MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key Messages

To succeed in this paper, candidates need to have completed the full Core syllabus, be able to remember and apply formulae and to give answers in the form required.

General comments

Candidates must check their work for sense and accuracy as it was very noticeable that there were many answers in context that made no sense or numerical errors that lost candidates' marks. Candidates must show all working to enable method marks to be awarded. This is vital in two or multi-step problems, in particular with algebra where each step should be shown separately to maximise the chance of gaining marks, for example **Questions 4**, **15**, **17**, **18** and **21(b)**. This will also help candidates check their own work. Another area that gave concern was that candidates prematurely rounded values in the middle of calculations. This was particularly noticeable in **Questions 17** and **18**.

The questions that presented least difficulty were **Questions 4**, **7**, **10(a)**, **11**, **12(a)** and **13**, Those that proved to be the most challenging were **Questions 3(a), 12(b)**, **14(b)**, **15**, **16(b)** and **21(b)**. The questions that showed the highest number of blank responses were **Questions 14(b)**, (write a formula), **15** (angles of polygons) and **22(b)** (trigonometry and bearings). It is more likely that the blank responses were down to the syllabus area of particular questions rather than lack of time.

Comments on specific questions

Question 1

Less than half the number of candidates gave the correct answer to this question which was expected to be a straightforward start to the paper. Many candidates had difficulty with this question and common errors included confusing the x and y directions and incorrect use of negative signs. Few candidates treated the vector as a fraction, including a horizontal line between components.

Answer: $\begin{pmatrix} 7 \\ -4 \end{pmatrix}$

Question 2

Many candidates gave truncated values as their answer to part **(a)** such as 15.0 or 15.07 or rounded to an incorrect number of decimal places. Also, some changed the position of the decimal point giving answers of 151 or 1.51. In part **(b)**, integers such as 10, 15 or 16 were seen instead of the correct answer.

Answers: **(a)** 15.1 **(b)** 20

Question 3

Most candidates were able to identify some letters with reflection symmetry, but many made errors or omissions. Identifying Z as the only letter with rotation symmetry proved difficult for many, with extra letters being listed by many candidates, in particular B or E.

Answers: **(a)** E B A **(b)** Z

Question 4

Common incorrect answers assumed the diagram contained parallel lines so answers such as 105, 75 or 98 were seen. Some candidates did score the method mark for 67 but as this was a two-step problem, the 67 needed to be subtracted from 180. Some who used the sum of angles in a quadrilateral forgot to include the right angle in their subtraction.

Answer: 113

Question 5

The majority of candidates placed the numbers in order with some omitting the multiple copies of 132. After a correct ordering, some candidates went on to pick out the 6th number rather than realising that the middle of 12 values is half way between the 6th and 7th values. After the correct first step of ordering the data, some still went on to find the mean so candidates must remember the differences in the three averages and how to find them. Some however, found the value half way between 145 and 163, the centre of the given unordered list.

Answer: 137

Question 6

This question caused significant problems for many candidates as both π and $\frac{22}{7}$ needed to be evaluated to four decimal places to differentiate between these values and the given 3.142. This was the only question attempted by all candidates.

Answer: 3 3.14 π 3.142 $\frac{22}{7}$

Question 7

This question was answered well by the majority of candidates, most of whom showed complete and convincing working. Some candidates made arithmetical errors which should have been picked up when checked. Some ignored the need for a common denominator and simply added the numerators and the denominators to give $\frac{2}{10}$ cancelled down to $\frac{1}{5}$. A few candidates arrived at a correct answer, but showed spurious or no working. Candidates should be clear that when a fraction in its simplest terms is required, a decimal fraction is not acceptable.

Answer: $\frac{5}{12}$

Question 8

Most candidates made a sensible attempt at factorisation, with many being able to factorise correctly. However many did not factorise the given expression completely. A large number of candidates made algebraic errors. A single mark was available to those candidates who gave a correct partial factorisation.

Answer: $4w(2wx - 3y)$

Question 9

This was one of the more challenging circles questions as it involved area not circumference and many candidates were frequently confused about the method, often multiplying the circumference by the height or other incorrect attempts at a formula. Many candidates omitted π from their calculations.

Answer: 651

Question 10

There were many correct answers to part **(a**), the most common error being to identify one of the extreme values, with −11 being chosen much more frequently than −1. There were only a few candidates who gave an answer which was not one of the given values. Part **(b)** proved to be more challenging. Many candidates seemed to be under the impression that −11 was greater than all of the other numbers and that −1 was the smallest of the given values, so that a correct answer of −3 in part **(a)** was often followed by an incorrect answer of 1 in part **(b)**.

Answers: **(a) −**3 **(b)** 4

Question 11

The weaknesses in algebra skills of many were exposed in this question as less able candidates were unable to collect the terms correctly. Answers involving 15 + 8 or $10x + 6x$ were very common. Almost all of the candidates who were able to collect the terms went on to produce the correct expression but a number of candidates seemed very confused about what was required and added an equals symbol, for example arriving at $4x = 23$, before going on to attempt to solve their resulting equation.

Answer: $4x - 7$

Question 12

It appeared that many candidates had not read either part very carefully. Consequently, in part **(a)** many candidates spoiled correct answers by including extra numbers that did not meet the criteria. Others gave even numbers or numbers with only one digit that were factors of 182. It was acceptable to give both correct factors, 13 and 91, as long as this answer was not spoilt with any other value. Often those that identified 91 as their answer to part **(a)**, went on to include it in the list of prime factors in part **(b)**. A significant number of candidates thought that 1 was a prime number. Some gave lists of all factors rather than just the prime factors.

Answers: **(a)** 13 or 91 **(b)** 2, 7, 13

Question 13

Generally, candidates did well with both parts with the occasional incorrect answer to part **(a)** being 2800 or 2.8 × 100. In part **(b)**, many got as far as 5000000 but were not always successful in putting this into correct standard form.

Answers: **(a)** 280 **(b)** 5×10^6

Question 14

This question caused significant difficulties with a high number of answer lines left blank. Many candidates started part **(a)** by working out how much it cost to hire the bicycle for a day and subtracted that from the total charge. Candidates divided this by the daily charge to get an answer of 3 days hire but then the first day was ignored. Others divided $39 by $6 to obtain 6.5 days or even 6 or 7 days which showed a misunderstanding of the context. The misunderstanding of the context also was noticeable in part **(b)** as many candidates were unable to construct the correct formula.

Answers: **(a)** 4 **(b)** $15 + 6d$

Question 15

This question had no scaffolding so candidates were left to determine the approach, which raises the difficulty level of the question. A number of candidates evaluated the exterior angle, but were unable to make any further progress. Attempts that involved the sum of the interior angles being $180\times(n-2)$ were very common, but rarely resulted in a complete method. The majority of the less able candidates appeared to attempt various spurious calculations involving 360 or 180 and the given angle. A few candidates gave nonagon as their answer without showing any working. Only the most confident of candidates arrived at the correct answer after showing minimal or no working.

Answer: 9

Question 16

There were many correct answers to part **(a)**. The majority of candidates realised that an angle of 90° was involved in the question, however a significant number incorrectly identified x as being a right angle. There were fewer correct answers to part **(b)**, with candidates often making errors in identifying which angles were alternate, or believing that angle y was equal to angle *OAC*, or suggesting that *BAC* was a right angle. The vast majority of candidates who started by labelling some of the missing angles on the diagram gained at least one mark for part **(b)**. In this part, candidates gained marks for a follow through of their answer to the pervious part as long as that value was viable as an angle in the diagram.

Answers: **(a)** 66 **(b)** 42

Question 17

This question caused a range of problems. Many candidates gave answers that showed some understanding, but that were not accurate. The most common error was to round intermediate values, resulting in an inaccurate answer. Incomplete working was seen in many cases, making it difficult to award marks if the final answer was inaccurate. Good work was often spoiled by the principal being added or subtracted at the final stage. A significant number of candidates attempted simple interest. Questions on interest have various aspects for candidates to consider; compound or simple interest, total interest earned or the total interest and the principal, what form the answer should take? One final point, candidates should take a moment to consider whether their answer makes sense in the context.

