but not how to write it. Answers of 0–5 and the inequality $0 \leqslant x \leqslant 5$ were common incorrect answers. Some candidates found the range of the frequencies.

(c) Many candidates were successful in forming and solving an equation with clear, formal working shown. Occasional sign errors and other slips in rearranging the equation were seen after correctly removing the denominator. A few candidates added the frequencies, divided by 3 then equated this to 70.3. Some candidates showed a correct trial of 24 leading to the required 70.3.

Answers: **(a)(ii)** Positive **(b)** 3.1, 3, 5, 5 **(c)** 24

Question 9

(a) Candidates displayed a good understanding of the cosine rule and generally earned all four marks. Where errors were seen they usually resulted from starting with an incorrect statement of the cosine rule, errors in rounding where the calculation was carried out in stages or simple slips when keying in values, from a correct cosine rule, into their calculators.

(b) This proved more challenging to many of the candidates. Some candidates achieved the final answer using a correct method whereas others had used an incorrect method such as $QB = 872 \times \sin 1$. Others were unable to attempt the question. Some candidates gave an answer based on calculations carried out on triangle ABC.

(c) (i) Many correct answers were seen, usually starting with the formula $\frac{1}{2}ab\sin C$. Some attempted to calculate one of the perpendicular heights of the triangle, often successfully, but rounding errors at the various stages meant the final answer was out of the acceptable range.

(ii) This part proved challenging for many and only a minority earned full marks. Some recognised the need to use 100^2 or $20\,000^2$ but not both. Many simply divided by 20 000 and some multiplied by 20 000. Attempts to change the given scale to an area scale such as 1 cm : 20 000 cm followed by 1 cm : 200 m then $1\,\text{cm}^2 : 200^2\,\text{m}^2$ were rarely seen.

Answers: **(a)** 1120 **(b)** 1.7 **(c)(i)** 222 000 **(ii)** 5.55

Question 10

(a)   The most common error seen was omission to place 26 and 28 inside the universal set but outside of A, B and C. Some confused $x : x \leqslant 25$ with $x : x \geqslant 25$ for set C. Most left the intersection of A and B empty, just a few incorrectly writing 0 in the two regions. Some candidates incorrectly placed the same numbers in more than one region. A variety of incorrect Venn diagrams were seen with no particular pattern to the errors.

(b)(i)   Only a minority of candidates were able to give the correct symbol and answers such as $\neq$, $\varnothing$, $\cup$ and $\subset$ were often seen.

   (ii)   Slightly more candidates were aware of the symbol for an empty set but some spoiled their answer by writing $\{ \varnothing \}$. Some gave the answer as the number 0 which was unacceptable along with a variety of incorrect responses similar to part **(i)**.

(c)   If candidates were able to identify the correct region they were generally successful in listing the correct elements.

(d)(i)   The symbol 'n' in, e.g. n(C) was often not recognised as being the 'number of elements in', and so the list of elements was often given as the answer. Other incorrect answers were the sum of all the elements in C. A significant number made no attempt at this part.

   (ii)   Those who experienced difficulties in the previous part did so again in this part. Lists of elements and totals of the elements were also common errors in this part.

(e)   The subset symbol was more generally recognised and many correct answers were seen. Common errors seen involved the use of the symbols $\cup$ and $\in$. Some candidates incorrectly used $<$.

Answers: **(b)(i)** $\notin$ **(ii)** $\varnothing$ **(c)** 21, 23, 24, 29 **(d)(i)** 5 **(ii)** 9 **(e)** $\subset$ or $\subseteq$

Question 11

(a)   Almost all candidates were able to complete the column for the fifth term of each sequence, with only occasional slips being seen. The linear expression for sequence B and the linear expressions for the numerator and denominator for sequence D proved straightforward for the more able candidates, although some less able candidates left these parts of the table blank. The nth terms of sequences A and C posed the greatest challenge. Those that realised the need to use the method of differences usually went on to earn at least one mark for the recognition of a quadratic expression. Some only managed to find the second differences and could make no further progress.

Answers: A 64, $(n + 3)^2$ B 17, $3n + 2$ C 47, $(n + 3)^2 - (3n + 2)$ D $\dfrac{7}{6}$, $\dfrac{n + 2}{n + 1}$