MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key Messages

It is most important for candidates to read the questions with care and make sure that they are clear about what is required. Full coverage of the syllabus and knowledge of the basic perimeter and area formulae are essential.

General comments

Candidates must check their work for sense and accuracy and all working must be shown to enable method marks to be accessed. This is vital in 2-step problems; in particular with algebra where each step should be shown separately to maximise the chance of gaining method marks in, for example **Questions 12** and **22(b)**. Candidates' attention must be drawn to the cover instruction that exact answers, such as that for **Question 11(a)**, should not be rounded to 3 significant figures.

The questions that presented least difficulty were **Questions 4b**, **6**, **9**, **10**, **11**, **16(a)**, **20** and **23(a)(i)**, which included many of the questions on number. Those that proved to be the most challenging were **Questions 13, 15**, **18**, **22(b), 23(b)** and **(c)**. This list includes an explanation question, construction and algebra questions. The question that showed the highest number of blank responses was **Question 18(b)** but in general the number of questions with no responses was very low.

Some candidates didn't distinguish between large numbers in the thousands and decimals numbers, with many using full stops as separators in both. It is vital that candidates are consistent with their notation as the very many inconsistencies lost a number of marks.

Occasionally non-English words were used to answer explanation questions. There is some tolerance allowed for poor spelling but the words themselves must be recognisable as English.

Comments on specific questions

Question 1

There were many incorrect answers to this question which was expected to be a simple start to the paper. Candidates often missed out the 0 and often the last digit was given as 0 rather than the correct 2. Occasionally, candidates included a dot but as noted above, it was often unclear whether this was intended to be a decimal point or whether it was being used as a thousands separator.

Answer: 121 042

Question 2

Although this question was accessible to many candidates, there were some incorrect conversions with answers such as 2500 and 0.025 seen. A number of candidates produced responses that did not show any real understanding of the situation.

Answer: 250

Question 3

Many candidates answered well but other candidates made one of two errors, either working out 72% of 83 or giving a 2 significant figure answer.

Answer: 86.7

Question 4

In **part (a)**, the most common errors were to round to the nearest 100 or 10 000 or to truncate the given number to 41 000. Often in **part (b)**, candidates gave the number of people remaining at the football match rather than those leaving.

Answers: **(a)** 42 000 **(b)** 10 381

Question 5

Often, 4 or 1 was given as the answer to **part (a)** but this part was generally well answered.
Part (b) was less well answered with only one of the correct lines drawn or two lines that were horizontal and vertical. A few candidates gave the answer as the word infinity as they did not appreciate the diagram was more than just a circle.

Answers: **(a)** 2

Question 6

This question was answered correctly by most candidates. Candidates that gave $x = 4$ and $y = 1$ in the answer space for **part (a)** gained no marks. The most common error was to reverse the *x* and *y* co-ordinates in both parts of the question but some candidates reversed the co-ordinates for one part only.

Answers: **(a)** (4, 1)

Question 7

Most candidates knew what 'simplify' meant but the signs caused difficulties for some. Most candidates were able to collect the terms in *a*, but some were unable to deal with the terms in *b*. The most common incorrect answer was $3a - 2b$ but $7a - 4b$ was also seen; both of these scored 1 mark as one set of terms was dealt with correctly.

Answer: $3a - 4b$

Question 8

Many candidates were able to evaluate the calculation correctly, but few were able to give the answer correct to 4 significant figures. The most common incorrectly evaluated answer arose from incorrect use of the calculator, with $5.27 - 0.93 \div 4.89 - 4.07$ being input without the use of brackets. In this case, no accuracy is lost by evaluating the denominator or numerator separately prior to the division as long as no rounding is done at this interim stage.

Answer: 5.293

Question 9

This question was well answered with many candidates showing working and a good number using the diagram so a method mark could be awarded where understanding had been shown. The most common errors were to give an answer of 55° or of 135° following an arithmetic slip with the subtraction.

Answer: 125

Question 10

For some candidates, this question to find a percentage caused difficulties similar to that with **Question 3**. Candidates must appreciate the difference between finding a percentage of an amount and expressing one number as a percentage of another. Some answered with 7700 and as this was not clear whether this was the number of grams or due to a method error, it did not score any marks. This question was worth 2 marks so it was vital to show workings to gain any marks if the answer was incorrect.

Answer: 7.7

Question 11

This was the most successfully answered question on the paper, although sometimes 6561 was seen then changed to 6560 or even to 656 on the answer line. Very occasionally 36 (from 9 × 4) was seen as the answer. For **part (b)**, incorrect answers of 0 or 6 were the most common.

Answers: **(a)** 6561 **(b)** 1

Question 12

The most common difficulty experienced by candidates was dealing with signs correctly, producing equations such as $x = -24$ or $5x = 14$. Almost all of the candidates who were able to collect the terms went on to produce the correct solution. Candidates tried to do two steps in one instead of dealing with one movement at a time which might have helped clarify what to do.

Answer: 4.8

Question 13

A common error was to attempt to give a general definition of an isosceles triangle, without answering the question about Yim's triangle. The term isosceles was not widely understood, with descriptions stating that an isosceles triangle has a right angle, no equal angles or all angles equal being seen quite frequently. Some candidates referred to the sides throughout their explanations instead of the angles as indicated in the question. Many candidates did not score because they did not recognise that a calculation or diagram was required in their explanation. Relatively few candidates suggested the alternative of 84°. Many candidates suggested that Yim's error was to imply that only one of the other angles was 66°; these candidates were usually able to give a clear explanation that showed why two angles of 66° were required.
Candidates should be encouraged to use precise language in their explanations and need to be exposed to the full range of triangles of all sizes and orientations so that they can become proficient at naming, recognising and using their properties in calculations.

Answer: Other angle could be 84

Question 14

Most candidates gave the probability in the correct form although **part (b)** was frequently written as a fraction and some answers were greater than 600. Some candidates gave $\frac{1}{6}$ as the probability and scored a follow through mark in **part (b)** for the answer, 100. A small number answered with $\frac{1}{5}$ reflecting the misunderstanding that the number of different letters is needed instead of the total number of letters. Candidates must realise that it is perfectly acceptable to leave a probability as a fraction, if the question does not say what form to use, as candidates often make errors trying to convert to decimals or percentages and do not give enough figures. The number of candidates who use ratios is getting less each year; answers in that form do not gain any marks.

Answers: **(a)** $\frac{2}{6}$ **(b)** 200

Question 15

This was one of the more straightforward types of questions on upper and lower bounds as candidates did not have to deal with decimals but it still caused problems. Many simply added and subtracted 10 cm to give answers of 430 and 450. A variety of other errors were seen, including answers involving decimals. It was more likely for only the lower bound to be correctly seen often in answers such as 435 and 444. A large number gave 10 and 440 as their answers reflecting a lack of understanding with this topic.

Answer: 435, 445

Question 16

There was often confusion over what was required with answers of the mean and range seen, as well as the mode and median swapped over. Also for **part (b)**, candidates sometimes gave the middle number of the unordered list, the mean of the middle three numbers or the median of a list of numbers without the repeats.

Answers: **(a)** 4 **(b)** 7

Question 17

Questions on interest have various aspects for candidates to consider; is this compound or simple interest, is the answer just the total interest earned or the total amount, should the final answer be rounded to the nearest cent? This time, the question wanted the total amount Bruce has after earning simple interest for six years and there is no need to round as the answer is an exact number of dollars. Apart from candidates not considering the aspects above, errors included finding the interest correctly for one year then adding it to $800 and multiplying this by 6, some subtracted the correct amount of interest from $800.

Answer: 944

Question 18

While the two parts of this question used different wordings to express the two constructions than have been generally seen in previous papers, some candidates produced some very good answers. However, many struggled with these constructions. In both parts, the correct lines were often accompanied by incorrect or spurious arcs which appeared to have been added after the line had been drawn. A lot of candidates understood ‘a line perpendicular’ in **part (a)** but did not draw it through point *P* or simply drew a line connecting *P* to *C*. In **part (b)** some drew a line at right angles to *AC* but not at the centre point. Some drew arcs but then did not draw the lines while others just drew a line which looked correct but had no arcs. Many drew the angle bisector of the angle at *B;* maybe this was because they had drawn a perpendicular bisector already but candidates must read the question carefully.

Question 19

Most candidates realised the need to use a trigonometric ratio, but fewer were able to identify the correct one. A significant number of those that did select the correct ratio were unable to substitute the given values correctly for example, $\sin 56 = \frac{8}{h}$ was seen often. Many candidates confused 8 sin 56 and 56 sin 8 or just forgot to use the sine altogether calculating 56 ÷ 8 or 56 × 8. As this question was worth 3 marks, it was vital to show working in order to capture the method marks if the final answer was incorrect. Some candidates who chose to calculate the base and then use Pythagoras’s Theorem to find the height often found the sum of the squares instead of the difference. If candidates use a long method such as this, they do not gain any marks until the full method is completed. Inaccurate values arising from inappropriate rounding were common. Only a minority of those who calculated *h* correctly were able to go on to give their answer correct to 2 significant figures as asked for in the question. There were also some candidates who appeared to have their calculators set in grads or radians rather than degrees. Candidates should be encouraged to check their calculators are in degree mode before the examination.

Answer: 6.6

Question 20

Many candidates multiplied the 4 by 4 but did not go on to multiply the 3 by 4 or multiplied both entries correctly and then cancelled back to the initial vector – maybe this is evidence of candidates thinking of vectors as fractions. However the number of candidates giving their answers with a horizontal line between the two entries has reduced for this session. In **part (b)**, dealing with the negative sign (in common with **Question 12**) was the main problem.

Answers: **(a)** $\begin{pmatrix} 16 \\ 12 \end{pmatrix}$ **(b)** $\begin{pmatrix} -3 \\ 5 \end{pmatrix}$

Question 21

Here, the common problem was not to show all the steps of working. The question asked for answers to be given in their lowest terms and this was forgotten by many candidates. Candidates should not convert to decimals but work in fractions throughout. In **part (b)**, candidates occasionally inverted the second fraction, or tried to use a common denominator.

Answers: **(a)** $\frac{9}{12}-\frac{1}{12}=\frac{8}{12}=\frac{2}{3}$ **(b)** $\frac{5}{2}\times\frac{4}{25}=\frac{20}{50}=\frac{2}{5}$

Question 22

In **part (a),** many candidates were able to give a partial factorisation of the expression but did not realise that $6b$ was a factor, rather than just $3b$ or $2b$. **Part (b)** caused more problems, mostly because candidates tried to do all the rearranging in one line rather than dealing with one variable at a time. Those that moved k to the left hand side first, often didn't realise n needed to multiply both variables not just one.

Answers: **(a)** $6b\,(a-4c)$ **(b)** $n\,(j+k)$

Question 23

Part (a)(i) was answered correctly by the majority of candidates but the most common incorrect answer was 31, from continuing the sequence in the wrong direction. Sequences always go from the left to the right. For the next part, many did not seem able to clearly express what they had done to find the next term. Equivalent expressions to 'subtract 4' were accepted. In **part (b),** there were few completely correct answers. A wide variety of answers was seen with one of the more common errors being to give -2, 2, 6 as the three terms. This is the result of substituting $n = 0$ for the first term rather then $n = 1$. Some wrote $4n - 2$, $4n - 3$ and $4n - 4$ or even 4, n, -2 in the three spaces. A few candidates started with 2 but then continued with 4 and 6. For **part (c),** some wrote 11, the value of the next term. Of those who tried to use algebra, $n + 3$ was the most common incorrect answer. Several candidates tried, with only limited success, to use the formula for the nth term of an Arithmetic Progression.

Answers: **(a)(i)** 11 **(ii)** subtract 4 **(b)** 2, 6, 10 **(c)** $3n - 4$

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key Messages

It is most important for candidates to read the questions with care and make sure that they are clear about what is required. Full coverage of the syllabus and knowledge of the basic perimeter and area formulae are essential.

General Comments

Many candidates, of all levels of ability, made progress on the more algebraic questions while showing less understanding of more basic wordy questions.

There were many blank responses to questions with gradient and equation of lines, and construction questions.

Lack of working continues to be an issue and candidates must realise that where a question or part of a question has more than 1 mark, there is at least one mark available for method or approach work. An incorrect answer with no working from a candidate will get zero, even if the incorrect answer suggests an error that might have been worth a mark if working had been seen.

Comments on Specific Questions

Section A

Question 1

The majority of candidates placed the brackets correctly. However, some did not follow the instruction for one pair of brackets and some candidates did not attempt the question.

Answer. $3 + 5 \times (4 - 2) = 13$

Question 2

This question was generally answered well. Some candidates did not understand vectors and combined the components as fractions to form a single value response, often $-1\frac{3}{4}$. A fraction line between the components also caused the loss of the mark for some candidates.

Answer. $\begin{pmatrix} 2 \\ 2 \end{pmatrix}$

Question 3

While there were many correct answers to this question, a common error was to interpret the question as a probability, $\frac{12}{240}$, rather than an actual number which was clearly asked by the command 'How many'. Other incorrect responses were 120 and 240.

Answer. 12

Question 4

Part **(a)** was well answered with few errors seen, although there were some poor drawings which were not penalised.

While the responses to part **(b)** were usually correct, the word ‘more’ in this and other questions did not appear to be understood by a significant minority of candidates. Answers of 22 and 15 for the number of cups of coffee and tea respectively were often given.

Answers: **(a)** 3 complete and one half shape **(b)** 7

Question 5

The question required some working of decimal equivalents in order to compare the items. This working was often absent. Often when working was seen, an insufficient number of decimal places was given to make a definitive order. Some could not work out the value of 0.719^5 and a large number of candidates began with $\frac{1}{5}$ as the smallest.

Answer. 19%, 0.719^5, $\sqrt{0.038}$, sin 11.4, $\frac{1}{5}$

Question 6

Both parts of the question, particularly part **(a)**, were answered well. However, some candidates seemed unable to use their calculator correctly. They did not know how to use the tan and sin keys and so produced incorrect answers for part **(b)**.

Answers: **(a)** −447 **(b)** 2

Question 7

This straightforward bookwork question was found challenging mainly due to many candidates not knowing the formula for the circumference of a circle. Consequently answers of 19.6 (the area) and 7.85 (half the circumference) were very commonly seen. Some candidates did not involve π in their calculations and simply doubled the radius.

Answer. 15.7

Question 8

Many candidates achieved the correct solution but many did not understand what was required in this question with some not realising that they had to find an angle. Some did find the correct fraction but did not multiply by 360. Others gave 4 as the numerator of the fraction.

Answer. 160°

Question 9

Part **(a)** was well answered but a lack of understanding of this slightly different type of symmetry question was evident for some. Just seeing the lines of symmetry in both parts was common although these were ignored provided it was clear they were not the required lines. A considerable number of candidates did not follow the instruction of one line in part **(a)** and two lines in part **(b)**.
A vertical line was the main error in part **(a)**. A ‘house’ shape with a pitched roof was a very common incorrect answer in part **(b)**. While a variety of correct solution responses were seen the most common was ‘H’.

Question 10

Many candidates answered this well but some could not apply Pythagoras' theorem and achieve the correct solution to this question. A clear diagram was provided and this was the simplest case of finding the longest side, even though some squared and subtracted. Some candidates simply added the sides and a few attempted to use trigonometry.

Answer. 8.54

Question 11

This was a slightly different type of question on a familiar topic which many candidates found challenging. The word 'more' was ignored by some and only one, usually the highest, rate was multiplied by 500. When both were considered, sometimes the lower one was taken to be the first in the table, rather than the actual lowest exchange rate. Some candidates divided 500 by the rate or divided the rate by 500.

Answer. 10.1(0)

Question 12

Candidates also found this question challenging. Reading values from a table is a regular topic on core papers but this table had a more complex selection. Many candidates attempted a calculation with the individual data items or simply added the columns. Those who did make progress often had problems with the third item.

Answer. 10(.00)

Question 13

Part **(a)** was answered well but there were a few incorrect responses seen. Some clearly did not understand what a factor was and 60, a common multiple, was sometimes seen. 2 and 3 were other common errors meaning that only one of the given numbers was considered.

While most candidates knew what a square number was, an answer of 14^2 was often seen for part **(b)**. Other answers given were below 196, or 225, while some candidates simply found the square root of 169.

In part **(c)** many understood prime numbers but some gave numbers outside the required range. Some candidates did not understand prime numbers as even numbers were commonly seen.

Answers: **(a)** 5 **(b)** 196 **(c)** 97

Question 14

Many responses to this question showed a lack of understanding of the equation of a straight line, namely $y = mx + \mathrm{c}$. Some found the intersection point with the y-axis for part **(a)** but many responses did not even include one zero for the co-ordinates of a point crossing an axis.

In part **(b)** there was also a lack of knowledge evident of the gradient being the coefficient of x in the equation. 2 and 5 were commonly seen.

Although some candidates appreciated the idea of a parallel line for part **(c)** a few gave the same equation as that given but written as $y = -2x + 5$.

Answers: **(a)** (0, 5) **(b)** −2 **(c)** (y =) $-2x + k$

Question 15

While most candidates calculated part **(a)** correctly there were quite a number who did not understand that just working out the formula for the given value of *d* was all that was required. Some responses included letters *c* and/or *d*.

The more able candidates changed the subject of the formula in part **(b)** successfully. However, 1 mark was often gained for at least one correct step in changing the subject. A few gave a numerical answer.

Answers: **(a)** 26 **(b)** $d = \frac{c-3}{10}$

Question 16

A number of clear, correct solutions were seen. Many candidates calculated the whole area as 10 × 6 = 60 and totally ignored the semicircle. Of those who did recognise the need for two parts of the area, the same problem of confusing area and perimeter was once again sometimes in evidence. Using 6^2 and then halving or just simply finding the area of a complete circle were common errors.

Answer. 74.1

Question 17

Many correct responses were seen in this question. The elimination method was the usual approach and those who used substitution were less likely to make significant progress. Those who struggled with the method for the first variable often gained a follow through mark for finding their other variable.

Answer. (x =) 3 (y =) 4

Question 18

This algebra question, particularly part **(a)**, was answered well. A common error in part **(a)** was multiplying the indices but also a few had an index of 3 or even −3.

Part **(b)** was not so well answered with many gaining just the 1 mark, usually for the integer 5. Also seen quite a number of times was just 5^6. Once again, errors with the indices led to an index of 2 or even −2.

Answers: **(a)** x^7 **(b)** $5y^6$

Question 19

Many correct lines were seen in part **(a)** although some had a negative gradient going from a point on the litres axis to (5, 0). Some candidates drew horizontal and/or vertical lines to the point (5, 22.5). Of those who did draw a line from the origin, it sometimes went to 20, 21.25 or 25.

Even with an incorrect line, quite a lot of candidates worked out the correct answers in part **(b)** and this was credited even though they were not from their graph. Others did gain follow through marks from an incorrect line. Reading the vertical scale incorrectly lost the mark for some in part **(b)(i)** and just giving 3.5 in part **(b)(ii)** was seen quite a number of times.

Answers: **(b)(i)** 17.5 to 18.5 **(b)(ii)** 3.3 to 3.4

Question 20

While most candidates seemed to appreciate what a net was, many lost a mark for not including one of the rectangles, usually the one to be the top of the cuboid or from missing one or both sides. A significant minority attempted to draw a 3D shape or add extra overlapping rectangles.

Many candidates did not realise that the volume only required the 3 dimensions to be multiplied and a wide variety of responses, with even attempts at surface area, were seen, with or without working. Units were ignored by many even though a clear break in the answer line should have reminded them. However, many did attempt the units but units^3 and cm^2 were common errors.

Answers: **(b)** 30 cm^3

Question 21

There were many blank responses to some or all parts of this question.

Part **(a)** was a standard angle bisector construction but some attempted it from point *A* instead of point *B*. There were also many cases of missing arcs, particularly on *BA* and *BC*. Some simply drew a line approximately bisecting the angle while others drew a line from the midpoint of *AC*.

Part **(b)** was a standard line bisector and was better answered than part **(a)**. Only one pair of arcs instead of two pairs, and lines which did not bisect at 90°, were common errors while some bisected *AC* instead, which may have been their attempt at part **(a)**.

Some candidates made a good attempt at part **(c)** although there was some confusion with many not attempting an arc from *C*.