Answer: 942.41

Question 18

This was another question without scaffolding leaving candidates to determine their method. This required two steps and then giving the answer to the nearest cent. The majority of candidates were able to perform a correct currency conversion, but only a minority went on to evaluate the correct final answer. Rounding errors were very common, with the answer \$0.30 being seen very frequently. Often \$0.30 or \$0.3 was given with no working. This is a good example to show that lack of working can be very costly. Working that involved a mixture of currencies was not uncommon, for example converting \$30 to euros, €24 to dollars and then using both the resulting values in a subtraction.

Answer: 0.29

Question 19

There were some very accurate nets seen with crossed arcs to mark the triangles' apexes. Most candidates were able to identify the elements required for the net and could also construct the rectangles accurately. Many drew triangles with a height of 4cm, rather than a side length of 4cm. In some cases, candidates attempted to draw triangles with side lengths of 4cm, but were unable to do so to the required level of accuracy. In these cases the apexes of the resulting triangles were often off-centre. Some candidates did not know what, 'draw a net' meant as evidenced by 3D-like sketches. Others did not understand the diagram of the triangular prism and used triangles or trapezia to replace the rectangles.

Question 20

There were three main methods used by candidates. The majority of candidates attempted an elimination method, usually with some success. It is worth candidates looking at the equations to see what the simplest multiplication that needs to be done is to keep the numbers small and minimise sign errors. Here, the simplest method was to multiply the first equation by 2 to equate the coefficients of y and those who attempted this method were often successful. A number of able candidates made an error in the final stage of calculating y, when $26y = 13$ was followed by $y = 2$. A second method used was to rearrange one equation and substitute it in the other equation but this was not common. Candidates often make more errors with this method as there is probably a denominator to take into account. Also, candidates can get confused with this method and substitute back into the equation they have already used. A significant number rearranged both equations to make x the subject (or y), equated the two resulting equations and solved this. A few candidates used Cramer's Rule which is fine as long as candidates know exactly what they are doing but frequently they go wrong at one stage or another. There were many arithmetical errors in all methods and negative signs also caused difficulties for a large number of candidates.

Answer: (x =) 3, (y =) 0.5

Question 21

In part **(a)**, the two most common errors involved the negative sign, leading to an answer of −80 or squaring the 5 as well as the −4. Some wrote the correct $5(-4)^2$ but still gave their answer as −80. In part **(b)**, many candidates seemed unable to select the correct inverse operations. For the inverse of squaring, answers included dividing by 2 or x. Similarly, subtracting 5 was sometimes seen as inversing the multiplication by 5. The order in which the steps of the rearrangement should be carried out also proved problematic. Many candidates didn't show the distinct steps in their rearrangement, making it impossible to award marks for a partially correct method. A large number of those who showed some understanding were unable to express their final answer correctly, with the position of the square root sign proving particularly problematic.

Answers: **(a)** 80 **(b)** $\sqrt{\frac{y}{5}}$

Question 22

In part **(a)**, those candidates who showed some understanding of the situation often produced good working. Unfortunately, many made rounding errors or didn't give their final answer to a sufficient number of significant figures. The less able candidates often didn't use Pythagoras' theorem and simply added or subtracted the given lengths, possibly since the given lengths were square numbers. In part **(b)**, most candidates realised the need to use a trigonometric ratio, but few 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. Inaccurate values arising from inappropriate rounding were common. Some candidates did not realise that their answer was also the correct bearing so subtracted their answer from 360 or 180.

Answers: **(a)** 18.4 **(b)** (0)60.6

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key Messages

To succeed on this paper, candidates need to have fully studied all topics in the syllabus and be well practised on applying standard techniques.

General Comments

The paper was tackled well by many candidates but there were some who had difficulties in understanding the meaning of terms, or how to apply basic methods.

Lack of careful reading and understanding what is required in a question caused many marks to be lost. The difference between factor and multiple, together with the differences in algebra between factorise, solve and changing the subject of a formula, are examples of essential skills required by all candidates.

Work was generally presented well and working, where shown, was mainly contained within the designated area. There was reluctance by many candidates to write lengths and angles on diagrams which could have helped considerably to work out the solutions.

Comments on Specific Questions

Question 1

Although some candidates changed the question to two pairs of brackets, this was generally answered correctly. Occasionally, the multiplication sign was included in the bracket.

Answer: 6 + 5 × (10 – 8) = 16

Question 2

As there was only one mark for the calculation, leaving the answer as $\frac{10.8}{0.54}$ could not score. It was common to see the answer 9.55 from entering the data as it stood without any regard to the order of operations. However, it was generally calculated correctly.

Answer: 20

Question 3

It was evident that rotational symmetry is not clearly understood by many candidates since there were a considerable number of different responses for the order, apart from the likely one of 4. Answers of 2, 1, 0, infinite and even 'sun' were regularly found.

Answer: 8

Question 4

(a) Many candidates did not know the term 'product' and clearly confused it with 'sum' or just omitted the part. Even many of those who found correct digits did not give opposite signs.

(b) 'Range' is a positive value so many writing −60 did not earn this mark. Other incorrect answers regularly seen were 6 and −6.

Answers: **(a)** 5 and −3 or −5 and 3 or 1 and −15 or −1 and 15 **(b)** 60

Question 5

While answers or working seen of 81 and 3^6 gained some credit, many did not find the correct answer. A common incorrect answer was 1^6. Also the request for an 'ordinary' number was often ignored.

Answer: 729

Question 6

Only a small number of candidates gained marks on this minimum and maximum question. The combination of mixing centimetres and millimetres in the question and using decimal numbers seemed to defeat all but the most able candidates. Adding and subtracting 0.05 was all that was required. There were a few correct responses in millimetres which gained 1 mark.

Answer: 95.55, 95.65

Question 7

(a) Most candidates gained this mark but 2 was sometimes included and the third space was blank a number of times.

(b) The main reason this was not so well answered was that very many candidates listed 1 as a prime factor. Some gave 15 which showed a lack of understanding of prime numbers.

Answers: **(a)** 3, 6, 15 **(b)** 2, 3, and 5

Question 8

(a) This was quite well answered although some candidates clearly did not know what standard form was. Common incorrect responses were 64×10^4 or 6.4×10^{-5}.

(b) This part was a little more challenging than part **(a)** and that was reflected in the responses. The decimal point was missing in many answers that were otherwise correct but there was also a lot of miscounting the zeros.

Answers: **(a)** 6.4×10^5 **(b)** (0).000782

Question 9

Many candidates did not know the difference between changing the subject of a formula and solving an equation, resulting in numerical answers. Some made a correct first step but then did not know how to complete the question. Others did not change the signs when isolating the 'y' term. There were a lot of cases of combining terms such as a first step of $13y = 3x$. Although many included 0 + in the numerator this was not penalised.

Answer: $\frac{3x-8}{5}$

Question 10

(a) The vectors question was found challenging, with some candidates giving a 2×2 matrix as their answer. Incorrect signs and components reversed were very common from those who knew 2 numbers were needed. A fraction line between components was rarely seen but co-ordinates were common.

(b) Many candidates gained the mark from multiplying their incorrect part **(a)** components by 3 but many either left this out or just wrote 3 outside the brackets of their part **(a)**.

Answers: **(a)** $\begin{pmatrix} -5 \\ 4 \end{pmatrix}$ **(b)** $\begin{pmatrix} -15 \\ 12 \end{pmatrix}$

Question 11

This ordering question was quite well answered by those who showed the conversion to decimals. Some gave a reverse order. Many candidates did gain one mark by having 3 items in the correct order. A common error was to write 0.41 less than 40.4% but more prevalent was not giving enough places of decimals to make a comparison. Many candidates thought that 3 figures were sufficient.

Answer: 40.4% $\frac{17}{52}$ $\frac{15}{37}$ 0.41

Question 12

(a) This was well answered but a significant number of candidates left out the 'k'. The question was the most straightforward type of simplification but answers of $-2k$, $6k$ and $-6k$ were regularly seen. Some thought indices were involved giving $2k^3$ as their answer.

(b) Many candidates gained one mark for working out one of the terms but many did not understand how to substitute numbers into an expression, resulting in algebraic answers. However, the question was quite well answered although −31 was a common incorrect answer.

Answers: **(a)** $2k$ **(b)** −1

Question 13

(a) This was a more challenging question on currency than many but it was answered quite well. Most candidates attempted multiplication, rather than division, by the conversion rate but some multiplied the 210. The subtraction of 210 was not done by some and rounding the conversion factor to two decimal places was seen.

(b) This was not answered well in general with many answers of 3.57 seen from 750 ÷ 210.

Answers: **(a)** 700 **(b)** 0.28

Question 14

Nearly all candidates gained the mark for converting $1\frac{1}{6}$ to $\frac{7}{6}$ but there were many poor attempts at a correct form for a division of fractions. The improper fraction was inverted and fractions were added or subtracted instead of being divided while some tried to convert to decimals. Finding a common denominator was an acceptable method but usually went straight to the answer without evidence of an intermediate stage. For example $\frac{28}{24} \div \frac{21}{24}$ needed evidence of cancelling the 24's or $\frac{28}{21}$ seen before giving the final answer in its simplest form.

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

Question 15

There were quite a lot of good, clear answers to the simultaneous equations question, but the weakness with manipulating directed numbers was evident again. Most candidates chose to multiply both equations to eliminate x rather than the simpler alternative of one equation multiplied to eliminate y. Only a few tried a substitution method but rarely made progress and was not really suitable with all coefficients greater than 1.

Answer: $x = 2$, $y = -5$

Question 16

(a) Many candidates did not know the term relative frequency. While many did start with $\frac{136}{360}$ this was then multiplied by 90 to give 34. Others just gave the red angle of 136°.

(b) Most candidates realised that the angle for green, 76°, was needed for this part and so gained one mark. A significant number did progress further and related the angle to the number of times required.

Answers: **(a)** $\frac{136}{360}$ **(b)** 19

Question 17

(a) Most candidates were able to plot the points correctly, or at least only had one incorrect. However a significant number did not attempt this part. Some needed to take more care interpreting the scales.

(b) While most candidates understood the term 'line of best fit' many did not fit within the tolerances set. Candidates must realise that the line needs to show a clear trend and not join specific points such as the common error of joining the two corners of the grid.

(c) Those familiar with the topic most often gave the correct response for the correlation but there were a significant number who seemed unfamiliar with this area of the syllabus. They offered a totally incorrect or no response.

Answers: **(c)** Positive

Question 18

(a) Many candidates gained the mark for the cube root but quite a number who realised the correct answer wrote 9^3 which did not score. Answers of 27, the square root, 243 (from dividing by 3) and 81 were often seen. Some even worked out 729 cubed.

(b) While many candidates understood the term 'square root' and so gained one mark, very few realised that the required second root was simply the negative value. A repeat of 15 was seen at times. As in part **(a)** some wrote 15^2.

(c) There was a poor response to this part which showed that many candidates did not know the difference between factor and multiple. More responses of 3 were seen than all those suggesting some understanding of common multiple.

(d) This was very well answered but some gave −16. Other errors included −8 and $\frac{1}{16}$.

Answers: **(a)** 9 **(b)** 15 and −15 **(c)** any multiple of 18 **(d)** 16

Question 19

In order to find all the answers to the required angles, some other angles were needed. If candidates write on the diagram angles that they can see from known properties it helps greatly in working out the required angles.

(a) This was quite well answered but there was little evidence of seeing the angle at *E* marked as 90°. Many responses were greater than 90° with the most common being 156° from subtracting 24° from 180°. The other common error was to assume the triangle was isosceles for which there was neither a statement in the question or an indication of equal sides as in triangle *ABC*.

(b) This was answered well as many realised it was equal to angle *BDE* even if the alternate angle property was not known. However, there were a significant number of responses which bore no relation to the diagram.

(c) This was less well answered, probably due to needing to work it out in stages. Few made any real attempt to use the circle property of the right angle between tangent and diameter. It should have been clear that angle *ABC* was required but few attempts were seen to find it or write it on the diagram. Many candidates did not attempt the part and many others had little strategy to find the angle.

Answers: **(a)** 66 **(b)** 24 **(c)** 48

Question 20

(a) Although there were many correct answers to the actual length of *BC,* measurement was rather careless by some candidates as 5 centimetres leading to 100 metres was often seen. Having measured the length correctly quite a number ignored the scale conversion. More than just the occasional candidate measured the wrong side.

(b) This construction question caused a lot of difficulty for many candidates. Candidates had to realise that two constructions were needed to define the position of the fountain but few achieved the required result. Most did not realise that equidistant from *AB* and *AD* meant the angle bisector as this was given in the locus form. Bisecting a side or sides was very common. Many gave a point that was 8 centimetres from *C* but did not know that an arc was needed.

Answers: **(a)** 102 to 106

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key Messages

To succeed in this paper, candidates need to have completed the full Core syllabus, be able to remember and apply formulae and to give answers in the form required.

General comments

The vast majority of candidates could make an attempt at most questions and candidates did not appear to have a problem completing the paper in the allotted time.
It is important that candidates understand the correct form for answers - probability should not be written as a ratio and vectors should not contain a fraction line. When solving a non-calculator question where the instruction to show each step of the working is clearly stated, candidates should realise that marks will be lost if working is not shown.

Answers to **Question 20** suggested a small number of candidates did not have access to, or were not able to use, a pair of compasses correctly. Candidates should be reminded to give answers to 3 significant figures. There were several questions where candidates lost marks for either truncating answers or premature rounding.

Comments on specific questions

Question 1

This question was generally well answered. A small number of candidates did not give the answer as a fraction.

Answer: $\frac{13}{100}$

Question 2

(a) This was not well answered considering it was a straightforward question. 300 4620 was a common incorrect response.

(b) Many candidates did not know how to round to 3 significant figures and 305 with zeros missing was often seen. Only a small number of candidates gained the mark following through from their answer in part **(a)**.

Answer: **(a)** 304 620 **(b)** 305 000

Question 3

(a) The term rotational symmetry was not well known. Several candidates did not answer the question and there were a variety of incorrect answers, 4 being the most common.

(b) There were many correct responses in this part. The most common errors were extra lines usually vertical and horizontal.

Answer: **(a)** 2

Question 4

Most candidates were able to carry out the calculation but were let down by poor rounding and a lack of working with 9.6 and 9.60 being commonly seen.

Answer: 9.61

Question 5

(a) Many correct answers were seen, but several gave the answer as a probability.

(b) This part was not well answered. Several candidates did not relate the question to the diagram and 15 was a common incorrect answer.

Answer: **(a)** 5 **(b)** 0.75

Question 6

(a) This was generally well answered. The most common incorrect answers were 17.7 or −17.7.

(b) Again most candidates were able to give the correct answer. However a small number omitted the negative sign.

Answer: **(a)** 23.3 **(b)** −15.5

Question 7

(a) The majority of candidates gave the correct answer.

(b) Almost all candidates gave the correct answer.

Answer: **(a)** 14 **(b)** 1296

Question 8

(a) Many correct answers were seen to this part. Candidates showed an understanding of vectors and vector notation, although a small number gave 4 values in the vector bracket.

(b) Again the majority gave the correct answer. In both parts it appeared that errors were made adding or multiplying directed numbers rather than a lack of understanding of vectors. A small number of candidates had written vectors with a fraction line.

Answer **(a)** $\begin{pmatrix} 2 \\ 4 \end{pmatrix}$ **(b)** $\begin{pmatrix} -9 \\ 18 \end{pmatrix}$

Question 9

The majority of candidates were able to correctly answer this question. Some however did not understand the basic rules for subtracting fractions. A significant number of candidates lost marks for not showing each step of working as stated in the question.

Answer: $\frac{2}{15}$

Question 10

Many candidates were able to correctly rearrange the formula. However many less able candidates struggled with the algebra. The main error was to subtract 1 from y, rather than adding, but several candidates were able to gain one mark for a correct first step.

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

Question 11

Many candidates scored both marks. Many of those who did not, used decimals and often scored at least one mark.

Answer: 0.34 0.7^3 0.6^2 $\sqrt{0.6}$

Question 12

Only the more able candidates were able to score both marks on this question. Many did not know the correct format for standard form with 240 000 000 and 24×10^7 being common incorrect answers.

Answer: 2.4×10^8

Question 13

More able candidates realised that an equation was needed, although some wrote $2x + 3x + 4x = 90$. Many candidates did not know how to attempt this question and several did not make any attempt.