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key Messages

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

General comments

The vast majority of candidates could attempt all the questions. It is important, however, that candidates read the questions carefully in order to understand what is required. Careful checking would help to reduce the number of errors.

Generally presentation was good. Many candidates showed method and were able to earn partial credit if they did not obtain the final answer, although as always, a lack of working did cost some candidates marks. The majority of candidates are showing working especially in, for example, the question which said "show that". On constructions it appears a small number of candidates did not have access to, or were not able to use a pair of compasses correctly. Some candidates were unable to distinguish between significant figures and decimal places.

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

Comments on specific questions

Question 1

This question was generally well answered. A small number of candidates gave the calculation rather than the value. The common incorrect answer was 176, which was the mean.

Answer: 84

Question 2

This question was well answered with the majority of candidates giving the correct answer. A small number attempted to simplify the expression as $3a^2$.

Answer: $a(2a - 5)$

Question 3

This was also well answered with the majority of candidates giving the correct answer. A small number gave the answer –29.

Answer: 29

Question 4

Many candidates were able to give the correct answer while others appeared to understand what to do but errors occurred from the incorrect use of decimals e.g. 45 minutes is equal to 0.45 hours. Many multiplied 52 by 45 and stopped or divided by 100 rather than 60.

Answer: 39

Question 5

(a) This was generally well answered with just a few candidates rounding to 2500 or just 600.

(b) This part was less well answered. It was very common to see 0.06 or 5.84. Candidates need to understand the difference between significant figures and decimal places.

Answer: **(a)** 2600 **(b)** 0.058

Question 6

(a) Many candidates were able to give the correct answer but several gave the answer $\frac{5}{11}$ suggesting they had not read the question carefully and counted the letters with curved parts, despite the question stating in bold "**no** curved parts".

(b) Many candidates were able to mark a point in the correct range, although some marked 0.5. Candidates must ensure their answer to questions such as this are clearly marked as many were ambiguous.

Answer: **(a)** $\frac{6}{11}$

Question 7

Most candidates managed to score at least 1 mark for this question, usually for the point (20,8), with others gaining both marks for also writing, in most cases (12,24). It was rare to see (**–** 4, 0). Common incorrect answers were (8,20), (12,12) and (24,24).

Answer: Any two of (20,8), (12,24), (– 4, 0).

Question 8

(a) The majority of candidates were able to answer this question correctly, although 10h 35 was a common incorrect answer.

(b) The majority of candidates were able to correctly work out and write the time. A small number who had calculated the correct time had written the answer in an incorrect form, usually 19 25 pm or 19h 25.

Answer: **(a)** 9 (h) 35 **(b)** 19 25

Question 9

(a) The majority of candidates gave the correct number of lines of symmetry, although 2 and 6 were seen.

(b) This part was also well answered. A few gave the answer 2 and some gave a direction or angle.

Answer: **(a)** 3 **(b)** 3

Question 10

Many candidates gained both marks, although few showed any working. The majority scored 1 mark, usually for 4 of the values in the correct order, rather than decimal conversions.

Answer: $\frac{9}{22}$, 0.41, $\frac{3}{7}$, 43%, $\frac{\pi}{7}$

Question 11

(a) This part was generally not well answered. Many candidates wrote + or – 6 and + or – 7, but not always in the correct place. The values 1 and 4 were often seen in the brackets and some candidates wrote a matrix, while others inserted a fraction line.

(b) Candidates found this part challenging also. Many of the answers in part **(b)** did not appear to relate to the answer in part **(a)** although some candidates did multiply by 3, rather than the required -3.

Answer: **(a)** $\begin{pmatrix} 6 \\ -7 \end{pmatrix}$ **(b)** $\begin{pmatrix} -18 \\ 21 \end{pmatrix}$

Question 12

(a) In general candidates showed a lack of understanding of correlation for a question presented as words rather than a graph. It was common to see the answers reversed or to see the same answer for both parts. A significant number of candidates were describing the labels e.g. distance/time, or giving answers unrelated to correlation such as balanced, bar graph, time taken, increase in speed.

(b) As with part **(a)** this was also not well answered, with responses such as increased line, proportional, length, close and minutes and metres.

Answer: **(a)** Negative **(b)** Positive

Question 13

Many candidates were able to score full marks. Those that did not often scored 1 mark for usually the correct distance from *A*. The most common incorrect bearing was 228°.

Question 14

The majority of candidates were able to give the correct answer, with many showing working.

Answer: 1.75

Question 15

This fractions question was generally well answered with the majority of candidates showing each step of working. If a mark was missed it was generally the first mark for conversion to an improper fraction. Many of the candidates who were unable to do this correctly then went on to score the second and third marks. It was apparent in a small number of cases that candidates had used their calculators. It should be stressed to candidates that marks will not be awarded for questions without working when the question clearly states "You must show each step of your working."

Answer: $\frac{61}{35}$ or $1\frac{26}{35}$

Question 16

Although many candidates clearly knew they had to use trigonometry to work out the answer, many scored just 2 marks as they had not read the question carefully and did not give their answer to 2 significant figures. Many candidates correctly identified that they needed to use the sine ratio, with a small number using the cosine ratio. Some had just labelled the triangle O, H and A but hadn't progressed any further.

Answer: 160

Question 17

The majority of candidates knew they had to subtract the area of the circle from the area of the square in order to get the answer. However the area of the circle caused many problems and as a result a significant number only scored 1 mark for 144. A common error was to use πd to calculate the area of the circle. Many candidates rounded their answers prematurely or did not show working and gave an answer of 31.

Answer: 30.9

Question 18

There was a high number of correct answers seen to this question. Candidates are showing a greater understanding of simultaneous equations, and a large number showed working. Less able candidates often attempted a method, but showed little understanding of what they were doing with some adding or subtracting the equations without finding a common coefficient. There were large variations in the working seen - some just multiplied one or both equations but were unable to make further progress, others made errors in deciding or executing the addition or subtraction of their equations. Some candidates who had reached $x = 3$ often did not correctly substitute to find $y = -2$. Very few candidates used the substitution method.

Answer: **(**x =) 3, **(**y =) −2

Question 19

(a) The majority of candidates scored at least 1 mark, usually for 0.075. Many were then able to score the second mark by converting this into standard form. Some clearly did not fully understand standard form and 75 and the power 2 were often seen.

(b) Many candidates were able to correctly calculate the answer, but converting the answer to standard form proved more difficult. Many candidates scored 1 mark for 93 000 000 or 93×10^6.

Answer: **(a)** 7.5×10^{-2} **(b)** 9.3×10^7

Question 20

(a) This part was generally well attempted. Some candidates had left the arc inside the rectangle, while others had only drawn part of the required arc. A small number of candidates appeared not to have used a pair of compasses.

(b) Many candidates drew rather than constructed a line of symmetry.

Question 21

(a) This part was generally well answered with candidates often giving the fully correct answer. Some were confused by the signs but many were able to earn a mark for one correct term.

(b) Many candidates were successful although many scored partial marks, usually for $8a - 12b$. $3a - 22b$ was a very common incorrect answer.

Answer: **(a)** $11x - 7y$ **(b)** $3a - 2b$

Question 22

(a) (i) Many candidates did not read this question carefully and gave the full total distance rather than the part walked, despite the word walk being in bold. The answer 1600 was commonly seen as the answer.

(ii) This part was well answered by the majority of candidates, although few showed any working.

(iii) Almost all candidates were able to answer this part correctly.

(b) (i) Many candidates were able to draw the correct line, with only a small number not using a ruler. Lines from (1110, 1600) to somewhere on the *x*-axis after 1110, often 1125, 1130 or 1140 were often seen. Some candidates drew a line from 1600 with a positive gradient or a line back to (1030,0). Very few candidates showed the calculation.

(ii) The majority of candidates scored the mark for this question for either the correct answer or from following through from their line.

Answer: **(a)** **(i)** 1000 **(ii)** 80 **(iii)** 20 **(b)** **(ii)** 1135

MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key Messages

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

General Comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates showed evidence of good work in percentages, fractions, probability and solving equations. Candidates found challenging the topics of converting between volume and length scale factors, including a change of units, and in working with speed and distance, also including different units. Candidates also found working with the surface area and volume of a hemisphere and vector notation particularly challenging.

Not showing clear working, and in some cases any working, is still occasionally an issue; this was particularly evident in questions **3**, **19a** and **21**. When there is only an incorrect answer on the answer line and no relevant working, the opportunity to earn method marks is lost. More candidates gave their answers to the correct degree of accuracy than in previous years, although this was still occasionally a problem in the first two questions. Premature rounding part way through calculations was evident this year and caused problems for quite a few candidates when it came to final accuracy marks, particularly in **Question 21a**.

Comments on Specific Questions

Question 1

The majority of candidates correctly answered this question on percentages, giving their answer to the appropriate degree of accuracy of 3 significant figures or occasionally more accurate. The most frequent incorrect answers were 59.76 and 87, the first of these was where candidates found 72% of 83, the second was due to rounding to only 2 significant figures. A candidate was not penalised for an answer of 87 if a more accurate answer was seen in the working. A minority calculated 72 ÷ 83 but then to forget to multiply by 100.

Answer: 86.7

Question 2

In this question on using a calculator, the calculation was almost always carried out correctly with nearly all candidates gaining at least one mark. The errors occurring were usually in the rounding mark with 5.29, 5.292 or 5.2927 commonly given; rounding to 4 decimal places instead of 4 significant figures being the most common of these errors.

Answer: 5.293

Question 3

The majority of candidates correctly answered this question on angles. Little use was made of the diagram or of showing any working, which is inadvisable in a 2 mark question. Candidates are advised that in angles questions, method marks can sometimes be gained by marking other known angles on diagrams; of those not gaining 2 marks the ones who showed working on the diagram were often able to gain a mark for correctly marking another 55° or 125° angle in any correct position.

Answer: 125

Question 4

The majority of candidates were able to correctly obtain the answer of 7.7 to this percentages question. It was rare to see an incorrect answer. In a small minority of cases, candidates then went on to spoil their method by adding 7.7 to 44 or by subtracting it from 44, therefore increasing or decreasing by 17.5%; this resulted in no marks being awarded. Careful reading of the question and checking answers would have helped candidates here. Occasionally, an incorrect answer of 39.8 was seen as a result of the working $\frac{17.5}{44}\times 100$. The candidates with the most success were those who converted 17.5% to the decimal 0.175 and then multiplied this by 44.

Answer: 7.7

Question 5

This question on equations was answered correctly by most candidates. The most frequent errors seen were in dealing with the negative signs, particularly for those candidates who showed the least amount of working or who attempted to do more than one step in one line of working. The most common incorrect answers were 24 and 2.8, arising from the incorrect starting points $5 = 3x - 19 - 2x$ and $- 2x = 3x - 19 + 5$ respectively.

Answer: 4.8

Question 6

The majority of candidates answered this question on probability well. The most common incorrect answers in part **(a)** were $\frac{1}{6}$ and $\frac{1}{5}$, where the candidate did not take into account the fact that the letter S appears twice. In part **(b)**, candidates should note that in this case the answer must be an integer. It was quite common to see the answer incorrectly presented as a probability fraction equivalent to $\frac{2}{6}$ e.g. $\frac{200}{600}$. Those who wrote $\frac{1}{6}$ or $\frac{1}{5}$ in part **(a)** gained the mark in part **(b)** for the correct follow through answers of 100 and 120 respectively.

Answer: **(a)** $\frac{2}{6}$ **(b)** 200

Question 7

Many candidates were able to obtain at least one mark on this question on upper and lower bounds, with slightly more correctly identifying the lower bound than the upper bound. The two most common errors were adding and subtracting 10 from 440, i.e. 430 and 450; or adding and subtracting 0.5, i.e. 439.5 and 440.5, the latter being 440 correct to the nearest 1 cm instead of the nearest 10 cm. Occasionally there was a misunderstanding of the inequality symbols and the answers were reversed, candidates were still able to get one out of the two marks if this was the case. Another pair of answers occasionally seen was 10 and 440.

Answer: 435, 445

Question 8

This question on simple interest was generally well answered. The best candidates approached this by using the formula $I = \frac{PRT}{100}$, going on to correctly substitute and rearrange this accordingly, those using the formula $I = PRT$ were more likely to forget that the interest rate given needed to be expressed as a decimal, going on to wrongly use 3 instead of 0.03 for R. The four most common errors were to use the compound interest formula; to treat the $20.10 as the principal amount; to forget to divide by 100; or to use $T = 1$ instead of 5. Another misunderstanding was to think that the $20.10 included the capital so the working $20.10 = x + \frac{x \times 3 \times 5}{100}$ followed by an answer of $17.48 was sometimes seen. Candidates are advised to consider the common sense of answers such as this where the interest exceeds the initial investment after such a short time at such a low rate.

Answer: 134

Question 9

This question on sequences proved challenging for many candidates. The majority of candidates wrote down the next term in each of part **(a)** and part **(b)** rather than the nth term, so $\frac{6}{8}$ and 35 were frequent incorrect answers. It was common to see incorrect use of formulae such as $a + (n - 1)d$ to find the nth term in part **(a).** Candidates are advised in fractional sequences, such as this, to consider the nth term of the numerator and denominator separately. Part **(b)** was generally answered with a little more success than part **(a)** with some candidates seeing that the sequence was quadratic by using the method of looking at the first and second common differences and seeing that the second common difference was consistent.

Answer: **(a)** $\frac{n}{n+2}$ **(b)** $n^2 - 1$

Question 10

The majority of candidates scored one or more marks on this question on rearranging formulae, with a large number of correct answers. One common misconception was to separate the a^2 and b^2, incorrectly dealing with the square root, i.e. converting $\sqrt{a^2 + b^2}$ to $\sqrt{a^2}$ + $\sqrt{b^2}$, consequently followed by $c = a + b$. Or with a similar misconception, having the correct answer b= $\sqrt{c^2 - a^2}$ spoilt by the subsequent working $b = c - a$. Some candidates also square rooted c as a first step, instead of squaring. The best candidates showed full working with only one rearranging step completed in each line of working; those who attempted to complete two steps in one line of working often made mistakes.

Answer: $[\pm]$ $\sqrt{c^2 - a^2}$

Question 11

This question on volumes of proportional shapes was one of the most challenging questions on the paper, with the correct answer of 150 occasionally seen. The most common answer given was 3.375, which was a calculation of only one step using the figures in the question, namely 4050 ÷ 1200. Candidates are advised that 3 marks are extremely unlikely for a one step calculation such as this. Candidates are advised to read questions very carefully, looking out for unit changes in their final checks; some candidates were seen to underline the different units in the question once they had noted that the units were different, which is good practice. The step of converting the units to the same form was the most commonly awarded method mark and an answer of 3 375 000 was seen quite often. Many candidates who did notice the different units still struggled to convert them. Another common error was to use the conversion from m to cm, i.e. multiplying by 100 instead of multiplying by 100^3 to get from m^3 to cm^3, or multiplying by 1000. Consequently common wrong answers were 337.5 and 3375. Few realised that they needed to find the cube root of the volume ratios to get the length ratios; some that did realise this often forgot the unit conversion, and consequently 1.5 was another common incorrect answer.

Answer: 150

Question 12

This question on angles in circles was well answered by some of the candidates, with more success in part **(a)** than in part **(b)**. A common misconception in part **(a)** was the belief that opposite angles in a cyclic quadrilateral are equal rather than supplementary, and the working 42° + 28° followed by an answer of 70° was sometimes seen. Other misconceptions were to assume that *CD* and *AB* were parallel or to assume that certain triangles were isosceles, and consequently it was common to see angle *ACD* labelled as 31° and *BDC* labelled as 28° or both of these labelled as 29.5°. Candidates are advised not to assume facts just by looking at a diagram, in the same way that they cannot measure diagrams because diagrams are clearly labelled as not to scale. Candidates were much better at marking missing values of angles on the diagram in this question than in **Question 3** and often gained credit for this. The most common mark in part **(b)** was to award one method mark for candidates correctly calculating one of the three angles *DAC*, *ACB* or *ACD* and this was usually angle *ACB* as 79°.

Answer: **(a)** 110 **(b)** 79

Question 13

Approximately half of the candidates gained the available mark in part **(a)** of this question on indices, with the two most common incorrect answers being $\frac{4}{5}$ and $3^{\frac{5}{4}}$. Some candidates attempted to use logs to solve part **(a)**, rather than knowledge of powers and roots. Part **(b)** proved to be more challenging with a mark of one being the most common, usually for y^6, with a mistake being made in the coefficient. This was commonly incorrectly given as 204.8 (from $\frac{32^2}{5}$), 12.8 (from $32 \times \frac{2}{5}$) or simply 32. The answer in part **(b)** was also sometimes seen as $\sqrt[5]{1024y^{30}}$ or $\sqrt[5]{32y^{30}}$.

Answer: **(a)** $\frac{5}{4}$ **(b)** $4y^6$

Question 14

The subtraction part of this question on algebraic fractions was problematic for a high proportion of candidates, with the most common error being in the handling of the $-(t + 2)$. Many candidates dealt correctly with the 3 and the best candidates used a single common denominator of $t - 1$, i.e. $\frac{3(t-1)-(t+2)}{t-1}$ with brackets clearly around the whole of $t + 2$, to show that the entire expression was being subtracted. Consequently, the first mark was often scored and the second mark sometimes scored. It was less common to see the third mark awarded. The most common incorrect answer, often seen, was $\frac{2t-1}{t-1}$ arising from the incorrect working $\frac{3(t-1)-t+2}{t-1}$. If candidates obtained the correct answer it was rare to see it spoilt by an incorrect attempt at cancelling terms involving *t*, although this did occasionally happen. Occasionally, attempts were made by candidates to turn the expression into an equation which they subsequently tried to solve e.g. $\frac{3(t-1)}{t-1} = \frac{(t+2)}{t-1}$.

Answer: $\frac{2t-5}{t-1}$

Question 15

This question on manipulating fractions was generally well answered by the majority of candidates. Most candidates showed all their working. The majority worked with 12 as their common denominator in part **(a)**, a few used 48, occasionally the answer was not fully cancelled. In part **(b),** the multiplication was also well answered although a few candidates thought that they needed a common denominator to multiply the fractions. These candidates were usually less successful because the common error here was to not multiply the denominators as well as the numerators. Another misconception in part **(b)** was to think $2\frac{1}{2}$

meant $2\times\frac{1}{2}$, consequently a common incorrect answer was $\frac{4}{25}$. It was rare to see answers with no working; attempts at using decimals; or evidence of using a calculator.

Answer: **(a)** $\frac{2}{3}$ **(b)** $\frac{2}{5}$

Question 16

About a third of candidates answered part **(a)** of this question on coordinates and vectors correctly, with the two most common incorrect answers being the coordinates of *B* or the coordinates of *A* and *B* presented in a matrix, i.e. $\begin{pmatrix}8\\7\end{pmatrix}$ and $\begin{pmatrix}-1 & 8\\1 & 7\end{pmatrix}$ respectively. The latter either caused, or was a cause of, the common misconception that the notation in part **(b)** was asking for the determinant of a matrix rather than the magnitude of a vector. It was common to see a vector in part **(a)** crossed out and replaced with a 2 x 2 matrix. Other common misconceptions in part **(b)** were to add the 9 and 6 together (or their own values in part **(a)**); to use Pythagoras' Theorem incorrectly, e.g. subtracting the two squares rather than adding; to write down the coordinates (9, 6); or to write the mid-point of the line segment *AB*. Few candidates correctly answered part **(c)**. There was a lack of appreciation that point *B* was the mid-point of *AC* and the most common misconception and the most common answer by the majority of candidates was to double their answer to part **(a)**.

Answer: **(a)** $\begin{pmatrix}9\\6\end{pmatrix}$ **(b)** 10.8 **(c)** (17, 13)

Question 17

In part **(a)** of this question on factorising, lots of candidates were able to score at least one mark for a correct attempt at partial factorisation. Many candidates stopped at $a + b + t(a + b)$, with the step to $1(a + b) + t(a + b)$ beyond them, although many did manage two marks in going from $a + b + t(a + b)$ straight to a correct answer. Of those who had $a(1 + t) + b(1 + t,)$ it was rarer to see an incorrect answer. Part **(b)** was generally answered with more success, with many obtaining the correct factorisation. Some then went on to spoil this work with subsequent working, i.e. writing on the answer line $x = 6$ or $x = -4$. Occasionally, the answer was given with incorrect signs or incorrect values that either added to -2 or multiplied to give -24, rather than both, demonstrating a partial understanding of the correct method.