Answer: 30

Question 14

Several errors on this question prevented many candidates from scoring both marks. The errors included using 1 hour as 100 minutes or premature rounding. 65 × 52 and 52 ÷ 60 were also seen.

Answer: 48

Question 15

(a) The majority of candidates were able to correctly calculate the volume. A small number added the dimensions rather than multiplying.

(b) Most candidates were able to give the correct answer. Incorrect answers seen were 170, 0.17, 17 000 and 17.

Answer: **(a)** 1440 **(b)** 1700

Question 16

(a) The majority of candidates were able to give the correct answer. However a small minority who reorganised the terms finished with incorrect signs. The j term was usually correct for candidates scoring one mark. Some candidates multiplied the terms.

(b) Many correct answers were seen to this basic factorising question. However some did not know how to factorise and gave numerical answers.

Answer: **(a)** $6j - k$ **(b)** $5(p + 2)$

Question 17

(a) This was generally correct. A small number of candidates had not read the question correctly and gave the answers 2 and 6.

(b) This was also generally correct. Some candidates did not choose a two digit number while others confused the term multiple with factor.

(c) This part was found more challenging and a correct answer was rarely seen. 1.5 was a common answer. The term irrational was not understood by many candidates.

Answer: **(a)** 12 **(b)** 60 **(c)** Irrational number between 1 and 2

Question 18

Many candidates were able to give the correct answer. Of those who did not give the correct answer several earned 1 or 2 marks for correct working.

Answer: 9.5

Question 19

(a) This was generally correctly answered, with candidates showing an understanding of scatter diagrams.

(b) This was also generally correct, but several candidates appeared not to be familiar with the term correlation and gave a description. The word increase was often seen.

(c) (i) Many correct answers were seen. There are still a significant number of candidates who do not interpret “a line” as a single straight line. A zigzag line joining the points is still quite common. Some candidates think the line of best fit must go to the point where the axes meet.

(ii) Where a ruled line had been drawn in the previous part most candidates were able to gain this mark.

Answer: **(a)** 16 **(b)** Positive

Question 20

(a) Many candidates did not attempt this question. Of those who did make an attempt in this part many had drawn a line of 3cm from point *E*. Some who had made an attempt at a circle hadn’t used a pair of compasses.

(b) Only a small number of candidates were able to construct an angle bisector. Some just drew a diagonal line between the corners.

(c) This mark was awarded infrequently as it was dependent on constructions in the previous parts.

Question 21

(a) The semi-circle property was not well known. Many who applied trigonometry hadn’t indicated that the angle at *C* was a right angle. Candidates who did know the property were almost always successful.

(b) Trigonometry was applied more often than Pythagoras’ theorem and often resulted in errors usually due to rounding or truncation of the answer. Candidates who used Pythagoras’ theorem were almost always correct although a small number subtracted the squares rather than adding.

Answer: **(a)** 58 **(b)** 9.43

Question 22

(a) This was generally correct with the most common incorrect answers being rhombus and parallelogram.

(b) The majority of candidates were able to correctly identify and measure the angle.

(c) Most candidates were able to accurately measure the lengths and the formula was often applied correctly. A small number split the shape into a rectangle and a triangle but this method at times produced errors.

Answer: **(a)** Trapezium **(b)** 55° **(c)** 21.4

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 number work with many correct responses in the standard form, rounding and fractions questions. Candidates found more involved multi-stage questions such as **16** and **19** particularly challenging.

Candidates were better this year at showing their working and there was a good reduction in candidates showing just the answers and more method marks were scored as a consequence. Premature rounding part way through calculations and using $\frac{22}{7}$ as an approximation for π were occasionally seen causing some candidates to miss out on accuracy marks, particularly in **Questions 16, 17** and **19**. Candidates particularly struggled to communicate their understanding of the mathematics involved in **Question 19(a)**.

Comments on Specific Questions

Question 1

The majority of candidates answered this question well with the most common incorrect answers being to round to 5 decimal places or to truncate at 5 significant figures rather than rounding to 5 significant figures. Some candidates arrived at a different answer altogether showing evidence of incorrect calculator use although marks of zero were rare.

Answer: 8.1722

Question 2

This question was well answered by the majority of candidates. The most common incorrect response was 3 3.14 3.142 π $\frac{22}{7}$ (with 3.142 often being written as the conversion of π to a decimal). A small number of candidates gave the five values in reverse order.

Answer: 3 3.14 π 3.142 $\frac{22}{7}$

Question 3

In part **(a)** candidates responses were often incomplete, with A, B or E given as a single letter answer or as a pair of letters. An incorrect R was rarely given in an answer. Another common error was to include a Z in the answer. In some cases, candidates wrote the value 3 as their answer, i.e. the number of letters that had a single line of symmetry. Candidates had more success in part **(b)** with the majority of candidates scoring the mark. Common incorrect answers included the pair of letters Z and E or the values 1 or 2.

Answer: **(a)** E B A **(b)** Z

Question 4

A large number of candidates were successful in part **(a)** and it was always attempted. Occasionally candidates wrote a day of the week, often Sunday, instead of a numerical answer. The other common incorrect answers were −11 and −1 or to give the mean or median. Candidates found part **(b)** more challenging with a significant number giving an answer that was the number of days where the temperature was higher than the mode demonstrating a lack of understanding of negative numbers.

Answer: **(a)** –3 **(b)** 4

Question 5

The vast majority of candidates answered this well and showed all the necessary working. The most successful candidates used the more efficient common denominator of 12. However those who used the denominator of 24 still usually showed full working, including cancelling their answer to get to the correct answer. The most common incorrect responses were where candidates worked in decimals or added the numerators and denominators obtaining firstly $\frac{2}{10}$ then giving an answer of $\frac{1}{5}$.

Answer: $\frac{5}{12}$

Question 6

Almost all candidates answered part **(a)** correctly with the most common incorrect answers being to truncate to 15.0 or to leave in extra trailing zeros after 15.1. Candidates found part **(b)** more challenging with a significant number rounding it to the nearest whole number or again including trailing zeros. Consequently the two most common incorrect answers were 15 and 20.0.

Answer: **(a)** 15.1 **(b)** 20

Question 7

The most successful candidates used the most efficient method of 2.1×1.06^3. It was common to see a conversion of 2.1 million to 2 100 000. Candidates who did this occasionally got an incorrect number of zeros or forgot to convert back to 2.5 at the end giving the answer 2501133.6. Of those candidates using the less efficient method, working out a year at a time, there were very often slips in writing down the numbers or very occasionally premature rounding causing them to lose the accuracy mark. The most common incorrect working was for candidates to work out an 18% increase, giving the answer 2.478.

Answer: 2.5

Question 8

This question produced a variety of answers and working. A large proportion of candidates successfully achieved the unrounded answer 0.2928. Of these candidates it was as common to see this answer then rounded to 0.3 as it was to see the correct answer to the nearest cent. When candidates did not score full marks the most common marks were 2 method marks for 30−29.7 or 1 mark for the answer 29.7072. Alternative methods were sometimes used but overall it was rare. The answers 0.0122 and 24.2 were sometimes seen arising from incomplete attempts at the alternative methods $(\frac{30}{24} - 1.2378) \times 24$ and $((30 \div 1.2378) - 24) \times 1.2378$ respectively.

Answer: 0.29

Question 9

It was extremely rare to see an incorrect answer in part **(a)** with the most common of those being 2800 and 2.800. The majority of candidates also scored full marks in part **(b)** or at least 1 mark for 5 000 000 or equivalent answers, such as 0.5×10^7.

Answer: **(a)** 280 **(b)** 5×10^6

Question 10

Candidates were generally very successful at this question with the majority scoring full marks. The most common incorrect starting points were in the multiplying by 3 stage e.g. $\frac{3x+5}{x} = 7$ and $\frac{3x+15}{3x} = 7$ were often seen. Of those who began by separating into fractions i.e. $1+\frac{5}{x}=\frac{7}{3}$, some went on to lose accuracy by working in decimals, e.g. $1 + \frac{5}{x} = 2.3$ (or 2.33) followed by further correct rearranging and then an answer of 3.85 (or 3.76) was often seen. The most common incorrect answer was 1.25 arising from the incorrect starting point $3x + 5 = 7x$.

Answer: 3.75

Question 11

A high proportion of candidates answered part **(a)** correctly. The most common incorrect answer was to just write down the 6 rather than the entire expression or to write x^4. Candidates found part **(b)** more challenging with a significant number scoring 1 out of the 2 marks. Quite a few candidates demonstrated that they understood that a power of $\frac{1}{3}$ meant cube root but did not know how to deal with this with the numerator. Equally quite a few multiplied the power on the numerator by $\frac{1}{3}$ and also multiplied 27 by $\frac{1}{3}$.

Answer: **(a)** x^6 **(b)** $\frac{x^2}{3}$

Question 12

The most successful candidates multiplied one equation by a number and then used the elimination method to solve these simultaneous equations taking careful note of the signs of all the terms. Those who tried the substitution method were generally more prone to errors. The biggest cause of errors was inconsistencies when adding or subtracting the equations. It was common for 2 out of the 3 terms to be added and the third term to be subtracted, or vice versa, or for not all 3 terms to have been consistently multiplied in the first instance.

Answer: $x = 5$, $y = -5$

Question 13

This question was answered well by a large number of candidates. The most successful candidates used the method $y = k\sqrt{x+5}$ followed by $k = 2$. A significant proportion of candidates had poor working here and missed out on method marks that otherwise they would have earned. A common error was to write $y=\sqrt{x+5}$ and not show any constant. Using inverse variation or forgetting the square root were other common errors as was the answer of 2. A number of candidates introduced a constant but left their working with a proportion sign throughout.

Answer: 8

Question 14

Most candidates scored at least 1 mark for correctly evaluating 4**A**. By far the most common incorrect answer was $\begin{pmatrix} -4 & 32 \\ -3 & 0 \end{pmatrix}$ arising from the extremely common error of squaring every element in **A** rather than evaluating $\mathbf{A}^2$. A significant number of candidates worked out −4**A** then went on to subtract this from $\mathbf{A}^2$ rather than adding it. A significant number of candidates scored 2 out of the 3 marks, usually because of arithmetic slips and sign errors in the process of evaluating $\mathbf{A}^2$.

Answer: $\begin{pmatrix} 4 & 16 \\ 2 & 8 \end{pmatrix}$

Question 15

Most candidates were able to draw the bisectors accurately. The majority also used correct arcs to construct rather than using measuring. There were more inaccuracies in the angle bisector where candidates appeared to know where to place the arcs but small inaccuracies in each arc caused the line to be out of tolerance. The more successful candidates avoided this by placing their initial arcs further away from point *C*. Occasional errors were also made by candidates bisecting the wrong line or angle. Where both lines were drawn accurately, the correct region was largely identified. Where it was incorrect, it was often because one of the constraints was ignored and the whole region on one side of either bisector was shaded. Some candidates appeared to have different types of shading for each constraint but did not clearly indicate which the required region was. A significant number of candidates did not answer part **(b)**.

Question 16

This question was a good discriminator. The most successful candidates used the sine rule and showed each stage of their working clearly. Many of these candidates got as far as working out angle *BDC* as 22° then a few struggled with the bearing aspect of the question. Those using less efficient methods, such as attempting to split the triangle into two right-angled triangles, were generally less successful. Many candidates were able to earn 1 out of the 5 marks for correctly identifying angle *CBD* as 30°. Some also gained the final mark. Common errors were to incorrectly use Pythagoras' theorem to find the length of *BD* (as $\sqrt{6^2+8^2}$ = 10), or to try to use the cosine rule, or to prematurely round in the middle of working.

Answer: 142°

Question 17

The response to this question was varied. A common error was to find the volume of a sphere instead of the volume of the hemisphere. A small number of candidates calculated the surface area instead of the volume of the cylinder. A small number of candidates did not earn the final accuracy mark because of premature rounding or because they had used the value $\frac{22}{7}$ for π in their calculations. Candidates need to follow the instruction on the front of the question paper, 'For π, use either your calculator value or 3.142.'

Answer: 890

Question 18

Part **(a)** was the more successful of the two parts. The correct decimals were usually given. The most common error was to misplace the decimals with 0.6 usually correct then quite often followed by 0.4 and 0.6 again on the next branches or 0.8 and 0.2 the wrong way round. In part **(b)** the most successful candidates used the efficient method of 1 – (0.6 × 0.8). Of those who used the less efficient method of 0.4 × 0.4 + 0.4 × 0.6 + 0.6 × 0.2 the most common cause of lost marks was for an incomplete method, usually omitting the raining on both days combination with a common incorrect answer of 0.36 frequently seen. Candidates usually gained at least 1 mark for showing a correct multiplication from their tree diagram. Some candidates were not aware that they needed to multiply along branches of the tree diagram and common errors were adding 0.4 to 0.2 or writing probabilities such as $\frac{0.4}{0.6}$. Others muddled up what to multiply and what to add. There were very few candidates this year giving answers greater than 1.

Answer: **(a)** 0.6, 0.2, 0.8 **(b)** 0.52

Question 19

This question was a good discriminator. Part **(a)** caused the most problems with very few correct answers seen and some candidates leaving the answer space blank. Many of the explanations used an incorrect circular argument, e.g. using the area answer of 67 in part **(b)** to work backwards to get to the answer of 120°. The most common incorrect responses were 'because it is $\frac{1}{3}$ of the circle' and 'because it is obtuse'. Part **(b)** was the most successful part of this question with a significant number of candidates managing to obtain both marks. In a number of cases, candidates calculated the segment area instead of the sector area. Some candidates correctly knew that the fraction of the circle was $\frac{120}{360} = \frac{1}{3}$ then prematurely rounded this fraction to a decimal of 0.3 or 0.33 before performing an otherwise correct calculation and so lost the accuracy mark. Some candidates confused their circle formulas and found arc length $\frac{120}{360} \times 2 \times \pi \times r$. Others mistakenly used $\frac{1}{4}$ rather than $\frac{1}{3}$. In part **(c)(i)** the most successful candidates used the efficient method of $\frac{1}{2} \times 8^2 \times \sin 120$ to find the area of the triangle. In a number of cases candidates attempted to use trigonometry to find both the height and base of the triangle. These were often incomplete and contained errors in methods, with the wrong trigonometric ratio being the most common. In these cases, candidates also frequently lost the accuracy mark due to premature rounding. Part **(c)(ii)** was a struggle for a significant number of candidates, with some not offering a response and many others offering new calculations rather than simply doubling their answers to part **(c)(ii)**.

Answer: **(a)** *CBA* and *BDA* are equilateral **(b)** 67.0 **(c)(i)** 39.3 **(ii)** 78.6

Question 20

Parts **(a)** and **(b)** were well answered by the majority of candidates with part **(a)** being the most successful. In part **(a)** the most common incorrect methods were to either substitute 2 into the functions in the wrong order, i.e. finding fg(2), or to substitute into each function and then multiply the results i.e. finding g(2) × f(2). In part **(b)** the most common errors were to find g(10), leading to an answer of $\frac{2}{11}$ or to make a mistake with the algebra, usually not multiplying out the brackets correctly. It was common to see the first line of working as $2 = 10x + 1$. Other errors included incorrectly rearranging a correct equation of $2 = 10x + 10$, often leading to a positive answer. In part **(c)** the majority of candidates scored 1 mark for evaluating one of the functions correctly, usually for $3(2x) - 2$. Many candidates had the incorrect answers of $3x - 10$ from the incorrect $3(2x) - 2 - 3(x + 2) - 2$, or $3x + 2$ from the incorrect $6x - 2 - 3x + 4$. In both cases this was because of the missing essential brackets in the expression $3(2x) - 2 - (3(x + 2) - 2)$. A few candidates treated this as an algebraic simplification writing the working $2\mathrm{f}x - \mathrm{f}x - 2\mathrm{f}$ followed by an answer of $\mathrm{f}x - 2\mathrm{f}$. A significant number of candidates also found $2\mathrm{f}(x) - \mathrm{f}(x) + 2$ (usually without brackets, as here) or $\mathrm{f}(x) \times 2x - \mathrm{f}(x) \times (x + 2)$.

Answer: **(a)** 0.4 **(b)** –0.8 **(c)** $3x - 6$

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key Messages

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

General Comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates showed evidence of good number work with particular success in **Questions 1**, **2**, **7a** and **8**. Candidates struggled to explain their mathematical reasoning and they found **Questions 16a** and **19b** particularly challenging.