Answer: **(a)** $(a + b)(1 + t)$ **(b)** $(x – 6)(x + 4)$

Question 18

This question on the surface area and volume of a hemisphere was the most challenging question on the paper and it was very rare to see a fully correct answer or answers gaining more than 1 mark. The two most common errors were for candidates to forget to include the flat surface of the hemisphere, equating the 243π with $2\pi r^2$ or equating the 243π with $4\pi r^2$ because they also forgot to halve the sphere. As a result of these two errors, the most common incorrect answers were 893 and 315. In many cases these candidates were able to gain a method mark for correctly substituting their value of *r* into the volume formula $\frac{1}{2}\times\frac{4}{3}\pi r^2$, however a large proportion again did not take the hemisphere into account and lost this mark for forgetting to halve and so another common incorrect answer was 631.

Answer: 486

Question 19

Quite a few candidates found the correct speed in part **(a)**. The most common errors here were converting into metres multiplying by 100 instead of 1000; only dividing by 60 instead of 3600; not taking the time conversion into account; or multiplying by 3600 instead of dividing. Many gained a mark in part **(b)** for dividing a length by their speed, however a large number of candidates did not link the two parts of the question together and started from scratch in their working. Only the best candidates were able to work out that the correct distance the train had to travel was 140 m. 120 m or 20 m were used far more frequently and it was also very common to see candidates thinking that 120 x 20 was a distance.

Answer: **(a)** 40 **(b)** 3.5

Question 20

The constructions in this question were generally carried out accurately and construction arcs were clear in the majority of cases. Candidates should be encouraged to make arcs for an angle bisector further away from the vertex as it can lead to inaccuracies when it is too close. Part **(a)(i)** was slightly more successfully completed than in part **(a)(ii)** because the added difficulty of interpreting the meaning of the locus description proved challenging for some. The majority realised it was a perpendicular bisector that they needed to construct. Sometimes candidates had one set of arcs missing from the perpendicular bisector where they had measured the mid-point of line BC to make one point on the bisector. Candidates are advised that measuring is not correctly constructing the perpendicular bisector and that is why the instruction in the question is to use a straight edge rather than a ruler. Another common error was that some candidates did not set their compasses at a wide enough length and so sometimes construction arcs touched at the mid-point of *BC*, making the line impossible to draw, or overlapped only very slightly, making drawings inaccurate. When the lines were in the correct place, candidates usually went on to identify the correct region for part **(b)**.

Answer: **(a)** **(i)**
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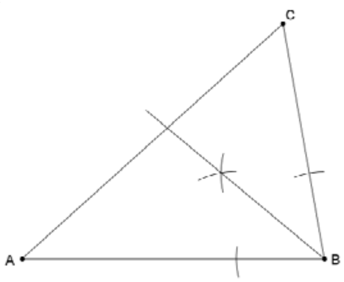
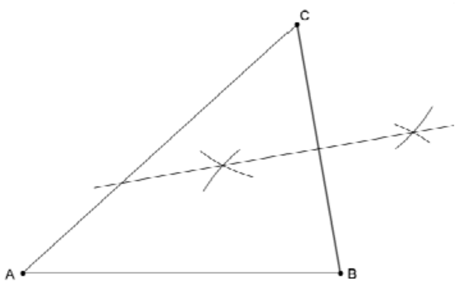
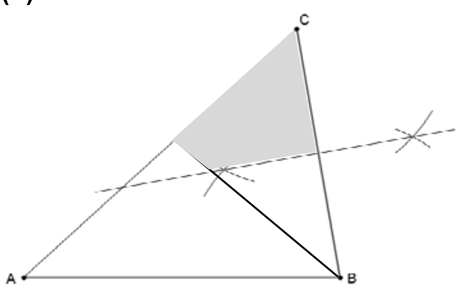


(a) **(ii)**



(b)



Question 21

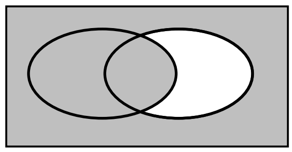
This question on the properties of a kite was answered well by approximately half of the candidates. In part **(a)**, the length of 8 for *XB* was usually shown on the diagram. The most common misconception was to incorrectly use the ratio 3:2, taking *DX* as the length 20 and then consequently writing the length I as 13.3. The best candidates used the most efficient method of $\tan B = \frac{6}{8}$. It was also common to see the less efficient methods of using the sine rule, cosine rule or the sine and cosine ratios. All of these methods required the candidates to do an unnecessary stage in their calculation, i.e. finding the side length *BC* = 10 first, using Pythagoras' theorem. Quite a lot of candidates lost the accuracy mark due to premature rounding. It was common to see the angle ½*ABC* written as 36.9, followed by an incorrect final answer of 73.8. Candidates are advised to use the value still in their calculator display or to work to 4 or more significant figures in interim work to ensure that the final answer is accurate to 3 significant figures. The best candidates used the efficient method for the area of a kite in part **(b)**, i.e. $\frac{1}{2} \times 20 \times 12$. A larger proportion of candidates, who could not recall this, used the less efficient method of dividing the shape into a series of triangles and then calculated $\frac{1}{2}$ × base × height for these triangles. Some candidates used the $\frac{1}{2}ab\sin C$ formula, creating a lot of extra work in calculating missing angles such as angle *ADC*. Unclear labelling of the lengths in the diagram sometimes lead to incorrect lengths being used for the area in part **(b)**, e.g. *DX* as 20 instead of 12.

Answer: **(a)** 73.7 **(b)** 120

Question 22

Part **(a)** of this question on Venn diagrams and probability was well attempted by many candidates. In part **(a) (ii)** $\frac{11}{16}$ was a fairly common incorrect answer. In part **(b)** $\frac{11}{50}$ was the most common incorrect answer, appearing frequently. Part **(c)** proved more challenging for the candidates with the four most common incorrect methods being: $\frac{20}{50} \times \frac{20}{50}$, $\frac{20}{50} \times \frac{19}{50}$, $\frac{20}{50} + \frac{19}{49}$ and $\frac{15}{50} \times \frac{14}{49}$. Part **(d)** also proved to be challenging for the candidates with few common errors indicating that this answer may well have been a guess for many candidates. A slightly higher proportion shaded T', (R ∪ T)', R ∩ T' or T ∩ R'.

Answer: **(a)(i)** $\frac{5}{50}$ **(a) (ii)** $\frac{11}{50}$ **(b)** $\frac{11}{16}$ **(c)** $\frac{380}{2450}$ **(d)**



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

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

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

The questions that presented least difficulty were **Questions 1**, **2**, **3**, **6**, **7**, **14**, **15**, **17** and **20(a)**. The questions that proved to be the most challenging were **Questions 8**, **9**, **12**, **13**, **18(c)**, **19**, **20(b)** and **(d)** and **21(b)**.

Comments on specific questions

Question 1

This question on ordering values was well answered, with almost all candidates scoring at least one mark. A few candidates did not show any working, meaning that where their order was incorrect it was not always possible to award marks. A common error was to treat 19% as 19 and make it the largest in their list of numbers. Some candidates thought that 0.2 was less than 0.19, presumably because 2 is less than 19.

Answer: 19% 0.719^5 $\sqrt{0.038}$ sin 11.4 $\frac{1}{5}$

Question 2

The vast majority of candidates were successful with both parts to this question on using a calculator. Where incorrect answers were observed, there were no common mistakes noted. On a few occasions an incorrect answer of −477 was seen in **part (a)**, presumably due to candidates misreading their calculator display.

Answers: **(a)** −447 **(b)** 2

Question 3

The response to this question on circles was very good. The most common error was to find the area (19.6) rather than circumference of the circle. A small number of candidates used $\frac{22}{7}$ or 3.14 for π which often resulted in their answers not having the required accuracy. Candidates must follow the instructions on the front of the question paper and use either their calculator value for π or 3.142.

Answer: 15.7

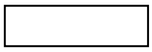
Question 4

This question on creating a pie chart was generally well answered by the majority of candidates. In incorrect solutions, candidates failed to observe the correct number relating to the score of 4. Occasionally the correct fraction 8/18 was seen but was then multiplied by 100 instead of 360. Some candidates wanted to make this question harder than it was and used the area of a circle in their calculations.

Answer: 160

Question 5

Part (a) of this question on symmetry was usually correct. The most common error was to just draw a vertical line of symmetry. **Part (b)** was less successful. The most common errors were to draw the two diagonals or to draw two lines above the shape to make a pentagonal "house" shape.

Answers: **(a)**  **(b)** a correct diagram

Question 6

This question on rearranging a formula was well answered, with the majority of candidates presenting a correct solution. On occasions $x^2 = y - 4$ was observed but it was then unclear whether all of the expression $y - 4$ was included in their square root sign, resulting in incorrect final answers of $\sqrt{y} - 4$ or $\sqrt{y -}\ 4$.

Answer: $\sqrt{y-4}$

Question 7

Candidates performed well in this question with the majority choosing to use the formula for the area of a trapezium rather than splitting the trapezium into a rectangle and a square. Of the few candidates who were not successful in this question, the most common errors were to evaluate ½ × (12 × 22) × 10 or simply to attempt to add up the lengths of the given sides.

Answer: 170

Question 8

This question on the volume of a hemisphere was one of the less well answered on the paper. Even though the word **hemisphere** was highlighted and the formula for the volume of a sphere was given, a very significant number of candidates presented a solution that simply calculated the volume of a sphere. Those who realised what the question required and divided the volume of the sphere by 2 usually gained full marks. Accuracy was occasionally lost by candidates who used 3.14 or $\frac{22}{7}$ for π.

Answer: 3619 to 3620

Question 9

This question on angles in polygons caused difficulty for a significant number of candidates. 180/36 was often seen in the working, giving the value 5, which was then often followed by pentagon. Many candidates were able to calculate that there were 10 sides but then failed to give the correct name for the polygon. Most candidates used the exterior angles but a fair number attempted to use the interior angle of 144 and in many cases this led to errors as this alternative method involved many more steps in the calculation. Incorrect spellings of the word decagon were common as were imaginative attempts such as tentagon.

Answer: decagon

Question 10

The majority of candidates correctly selected the highest (1.3401) and lowest (1.3199) rate of exchange and then multiplied each by 500 in this question on currency conversions. A small number who managed these stages correctly were then unable to correctly subtract their two products, with the number of cents often being the most common error. A significant number of candidates used the two end values from the table (1.3311 and 1.3401) in their calculations.

Answer: 10.10

Question 11

This question on inverse proportionality was generally well answered, with most candidates knowing the correct steps after setting up the initial relationship. The most common errors were normally made at the start with an incorrect relationship, such as $v = kd^2$ or $v = k\sqrt{d}$ or $v = \frac{k}{d^2}$, being used. A few candidates successfully set up the correct relationship, found the constant of proportionality but then failed to square root the 25 in the final step of the solution. A small number of candidates calculated 30 × 20 as 60.

Answer: 120

Question 12

A significant number of candidates found this question on the upper and lower bounds of the area of a circle challenging. The majority of candidates found the upper and lower bound values of the radius correct to the nearest 0.1 cm. A high proportion then correctly squared their bounds but failed to appreciate that since this was a bounds question, they should not give rounded values for p and q as their final answer. A common incorrect method used by candidates was to find the area using 8.5 and then find upper/lower bounds for their area.

Answer: p = 71.4025 q = 73.1025

Question 13

The response to this question was disappointing. A surprisingly large number of candidates did not demonstrate that they were aware of how to read values from a table, and simply added four values, using 3.40 and 5.20 for the UK parcel. Many candidates tried to process the costs to get a 'more accurate cost' i.e. not understanding the concept of 'maximum lengths'. Another common error was to price the UK parcel at $3.40 instead of $5.20 by rounding the dimensions down.

Answer: 10

Question 14

In general, this question on angles in circles was well answered. Common errors that were seen involved incorrect statements such as angle CAB = 38, or angle ACB = 2 × angle AOB, or angle AOB = 90. To gain partial credit for method, candidates must either clearly state which angles they are referring to in their working out or clearly show the angles on the diagram.

Answer: 52

Question 15

This question on simultaneous equations was well answered, with the majority of candidates using the method of elimination. There were a significant number who made mistakes with the signs but who were then able to correctly substitute and evaluate the second value to gain at least the SC1 mark. Some candidates used the method of substitution and, of these candidates, the most common problem seemed to be an inability to deal correctly with algebraic fractions. It was not uncommon to see x = 8 and y = 2 in the working but then (2, 8) on the answer line.

Answers: (8, 2)

Question 16

A significant number of candidates were unable to correctly eliminate the two denominators in this question involving an inequality and algebraic fractions. Multiplication by 5 (= 2 + 3) was not uncommon with the result that the stage $5x - 4 < 30$ (or equivalent) was often not reached. Even with this stage correctly shown, a significant number of candidates then stated that $5x < 26$. This question involves solving an inequality and candidates are expected to write an inequality on the answer line. The final mark was withheld when candidates simply wrote 6.8 on the answer line.

Answer: $x < 6.8$

Question 17

This question on matrices was well answered, with the majority of candidates scoring full marks.

In **part (a)**, some candidates simply multiplied the corresponding numbers in each matrix. In **part (b)**, a few gave only the transpose or obtained an incorrect value for the determinant.

Answers: **(a)** $\begin{pmatrix} 11 & 5 \\ 26 & 30 \end{pmatrix}$ **(b)** $\frac{1}{8}\begin{pmatrix} 6 & -1 \\ -4 & 2 \end{pmatrix}$

Question 18

Part (a) of this question on coordinates and lines was well answered by those who knew and applied the formula for finding the coordinates of a mid-point of a line segment. A common error arose from subtracting the coordinates rather than adding them in their method, resulting in an incorrect answer of (3.5, 10.5). Another common error was to give the coordinates in reverse order i.e. (12.5, 1.5). In **part (b)**, most candidates knew and applied correctly the general equation of a straight line ($y = mx + c$). Some candidates made errors in determining the gradient correctly usually due to the minus signs or less rarely by determining the gradient as the (change in x) ÷ (change in y). In **part (c)**, candidates were less successful at explaining why the point (3, 17) lay on the line AB.

Answers: **(a)** (1.5, 12.5) **(b)** $y = 3x + 8$ **(c)** Correctly substituting (3, 17) into $y = 3x + 8$

Question 19

This question on vectors was one of the least well-answered questions on the paper. There were many incorrect answers to all parts of this question, usually caused by confusion about the equality of vectors. Candidates often failed to start by writing down the "route" that they were using which meant that it was often not possible to award part marks. Only a few candidates realised that the answer to **part (c)** was half of the answer to **part (a)** and were able to earn the follow through marks. Some candidates clearly did not understand the concept of position vectors and made no attempt at **part (c)**.

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

Question 20

There was a mixed response to this question on statistics and data handling, with candidates being more successful in **part (a)** than in parts **(b)**, **(c)** and **(d)**. The main error seen in **part (b)** was the 20th percentile being read from 20 on the cumulative frequency axis, resulting in a common incorrect answer of 3.7. Candidates would have found it helpful if they had indicated how they were determining the 20th percentile. The value of 9.6 was not often shown. In **part (c)**, a common incorrect answer was 4.1 as a result of candidates using 36 people (UQ) − 12 people (LQ) = 24 people = 4.1. In **part (d)**, a common incorrect answer was 0.1 as a result of candidates using the total number of people as 50.

Answers: **(a)** 4.05 to 4.2 **(b)** 2.6 to 2.75 **(c)** 2.05 to 2.25 **(d)** $\frac{5}{48}$

Question 21

Part (a) of this trigonometry question was well answered, with most candidates realising that this was a sine rule question. It is important that candidates use complete values in calculations as a significant number of candidates lost the accuracy mark through premature rounding. A small number of candidates incorrectly assumed the triangle to be right angled at *B*. **Part (b)** was not as well answered as **part (a)**. A significant number of candidates did not choose to use the most efficient method and this led to lengthy calculations, which often contained errors through premature rounding. The most common incorrect answer came from using ½ × 4 × 6 × sin65.

Answers: **(a)** 37.2 **(b)** 11.7

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key Messages

It is important that candidates read the degree of accuracy required in the demand in the question and ensure that their final answer is correctly rounded to that degree of accuracy or to three significant figures.

General Comments

Many candidates did not give their answered to the degree of accuracy required in the question, or gave answers to two figure accuracy, especially in **Question 16(a)**. Another common related issue was premature rounding, which was quite widespread and instead of keeping the accurate figure on the calculator, the inaccurate rounded version was often used in subsequent calculations.

In some questions there were short efficient methods available to achieve the answer, and these were largely ignored by many candidates who seemed to prefer the longer methods which were more prone to error. The best examples of this were **Questions 7**, **9(b)**, **11(a)**, **16(b)**, **19(b)** and **19(d)**. Candidates are advised to think about all the alternatives before selecting the method to solve the problem given to them.

There was evidence that some candidates did not have the necessary equipment such as a ruler and compasses, and that calculators used were sometimes in the wrong mode for trigonometry.

Comments on Specific Questions

Question 1

Most candidates answered this question on time correctly. There were a range of different methods from $52 \times 45 \div 60$ to $52 \times \frac{3}{4}$. The most common error seen was from those who assumed that there were 100 minutes in an hour.

Answer: 39

Question 2

A common error in this coordinates question was to write the *x* and *y* coordinates the wrong way around. Common wrong answers also included (12, 20), (24, 20), (8, 4), (20, 12), (16, 8).

Answer: Any two of (20, 8) (-4, 0) (12, 24)

Question 3

The majority of candidates answered this question on solving an equation well. The most common error was to incorrectly subtract 1, usually getting $2x = -14$ leading to an answer of -7.

Answer: -8

Question 4

Many candidates had their calculator in the wrong mode for trigonometry. Some candidates failed to understand the inequality sign and therefore they put their answers in reverse order. A number of candidates dropped the minus signs in front of the first two calculations.

Answer: tan 100, cos100, 1/100, $100^{-0.1}$

Question 5

(a) Some candidates squared 60 whilst others multiplied by 100 rather than 100^2 in this question on converting between units of area. Some divided by powers of 100 instead.

Answer: 600 000

(b) Some candidates thought there are 100 m in 1 km. The correct method was to multiply by 60^2 and divide by 1000 but many did these calculations the wrong way round.

Answer: 79.2

Question 6

Those who knew how to answer this question on reverse percentages usually obtained the correct answer. The common incorrect method was to find 20% of $30 and then to subtract this from the $30 to get $24.

Answer: 25

Question 7

The best solutions to this question on a quadratic equation usually involved factorisation and the realisation that for *d* to be prime, the other factor had to be 1. Some candidates substituted 1 into the equation instead and obtained the correct answer. There was also a variety of other methods used, many of which would not lead to a correct answer.

Answer: 5

Question 8

The main errors seen in this question on proportionality involved the setting up of the initial equation; candidates either omitted the 'cube' or worked with inverse proportion. Some candidates found a value for *k*, but then did not substitute it correctly back into their equation, omitting the cube power.

Answer: 1.6

Question 9

(a) In this question on expanding brackets it was common to see $a^2 + ab + ab + b^2$ written out correctly and then incorrectly simplified. Some candidates gave $a^2 + b^2$ as their answer. *bb* for b^2 was also seen.

Answer: $a^2 + 2ab + b^2$

(b) There were very few candidates who realised that these two parts were linked and so there were many different methods with no common approach.

Answer: 22

Question 10

Many candidates gave 163 or 162·5 as their final answer in this trigonometry question, and they did not read the question demand carefully; giving their answers to degrees of accuracy other than two significant figures. A small number of candidates truncated their answer incorrectly to 162 without showing a more accurate answer. Some had their calculator in the wrong mode for trigonometry.

Answer: 160

Question 11

(a) This part of this question on matrices was answered correctly by most candidates and the common method was to multiply the matrices together. Incorrect answers often arose from errors in the multiplying. Many failed to realise that the answer could be written down without any calculation at all.

Answer: $\begin{pmatrix} 3 & -1 \\ 4 & 2 \end{pmatrix}$ or A

(b) Common errors in this question included $\begin{bmatrix} 3^{-1} & -1^{-1} \\ 4^{-1} & 2^{-1} \end{bmatrix}$, omitting the denominator or calculating it as 2 and making errors in the transformation of the matrix.

Answer $\frac{1}{10}\begin{pmatrix} 2 & 1 \\ -4 & 3 \end{pmatrix}$

Question 12

(a) This question on standard form was usually answered well except for those who, having worked out 0.075 then could not write it correctly in standard form.

Answer: 7.5×10^{-2}

(b) Again many could write the answer correctly in normal form but not write it correctly in standard form.

Answer: 9.3×10^{7}

Question 13

(a) There were many correct answers to this question on angles in circles. Some gave 48° as their answer, which was the value of angle *MOC.*

Answer: 24

(b) Those who got part **(a)** correct usually answered part **(b)** correctly. Otherwise credit was awarded for a follow through if both answers added to 48°. A common wrong answer was 48°.

Answer: 24

Question 14

(a) There were a wide variety of responses seen to this question on indices. The vast majority of candidates attempted the question and generally were able to identify that the power ½ was equivalent to square root. The -2 as the power of q caused confusion as some candidates associated this with both the 64 and the q, whilst other candidates identified 8 and q^{-1} but gave $1/(8q)$ as their answer.

Answer: $8q^{-1}$

(b) This part was answered well but sometimes √25 or √0.4 were attempted.

Answer: 0.2

Question 15

(a) This question on loci was answered well, with the alternative of a full circle of the correct radius being awarded some credit. A reasonable number of candidates had the correct answer, but also drew the same ¾ section of a circle at each of the corners of the rectangle; these were sometimes joined with line segments to create a 3 cm border around the rectangle. A small number of students appeared to know what the locus should be, but did not have the use of compasses, hand drawn attempts are not given any credit.

Answer: Circle, radius 3 cm, centre *A*, not inside the rectangle

(b) Most candidates were able to gain credit for drawing a line of symmetry, however significantly fewer did not use intersecting arcs to identify the location of the line of symmetry, drew freehand arcs or drew arcs which touched rather than intersected. A number of candidates included lines joining diagonally opposite corners as well as the line of symmetry.

Answer: One line of symmetry with the correct arcs

Question 16

(a) This part of this question on cross-sectional area was an effective differentiator as only a few were able to obtain the correct answer. The method for calculating the area of the triangle varied between the candidates, with some opting to split the triangle into two right angled triangles and others using ½*ab*sin *C*. It was in finding the area of the triangle that most errors were made; many candidates were able to find the area of at least one sector. In the triangle some candidates used ½ × base × height but the height used was not the perpendicular height. There were also many answers close to the acceptable answers but premature rounding in the early stages had led to an inaccurate answer.

Answer: 8.61 or 8.609 to 8.6102

(b) A large number of candidates were able to achieve their correct answer in the second part of the question after using their answer from part **(a)**. A few candidates did appear to start over again using other formulas which were not appropriate for this question.

Answer: 430 or 431 or 430.4 to 430.51

Question 17

(a) Some candidates were able to recognise the transformations represented by $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$, so it was common to see the first stage reflection drawn, for which credit was given. Others attempted to solve $\begin{pmatrix} p \\ q \end{pmatrix} = \begin{pmatrix} 3-x \\ 2+y \end{pmatrix}$ using the 3 values of $\begin{pmatrix} x \\ y \end{pmatrix}$ in turn. There were some plotting errors, especially for point (0, 3).

Answer: triangle at (0, 3) (2, 3) and (2, 4)

(b) This part was often answered better than part **(a)** though there was confusion over how to describe the line and answers involving $x = 0$, $y = 0$, x axis and y axis were all seen.

Answer: reflection in *y* axis

Question 18

(a) The most common issue seen in this question on cumulative frequency was to misread the scales on the axes and this error was common to all parts of the question. Most candidates did know how to find the median.

Answer: 19 – 19.1

(b) Some candidates did not subtract their reading from 50 to find the required answer.

Answer: 3

(c) Many candidates did not know how to find the quartiles, and many having identified 37.5 and 12.5 then subtracted these two numbers to get 25. Some only read one of these whilst others misread the scales again.

Answer: 4.9 to 5.7

(d) There were a lot of readings of 5 seen and some did not subtract this from 50. Some wrote the final answer incorrectly so '45 out of 50' was seen.

Answer: $\frac{45}{50}$ oe

Question 19

(a) The most common error was in this question on functions was to reverse the order of operations giving an incorrect answer of 225 from $(2 \times 6 + 3)^2$.

Answer: 75

(b) Those who started correctly by writing $(2x + 3)^2 = 100$ then made errors in the expansion of the brackets, such as $(2x)^2 = 2x^2$. The expansion of these brackets was unnecessary to the solution of this equation. Those who did take the square root path often forgot to write down both roots and it was common to see just 10 used, leading to the answer 3.5. The other answer was then given as -3.5.

Answers: 3.5; -6.5

(c) This question was often answered well but quite a few did not know the method of rearrangement so instead would write $1/(2x+3)$.

Answer: $\frac{x-3}{2}$ oe

(d) Many candidates missed the subtlety of the question and calculated the composite function by using an incorrect inverse function or alternatively reversed the order of operations again.

Answer: 5

MATHEMATICS

Paper 0580/31

Paper 3 (Core)

Key Messages

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

General Comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time, and there was an improvement in the number of candidates who were able to make an attempt at all questions, in comparison to previous years. Few candidates omitted part or whole questions. The standard of presentation was generally good and clear evidence that candidates were using the correct equipment to answer the questions, e.g. compasses, ruler and protractor. There was an improvement on the number of candidates who showed clear workings and so gaining the method marks available. Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Candidates have made substantial improvements, this year, in using the correct value for pi, the calculator value for π or 3.142. However some candidates continued to use 3.14 or 22/7 which led to inaccurate answers. Candidates should also be encouraged to fully process calculations and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set.

Comments on Specific Questions

Question 1

This question was well answered by the majority of candidates showing good understanding of averages and bar charts.

(a) (i) The majority of candidates showed good understanding of the range of a set of data and gave the correct answer of 36. Nearly all candidates could identify 38 and 2 as the highest and lowest values but some did not perform the subtraction. Others found the average of the difference giving the answer 18, with 20.5 another common answer.

(ii) Most candidates understood how to complete a tally chart and could work through the question methodically. A small number of candidates gave their frequencies in the tally column instead of the frequency column, or gave answers as probabilities, or as cumulative frequencies, or as some form of distribution percentage.

(iii) Most candidates could draw a bar chart – there were very few line graphs or stick graphs or scatter graphs. Most candidates chose an appropriate linear scale for their frequencies and were able to gain full marks even if they had made an error in their frequency table in the previous part. Marks were generally lost for not labelling the scale or using a non-linear scale, or for drawing bars of unequal widths. Those who drew unequal width bars usually went wrong on the first or final bar, making those a bar and a half whereas the rest were two or one bar wide.

(iv) Candidates with a correct frequency table in part **(a)(ii)** were generally able to identify the correct modal group. Some gave the frequency of 8 or the number 29 instead of the correct range.

(b) Successful candidates recognised that there were 60 minutes in an hour rather than using a decimal calculation. Many candidates tried to perform a "normal" subtraction, e.g. 16.10 – 8.45 = 7.65, which often led to 8 hr 5 min or 8 hr 55 min.

(c) (i) Most candidates identified that they should multiply to do the conversion but many did not recognise the context and as a result did not round correctly to 2 decimal places, either leaving their answer to 3 decimal places or rounding to the nearest whole euro. A number of candidates divided 167 by 1.428.

(ii) Most candidates correctly recognised the need to divide and as the answer was exact, gained full marks. Those candidates who had divided in part **(c)(i)** tended to multiply in part **(c)(ii)**. A number of candidates used €107 instead of the correct value of €107.10, as given in the question.

Answers: **(a)(i)** 36 **(a)(ii)** 5, 2, 3, 4, 3, 8, 1, 4 **(a)(iv)** 26-30 **(b)** 7 (hours) 25 (minutes) **(c)(i)** 238.48 **(c)(ii)** 75

Question 2

This question gave candidates the opportunity to show their number skills.

(a) (i) This was the most successfully answered question on the paper with the vast majority of candidates able to correctly identify a factor of 120. The most common answers were 2 and 60. Some candidates gave answers as a multiplication sum, e.g. 2x60, which did not gain the mark as it did not show a full understanding of what a factor of a number is.

(ii) This question again showed that candidates understood what a factor of a number is and most were able to give a common factor of the two values, although this proved more difficult for less able candidates. A small number gave the LCM instead of the HCF.

(b) (i) All candidates attempted this question but many continued in finding factors instead of a multiple. Just over half of the candidates were able to identify the correct multiple with the remaining candidates giving a factor instead.

(ii) This question was well answered by the vast majority of candidates who showed a good understanding of square numbers. The most common incorrect answers were giving a square number not from the list, 7 because seven squared is 49, and 24 because it divides by 4.

(iii) Successful candidates understood the difference between the cube root and the cube of a number. The most common incorrect answer was 512. Candidates need to be encouraged to read carefully each question and to check they have answered the question set.

(c) (i) The vast majority of candidates attempted this question with most successfully giving a correct example to disprove the statement. A successful answer needed to include the two values being multiplied together and the answer to their product. A large number of candidates identified correctly two values but did not give the result of the product.

(ii) Most candidates showed understanding of the question and what was needed to disprove the statement but the vast majority found it difficult to correctly present their answers. Most candidates omitted the essential brackets which are required to show that the negative value is being cubed, not the positive value cubed with a negative sign in front of it; e.g. $(-3)^3 = -27$ gained the mark, however $-3^3 = -27$ did not.

(d) (i) This question was attempted by all candidates and correctly by the majority. Workings out of each part of the inequalities were seen by the successful candidates who were then able to identify the correct inequalities symbol.

(ii) This question was found to be more difficult however those that showed workings out generally were able to give the correct symbol.

(iii) This part proved the most challenging of the three, with many candidates seeming to believe they had to use one of each symbol in the question, despite instructions at the beginning of the question that they did not. As a result the most common incorrect answer was = because candidates had used > and < in the previous two parts. Candidates should be reminded to read all parts of the question including the introductory sentences.

Answers: **(a)(i)** any other factor of 20 **(a)(ii)** 60 **(b)(i)** 60 **(b)(ii)** 49 **(b)(iii)** 2 **(d)(i)** > **(d)(ii)** > **(d)(iii)** <

Question 3

This construction and measuring question was more successfully answered than in previous years. The vast majority of candidates used the correct equipment to construct a triangle and the most successful candidates showed a good understanding of scales. Bearings still proves to be a question which candidates find challenging.

(a) (i) Candidates measured accurately with a ruler. However a large number gave their answer in cm. Candidates again need to be reminded to carefully read the question and to check their answers. Some other common errors were to try and convert their answer in cm to mm but with errors e.g. 450 mm.

(ii) The bearings question again proved one of the most challenging on the paper. Candidates who attempted the question generally gave an angle however had not identified the correct angle to measure. The most common error was to measure in an anti-clockwise direction and thus getting an answer in the range 120˚ to 140˚. Another common incorrect method was to measure a correct angle but then not to add it to 180˚. Some candidates had clearly measured in the correct angle in the correct direction but gave the answer of 230˚, which indicated poor measuring skills.

(b) (i) An improvement in candidates' construction skills were seen this year with the vast majority of candidates correctly using a pair of compasses and a ruler to correctly construct the triangle. Most candidates successfully converted the given measurements using the scale however some candidates did not leave their construction arcs or just used a ruler thereby only gaining 2 of the 3 marks. A small number of candidates drew both lines 6 cm or 8 cm.

(ii) The calculation of the area of the candidate's triangle proved to be one of the hardest questions on the paper. A large number could quote the correct formula; measure the correct height of their triangle, convert using the scale and substitute into the formula to calculate the correct area. As this was a complex question many candidates made errors in at least one of these parts. The most common error was to use the sides of the triangle to calculate the area, e.g. 0.5 x 550 x 300, or assume a right angle between their constructed sides. Most candidates correctly applied the scale to their height, however some did not measure with enough accuracy to gain a mark. Some candidates chose to work in cm and correctly found the area of the triangle in cm^2 but were then unable to convert to m^2. Another method used by more able candidates was to divide the base into two parts and to use Pythagoras' theorem to calculate the height; this proved successful as long as they had accurately measured the original length.

Answers: **(a)(i)** 44-46 **(a)(ii)** 231-235 **(b)(ii)** 52250 to 60500

Question 4

All candidates were able to attempt most parts of this transformations question.

(a) (i) Most candidates were able to correctly identify that the transformation was a translation and more able candidates were able to identify the correct vector, given as a column vector or described in words. Common errors were to not indicate that the shapes had moved left and down by using negative values in their vector or to reverse the values. Candidates need to be encouraged to use correct notation when describing a translation as many gave their vector in co-ordinate form. Very few candidates described the transformation using two transformations which is an improvement on previous years.

(ii) The description of the enlargement proved to be more challenging with few candidates giving the full description of an enlargement. Enlargement was identified by the majority of candidates, however many did try to convey the idea that the shape had got smaller by using terms such as 'shrunk' or 'disenlargement' which gained no marks. The centre of enlargement was found by more candidates this year and given as a co-ordinate or the word origin. The scale factor proved to be the most difficult part of the description with many candidates giving it as 2 or -2. More candidates gave two transformations in this part of the question, enlargement followed by a translation, than in part **(i)**.

(b) (i) Most candidates were able to correctly reflect the shape in the y-axis. Some candidates did reflect in the x-axis whilst others drew the shape one square to the left or right of the correct position.

(ii) The rotation proved to be more challenging to the candidates. More able candidates could identify the correct orientation and position required whereas less able candidates could correctly rotate the shape 90° anti-clockwise but used the wrong centre of rotation. The most common error was to rotate using a corner of the original shape as the centre of rotation.

Answers: **(a)(i)** Translation, $\begin{pmatrix} -7 \\ -8 \end{pmatrix}$ **(a)(ii)** Enlargement, 0.5, (0,0)

Question 5

Most candidates were successful in answering this algebra question, with all candidates attempting all or some of the questions.

(a) (i) This question proved accessible to most candidates and was correctly answered by the vast majority. The number of candidates showing their substitution, and not simply writing the answer, improved from previous years and this should be encouraged in all candidates.

(ii) This part proved more challenging to solve as many candidates believed they had to use their answer to part **(i)** to solve this part. Many candidates simply wrote the answer, which in most cases was correct, however the best solutions showed the method used.

(b) (i) The vast majority of candidates correctly solved this one step equation, realising the need to divide by 3. A very small number of candidates subtracted 3 or cube rooted to find their answer.

(ii) This equation was very well answered by most of the candidates. A far greater number of candidates showed their method for this question, which should be encouraged. A significant number of candidates however did subtract 4 from both sides instead of add 4.

(iii) This more complex equation was answered well by the majority of candidates. Many presented their method with very few candidates only giving the answer. The expanding of the bracket proved the most challenging part of the solution with many wrong answers coming from an incorrect expansion of $4(5q - 2)$, with $20q - 2$ being seen often. However a large proportion of candidates were able to gain a mark by correctly solving their resulting equation.

(c) This simultaneous equations question proved very challenging this year, with many less able candidates choosing not to attempt it or only able to attempt the first part of the solution. The higher co-efficients and answers to the equations led to a number of numerical errors. However candidates generally were able to choose the correct method to eliminate one variable and therefore were able to score 2 out of the 4 marks available. It was the manipulation of the terms involving negative co-efficients that seemed to prevent the candidates reaching a successful conclusion. Far more candidates chose to use the substitution method of solving simultaneous equations than in previous years. Many were successful in rearranging and substituting into the other equation, gaining two method marks, however most got no further than this.

Answers: **(a)(i)** 230 **(a)(ii)** 252 **(b)(i)** 9 **(b)(ii)** 3.5 **(b)(iii)** 4 **(c)** x = 1.5, y = -5

Question 6

This question was accessible to most candidates.

(a) Nearly all candidates attempted this question. Some candidates did not fully understand that the fence only went round three of the sides and calculated the cost of a fence surrounding the whole garden. Candidates who rounded their answers to one decimal place or to the nearest whole dollar lost the final mark but were able to gain a method mark if they had shown correct working.

(b) (i) Most candidates correctly calculated the area of the garden. The vast majority of candidates showed their workings and gained a method mark even if their final answer was incorrect.

(ii) This ratio question was successfully answered by candidates of all levels of ability. A full method was given by most candidates with few making errors; the most common was to divide by 5, then 3 and then 4.

(c) This Pythagoras' theorem question proved to be the most challenging part of the question although was well answered by the majority of candidates. Full workings were seen in most solutions with clear indication to square root seen throughout. Less able candidates either did not recognise the use of Pythagoras' theorem or chose to subtract instead of add.

(d) (i) The calculation of the area of the circular pond was attempted by most candidates with the majority identifying the correct formula although some less able candidates used the formula for the circumference. There was a significant improvement on previous years on the number of candidates who used the correct value for pi, however use of 3.14 and 22/7 was seen on a number of occasions.

(ii) This part of the question was not attempted by a large proportion of the candidates. Those who had correctly answered part **(i)** generally recognised the need to double their previous answer. Some candidates chose to start the question again using the formula for the volume of a cylinder. Candidates who had used the formula for the circumference in part **(i)** commonly used the same formula in part **(ii)**.

Answers: **(a)** 252.56 **(b)(i)** 510 **(b)(ii)** 170, 102, 136 **(c)** 34.5 **(d)(i)** 63.6 **(d)(ii)** 127

Question 7

This question gave candidates the opportunity to demonstrate their ability to calculate missing values and draw a quadratic curve.

(a) Candidates answered this part well with the majority of candidates correctly calculating 3 or all 5 missing values. Candidates found calculating the value for $x=-1$ most challenging with $y=2$ being a common mistake, from $-(1)^2$ instead of $(-1)^2$.

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

(c) Identifying the correct line of symmetry proved very challenging especially if errors had previously been made in parts **(a)** and **(b).** Successful candidates remembered that vertical lines start with x=, however a number of candidates identified the correct line on the graph but only wrote 0.5 as their answer. This part proved to be the question not attempted by the most candidates.

(d) (i) The line $y=9$ was drawn correctly by the majority of candidates with very few diagonal or vertical lines seen.

(ii) Many candidates were able to link the drawing of the curve and the straight line with the solution of the equation. However more than half of the candidates tried to solve the equation using the quadratic formula and only a very small number of candidates could do so correctly.

Answers: **(a)** 14, 4, 2, 8, 14 **(c)** $x=0.5$ **(d)(ii)** -2.15 to -2.25, 3.15 to 3.25

Question 8

All candidates were able to attempt all or part of this question as it offered a wide range of questions on various areas of mathematics.

(a) (i) All candidates attempted this question and the vast majority correctly identified the month. A small number of candidates gave the highest temperature instead of the month.

(ii) Most candidates could calculate the difference between a negative and positive temperature. Some less able candidates found dealing with negative numbers difficult.

(iii) All candidates who attempted this question clearly identified that they needed to use the values 2.7 and 12.3. However a significant proportion of the candidates subtracted in the wrong order.

(b) (i) This question asked to show the total was 600 so candidates had to use the fact that the angle in the pie chart was 90˚ and that the number of tourists travelling by boat was 150 to reach the conclusion that the total number was 600. Most candidates who attempted this question used the 600 given in the question to either show the angle on the pie chart was 90˚ or the number of tourists who travelled by boat was 150. In questions which require candidates to show something is true they must use the other facts given in the question to prove the statement rather than the other way round.

(ii) Candidates had to be able to measure accurately the angle for tourists who travelled by plane and then use this fraction with the total number of tourists taking part in the survey, which many candidates did.

(c) Many candidates found calculating a percentage decrease of a group of items challenging. Most were able to gain one mark for calculating 12% of the total amount or reducing the cost of one ticket by 12% but many solutions were left at this stage without understanding the need to calculate the total cost of all the tickets after the discount. The vast majority of candidates did show some working so were able to gain one or both of the method marks available.

(d) (i) Standard form again proved challenging for many candidates this year. More able candidates gave the correct form, however many candidates made errors such as 448×10^4 or 4.480×10^{-6}.