There was a good reduction in candidates showing just the answers and more method marks were scored as a consequence. Premature rounding part way through calculations, using $\frac{22}{7}$ as an approximation for π and truncating final answers all caused some candidates to miss out on accuracy marks particularly in **Questions 9, 13, 14** and **17**.

Comments on Specific Questions

Question 1

The majority of candidates answered this successfully with the most common errors being to bracket the 6 + 5 or 5 × 10 or to have two pairs of brackets inserted. Quite a few candidates did not offer a response.

Answer: 6 + 5 × (10 – 8) = 16

Question 2

This question was answered correctly by nearly all candidates. The most common error was to miss out brackets on the denominator i.e. to evaluate 8.24 + 2.56 ÷ 1.26 − 0.72 or (8.24 + 2.56) ÷ 1.26 − 0.72 and so consequently 9.55 and 7.85 were the most common incorrect answers. Occasionally some candidates added the numbers in the denominator and obtained the answer 5.45.

Answer: 20

Question 3

The majority of candidates were able to correctly answer this question with the most common incorrect answers being 4, 0, 7, 'infinity' and 'clockwise'.

Answer: 8

Question 4

Both of the Venn diagrams were generally well done with a large number of candidates able to score at least one mark. $(A \cup B)'$ was slightly more successful than $A' \cap B$. Common incorrect answers were $(A \cap B)'$ for the first and $A' \cup B$ for the second. Some candidates used ambiguous or unclear shading - regions need to be clearly indicated.

Question 5

A significant number of candidates answered this question correctly. The most successful candidates showed the interim stage of working $v^3 = p + r$. Of those that attempted to get straight to the final answer without showing this stage, many lost both marks. The most common incorrect first steps were $v = p^3 + r^3$, $\sqrt[3]{v} = p + r$ and $v - p = \sqrt[3]{r}$.

Answer: $v^3 - p$

Question 6

This question was generally well answered. Common incorrect answers were $0 \le l < 96$, $95 \le l < 97$ and $95.95 \le l < 96.05$. Often one mark was scored, usually for a correct lower bound. The upper bound was often 96.4 or 96.49 but no recurring 9s were seen.

Answer: 95.5 96.5

Question 7

It was rare to see an incorrect answer, particularly in part **(a)**, with the most common errors being to stop at 910 i.e. forgetting to subtract the 210, or to work out 2800 ÷ 0.325. In part **(b)** a fairly common incorrect answer was 3.57, from dividing the wrong way or to copy down the exchange rate from the start of the holiday from part **(a)**, not realising that exchange rates are fluid.

Answer: **(a)** 700 **(b)** 0.28

Question 8

The most successful candidates used the method $\frac{7}{6} \times \frac{8}{7}$ and cancelled this before multiplying. Of those that did not cancel before multiplying some did not cancel the answer or did not fully cancel the answer. When candidates used the common denominator method $\frac{28}{24} \div \frac{21}{24}$ some stopped at this point. If they continued, the next step was not always $\frac{28}{21}$ often it was $\frac{28 \div 21}{24}$ or equivalent. It was rare to not give at least one mark, for $\frac{7}{6}$. There were only a small number of candidates who showed no working or who attempted to do all their working in decimals. The correct answers $\frac{4}{3}$ or $1\frac{1}{3}$ were occasionally spoilt by converting the final answer to the decimal 1.33.

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

Question 9

Approximately half of the candidates answered this correctly with the common incorrect answer of 5.28 being almost as common as the correct answer. 5.28 was a result of treating it as a linear proportion problem. Most candidates who correctly realised they had a volume ratio worked accurately, although not always with clear solutions. Some lost the accuracy mark due to premature rounding part way through e.g. 12 ÷ 1.31 = 9.16 or 12 × 0.761 = 9.132. It was also common for candidates to use square roots instead of cube roots and 7.96 was a common incorrect answer from this method. A few cubed the scale factor rather than cube rooting. Most dealt well with the mixed units and the method mark for this was usually scored. A significant number of candidates did not read the question carefully and 440 was often misread as 400.

Answer: 9.13

Question 10

This question was answered well by a large number of candidates. The most successful candidates used the method $C = kr^2$ followed by $k = 30$. Using inverse variation or forgetting to square were the most common errors leading to answers of 423 and 140.4 respectively. A number of candidates gained the first two marks then forgot to square the 1.8. A small number of candidates tried to use the formula for the volume of a cylinder to reach their solution.

Answer: 97.20

Question 11

A large number of candidates successfully answered part **(a)** obtaining two marks with the most common errors still usually scoring one mark. There were occasional arithmetic slips resulting in one incorrect element or candidates missed out the brackets in their answer. Of those scoring zero marks, a commonly seen answer was $\begin{pmatrix} 6 & 0 \\ -5 & 28 \end{pmatrix}$ arising from simply multiplying corresponding elements in each matrix. Part **(b)** was slightly more challenging but many correct responses were seen. The most common error was not knowing when to stop, i.e. after obtaining 14 candidates wrote $\frac{1}{14}$ or the inverse matrix on the answer line. Also seen was the determinant of their answer to part **(a)** so 196 was another common incorrect answer.

Answer: **(a)** $\begin{pmatrix} 6 & -4 \\ -8 & 38 \end{pmatrix}$ **(b)** 14

Question 12

This was well answered by a significant number of candidates with the majority scoring 2 or 3 marks. A small number of candidates offered no response.

Question 13

This question proved a good discriminator with approximately half of candidates scoring marks. The most successful candidates remembered the formula correctly and wrote the working ½ × x^2 × sin 110 = 85 and rearranged it correctly. Some prematurely rounded part way through the calculation or truncated their final answer to 13.4 resulting in the loss of the final accuracy mark. A common error was in dealing with the ½ in the rearrangement of ½ × x^2 × sin 110 = 85; usually 85 was multiplied by ½ instead of 2. Often these candidates also had the other common error which was to have $2x$ in place of the x^2 and by far the most common incorrect answer was 90.5. Of those attempting a less efficient method involving a perpendicular from *A* to *BC* and using trigonometry, these were usually unsuccessful and often because of premature rounding. There were a number of attempts at using the sine rule with angles of 35° and 110°, usually with an incorrect length found using ½ bh = 85 incorrectly.

Answer: 13.5

Question 14

In part **(a)** the correct answer was often seen. Where it was not achieved this was usually because of candidates incorrectly using the 56° angle, with ¼ x π x 2.25^2 or 56 x π x 2.25^2 seen quite often. Another common error was to find the arc length ($\frac{56}{360}$ x 2 x π x 2.25), and consequently 2.2 or 2.199 were common incorrect answers. A number of candidates used the formula $2\pi r^2$ instead of πr^2. Premature rounding was a common reason for the loss of the accuracy mark e.g. 0.155 x 3.14 x 2.25^2 = 2.46. A number of candidates also lost the accuracy mark because they used $\frac{22}{7}$ as an approximation for π. Candidates need to follow the instruction on the front of the question paper, 'For π, use either your calculator value or 3.142.'
In part **(b)** it was usual for candidates who got the first part correct to get this part correct also and there were many who benefited from the follow though mark for multiplying their incorrect area by 0.3. Some candidates did not connect the two parts and produced a wrong calculation or left the answer blank. Some divided by 0.3 instead of multiplying.

Answer: **(a)** 2.47 **(b)** 0.742

Question 15

This question proved to be quite challenging for a significant number of candidates. It was common for the answer to part **(a)** to be a list of factors of 90, a list of prime factors of 90 or a product of two or more numbers where at least one was not prime. There were a significant number of candidates who offered no response at all. Also occasionally seen was 2 × 3 × 3 × 5 = 90 in the working but 90 on the answer line rather than 2 × 3 × 3 × 5. In part **(b)** the most successful candidates used their answer to part **(a)** as well as 105 as a product of primes to successfully get to 2 × 3 × 3 × 5 × 7. Some stopped here instead of continuing to write the answer 630 down. Multiples that were not the lowest were also fairly common e.g. 1890 was often seen.