(ii) Calculating the percentage increase of a population proved challenging to all candidates apart from the most able. The size of the figures given caused some candidates difficulty although the most common error was to divide by the final population rather than the original population. A large proportion of the candidates correctly identified the increase to be 440000, but many candidates' solutions stopped there or continued by dividing by the wrong value. Many candidates used the other approach of dividing the two populations with the successful candidates able to divide in the correct order and then convert to a percentage increase. However most candidates divided in the wrong order and gained no marks on this question.

Answers: **(a)(i)** July **(a)(ii)** 10.9 **(a)(iii)** -9.6 **(b)(i)** $150 \div \frac{90}{360}$ **(b)(ii)** 250 **(c)** 11682 **(d)(i)** 4.48×10^6 **(d)(ii)** 9.82

Question 9

This question offered the candidates the opportunity to demonstrate their understanding of circle theorems.

(a) (i) Candidates showed that they knew some of the names of parts of a circle with the most common correct answer being radius. Candidates found identifying the chord more difficult with a large proportion leaving this answer blank.

(ii) Most candidates showed some understanding of the circle theorem regarding the tangent of a circle. The majority were able to correctly identify the required angle. The reasons given were varied in their detail and only the most able gave the detail required to gain the mark. To gain full marks candidates had to quote the circle theorem they have used rather than giving a commentary on what calculations were done.

(iii) Similarly to part **(ii)** candidates showed some understanding of the circle theorem needed to correctly find the required angle. Many candidates correctly calculated the angle but gave their reason as a commentary on the calculations used. Less able candidates thought that the triangle in the question was isosceles and gave the incorrect answer of 24˚.

(b) (i) This was the most successfully answered part of this question with the majority of candidates correctly identifying the shape. Common incorrect answers were hexagon and heptagon.

(ii) This part proved the most challenging part of the question as candidates were reminded to show all their working. Most candidates made a correct start to the question calculating the external angle of the octagon or the total of the internal angles; however few made much further progress. More able candidates found the correct answer but had not shown intermediate stages, e.g. how they had found the 45˚. Candidates should be reminded that when asked to show all working they must show every calculation made in reaching their answer.

(c) The more able candidates correctly found the number of sides. A variety of methods were seen which resulted in incorrect answers and less able candidates generally chose to make no attempt at this question.

Answers: **(a)(i)** Chord, Radius **(a)(ii)** 12 **(a)(iii)** 66 **(b)(i)** Octagon **(b)(ii)** 67.5 **(c)** 15

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key Messages

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

General Comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper making an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required 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. Candidates should be encouraged to use a pencil for diagrams, constructions and graphs and to ensure that work can be clearly seen.

Comments on Specific Questions

Question 1

This question on triangles and transformations was generally well answered although a significant number of candidates did not know the required mathematical terms and names. Candidates continue to find describing a single transformation difficult with a significant number omitting part of the description or giving a double transformation as their answer. A small number simply stated the co-ordinates of both triangles.

(a) Few candidates stated the correct mathematical name of scalene for the triangle. A wide variety of names were given with the most common errors being isosceles, equilateral and right-angled.

(b) Few candidates stated the correct mathematical name of congruent for these triangles. Although many candidates were on the right lines the expressions same, identical and equal were not acceptable.

(c) (i) The majority were able to correctly state "translation" although many omitted the required column vector, or used incorrect numbers, or gave co-ordinates.

(ii) The majority were able to correctly state "rotation" and "180°" although many omitted the required centre of rotation, or used incorrect co-ordinates. Common errors were the use of reflections and/or translations.

(d) The correct reflection was generally drawn although common errors of reflecting in the *y*-axis, and translating below the *x*-axis were seen.

(e) The correct enlargement was generally drawn although a very common error of using an incorrect centre of enlargement was noted. This resulted in a triangle of the correct magnitude and orientation but in an incorrect position. A small yet significant number of candidates were unable to answer this part.

(f) The majority of candidates knew how to calculate the area of a triangle and applied it correctly to their triangle. The common error was to use "length x width".

Answers: **(a)** scalene **(b)** congruent **(c)(i)** Translation $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$ **(ii)** rotation, 180°, centre (0,0) **(f)** 6

Question 2

All candidates were able to attempt all or part of this question as it offered a wide range of questions on various areas of mathematics involving the use of fractions, ratio and percentages. More able candidates could demonstrate their ability to calculate the percentage decrease in the price of a car. The "show that" aspect of part **(c)** continued to cause problems for the less able candidates.

(a) (i) Most candidates who started with the correct fraction of $\frac{80}{144}$ were able to express this fraction in its simplest form of $\frac{5}{9}$. A significant number did not read the question carefully and started with $\frac{64}{144}$ but were able to gain one mark by simplifying to $\frac{4}{9}$. A small but significant number attempted to use the value of 3 in their fraction. Common errors included $\frac{3}{144}$, $\frac{3}{80}$, $\frac{144}{80}$, $\frac{144}{64}$, 80, $\frac{144}{3}$ and $\frac{80}{3}$.

(ii) This part on ratio was generally answered well although a common error was to calculate $\frac{6}{12}$ x 144 (finding petrol rather than diesel) which lost the accuracy mark although could be awarded the method mark if clearly shown. Other common errors included $\frac{144}{12}$, $\frac{144}{5}$ and $\frac{12}{5}$.

(b) Many candidates did not appreciate the full method to be used in this part, i.e. in Option 2 first find the initial payment ($\frac{2}{5}$ x 5200), then find the total monthly payments (24 x 175), then add these two amounts to find the total payment for Option 2, and finally to subtract the amount paid in Option 1, to find how much more Lola paid. However most were able to gain at least one of the two available method marks by showing clear working.

(c) This part proved challenging for a significant number of candidates due to the nature of the question – "show that" the reduced price of the car is $2932.50. In questions which require candidates to show a statement is true they must use the other facts given in the question to show the statement rather than the other way round. The method required was "$\frac{85}{100}$ x 3450" or "3450 – $\frac{15}{100}$ x 3450". Decimal equivalents of 0.85 and 0.15 were acceptable. It is not sufficient in a "show that" question to just state "15% x 3450" or "85% x 3450" as the method needs to be shown explicitly.

(d) This part on percentage reduction was much better answered than in previous years with the standard method of $\frac{(3300-2500)}{2500}$ x 100 being widely used. However a significant number continue to calculate the percentage reduction based on the selling price rather than the cost price. Common errors were $\frac{800}{3300}$ x 100, $\frac{2500}{3300}$ x 100, $\frac{800}{2500}$, $\frac{800}{3300}$, $\frac{800}{100}$ and 800.

Answers: **(a)(i)** $\frac{5}{9}$ **(ii)** 60 **(b)** 1080 **(d)** 32

Question 3

This question partly on algebra and partly on probability proved challenging for a number of candidates. The writing of algebraic expressions from the given statements proved difficult for many with a significant number unable to attempt this part **(a)** at all. The use of standard probability diagrams also proved difficult for many candidates.

(a) (i) This part was generally answered well although a significant number were unable to write a correct algebraic expression or spoilt their answer by incorrect simplification or turning it into an equation. Common errors included $n = 4n + 21$, $4n + 21 = 25n$, $25n$, 25 and $4n = 21$.

(ii) Many candidates did not appreciate that an equation was required and should have been stated as the first line of their answer despite the help given in the wording of the question. Those that did equate the two given expressions usually were able to find the correct solution. The most common error was to combine the two expressions as $5n + 3 + 3n + 27 = 8n + 30$ and then solve $8n + 30 = 0$ or $8n = 30$. A small number attempted a trial and improvement method but this was rarely successful.

(iii) Although the expression of $8n + 30$ was often seen few candidates appreciated that substituting their value of n from the previous part was needed. Common errors were $8n + 30$, $8n$, 30, 63, and 38.

(b) (i) The vast majority of candidates were able to correctly state the colour of sweet.

(ii) A significant number of candidates did not seem familiar with this standard diagram for a probability scale and were unable to draw the required vertical arrow.

(iii) This part was generally answered well with the majority able to write down the correct required probability with most answers given in a fractional form.

(iv) This part was again generally answered well with the majority able to write down the correct required probability although a common error was to give two separate answers of $\frac{10}{20}$ and $\frac{6}{20}$.

Answers: **(a)(i)** $4n + 21$ **(ii)** 12 **(iii)** 126 **(b)(i)** yellow **(ii)** arrow pointing to 0.5 **(iii)** $\frac{4}{20}$ **(iv)** $\frac{16}{20}$

Question 4

This construction and measuring question was more successfully answered than in previous years. The majority of candidates used the correct equipment, a pair of compasses and a ruler, to construct the required point, and the most successful candidates showed a good understanding of scales. Bearings still proves to be a question which candidates find difficult and was often not attempted. In the second half of this question more candidates were able to attempt all parts as they offered a wide range of questions on various areas of mathematics.

(a) (i) This part involving measurement and conversion was generally well answered although common errors of 7.5, 750, and 7 x 50 = 350 were noted.

(ii) The measurement of a given bearing continues to be difficult for many candidates. The common error was to repeat the measurement of 7.5 cm. Those who gave an angle as their answer did appear to use the North line but then to measure the incorrect angle leading to the common errors of 52°, 128°, 142°, 218° and 322°.

(iii) Those who answered this part generally made a good attempt at the required construction although a significant number were unable to make any response. One common error was in the measurements of the two required arc radii, either due to incorrect use of the ruler or compass, or perhaps more likely in the conversion of the two given distances. The other common error was the number of candidates who did not show the two necessary construction arcs.

(iv) Again the measurement of a constructed bearing continues to be difficult for many candidates. The common error was to repeat the measurement of 7 cm. Those who gave an angle as their answer did appear to use the North line, though sometimes an inaccurate one, but then to measure the incorrect angle leading to the common errors of 53˚, 37˚, 143˚, 127˚ and 233˚.

(b) Many candidates did not appreciate the full method to be used in this part, i.e. to find the time, then to convert into minutes, and finally to add this journey time onto the start time. However most were able to gain at least one of the two available method marks by showing clear working. A common error included dividing 700 by 525 to work out the time.

(c) This part on rounding was generally answered well although common errors included 4100, 4000, 4170 and 4.173.

(d) This part on unit conversion and rounding was less well answered suggesting that candidates are not so aware of the expression "significant figures". Common errors included incorrect conversions by dividing by 10 or 100 or multiplying by 1000, 13.107, 131 and 13.100.

(e) Many candidates found this part on bounds very difficult in concept although many correct answers were seen from the more able candidates. Common errors included 8510, 8500, 8519.5 and 851.

Answers: **(a)(i)** 370 to 380 **(ii)** 036˚ to 040˚ **(iv)** 300 to 310 **(b)** 11 25 **(c)** 4200 **(d)** 13.1 **(e)** 8515

Question 5

This question gave candidates the opportunity to demonstrate their ability to calculate missing values and to draw a reciprocal curve. Candidates continue to improve at plotting points and drawing smooth curves.

(a) The table was generally completed well with the majority of candidates giving 4 correct values.

(b) (ii) The graph was generally plotted well although the points ±(3,1.67) seemed to cause the most problems in plotting accurately. The majority were able to draw a correct smooth curve with very few making the error of joining points with straight lines and most candidates appreciating that the curve was discontinuous.

(c) Those candidates who appreciated that the intersections of their graph and the line $y = 4$ gave the required solutions were largely successful. Common errors were 20 and 0.8.

(d) (i) This part was generally answered well although a significant number do not appear to realise that a line in the form $x = k$ is a vertical line and can be drawn directly. Other common errors included lines at $x = 3.5$, $x = -3$ and $y = -3.5$.

(ii) This part was well answered by virtually all candidates although the common error of plotting at (-3, 5) was seen.

(iii) Those candidates who understood the term "perpendicular" were usually then able to draw the correct line particularly as a follow through basis was allowed. Common errors included drawing a parallel line and lines joining (5,-3) to (-3,5).

Answers: **(a)** -1, -1.25, 2.5, 1 **(c)** 1.15 to 1.35

Question 6

This question on sequences was generally answered well although candidates continue to find expressing the *n*'th term in an algebraic form difficult.

(a) (i) The sequence was generally well understood and the correct value found.

(ii) The sequence was generally well understood and the correct value found.

(iii) The sequence was generally well understood and the correct values found although the missing fifth term proved more difficult.

(b)(i) The rule given in this part proved more difficult to apply and although often correct, the common errors seen included 7,9, 8,24 and 8,14.

(ii) Candidates did appear to find this part difficult and although the correct answer was most often seen the common errors included even, square, prime and numerical values such as 5.

(c) (i) The majority of candidates were able to use the pattern from the 3 given values and obtain the correct answer.

(ii) Stating the n'th term for the number of sticks proved more difficult with common errors of $n + 5$, $n + 3$, $n + 23$, $5n$, n, and simply giving a numerical value such as 5 or 28.

(iii) This part was generally answered well with candidates either using their previous expression or using repeated addition.

Answers: **(a)(i)** 26 **(ii)** 16 **(iii)** 17, -3 **(b)(i)** 9, 17 **(ii)** odd **(c)(i)** 23 **(ii)** $5n + 3$ **(iii)** 19

Question 7

This question on statistics proved a good discriminator and the full range of marks was seen.

(a) Many correct answers were seen although some candidates were confused between median and mean and/or which data set they should be using. Quite a number didn't order the data often ending up with an answer of 17·5 by using 15 and 20. Those that ordered the data generally scored full marks, however some did omit one value. Many stated (12 + 1) ÷ 2 or 6·5 was seen but not taken further or used incorrectly. A few candidates did order both the age and time and then found the median of the 24 numbers. Quite a number of answers of 34 have been seen following (22 + 24) ÷ 2 in the work space indicating poor use of their calculator. Candidates who showed no working denied themselves of the opportunity to gain credit for method if their answer was wrong.

(b) Most candidates struggled with this part. Many talked about time not age. Many said it was because "they don't have the same age" or talked about the range of ages in that there are young and old people. Others talked about "the answer being a decimal" or "the answer will not be accurate" or "the diagram is scattered". Very few candidates used the word/phrase 'extreme value' or were aware that the mean was affected by the 68.

(c) Mixed answers were seen here. Often 491 was seen but not taken further while others wrote "491" ÷ 12 then went wrong either by poor/incorrect rounding. A number of candidates multiplied the age by the time and 13745 ÷ 12 or 491 was seen. A significant number didn't show enough working in this part of the question and denied themselves the chance of method marks.

(d) (i) A significant number of candidates didn't complete the scatter graph by plotting any of the extra points. Most of those that attempted to plot the points scored the 2 marks.

(ii) Whilst 'positive' was the most common answer, errors included "negative" or "none/no correlation", and attempts at describing the polygon they had formed from joining the given plotted points.

(iii) Again this part was not particularly well answered, although many did know that the line had to be a straight ruled line. Those that plotted the extra points did tend to draw a line that was acceptable. Common errors included lines that went below all the points except the 68, unruled lines, joining the points in a zig zag line, and creating a polygon from the points plotted.

(iv) Candidates struggled with this part. Few candidates appreciated that the question was about 8 being outside of the range of the data. When a comment was given it often had reference to the given data not having a child of age 8 or that the time taken would be longer or that the child would not be able to complete the puzzle because they were too young or not clever enough. Others thought the answer was "yes" because "the child can do it", "the line of best fit is drawn so we can estimate".

Answers: **(a)** 23 **(b)** affected by the extreme value of 68 **(c)** 40.9 **(d)(ii)** positive **(iv)** No, estimate unreliable as outside range of data.

Question 8

This question tested geometrical properties requiring mathematical names of shapes, and knowledge of the angle properties of parallel lines, polygons and circles. Candidates should show all working and could benefit from putting the known angles onto the given diagram.

(a) Many candidates were successful in this question. A range of integers accompanied "Heptagon" including the most common errors of 6, 8, 9 and 10. The range of answers that accompanied "5" included the most common errors of hexagon, nonagon and octagon.

(b) (i) This part asking for the mathematical name of the quadrilateral was not so well answered with the common errors of parallelogram, rhombus and kite.

(ii) Many candidates recognised the use of the complementary angle and were able to give the correct answer although common errors of 55˚, 35˚ and 23˚ were seen.

(iii) Many candidates did not appreciate the need to use corresponding angles in this part of the question together with their answer to part **(b)(ii)**. Common errors included 67˚ (taking angle *ECD* as 90˚), 23˚ (treating triangle *CDE* as isosceles) and 157˚ (from 180 – 23).

(c) (i) The majority of candidates correctly stated that the angle *ABC* was 90˚ but many were unable to describe the circle theorem correctly. Common errors included "because it is a right-angled triangle", "the triangle is on the diameter", "triangle in a semicircle", and "it is a tangent". The essential words required were angle and semicircle.

(ii) This part was generally answered well with the majority knowing that the triangle was right-angled and then able to subtract the 35˚ successfully. Common errors of 35˚, 38˚, 145˚ and 52˚ were seen.

(iii) Many candidates did not appreciate the full method to be used in this part, i.e. recognising angle *CAD* was 90˚, then finding the angle *ACD* as 38˚ by using the triangle property, and finally adding this 38˚ to their 55˚ to find the required angle *BCD*. The alternative method of (360 - 90 - 90 - 52 - 35) is equally valid and was attempted by a number of candidates. Common errors included 35˚, 38˚, 145˚, 90˚ and 183˚.

Answers: **(a)** 7, pentagon **(b)(i)** trapezium **(ii)** 125˚ **(iii)** 32˚ **(c)(i)** 90˚, angle in a semicircle
(ii) 55˚ **(iii)** 93˚

Question 9

This question tested the use of negative numbers and standard form in context.

(a) (i) This part was generally answered well although common errors of ±25 and ±11 were seen.

(ii) This part was not generally answered as well with the common errors of +32, 36 and -36 frequently seen.

(iii) This part was generally answered well although the common errors of ±21and -4 were seen.

(b) Standard form appeared to be well understood and a significant number of fully correct answers were seen. In part **(i)** the most common error was $10{\cdot}5 \times 10^6$ while some decided to round to 1.1. In part **(ii)** the common error was 458000000, i.e. adding 6 zeros rather than considering the decimal point. Ordering the numbers in part **(iii)** caused some problems with Omsk and Moscow being common errors. Part **(iv)** was also well attempted with the majority gaining at least one mark for figures 27. The common errors included leaving as the ordinary number 270000, giving the correct number incorrectly in standard form often 0.27×10^6, and 0.27 coming from the subtraction of the decimal numbers.

Answers: **(a)(i)** 7 **(ii)** -32 **(iii)** -11 **(b)(i)** 1.05×10^7 **(ii)** 4580000 **(iii)** Kaliningrad **(iv)** 2.7×10^5

Question 10

This question on algebra proved challenging for a number of candidates. Those candidates who showed clear and full working were often able to pick up method marks.

(a) A majority of candidates gave the correct answer. Those who did not, often earned a method mark for the correct expansion of the bracket. Some candidates incorrectly multiplied all terms by 6 and so $6x - 12 = 54$ was sometimes seen and some did not multiply the 2, giving $6x - 2 = 9$. Errors were also made rearranging the equation and $6x = 12 - 9$ leading to an answer of $\frac{3}{6}$ was common. The alternative method of a first step of $x - 2 = \frac{9}{6}$ leading to $x = 1.5 + 2$ was rarely seen although the error of $x - 2 = 9 - 6$ was noted.

(b) The majority of candidates were able to demonstrate some knowledge of expansion and simplification and the correct answer was often seen. Common errors included $2n - 2$, $2n + 2$, $2n - 6$, $2n + 4$, $14n - 10$ and $14n + 2$. These errors often came from incorrect working where the final term was often given as +10 rather than -10, or from an incorrect attempt at the collecting of like terms. Sometimes the answer was spoilt by being made into an equation and 'solved' which often led to the incorrect answer of $n = 9$. The majority of candidates were able to score at least one mark, usually for $8n - 8$ in the first line of their working or $2n$ from correct working. As in part **(a)**, the second number in the bracket was often not multiplied, leading to $8n - 1$ and $6n \pm 5$.

(c) Most candidates appeared to understand the requirements of factorisation with many giving a correct fully or partially factorised expression. Those who gave a correct partial factorisation usually gave $5p(2p + p^2)$. Candidates should be encouraged to check their factorisations carefully by multiplying back as many lost both marks by "losing" a power of p or having a 5 inside the brackets when they clearly had a good understanding of what they were doing. The most common fundamental error was to "combine" the terms giving answers such as $15p^5$.