Answer: **(a)** 2 × 3 × 3 × 5 **(b)** 630

Question 16

In part **(a)** there was almost an equal distribution between the marks of zero, one and two. The most successful candidates had learned the correct definition and language from the syllabus. When 1 mark was awarded it was nearly always for the angle 108° followed by a significant number of candidates showing the working out for this rather than giving the required geometrical reason or stating reasons such as using the "butterfly" or "bow tie" rule. A large number of candidates gave the answer 54° stating the angles were both in the same segment. Other common incorrect answers included "90° because it is in a right angle" and "27° because the angle at the centre is half the angle at the circumference'. In the latter case candidates should think of the common sense of their answer. Whilst diagrams are not drawn to scale it is still clear to see which angle of the two is bigger. Part **(b)** proved to be a good discriminator with candidates being more successful in part **(i)** than part **(ii)**. The most common incorrect answers were $-\frac{3}{4}$, $\frac{4}{3}$, 1.3 or the 2 significant figure answer −1.3. Another very common incorrect answer was 5, where candidates mistakenly found the modulus of the vector. Many candidates did not offer a response to part **(ii)** with very few scoring the mark. The most common incorrect answers were 0, 9, 9.33, −6.1 and −4 with 0 being the most frequent of these.

Answer: **(a)** 108 **(b)(i)** $-\frac{4}{3}$ **(ii)** −1

Question 17

Many candidates successfully gained all four marks on this question with the next most common mark being two arising from forgetting to subtract 200 and calculating $200\times\left(1+\frac{2}{100}\right)^2-\frac{200\times2\times2}{100}$. Consequently the most common incorrect answer was 200.08. Of those scoring only 1 mark this was usually for the simple interest being correctly found. Errors in working included $\frac{200\times2\times2\%}{100}=0.08$ and more commonly a variety of wrongly remembered versions of the formula $P\times\left(1+\frac{r}{100}\right)^n$. Also premature rounding of 200.08 to 200.1 was sometimes seen. Another common error was to write 8.08 – 8 = 0.8 which was seen a significant number of times. Candidates should be encouraged to consider the sense of their answer. An answer greater than 200 and in some cases in the thousands was not considered out of place by a large number of candidates.

Answer: 0.08

Question 18

The most successful candidates read the question carefully, used 72 throughout as the total number of candidates and showed all their working including 'reading off' lines on the graph. Many candidates used 80 as the total number of candidates (as that is what the cumulative frequency axis went up to). This was particularly evident in part **(b)**, (as 80 or 72 were not always used consistently). Another common error was to misread the scale on the vertical axis assuming 1 small square represented 1 unit as it does on the horizontal axis. Common incorrect working for part **(a)** was 80 – 18, 80 – 16 or 72 – 18. Common incorrect answers were 65 in part **(b)(i)** and 25 or 25.5 in part **(b)(ii)**. Another common incorrect answer in part **(b)(ii)** was 36 arising from subtracting the positions of the lower and upper quartile (54 – 18) rather than the quartiles themselves.

Answer: **(a)** 56 **(b)(i)** 63 **(ii)** 22

Question 19

Candidates performed very well in part **(a)(i)** with few incorrect answers seen. Common errors were **a** – **c** and **a** + **c**. In part **(a)(ii)** the most successful candidates identified a correct route through the vertices and then worked correctly with vectors. Most simplified their answers but occasionally answers were left as $-\mathbf{a}+\frac{1}{3}(\mathbf{c}+2\mathbf{a})$ or $-\mathbf{a}+\mathbf{c}+2\mathbf{a}-\frac{2}{3}(\mathbf{c}+2\mathbf{a})$. The most common errors were sign errors (e.g. –**a** was often **a**); missing brackets (around **c + 2a**); or using $\frac{1}{2}$ (instead of $\frac{1}{3}$ or $\frac{2}{3}$). Many candidates were able to gain at least one mark for identifying a correct route, usually $\overrightarrow{AO}+\overrightarrow{OX}$ and less frequently $\overrightarrow{AO}+\overrightarrow{OC}+\overrightarrow{CB}+\overrightarrow{BX}$. Some were unable to score anything as they missed this useful stage of working out. Part **(b)** was a challenging question for nearly all candidates, with one mark occasionally seen and two marks rarely seen. A large proportion of candidates presented no response to this question or talked about the shape being a trapezium or lines being parallel without explaining how they knew the lines were parallel. The most common mark awarded was for '$\overrightarrow{AC}$ is a multiple of $\overrightarrow{AX}$'.

Answer: **(a)(i)** $\mathbf{c}-\mathbf{a}$ **(ii)** $-\frac{1}{3}\mathbf{a}+\frac{1}{3}\mathbf{c}$

Question 20

A high proportion of candidates were able to successfully answer part **(a)** with the occasional error of an incorrect side being measured or an incorrect conversion being used. The majority of candidates scored at least two marks in part **(b)** usually for the arc centre *C* radius 8 cm. Many also produced accurate bisectors of angle *A* with clear construction arcs. A mark of five was quite common. Some lost the final mark because a region for the fountain was indicated rather than making it clear that *F* was at the intersection of the two previous constructions. The most common error, for finding the angle bisector, was to construct the perpendicular bisectors of *AB* and *AD* and use the intersection of these as the reference for ruling the angle bisector.

Answer: **(a)** 104

Question 21

The best solutions in part **(a)** were when candidates clearly included brackets in the numerator i.e. $3(x+2)-1(2x-1)$ and remembered to take the signs into account in the removal of the brackets. It is sensible to leave the denominator in brackets. A number of candidates spoilt an otherwise correct answer because of an incorrect expansion in the denominator. Candidates found part **(b)** more challenging. It was very common for incomplete factorisation in either the numerator or the denominator. It was quite common for candidates to get to an answer such as $\frac{4x(x-4)}{(x+7)(2x-8)}$ only to then stop without doing any cancelling. It was extremely common for the 2 to disappear in the denominator altogether and $\frac{4x(x-4)}{(x+7)(x-4)}$ followed by the answer $\frac{4x}{x+7}$ was frequently seen. This was often because candidates used the quadratic formula to find the roots of $2x^2 + 6x - 56$ to help them factorise. Because the roots are 4 and −7, this was often a reason why $(x - 4)(x + 7)$ was written on the denominator. Some candidates did not attempt any form of factorisation and instead cancelled specific individual terms in the numerator and denominator.

Answer: **(a)** $\frac{x+7}{(2x-1)(x+2)}$ **(b)** $\frac{2x}{x+7}$

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key Messages

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

General comments

The candidates demonstrated sound knowledge in some topic areas such as statistics, money problems, mensuration and functions. However a weakness in algebra was evident as demonstrated in the difficulties experienced in changing the subject of the formula and manipulating algebraic fractions. Solving of linear equations questions were quite well answered but many still struggle to multiply powers of a variable and to square algebraic terms. There are many who do not understand vectors and cannot express one vector in terms of other equivalent ones.

There is often an absence of clear method and a tendency for doing a number of stages in one go, which is hindering the success of many, especially in questions which appear to be easy or straightforward. Candidates are advised to set work out methodically showing every stage of their working clearly.

Comments on particular questions

Question 1

This question was answered well. The few exceptions showed working that divided rather than multiplied or by those who attempted a unit conversion.

Answer: 2870

Question 2

The common error was to put 0.7^3 in the third position rather than in the second, placed through incorrect evaluation or writing the number in an inaccurate form.

Answer: 0.34 0.7^3 0.6^2 $\sqrt{0.6}$

Question 3

Most responses gave the correct value but it was not always in standard form so 24×10^7 or 240 000 000 were often seen.

Answer: 2.4×10^8

Question 4

The common error was to make the correct expression equal to 180 leading to an answer of 10.

Answer: 30

Question 5

There were two main errors, the first being the use of time divided by distance and the second being an incorrect value for the time with a common value being 1.05.

Answer: 48

Question 6

This question was answered well. Some multiplied the $2x + 5$ by 3 as well as the 8. The other main error was to add 5 to the 24 rather than subtract it.

Answer: 9.5

Question 7

Most of the candidates knew the approximate method but not precisely. Many responses gave the sum of the angles, 2880, as their answer. Some used an incorrect version of the formula, either (18 – 1) × 180 ÷ 18 or (18 – 2) × 360 ÷ 18 were often used.