Answers: **(a)** 3.5 **(b)** $2n - 18$ **(c)** $5p^2(2 + p)$

MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key Messages

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

General Comments

The paper gave the opportunity for candidates to demonstrate their knowledge and application of mathematics. The majority of candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates attempted all of the questions with the occasional part question being omitted by individuals. The standard of presentation was generally good. A substantial number of candidates did show all necessary working. However, many 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 all working clearly in the answer space provided. The formulae being used, substitutions and calculations performed are of particular value if an incorrect answer is given.

Comments on Specific Questions

Question 1

Most candidates answered this question.

(a) The vast majority of candidates understood how to obtain the values from the information given. When an error was made the final addition was usually carried out correctly for the candidates' values.

(b) (i) Only a minority of candidates understood that you cannot use the final value to show that this final value is \$2040. Starting from $\frac{2040}{17}$ is incorrect; the correct starting point is $\frac{600}{5}$.

(ii) Many candidates did get this part correct even if they did not succeed in part **(a)**. However, some candidates found this challenging and did not appear to know which values to use.

(c) Most candidates understood the principle of calculating percentage profit but many used the incorrect denominator or didn't subtract the original amount in the numerator.

(d) The vast majority of candidates used the compound interest formula. Very few candidates used simple interest. Fewer candidates used the direct method formula for the calculation, the majority using the year by year approach. Some candidates lost marks for providing insufficient details or not working to sufficient accuracy. A common incorrect answer was 1761.36.

Answers: **(a)** 240, 900, 1640 **(b) (ii)** 30 **(c)** 43.1 **(d)** 261.36

Question 2

Candidates appeared to understand the different transformations although many did not understand in part **(b)(iii)** that only one transformation can be used. When two transformations were given the second transformation tended to be "then move ...". Part **(c)** was very challenging for candidates; many didn't show sufficient working or used premature approximations so marks were lost.

(a) Although about half the candidates gave the correct answer many alternatives were given such as quadrilateral and rhombus.

(**b**) **(i)** Few candidates gave all three pieces of information needed to describe the transformation. When three pieces of information were given some candidates did not say the 90^{o} was clockwise.

(ii) More candidates got this correct than the other parts. Some candidates gave the vector as the number of squares moved left and down.

(iii) Many candidates attempted to describe this by using several transformations such as enlargement and a rotation.

(c) (i) Some candidates produced very good work to show this result but didn't show their square root value to sufficient accuracy - a value of 3.162 was required.

(ii) Most candidates attempted this part but few produced solutions that included a calculated 1.41. Many appeared to have measured the diagram.

(iii) Although many candidates did multiply their previous answer by 3, some started again and made the same errors as in the previous part.

Answers: **(a)** Kite **(b) (i)** Rotation, 90^{0} clockwise, about origin **(ii)** Translation $\begin{pmatrix} -2 \\ -10 \end{pmatrix}$ **(iii)** Enlargement, scale factor -3, centre (-3,4) **(c) (ii)** 9.15 **(iii)** 27.45

Question 3

Many candidates understood the terms such as multiple, square, even etc.

(a) (i) Many correct answers were seen with a common error of an answer of 1.

(ii) There were slightly fewer correct answers seen to this part. Some candidates wrote down, for example, 5^2 instead of 25.

(iii) A similar number of correct answers were seen in this part. The majority of incorrect answers were due to writing down one of the prime numbers that were not even.

(iv) Candidates found this part the most challenging of the question. Many wrote down a number which was one less than a multiple of 5 but forgot that it had to be prime as well.

(b) (i) Nearly all candidates gave the correct answer.

(ii) A very large number of candidates gave the correct answer. When candidates showed their working part marks were given for seeing 216 or $\frac{1}{8}$.

Answers: **(a) (i)** 28 **(ii)** 1 or 9 or 25 or 49 **(iii)** 2 **(iv)** 19 or 29 **(b) (i)** 5 **(ii)** 27

Question 4

Candidates showed a good understanding of angles. However, their answers could be improved by understanding which theorems should be used in a particular case and given practice at writing down suitable reasons why an angle has a particular value.

(a) (i) Some candidates gave the correct answer. The common incorrect answer was 140^{o}.

(ii) More candidates gave the correct answer or the correct follow through from the previous part.

(b) (i) Candidates appeared to be equally divided between those who gave the correct answer, those who gave an answer of 66^{o} and those who did not give an answer.

(ii) More candidates gave the correct answer in this part. A common error was to assume that the triangle was isosceles.

(iii) Many candidates either gave the correct answer or gained the mark by subtracting their previous two answers from 180°.

(c) Some candidates understood that this answer was the same as **(b)(iii)** or 90° – **(b)(ii)**. However, very few candidates could complete the statement. Many understood that it was to do with tangents but did not connect it to the radius/diameter.

Answers: **(a) (i)** 40 **(ii)** 140 **(b) (i)** 90 **(ii)** 24 **(iii)** 66 **(c)** 66

Question 5

Candidates showed good ability at graphs and understood how to read them. Candidates could improve their answers by taking care to draw smooth continuous curves and not using straight lines instead of curves.

(a) (i) The majority of candidates completed the table correctly. The common error was +3 at x=-1, most probably arising from incorrect use of brackets around the -1.

(ii) Many candidates plotted their points accurately. Although many then drew good curves for their points some candidates' curves were too thick or just straight lines between the points.

(b) Some candidates read the graph correctly to find the intersections with the x-axis. Candidates showed a good understanding of how to use the scale and negative values. However, many candidates attempted to use the quadratic formula and because the equation was in 'reverse' order (constant first instead of last) this almost always did not yield the correct answer.

(c) (i) A slight majority of candidates recognised and drew the line of symmetry whilst many did not give an answer. Candidates could improve their answers by clearly labelling the line of symmetry.

(ii) Most candidates who drew the line of symmetry gave an answer, often the correct answer. The most common error was to write y=1.5 or y equals a quadratic.

(d) (i) Many candidates drew the correct line accurately although a few attempted freehand lines or drew a non-continuous line.

(ii) Candidates were challenged by this part. Most used the difference in y divided by difference in x. However, many inverted the formula or didn't take account of the difference in the scale between the two axes. Most candidates did take account of negative values correctly.

(iii) When the candidate obtained the correct answer for the previous part they normally wrote down the correct answer here. The common error was to give an incomplete answer, either omitting the constant term or simply writing 'c'.

Answers: **(a) (i)** 1, 7, 1 **(b)** -1.1 to -1.3 and 4.1 to 4.3 **(c) (ii)** x=1.5 **(d) (ii)** 1 **(iii)** x+2

Question 6

A majority of candidates showed a good understanding of statistics and pie charts. They could improve by clearly understanding the difference between mean, mode etc. Some candidates gave the correct answers but in the wrong spaces.

(a) (i) Many candidates gave the correct answer. The common error was poor ordering, including just using the terms in the order given.

(ii) The vast majority of candidates gave the correct answer.

(iii) Generally candidates understood the necessary calculation but didn't show sufficient working so method marks couldn't be given if errors had been made in the calculation.

(b) This proved challenging to many candidates. There were good clear answers but many gave a general response about the scores without mentioning the mean or median. Quite a few candidates did not answer this part.

(c) (i) In general candidates gave correct answers in the table.

(ii) The candidate's answers were then translated accurately to the pie chart with correct labelling.

(d) Some candidates gave the correct answer although some did not recognise the answer had to be in its simplest form. A common error was to misread the question and give an answer of $\frac{3}{5}$.

Answers: **(a) (i)** 18 **(ii)** 7 **(iii)** 25 **(c)** Frequencies 3, 2, 1; angles 72°, 48°, 24° **(d)** $\frac{2}{5}$

Question 7

Candidates showed a reasonable understanding of trigonometry but some did not appear to understand three dimensional objects and their relationship to two dimensions.

(a) Most candidates recognised the need to calculate the length *DE*. Although many candidates understood and wrote down the correct expression they lost marks for accuracy. A number of candidates believed they needed to use Pythagoras' theorem.

(b) Many candidates gave the correct answer, often without showing any working. When working was shown, the two alternative ways of calculating the area were used equally by the candidates.

(c) A few candidates understood that the answer here was twice the answer to the previous part. However, a large number of candidates did not answer this part.

(d) A few candidates drew completely correct nets. The most common error was to omit the smallest rectangle. The trapezium was the most commonly correct shape although when not correct, it tended to be the longer side being one square shorter than required.

Answers: **(a)** 36.9 **(b)** 1.875 **(c)** 3.75

Question 8

Although candidates were generally able to calculate specific values, writing expressions was challenging. Candidates could improve their answers by having further practice on writing general expressions.

(a) Many candidates gave the correct answer. The common error seen was hexagon.

(b) The vast majority of candidates gave completely correct answers. When full marks were not earned it was usually the vertices rather than the lines which were inaccurate.

(c) (i) Only some candidates gave the correct answer. There did not appear to be any common errors with many candidates not showing an understanding of expressions.

(ii) A significant number of candidates got the correct answer even though they may not have had a correct answer, or an answer at all, to the previous part. Many of these candidates showed their working as writing down each pattern up to the pattern required. Sometimes this included an error which meant no marks could be scored.

(d) Only some candidates gave the correct answer. There did not appear to be any common errors with many candidates not showing an understanding of expressions.

(e) Very few candidates gave the correct answer. The common error was to subtract the vertices from the lines.

Answers: **(a)** Octagon **(b)** 20; 22; 26; 29; 44; 50 **(c) (i)** $6n+2$ **(ii)** 140 **(d)** $7n+1$ **(e)** $n-1$

Question 9

Some candidates showed an understanding of rearranging and substituting into formulae. Candidates can improve their answers by practise and understanding that multiplication and division go together whilst addition and subtraction go together.

(**a**) **(i)** A few candidates rearranged the formula correctly. The common errors were to leave a three tier division or to move a letter incorrectly (subtracting instead of dividing for example).

(**ii**) Many candidates started again instead of using the formula they had obtained in the previous part. A common error was not to show sufficient accuracy after the square root had been taken to allow for rounding to the answer 3.

(**b**) Some candidates gave the correct answer. The common error was to use the formula for area instead of circumference.

(c) A few candidates gained full marks. Many candidates gave an answer of 2 with or without working. Common errors were to divide the volume by the cost or to not give an answer to one decimal place.

Answers: **(a) (i)** $r = \sqrt{\dfrac{3V}{\pi h}}$ **(b)** 18.9 **(c)** 1.9

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key Messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus.
The accurate statement and application of formulae in varying situations is always required.
Work should be clearly and concisely expressed with an appropriate level of accuracy.
Candidates need to be aware that in geometrical constructions all arcs should be clearly visible so examiners can give credit when appropriate.
Straight lines in graphs should be accurately ruled with the correct intercepts on the axes. Curves should be drawn with a single curved line.

General comments

This paper proved to be accessible to many of the candidates. There were however some candidates who were not able to attempt a number of the questions and did not appear to have the knowledge and skills for this extended paper and would have been more appropriately entered at the core tier.

The more able candidates showed well-structured answers with clear method and answers given to appropriate accuracy. Candidates should record all of their working and solutions inside the question booklet provided. There were more candidates this year who showed minimal or no working and a number that gave answers only. As a general point, candidates should be encouraged to cross out any incorrect/redundant work and replace it rather than writing over it.

The questions/parts of questions on arithmetic (percentages, ratio etc.), speed/ time graphs, curved surface area and volume of a cone, rotation and reflection, calculating an estimate of the mean and drawing a cumulative frequency diagram, making predictions about the next pattern in a sequence were very well attempted. The questions involving finding sector angles, general trigonometry, aspects of functions, matrix transformations, setting up and solving an equation in context, describing a region using inequalities and generalising patterns in a sequence proved to be the more challenging aspects on the paper.

Candidates appeared to have sufficient time to complete the paper and omissions were due to difficulty with the questions rather than lack of time. The use of at least 3 significant figure accuracy unless specified was noted by most candidates and only a few approximated to 2 significant figures in their working. A few candidates lost accuracy marks in **Question 3** by not following the instructions on the front of the question paper concerning the values to use for π. Those that chose to use $\frac{22}{7}$ or 3.14 gave answers outside the required range for accuracy.

Words printed in bold, e.g. **integer** in **Question 6(a)(iii)** are intended to help candidates focus on the requirement. This was ignored in a few cases when candidates gave a decimal answer.

Comments on specific questions

Question 1

This question involving application of number work in a context was generally well answered.

(a) (i) Most candidates had few problems and gave the fraction in its simplest form. A few gave an answer of $\frac{2}{3}$ from $\frac{80}{120}$ rather than starting with $\frac{80}{200}$. Some others gave a decimal or percentage answer such as 40%.

(ii) Most candidates also did well with this question, with a few incorrectly going on to further 'simplify' the ratio to 1: $\frac{2}{3}$ or 1.5: 1 which does not earn credit. A few used the values 80 and 200 rather than 80 and 120 in their ratio.

(b) (i) Most candidates were successful with this money problem and found the total cost of the oranges first before subtracting this from the total $86.38. A few candidates made errors in transcribing their values from one method line to the next and care needs to be taken as this type of error will lose the final mark for the accuracy.

(ii) Answers to this reverse percentage problem were mixed. Quite a number calculated 20% and then subtracted this from 1.56 to arrive at 1.25. Those that associated 1.56 with 120% as their first step almost always went on to complete the method correctly.

(c) A range of answers were given to this problem on profit. Many showed full working, subtracting 314.2 from 667 before dividing by 10.5. A number mistakenly divided by 10.3 instead of 10.5. Some did not subtract the cost of 314.20 and simply divided 667 by 10.5.

Answer: **(a) (i)** $\frac{2}{5}$, **(ii)** 3: 2; **(b) (i)** 1.22, **(ii)** 1.30; **(c)** 33.60.

Question 2

This question involving speed-time graphs was generally well answered.

(a) This part was well answered. Only a few candidates made an error with one of the required lines, usually the horizontal section giving it a length of 20 seconds rather than 60 seconds, but then they were usually able to follow through to give the final line correctly to earn partial credit.

(b) This part was usually answered correctly with candidates understanding that the acceleration was the change in speed divided by the time. The most common error was to give an answer of 8 from 40 divided by 5.

(c) For many candidates, this was a standard problem and they had few difficulties in finding the area under the graph as the distance and then dividing this by 120 to find the average speed. A number were unable to work out the total area correctly but earned partial credit for finding one relevant area. Some of the less able candidates did not understand that to find the total distance they needed to find the area under the graph. A few found the correct area under the graph but then did not go on to find the average speed.

Answer: **(b)** $\frac{5}{40}$; **(c)** 3.75.

Question 3

The more straightforward parts on surface area and volume of a cone were answered very well.
Conversion of units and the problem solving aspect of finding a sector angle was only answered well by the more able candidates.

(a) (i) This part was well answered. Virtually all candidates knew how to find the curved surface area of the cone but a few used incorrect values of $\frac{22}{7}$ or 3.14 for π which resulted in an answer that was out of range.

(ii) The majority of candidates recognised that Pythagoras' theorem should be used to find the vertical height of the cone. Most were able to obtain 12 cm correctly but a number incorrectly added the squares of the slant height and the radius to get 13.9 cm and did not apply Pythagoras' theorem correctly to this problem.

(iii) Most candidates were successful in calculating the volume of the cone. Some again used incorrect values of $\frac{22}{7}$ or 3.14 for π which resulted in an answer that was out of range.

(iv) Many candidates struggled with the conversion factors involved and a common error was to divide by 100 or 10 000, and not 100^3 and a few even multiplied by these incorrect conversion factors. Some who used the correct conversion factor did not record their answer in standard form as required. Candidates should always re-read the question before writing their final solution to avoid this type of error.

(b) This question proved to be a good discriminator as only the more able candidates were able to give fully correct solutions. Some used their answer to part **(a)** and the area of the full circle to find the angle required, while others used the circumference of the full circle and the arc length of the sector to find the angle. Many were able to score 1 mark for identifying either $\pi \times 13^2$ or $2\times\pi\times13$ as part of their method. Quite a large number incorrectly used entirely trigonometrical methods to find the angle. Of those who attempted a 'correct' method for areas or lengths of arcs, many used a sector radius of 5 cm rather than 13 cm.

Answer: **(a)** **(i)** 204, **(ii)** 12, **(iii)** 314, **(iv)** 3.14×10^{-4}; **(b)** 138.

Question 4

This question involving application of trigonometry and area scale factors proved challenging for some candidates, in particular the use of area scale factors.

(a) Most candidates recognised the use of the cosine rule for this problem and many were able to arrive at a correct solution using this method. There were errors by a number of candidates who, having quoted the cosine rule correctly and made the correct substitution, did not follow the correct order of operations to complete the problem and calculated $(70^2 + 55^2 - 2 \times 70 \times 55) \cos 40$. A few could not recall the formula for the cosine rule and could not score as a result.
A significant number incorrectly used trigonometry methods for right-angled triangles despite there being no right angle and scored no marks.

(b) Many candidates recognised the use of the sine rule to calculate BC. Those that used the sine rule usually went on to give an accurate answer but there was sometimes a premature approximation of the sin 32 and sin 40 within the method, resulting in an answer that was out of range. Some candidates quoted the sine rule and then went straight to the answer and Centres should advise candidates to show each stage in their working. A few did not recognise that angle BDC was 40°.
Less able candidates incorrectly used trigonometry methods for right-angled triangles as in part **(a)**.
Quite a number dropped a perpendicular from B to DC and used longer methods in this part.

(c) (i) There were two successful strategies to find the area of the playground. The first was to find the sum of the areas of triangle ABD and triangle BCD. The second was to calculate the length of DC and then find the area of the trapezium $ABCD$. The first method was more successful than the second as candidates often made incorrect assumptions about the length of CD such as $CD = 2 \times 55$.
Errors in previous parts did not affect the method marks here but some were unable to achieve the final accuracy mark because of previous errors. Many found this question very challenging and were unfamiliar with how to find the area of a general triangle and did not score at all.

(ii) This question proved to be one of the hardest parts of the paper. Only a few were able to interpret the scale 1 : 200 with the area scale factor and divided part **(c)(i)** by 4. The majority divided by 2 or 200.

(d) Many candidates were well prepared for this and drew a perpendicular line from A to BD before correctly using trigonometry. Fewer used an area method using the area of triangle ABD and the base of 70 m. The most common error was to assume that the perpendicular from A to BD divided BD into two equal lengths of 35 m.

Answer: **(a)** 45.0; **(b)** 84.9; **(c)** **(i)** 4060, **(ii)** 1020; **(d)** 35.4.

Question 5

This question on transformations and vectors was answered well in parts with matrices and drawing geometric conclusions from vectors the most challenging areas.

(a) (i) The reflection was done well by most candidates. A few used an incorrect mirror line usually $y = k$ with $k \neq 5$.

(ii) This was less well done than part **(a)(i)**. Some used an incorrect centre of rotation, but were able to rotate the shape 180° to earn partial credit. A number of candidates did not understand how to rotate the shape at all.

(iii) A full range of answers was given to this description of the transformation. Shear was often confused with stretch but enlargement and translation were also given by some. Those that gave shear were not always able to describe the shear accurately with a common error of *x* invariant rather than *x* – axis invariant. More candidates were able to give the correct shear factor.

(iv) The more able candidates recognised the form of the matrix that gives a shear, factor 2 with the *x* – axis invariant and were able to give a correct answer with no working. Those that attempted longer methods involving mapping co-ordinates in matrix form, were usually not able to obtain a fully correct matrix. A number earned partial credit for obtaining one correct row or column of the matrix required. This topic remains a weak area for many candidates however.

(b) (i) This part was well answered by many who recognised that the position vector of *Q* was $\overrightarrow{OQ}$. Those that recognised this, but were unable to give the correct vector in terms of **p** and **s**, were given partial credit. It is important on vector questions for candidates to show some working to ensure a method mark can be earned. A few did not do this.

(ii) This part proved slightly more difficult for candidates than part **(b)(i)** but many were successful again. A number were unable to get to the final answer but earned partial credit for correctly describing a vector route from *S* to *R* or for having an answer of the form **s** + *k***p** or *k***s** + ½**p**.

(c) Only a few of the most able candidates were able to give a correct complete answer to this part. Many made the observation about 'parallel' but did not mention that *OQ* = 2*SR*.

Answer: **(a) (iii)** Shear, *x*- axis invariant, factor 2, **(iv)** $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$; **(b)(i)** **p** + 2**s**, **(ii)** **s** + ½**p**, **(c)** parallel and *OQ* = 2*SR*

Question 6

This question on functions proved challenging for many candidates who struggled with the function notation used.

(a) (i) There were mixed responses to this part with a very common error of 2.2 from f(x) = 2 rather than f(2), misunderstanding the function notation used in the question.

(ii) More candidates were successful here in reading the graph correctly and interpreting the function notation used to get an answer of 1.2. A common error was to give an answer of 0.

(iii) Only a few of the more able candidates were able to give a correct integer answer. Others knew where to take the reading but gave a non-integer solution such as –0.7 or –0.8. Many did not understand what was being asked.

(iv) Candidates also found this question challenging with many not being able to draw the graph of $y = x$ accurately on the grid; indeed a number did not recognise that a line needed to be drawn. Many did not interpret the scale on the axes correctly and drew $y = 2x$ and then gave the intercepts of this line with the graph of $y = f(x)$. A number drew no line at all and appeared to pick 3 random values.

(b) (i) Many candidates were well prepared for this question on composite functions and had little difficulty in finding h(3) before substituting the result into g(x). Some attempted the calculation as $1 - 2(3^2 - 1)$ but this sometimes led to arithmetic errors when expanding the bracket. A number found that h(3) = 8 but then tried to multiply this with g(x) and did not understand the requirements of the question.

(ii) The inverse function was done well by over half of the candidates. Some used the correct method but then lost a negative sign when rearranging. A number did not understand the requirements of an inverse function and gave answers such as $\frac{1}{1-2x}$. Those that tried to use a reverse flowchart method struggled with this function by not realising that "take from" is self-inverse.

(iii) Most candidates were able to earn a method mark for stating that $x^2 - 1 = 3$ and many were able to go on to solve this simple quadratic to give both the positive and negative solutions. However a number of candidates did not recognise the simple method of rearranging and then finding the square root of 4, with many treating this as a trinomial quadratic and in error trying to use the quadratic formula to solve the equation.

(iv) Interpreting the function notation correctly was crucial to solving this problem. Those that stated that $1 - 2(3x) = 2x$ usually went on to solve the problem correctly although a number were unable to collect x terms correctly with a common error being to arrive at $1 = 4x$. For those that did not interpret the initial statement correctly, $3\text{g}(x) = 2x$ giving $3(1 - 2x) = 2x$ was the common error made.

Answer: **(a) (i)** 1.4 to 1.6, **(ii)** 1.15 to 1.25, **(iii)** -1, **(iv)** -2.25 to -2.1, -0.9 to -0.75, 2.2 to 2.35;
(b) (i) -15,; **(ii)** $\frac{1-x}{2}$, **(iii)** -2, 2, **(iv)** $\frac{1}{8}$

Question 7

This question involving statistics and graphs was generally well answered.

(a) This part was well answered. The method for finding an estimate of the mean is well understood by most candidates. There were a few arithmetic errors or rounding errors seen such as giving answers as 24.6 within an otherwise correct method. Some candidates used the lower or upper bound, or in some cases, the class width of 10 rather than the mid-interval values for their calculations. There were very few finding the sum of the mid-interval values and then dividing by 6 in this session.

(b) (i) This was well answered with the majority of candidates able to complete the cumulative frequency table correctly.

(ii) Most candidates were able to draw an accurate cumulative frequency graph and most used a curve to connect the points. A few had difficulty in interpreting the vertical scale when plotting the points. A few plotted the values at the mid-interval of the class rather than the upper bound. Some did not understand that points should be plotted and joined and drew a 'bar type' graph.

(iii) The values were often read accurately but some had difficulty in reading the vertical scale of the graph. Some read the 60th percentile as the 60th value and not 60% of 120. A few left their answer to the 60th percentile as 72 rather than taking a reading at this value.

(c) (i) This part was well answered with most being able to record 50 and 30 in the table.

(ii) This part was also well answered, with almost all candidates using the correct widths for the blocks of the histogram. There were some errors with the heights of the bars where candidates did not appreciate the significance of finding the frequency density for the height of the bar and a common error was to divide both values from the table by 10 to get the heights.

Answer: **(a)** 24.7; **(b) (i)** 50, 90, 114, **(iii)** 21.5 to 23, 15 to 16.5, 24 to 26; **(c) (i)** 50, 30.

Question 8

This question on solving equations and proportion was answered well in parts where standard techniques were applied. Part **(c)** involving setting up an equation to solve from a problem proved challenging for many.

(a) This part involved solving a quadratic equation giving the solutions to a specified accuracy. Many candidates answered this well. For some the common errors were made such as minus signs and brackets in the wrong place, e.g. $-(11)^2$ leading to –121 or –11 instead of – (–11). Quite a few candidates showed correct working but either approximated their results incorrectly (e.g. 2.04 from 2.046/7) or gave one or both answers not to 2 decimal places, with a common error to write 2.04 and/or -0.672. There were other errors with the full division line not extended below the – (–11) or the square root not fully extended.
Only a few candidates used the completing the square method and were often unsuccessful with this. When solving quadratic equations using the formula it is important that candidates show full complete correct working as the correct solutions alone can be obtained from a calculator and do not earn full credit.

(b) This part was well answered generally. Once candidates had established that $y = k\sqrt{x}$, correct answers were usually obtained. Common errors were to read the proportional relationship as $y = kx$, $y = kx^2$ or $y = \frac{k}{\sqrt{x}}$.

(c) This part was one of the more challenging questions for candidates, with a large number of incorrect answers. The better solutions were where the initial equation was constructed and algebraic manipulation correctly done. Some candidates successfully used a longer method, forming simultaneous equations and then using substitutions to arrive at the correct answer. However, many candidates faltered at the start, multiplying x by 2.5 and (x -14.5) by 0.5, instead of dividing, to form an equation = 19. Even then, the algebraic manipulation was not always accurate. A very few obtained the correct answer with no algebra to earn one mark only as the question required an equation to be set up and solved.

Answer: **(a)** -0.67 and 2.05; **(b)** 132; **(c)** 20.

Question 9

This question involving inequalities and regions varied in the quality of the responses.

(a) Answers to this part were mixed with the equation for L_1 the best answered of the three lines. L_2 was often correct but common incorrect answers included $y = 2x + k$, where k was not zero, $y = x$ or $y = ½\,x$. L_3 was the weakest answered of all of the lines with common errors being $y = ½\,x + 5$, or $y = 2x + 5$. Few candidates gave answers only, where they could just look at the lines and read off the values required, spotting gradients and intersections. Many wanted to use co-ordinates to arrive at the equations and errors were often made.

(b) The three inequalities were only occasionally given all correctly. Errors in part **(a)** had an impact here, as well as many that were unable to enter the correct inequality sign. The use of strict inequalities was condoned in this part. There were errors in the notation with some placing inequalities before the equations and others introducing a variable R rather than y.

(c) (i) This part was better answered and many were able to determine the correct number of bushes and trees to give a total cost of $720. Some attempted trials to find the answer and a number used points that were not in the shaded region and so misunderstood the instructions given in the question.

(ii) Those that were successful in the previous part usually answered this well also and many gave the correct values with no working shown. Some attempted trials and again used points that were not in the shaded region. This was not understood by many.

Answer: **(a)** $y = 2$, $y = 2x$, $y = -½\,x + 5$; **(b)** $y \geq 2$, $y \leq 2x$, $y \leq -½\,x + 5$; **(c) (i)** 4, 3, **(ii)** 2, 4, 860.

Question 10

This question was on number patterns with extremes, containing some of the easier and the most difficult parts of the question paper, parts **(a)(i)** and **(b)(i)** being the easier and **(a)(v)** the most difficult.

(a) (i) Many candidates found giving the next line of the pattern straightforward. A few did not earn the mark as they gave an incomplete answer of 1 + 2 + 3 + 4 + 5 for example.

(ii) Some approached this as a verification using substitution with the value $k = 2$ rather than establishing that $k = 2$. Those that used $k = 2$ to show that the pattern worked with this value scored one mark only. Those that substituted values of n into the expression and then formed an equation by making this equal to the total for the pattern and then went on to establish that $k = 2$ from their equation scored both marks.

(iii) Many candidates used the previous result with $n = 60$, to find the correct sum of the first 60 integers. Others showed no working and had an incorrect answer.

(iv) This part was reasonably well answered. Some candidates set up an equation with 465 and were able to arrive at an answer of 30. Others set up a correct quadratic equation but then were unable to solve it. Some used trial and improvement to arrive at the answer 30.

(v) Very few candidates were able to make the link between the structure of sum of the pattern given in terms of n and the value of x required. Many omitted this part while others often quoted the expression given for the sum as their answer.

(b) (i) This part was well answered with most candidates scoring both marks for completing the statement.

(ii) This was only well answered by the more able candidates. Many misunderstood the pattern given and gave the general result for the sum of the cubes as the cube rather than the square of the previous result for the pattern in part **(a)**. Many did not make the link between parts **(b)(i)** and **(ii)**.

(iii) This was slightly more successfully answered than the previous part and some of those who obtained an incorrect general rule in part **(ii)** were able to get this correct by using the longer method of adding all of the first 19 cubes together. A common error was to give the value 190 from using $n = 19$ in the formula $\frac{n(n+1)}{2}$.

Answer: **(a) (i)** 1 + 2 + 3 + 4 + 5 = 15, **(iii)** 1830, **(iv)** 30, **(v)** $n - 8$; **(b) (i)** 225, 15, **(ii)** $\left(\frac{n(n+1)}{2}\right)^2$, **(iii)** 36100.

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key Messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus.
The accurate statement and application of formulae in varying situations is always required.
Work should be clearly and concisely expressed with an appropriate level of accuracy.
Candidates need to be aware that in geometrical constructions all arcs should be clearly visible so examiners can give credit when appropriate.
Straight lines in graphs should be accurately ruled with the correct intercepts on the axes. Curves should be drawn with a single curved line.

General Comments

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

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

Graphs were often well drawn and the readings taken from them were to the required accuracy. Some candidates still confuse the lines $y = 7.5$ with $x = 7.5$. Many candidates did not draw accurately the line $y = 10 - 3x$ in **Question 5(d)(i)**. Care is needed to ensure that the intercepts with both axes are accurate.

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

Many candidates showed little understanding of probability. Only the most able candidates scored well in **Question 6**.

Candidates should be aware that when factorising quadratic expressions only integers and not fractions should be used in the brackets.

Comments on Specific Questions

Question 1

(a) (i) There were many correct solutions to this question. The most common error was to ignore the tax free allowance and evaluate 0.24 × 18900.

(ii) A significant number of candidates omitted to divide by 12 after the correct subtraction. Others subtracted 5500 as well as their answer to part **(a)(i)**.

(b) This part was very well answered. A few candidates left the answer as 104.5% and others confused the original and final amounts.

(c) Most candidates successfully evaluated the simple interest and the compound amount but many did not gain all the marks. The final answer often involved the difference between the compound amount and the simple interest or just one of these values stated, demonstrating a misunderstanding of 'by how much'.

Answers: **(a)(i)** 3216, **(ii)** 1307; **(b)** 4.5; **(c)** A by 31.04.

Question 2

(a) There were many accurate solutions. Some candidates trivialised the question by assuming triangle *BCD* was isosceles. Others lost accuracy by using long methods or found angle *BDC* instead.

(b) (i) To gain full marks in this question, candidates needed to be rigorous in showing every step of their working to demonstrate an understanding of how to *show* a given answer rather than just calculate. Most realised that the use of Pythagoras' theorem was needed but lost a mark for the omission of $\sqrt{9}$. Others attempted to use trigonometry with their answer to part **(a)** but were unable to establish that the correct value was exactly 3 due to premature approximations in their working.

(ii) The candidates who quoted the explicit form of the cosine rule for angle *ABD* were more successful in completing the solution than those who quoted the implicit form. Premature rounding combined with minimal working often led to loss of accuracy and, in some cases, method marks. Some candidates found the wrong angle and others lost the negative sign in their working. Generally the instruction to use the cosine rule was followed but those who did the question by less efficient methods rarely achieved a sufficiently accurate answer.

(c) Finding the area of two triangles was very common but often ½ was omitted from the area of triangle *BCD*. Few candidates used the area of a trapezium formula.

Answers: **(a)** 36.9°; **(b)(ii)** 126.9°; **(c)** 39.6.

Question 3

(a) Candidates almost universally used a common denominator of 10. Those who used brackets in their first step in the numerator were considerably more successful in dealing with the subtraction and often the correct answer was seen. In other cases it was common to see $10x - 5 - 6x + 2$ leading to $4x - 3$ in the numerator. Occasionally, having reached $\frac{4x-7}{10}$ candidates went on to incorrectly simplify to $\frac{2x-7}{5}$.

(b) Candidates expanded $(2x - 3)^2$ competently but with occasional sign errors. When expanding the second bracket not enough attention was given to the subtraction resulting in the final term being $+ 12x$ instead of $- 12x$. A significant number of candidates omitted x from the final term. Some candidates who did reach the required expression went on to spoil this by incorrect factorisation to give $(x + 3)^2$ or $(x + 3)(x - 3)$ as their final answer.

(c) (i) Most candidates had 2x and x as the first terms in their brackets but there were occasional sign errors which could have been rectified if checked by expansion. Candidates need to be aware that fractions in the brackets are unacceptable so $2(x - ½)(x + 3)$, usually obtained by solving an equation using the formula and then working backwards to factors, did not score.

(ii) This question proved to be a challenge for many candidates. Cancelling the $2x^2$ was a very common error. Other candidates missed the factor of 2 in the denominator and some who did reach $2(x^2 - 9)$ didn't then recognise the difference of two squares. The more able candidates often factorised the denominator as $(2x - 6)(x + 3)$ and usually went on to the correct answer.

Answers: **(a)** $\frac{4x-7}{10}$; **(b)** $x^2 + 9$; **(c)(i)** $(2x - 1)(x + 3)$, **(ii)** $\frac{2x-1}{2(x-3)}$.

Question 4

(a) (i) Many candidates had good recall of the area of a sector formula and the correct first step of $90 = \frac{42}{360} \times \pi \times 8^2 \times h$ was often seen. To gain full marks it was then necessary to demonstrate the algebraic rearrangement of this to make h the subject, for example by including a step such as $h = \frac{90 \times 360}{64 \times \pi \times 42}$ and then to give the value of this to at least 3 decimal places. The more accurate value was often omitted or premature conversion of π or premature rounding led to inaccurate values.

(ii) The more able candidates gave fully correct solutions to this question but most gave only a partially correct method. The usual error was to omit one or more of the 5 faces in the calculation, often either finding the area of the 3 faces seen in the diagram or alternatively omitting the bottom face. The vast majority clearly showed their working and so earned method marks. Those who did include all 5 faces usually worked to the required degree of accuracy.

(b) This question proved to be a challenge for many candidates. By far the most common answer given was $h = 0.96$ from the incorrect relationship $\frac{3.84}{h} = \frac{90}{22.5}$. A few candidates who recognised the need for cubing in the relationship, cubed the volumes. Some attempted to use the volume formula but nearly always kept the radius as 8 instead of reducing this value. Premature rounding in the stages of the correct method often led to answers outside the required accuracy.

Answers: **(a)(ii)** 131; **(b)** 2.42.

Question 5

(a) The majority of candidates scored full marks here. The most common errors were answers of 6 and –4.5 for the first two values from those who did not understand the difference between for example -2^2 and $(-2)^2$ on their calculator.

(b) Candidates plotted most points correctly. It was common to make one or more errors when plotting the points at $y = 9.6$ and $y = -9.1$ or after correct plots elsewhere to plot (0.3, 18) at (0.3, 19). Most curves were good quality with two separate branches but a significant number of candidates joined their curve between $x = -0.3$ and $x = 0.3$.

(c) (i) The majority of candidates knew to obtain the reading at $y = 0$ and gave a sufficiently accurate answer in range provided that they had drawn a reasonable curve in part **(b)**.

(ii) Many solutions had at least two of the three values in range. Inaccuracies were due to poor curves in part **(b)** or misreading the scale on the x-axis, usually for the negative values.

(d) (i) Drawing the line $y = 10 - 3x$ proved to be challenging. A number of candidates drew $y = 10$ whilst others drew a line through 10 on the y-axis but with a positive gradient. Some candidates ignored the instruction to draw a suitable line and solved the equation algebraically.

(ii) Candidates were challenged by the algebra involved in this question with many errors occurring when trying to eliminate the fractions. Those who eliminated the $-3x$ terms as their first step were more successful than those who attempted to multiply by x^2 or x^3. A very common error was to change $\frac{2}{x^2} - \frac{1}{x} = 10$ to $2x^2 - x = 10$.

Answers: **(a)** 7, 11.5, 4.5; **(c)(i)** 0.69 to 0.81, **(ii)** – 2.3 to – 2.2, – 0.8 to – 0.6, 0.35 to 0.5;
(d)(i) – 0.55 to –0.45, 0.35 to 0.45,; **(ii)** 10,1, – 2 or –10, – 1, 2.

Question 6

(a) (i) This part was well answered by most candidates. Those who added the probabilities or used replacement giving each fraction a denominator of 11 continued to do so throughout the rest of **Question 6**.

(ii) This part was well answered by most candidates.

(iii) This part was well answered by most candidates.

(b) (i) Many correct answers were seen but a significant number of candidates continued with replacement or confusing addition with multiplication.

(ii) Those candidates who understood the context were usually successful in this part.

(iii) This was found to be the most challenging question of the examination. Few fully correct answers were seen. Candidates attempted to list the various possible combinations usually omitting one or more of them or including EEE in their answer. Those who identified and correctly showed the required product for one combination of two Es and one combination of two Ns gained some method marks. Only the most able candidates appreciated that there were 3 of each of these products in the complete solution.

Answers: **(a)(i)** $\frac{1}{110}$, **(ii)** $\frac{6}{110}$, **(iii)** $\frac{8}{110}$; **(b)(i)** $\frac{6}{990}$, **(ii)** $\frac{336}{990}$, **(iii)** $\frac{198}{990}$.

Question 7

(a) The vast majority of candidates used the twenty four hour clock and correctly obtained 14 10 as the answer. Occasionally 2 10 without pm was stated. There were some simple addition errors such as 45 mins + 25 mins = 1 hour 15 mins.

(b) There were many correct solutions to this question. A fairly common error was to convert 345 mins or 5.75 hours to 6 hours 15 mins. By far the most common error was to use 13.25 hours instead of 13.4…hours and using the correct decimal equivalent sometimes led to an inaccurate answer due to premature rounding.

(c) (i) Many correct solutions were seen. Again the common errors were to use 13.25 or prematurely round 13.416^r to 13.4 to give an inaccurate answer.

(ii) The vast majority of candidates correctly calculated the number of litres required but some didn't then convert their answer to standard form. Often when the conversion to standard form was attempted, candidates rounded to 2 significant figures instead of the required 3. Some candidates heavily penalised themselves by not showing any working and giving the answer as 1.8×10^5 as no marks are awarded for an inaccurate answer.

(d) This part was well answered by most candidates but a significant number found 18% or 118% or 82% of 10148.

Answers: **(a)** 14 10; **(b)** 5 hours 45 mins; **(c)(i)** 798, **(ii)** 1.82×10^5; **(d)** 8600.

Question 8

(a) (i) The majority of candidates correctly answered this question. The usual error of squaring –3 to give –9 was seen a significant number of times.

(ii) The majority of candidates found g(13) first but then, if they did not simplify this to $\frac{1}{2}$ they had problems with $h(\frac{7}{(13+1)})$. Occasionally the ($x \neq -1$) caused confusion as some candidates multiplied by this. There were instances of finding h(x) multiplied by g(x) and also of finding hg(x).

(b) This question was well answered by the majority of candidates. A few made a slip in the algebra and reached $\frac{x+3}{4}$ and a few misinterpreted the notation as $\{f(x)\}^{-1}$.

(c) (i) This part was well answered by most candidates. The common errors were to evaluate f(23) or an algebraic slip leading to $x = \frac{26}{4}$.

(ii) Almost all candidates attempted to use the formula and many reached the correct answers. There was some premature rounding and others lost a mark by not ensuring that the line in their fraction extended below – 5 as well as below $\sqrt{53}$. Some of the more able candidates used completion of the square successfully.

Answers: **(a)(i)** – 6, **(ii)** 2.75; **(b)** $\frac{x-3}{4}$; **(c)(i)** 5, **(ii)** 1.14, – 6.14.

Question 9

(a) (i) This part was usually well answered. Most candidates recognised the reflection but some gave $x = 2$ or $y = -2$ or the x-axis as the mirror line.

(ii) Unacceptable transformations of shift, move and translocation were seen but many candidates gave the correct word. Most used the correct vector notation but both co-ordinates and a fraction line in the vector were seen.

(iii) Some candidates thought this to be a shear and others gave an enlargement as the answer. The factor of 3 was often omitted or stated as 2. The invariant line was often not identified or stated as 'x invariant' or parallel to the y-axis.

(b) (i) There were many correct solutions to this part. The errors seen were to rotate about a different centre or anti-clockwise.

(ii) A significant number of candidates were unable to deal with a scale factor of –2. The most common errors were to enlarge by a scale factor of ½ or 2 or – 1. A few did use the correct scale factor but the wrong centre.

(iii) Only a minority of candidates gained full marks in this question. Many candidates made no attempt and others drew shears with the x-axis invariant.

(c) Some candidates who were unable to draw the shear in part **(b)(iii)** scored marks here as they recalled the required matrix or one correct row or column of it.

Answers: **(a)(i)** Reflection in $x = -2$, **(ii)** Translation by $\begin{pmatrix} -7 \\ 2 \end{pmatrix}$, **(iii)** Stretch with x-axis invariant by factor 3; **(b)(i)** Triangle (8, 2) (7, 3) (7, 5), **(ii)** Triangle (–2, –5) (–6, –5) (–8, –7), **(iii)** Triangle (1, –1) (4, –6) (3, –5), **(c)** $\begin{pmatrix} 1 & 0 \\ -2 & 1 \end{pmatrix}$.

Question 10

(a) This part was very well answered. A few gave the formula as $n + 9$ or $9n – 3$.

(b) This part was very well answered. A few gave the formula as $n – 6$ or $6n – 3$.

(c) Most candidates gained full marks.

(d) Candidates found this part more challenging as many did not see the connection with the previous part.

Answers: **(a)** 48, 57, $9n + 3$; **(b)** 56, 50, $86 – 6n$; **(c)** 125, 216, n^3; **(d)** 130, 222, $n^3 + n$.

MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key Messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus.
The accurate statement and application of formulae in varying situations is always required.
Work should be clearly and concisely expressed with an appropriate level of accuracy.
Candidates need to be aware that in geometrical constructions all arcs should be clearly visible so examiners can give credit when appropriate.
Straight lines in graphs should be accurately ruled with the correct intercepts on the axes. Curves should be drawn with a single curved line.

General Comments

The paper gave candidates an opportunity to demonstrate their knowledge and application of Mathematics. Candidates appeared to have sufficient time to complete the paper and any omissions were due to lack of familiarity and difficulty with topics rather than shortness of time. As always the standard of work was variable, with marks covering a wide range. Presentation of work was often good with some scripts showing working that was clearly set out. For less able candidates, working tended to be more haphazard and difficult to follow. Candidates need to be aware of the need to retain sufficient figures in their workings so that their final answer is accurate; a number of marks were lost due to premature approximation of values.

Comments on Specific Questions

Question 1

(a)(i) A large majority of candidates were able to calculate the correct number of pages. A common source of error was thinking the 63 was the total number of pages and division by 12, rather than 7, led to a final answer of 26.25.

(ii) Candidates were more successful in this part of the question, finding sharing in a ratio a simpler task. The common error was thinking the 56 referred to the number of review pages which led to division by 9, multiplication by 5 and an answer of 31.1. A few candidates either worked out the number of review pages or gave both correct values.

(iii) Roughly equal numbers of candidates chose to work with the annual price as with the price of an individual copy. A minority of candidates lost the accuracy mark by giving their final answer to two significant figures. Candidates working with the price of an individual copy were more likely to lose the final accuracy mark due to premature rounding of the price to 3.75. Another common source of error was calculating the saving of 14.9 as a percentage of the subscription cost rather than the actual cost of 13 issues.

(b) Only a minority of candidates obtained the correct answer of 128. For these candidates a variety of approaches was used. Most tended to work with percentages or fractions leading to 28.125% or $\frac{9}{32}$ representing the 36 pages of reviews. Almost all went on to calculate the total number of pages correctly. Some started with 37½% representing the reviews and calculated the remaining number of pages (96) before calculating the total number. A few attempted to set up an equation but not always successfully. A small number attempted trial and improvement. A large majority of the unsuccessful candidates mistakenly thought the percentage for features was 62.5% of the total.

Answers: **(a)(i)** 45; **(ii)** 20; **(iii)** 23.4; **(b)** 128

Question 2

A wide variety of responses were given to this question. Candidates that scored well used efficient methods but many candidates made incorrect assumptions about the diagram and used incorrect values in their calculations. Parts of this question were often not attempted.

(a) The vast majority of candidates attempting this part were able to write the sine rule correctly with very few attempting an alternative method. As candidates were required to show that *AC* rounded to 119.9 it was expected that they would give their answer with at least one more significant figure. Not doing so lost some candidates the final mark.

(b) A majority of candidates realised that the cosine rule was required and most were able to write a correct statement and evaluate it correctly. Rather than using the given answer of 119.9, some candidates rounded to 119 or 120 earning the method marks but losing out on the accuracy marks. Some candidates attempted less efficient methods but not always successfully. Incorrect assumptions such as angle *ABC* = 90° and using Pythagoras' theorem, assuming triangle *ABC* was isosceles and using *B* as 65° and assuming a cyclic quadrilateral and writing angle *ACB* as 57° and angle *ABC* as 58° were sometimes seen.

(c) It was expected that candidates would find the area of the triangle using ½ × 62 × 119.9 × sin 32. Those that did almost always achieved the correct answer. A significant number chose less efficient methods, often losing the final mark because of premature rounding and in some cases all the marks because of errors in the method. A few candidates found the area of triangle *ACB* instead. Candidates lost marks by not using a correct value for *AC*.

(d) Those candidates using an efficient method for the area of triangle *ABC* often went on to obtain the correct cost. A significant number didn't calculate the total area of the field, simply multiplying their answer to part **(c)** by 4.50. Those using less efficient methods lost marks either for lack of accuracy because of premature rounding or for using incorrect methods to find a perpendicular height. A small number divided their area by 4.50.

Answers: **(a)** 119.94; **(ii)** 109; **(iii)** 1970; **(b)** 22 300

Question 3

(a) Almost all candidates obtained the correct expressions for the length and width of the box. Only occasionally were answers such as $2x - 9$ and $2x - 7$ or $9 - x$ and $7 - x$ seen.

(b) If candidates were successful in the previous part they almost always earned the first mark for an expression for the volume. Some didn't score the second mark because of algebraic errors when multiplying out the brackets, usually involving an incorrect power or sign.

(c) Almost all candidates completed the table correctly.

(d) The plotting of the points was generally very good. Most curves were drawn accurately. However some candidates used a pen, rather than a pencil, making it difficult to correct errors. Very few graphs involved the use of ruled line segments.

(e) The answer $V \geq 30$ or its equivalent was seen quite often. However, a number between 0.65 and 0.75 was seen regularly, sometimes within a fully correct inequality.

(f) (i) Most candidates earned the mark for an answer in the range 36 to 37.

(ii) Answers of 36 in part **(i)** tended to lead to an incorrect answer of 1.5 in this part. A minority obtained a value in the acceptable range.

Answers: **(a)** $9 - 2x$, $7 - 2x$; **(c)** 24, 20; **(e)** $0.7 \leq x \leq 2$; **(f)(i)** 36 to 37; **(ii)** 1.2 to 1.4

Question 4

(a) Candidates usually scored both marks in this part. Loss of marks was usually the result of arithmetical slips.

(b) More able candidates were only slightly less successful in this part. Less able candidates often struggled, sometimes with the number of sides in a pentagon, sometimes finding an interior angle and sometimes an exterior angle.

(c) This proved to be the most challenging part of the question. Only the more able candidates realised that the problem could be solved simply by summing the angles at seven points and subtracting the interior angles of the pentagon and quadrilateral. Some assumed that the polygons were regular, using this to calculate the interior and exterior angles at the seven vertices, but the angles at *f* and *c* usually proved to be the stumbling block. A significant number of candidates made no attempt at all.

(d) (i) A majority of candidates realised they needed to work with the sum of the interior angles and were able to show the equation $7x + 4y = 390$. Less able candidates misinterpreted the question and used the solutions of the equations to show that $7x + 4y$ evaluated to be 390.

(ii) Fewer candidates realised that the interior angles at *A* and *B* added to give 180. Those that did had no difficulty in reaching the required equation. As in the previous part some used the solutions to show that $2x + 3y$ evaluated to be 195. A significant number of candidates made no attempt at all.

(iii) A large majority of candidates were able to solve the two equations. A greater number multiplied the equations in order to eliminate a variable than chose to use a substitution method. However, both methods were generally successful. Common errors included adding the equations instead of subtracting and arithmetical slips often resulting from multiplying the second equation by 3.5 in order to equate the coefficients of *x*. With the method of substitution, dealing with a denominator caused a few problems for some candidates.

(iv) Most of the candidates successful in solving the equations usually went on to find the sizes of the angles of the trapezium.

Answers: **(a)** 48, 84 and 66, 66; **(b)** 540; **(c)** 1620; **(d)(iii)** $x = 30$, $y = 45$; **(iv)** 65, 65, 115, 115

Question 5

(a) (i) The large majority of candidates knew the method, found the correct midpoints, showed clear working and gained full marks. A few lost the final mark by giving their answer to only two significant figures. Some added the frequencies and divided by 80 or sometimes 6.

(ii) Histograms were well drawn with a large majority of candidates earning all four marks. Less able candidates did not appreciate the need to use frequency densities and attempted to draw blocks with heights of 19, 13 and 12. As a height of 19 would fall off the grid they often left it at 16. However, they did gain a mark for correct widths. Other errors usually involved incorrect heights for 9.5 and 6.5. A small number subdivided each block with vertical lines one centimetre apart.

(b) (i) Many candidates were able to complete the tree diagram successfully. The first branch probability of $\frac{2}{5}$ was almost always correct but the second branches were sometimes interchanged or denominators of 5 used.

(ii) More able candidates earned full marks, choosing either the sum of three probabilities or one minus the probability that neither used the internet in roughly equal numbers. Less able candidates sometimes calculated the probability that only one candidate used the internet. Attempts at adding the probabilities was another common error.

(iii) This proved to be a straightforward question for a majority of candidates. A common cause of error was multiplying $\frac{3}{5}$ by 3 and occasionally $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3}$ was seen.

Answers: **(a)(i)** 3.81; **(b)(i)** $\frac{2}{5}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{4}$; **(ii)** $\frac{18}{20}$; **(iii)** $\frac{27}{125}$

Question 6

This proved to be a challenging question and it was rare to see candidates earning full marks. Most candidates attempted to use appropriate formula but often made significant errors in their application. With the exception of part **(a)**, each part had many candidates making no attempt at all.

(a) Most candidates realised that they needed to use πr^2 but this did not always lead to a correct answer. Not dividing πr^2 by 2, problems identifying the correct radius and adding all three semicircles meant that many candidates lost marks in this part. Less able candidates sometimes used the formula for circumference.

(b) Many found this part challenging and several incorrect methods were seen. Most candidates attempted to use πd but again there was confusion about the value of the radius or diameter that needed to be used. Some simply repeated their method of part **(a)** and subtracted the small semicircle. Not dividing by 2 also caused problems. Those that managed to find a correct curved surface area often treated the container as closed and added the area of the cross section twice.

(c) Candidates were far more successful in this part of the question, realising the need to multiply their answer from part **(a)** by 35 with many going on to earn all three follow through marks. A few did not know how to convert their answer into litres and division by 100 instead of 1000 was seen. A few candidates made the question more difficult, with much working, by restarting from the beginning instead of using their answer from part **(a)**.

(d) (i) Candidates found this very challenging. The vast majority made no connection with similar triangles and most simply wrote 40 ÷ 20 but didn't connect this with $\frac{h}{2}$.

(ii) Only the most able candidates made good progress in this part of the question. Attempts usually started by equating $\frac{\pi r^2 h}{3}$ with their volume from part **(c)**. Some could rearrange this to get r^2h but were unable to go any further. Others realised that $r = \frac{h}{2}$ and were able to gain a mark for $\frac{1}{3}\pi\left(\frac{h}{2}\right)^2 h$ equated to their volume. Some then made an error by writing $\left(\frac{h}{2}\right)^2$ as $\frac{h^2}{2}$. Even when continued correctly some didn't take the cube root, often using square root instead, and lost the final mark. Some candidates substituted $h = 2r$ and were slightly more successful. A few chose a scale factor method but some forgot to cube root and simply multiplied their answer by 40.

Answers: **(a)** 330; **(b)** 2970; **(c)** 11.5; **(d)(ii)** 35.3

Question 7

This proved to be another demanding question and it was rare to see candidates earning full marks. In part **(b)** a significant number of candidates ignored the instruction to give their answer in its simplest form and lost marks unnecessarily. Yet again, in each part of the question, many candidates made no attempt at all.

(a) (i) A large majority of candidates achieved the correct gradient. The most common error was calculating change in x divided by change in y. Other incorrect answers were often the result of arithmetic errors in calculating the change in y and/or x.

(ii) A small majority were able to obtain the correct equation, most of these using the co-ordinates of one point along with $y = mx + c$. Some candidates earned one mark for either m or c correct in an equation. Less able candidates struggled to make any progress and a significant number made no attempt at all.

(iii) Only a minority of candidates obtained the correct column vector. Many incorrect answers stemmed from candidates referring back to part **(i)** and answers such as $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$ were common, along with a variety of other components following errors in part **(i)**. A significant number gave their answer as a 2 by 2 matrix, the elements of which were the co-ordinates of *P* and *Q*.

(iv) As the answer was dependent on the answer in part **(iii)**, candidates were less successful in this part. Those candidates that realised that magnitude referred to the size (or length) of *PQ* made good progress in applying Pythagoras' theorem and usually obtained the correct answer. Many appeared unfamiliar with the term 'magnitude' and some simply divided the *x*-component by the *y*-component. A significant minority of candidates made no attempt at this part.

(b)(i)(a) A majority of candidates achieved the correct answer with 4**a** + 3**b** the most common error.

(i)(b) Candidates were generally less successful in this part of the question. Many could define a correct route for vector *AR* but simplifying $-4\mathbf{a} + \frac{1}{5}(12\mathbf{a} + 6\mathbf{b})$ proved a step too far for many. Some candidates treated vector *AO* as 4**a** rather than – 4**a**.

(i)(c) Many candidates worked with the correct route but some did not simplify 1.5 × 4**a**.

(ii) To earn this mark candidates were expected to conclude that *OR* and *OT* were parallel which was dependent on vector *OT* being correct. Some were able to express a numerical relationship between the vectors *OR* and *OT* but were unable to state the consequences of the relationship. Many others referred to similar triangles or referred to *OA* and *BT* being parallel.

(iii) Some candidates realised that $\frac{3}{2}$ was the ratio of the corresponding sides and went on to square it correctly. However, many more left the answer as $\frac{3}{2}$. Many other candidates gave fractions with numerators and denominators involving complex vector expressions, sometimes squared.

Answers: **(a)(i)** $\frac{3}{2}$; **(ii)** $y = \frac{3}{2}x + 2$; **(iii)** $\begin{pmatrix} 12 \\ 18 \end{pmatrix}$; **(iv)** 21.6; **(b)(i)(a)** 3**b** – 4**a**; **(i)(b)** $\frac{1}{5}(6\mathbf{b} - 8\mathbf{a})$;

(i)(c) 6**a** + 3**b**; **(ii)** *OR* is parallel to *OT*; **(iii)** $\frac{9}{4}$

Question 8

(a) A majority of candidates gained at least two marks here. The three parts of the rearrangement were carried out in a variety of orders. Most candidates attempted subtraction of the '*ut*' term as their first step and were often successful. Some started with multiplication by 2 but not always successfully, sometimes forgetting to multiply the '*ut*' term by 2. This was usually followed with subtraction of the '*ut*' term. Some chose to divide by ½ rather than multiply by 2 and this often led to an error, i.e. leaving the fraction in the denominator of their final answer. Dealing with the t^2 term was carried out correctly by some candidates while others thought that square root was needed to deal with the term. Having arrived at a correct expression some candidates spoiled their answer by cancelling the *t* terms.

(b) Those candidates choosing the correct three values usually gained full marks. Some then spoiled their answer by rounding to 36.8. A small minority calculated the upper bound using the values 15, 2 and 8 to give 31 which they adjusted to 31.5 as their upper bound. Others used 15.4 or 15.49.

(c) (i) Most candidates earned this mark with just a few incorrectly dividing 16 by either 20 or 25.

(ii) Many candidates realised that the area under the graph represented the distance travelled. Most of these then went on to find the correct average speed. The majority calculated the three areas separately with very few using the formula for the area of a trapezium. If errors occurred they were usually due to the misinterpretation of the time interval for at least one section of the journey. Some candidates reached 280 but then divided by 3.

Answers: **(a)** $\dfrac{2(s-ut)}{t^2}$; **(b)** 36.75; **(c)(i)** $\dfrac{16}{5}$; **(ii)** 11.2

Question 9

(a) Almost all candidates earned several marks for completing some parts of the table correctly, usually the numerical values. If errors occurred they tended to be with the number of triangles. The algebraic parts of the table proved more challenging. Many were able to recognise the linear rule, the common errors were usually $n + 3$, $3n$ or $3n + 1$. Some recognised the numbers of triangles as square numbers but gave n^2 as their formula. Most candidates with a correct formula opted for $(n + 1)^2$ with just a few opting for $n^2 + 2n + 1$.

(b) Many correct answers were seen to this part. Some candidates reduced the equation to $(n + 1)(n + 2) = 240$ and were able to spot the correct value of n. Some tried to multiply the brackets by $\dfrac{3}{2}$, which produced an equation which they found difficult to solve.

(c) (i) A small majority were able to show the given equation. More able candidates usually experienced no difficulty but less able candidates struggled to make progress. A common error involved the correct use of the formula but then not equating their expression to 9.

(ii) This proved to be the most demanding part of the question. Those that understood the question was about the **total** number of lines had few problems setting up and solving the equations and usually gained full marks. Some candidates made the equations more difficult by choosing higher values of n, $n = 3$ was common although values such as $n = 9$ and $n = 10$ were seen. The most common error was to use $n = 2$ with the number of lines as 18 rather than the total of 27. These candidates usually gained some credit for the correct multiplication and subtraction of their incorrect equations. Many candidates made no attempt at all.

Answers: **(a)** 15, 18, $3n + 3$; 6, 10; 25, 36, $(n + 1)^2$; **(b)** 14; **(c)(ii)** $p = 3$, $q = \dfrac{11}{2}$

Question 10

(a) Many of the candidates were able to demonstrate their algebraic skills to good effect and earn all three marks. Some didn't recognise the difference of two squares and factors such as $(x - 3)^2$ or $x(x - 9)$ were sometimes seen. Less able candidates simply cancelled the x^2 terms leading to an answer of $\dfrac{x}{3}$.

(b) More able candidates again demonstrated their algebraic expertise and earned all seven marks with efficient solutions that were clearly set out and easy to follow. Some candidates were clearly aware of the correct method of solution, but algebraic slips in expanding brackets such as $2x(x + 1)$ and $15(x + 1) - 20x$ produced the wrong quadratic equation. Eliminating the denominators led to some errors, typically $15 - 20 = 2x(x + 1)$. After obtaining an incorrect quadratic equation some candidates earned marks for a correct method for solving their quadratic.

Answers: **(a)** $\dfrac{x}{x+3}$; **(b)** $\dfrac{3}{2}$ and -5