Answer: 160

Question 8

The most common error was to attempt to square both sides first. Some of those who did make the correct move first by subtracting 2 from both sides then squared both sides but instead of writing $(y - 2)^2$ on the left hand side, wrote $y^2 - 4$. This was also a common error when expanding the brackets. In this question it was unnecessary to expand the brackets at all. Another common error was to perform the three correct operations in the wrong order.

Answer: $8 + (y - 2)^2$

Question 9

The most common error was to answer the question as direct proportionality leading to the answer of 9. Some used the correct method and found the value for k as 48 but then didn't substitute the correct value for x.

Answer: 4

Question 10

This question was answered well. The most common errors were calculating simple interest instead of compound interest (giving an answer of 13 800), calculating four years interest instead of three and on achieving the correct answer, working out the interest only of 1891.5.

Answer: 13891.5(0)

Question 11

In part **(a)** many achieved the correct answer. Most candidates substituted the value 39 but some made errors with the calculation. In part **(b)** most just doubled the expression in part **(a)** so giving an answer of $\frac{1}{2}n^2(n + 1)^2$.

Answers: **(a)** 608 400 **(b)** $2n^2(n + 1)^2$

Question 12

Generally this question was answered very well. In part **(a)** some did not draw a circle but instead drew a line bisecting *AB*. In part **(b)** some drew the diagonal of the rectangle and in part **(c)** some candidates shaded the union of both the regions rather than the intersection.

Question 13

There were many different approaches seen to this question. A common approach was to add the first two fractions often with the correct denominator of $6x$ and the numerator of $9 + 4x^2$. Some candidates then added the next two terms of $3 + 2x$ to their numerator without considering the denominator. It was clear that having two terms with a denominator and two terms without one, did confuse many candidates. There were many correct methods with errors, the common one being $2x \times 2x$ given as $2x^2$ or $4x$.

Answer: $\frac{16x^2+18x+9}{6x}$

Question 14

Many candidates found this question challenging. In part **(a)** the common error was to attempt $\overrightarrow{OP}$ rather than $\overrightarrow{AP}$ and in part **(b)** candidates attempted $\overrightarrow{AQ}$ rather than $\overrightarrow{OQ}$. A further error was to write **b** – **a** for $\overrightarrow{BA}$. Very few candidates wrote down the route they were taking in vector terms first; doing so would have assisted them in finding the required expression.

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

Question 15

In most responses there was little working except some numbers crossed out and replaced by others suggesting a trial and improvement approach. There were a few candidates who realised the links between parts **(a)** and **(b)** and did gain credit for transferring their numbers from part **(a)** to part **(b)**.

Answers: **(a)** 19 2 1 8 **(b)** 1 8 19 2

Question 16

In part **(a)** many candidates treated the composite function hf as a product and so calculated $1^3 \times (-2)^2$. Others used an incorrect order of functions and so worked out 1^3 first and then substituted the result into the other function. In part **(b)** many identified the correct operations and reversed them correctly but put them in the wrong order so $4(x + 1)$ was a common answer. In part **(c)** many used the two functions the wrong way round so a common answer seen was $((x - 1) \div 4)^3$. In part **(d)** many correct answers were seen but answers of 9 and 0 were also seen.

Answers: **(a)** 64 **(b)** $4x + 1$ **(c)** $\frac{x^3-1}{4}$ **(d)** 3

Question 17

Some candidates found the two scales difficult to read and there were some misreads from correct positions. In part **(a)** some candidates found the median instead. In part **(b)** it was common for many to read at 500 and give either 15 or 18 as their reading. In part **(c)** most candidates gave the correct values for the first two classes but gave 1.5 in the third class (from 6 ÷ 4), as they had not realised that the class width was smaller than the others.

Answers: **(a)** 3.1 **(b)** $\frac{16}{200}$ **(c)** 18.5 26 3

Question 18

In part **(a)** the majority of candidates were able to work out the volume of the glass. There was a distinct lack of working at this stage and many just wrote down the number of glassfuls without showing the working that led to it. Many did not read the demand for the number of complete glasses and so left their answer as a decimal. Part **(b)** did confuse some and they subtracted their number of complete glassfuls from their number of glassfuls and then multiplied this remainder by 1000 instead of multiplying it by the volume of the glass. The expected method was to work out the volume of 3 complete glassfuls and subtract that from 2000 and many used this method.

Answers: **(a)** 3 **(b)** 303

Question 19

In part **(a)** some candidates responded with reflection in the line $y = x$. Those who did state rotation sometimes did not give the direction of the rotation or stated 180° for the angle. In part **(b)** there were many 2×2 matrices with 1s, −1s or 0s but few were correct and there were many attempts to work it out from simultaneous equations or trial and improvement. Part **(c)** was answered better than the other parts. Some images were the correct size and shape but in the wrong position on the grid.

Answers: **(a)** Rotation of 90° clockwise centre the origin **(b)** $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

MATHEMATICS

Paper 0580/31

Paper 3 (Core)

Key Messages

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

General Comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time. The standard of presentation was generally good and there was evidence that most candidates were using the correct equipment to answer the construction question, e.g. compasses and ruler. Candidates continue to improve in showing their workings and gaining method marks. However many candidates were unable to gain marks in the show/explain questions if they used the value they had to show from the beginning. Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed. Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to fully process calculations and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set.

Comments on Specific Questions

Question 1

This question was attempted by all candidates with the majority able to gain marks in all parts except for part **(a)(i)**. The remainder of the question was well answered giving candidates the opportunity to show their understanding of ratio, percentages, fractions and money.

(a) (i) This ‘show that’ question proved to be one of the most challenging questions on the paper. All questions of this type require candidates to explicitly show each part of their method. The majority of candidates started their answer with 1.5 litres or 1500 ml and gained no marks because they have started with the value they are being asked to show. Candidates who correctly started with the 540 ml had to clearly show their division by 9 and multiplication by 25 to gain the 1500 ml. Candidates had to show the division by 1000 to gain the final mark.

(ii) Candidates were more successful in this part as they were permitted to use either the 1500 ml or 540 ml. The most common error was candidates dividing 540 by 25 and gaining the incorrect answer of 108 ml.

(iii) Most candidates were able to gain full marks on this question. Some less able candidates calculated 70% of the total amount of fruit juice rather than 70% of their answer in part **(a)(ii)**. Those who had made errors in the previous part were still able to gain full marks in this part.

(b) (i) This question was one of the best answered in the whole paper. Candidates who did not gain the mark generally rounded to an incorrect value of 2.3 or 2.

(ii) The majority of candidates gained full marks with less able candidates still scoring one mark for correctly calculating seven eighths of 16. Candidates who tried to calculate the profit of an individual carton scored no marks.

(iii) Only a minority of candidates scored full marks. Most found the actual profit of 16.60 but compared this to the total amount (52.60) instead of the original cost (36).

Answers: **(a)(ii)** 300 **(a)(iii)** 210 **(b)(i)** 2.25 **(b)(ii)** 52.6[0] **(b)(iii)** 46.1

Question 2

Candidates generally found the transformation parts of this question the most challenging.

(a) (i) The majority of candidates correctly identified the shape, although many different spellings were seen. The most common errors were parallelogram or rhombus.

(ii) Candidates found the calculation of the area of a trapezium challenging. Those who correctly gave the area as 16 generally split it into a rectangle and triangles. Most candidates could identify the units to be cm². Some candidates did not include units despite space given in the answer row for this. Candidates who attempted the formula for the area of a trapezium often went wrong in substituting the wrong values or quoting the wrong formula, often multiplying 6 and 2 rather than adding.

(b) The description of the rotation was attempted by most candidates, with the majority gaining one mark for correctly identifying the transformation as a rotation. Few candidates gained all three marks as most left out one of the two required parts to describe a rotation. A large number of candidates gave the incorrect direction of rotation or the wrong centre, with (–2, 8) often given or the correct values with no brackets.

(c) (i) Candidates found the transformation of the trapezium challenging with many less able candidates choosing not to attempt any of part **(c)**. The trapezium was often reflected in the wrong mirror line. A number of candidates lost marks because one of the points was incorrectly plotted outside the tolerance of the question.

(ii) The translation was the most successful of the three transformations, with most candidates who attempted this question gaining full marks. Again a number of candidates correctly identified the movement but drew one of the corners outside of the tolerance of the question.

(iii) The enlargement was the most challenging of the three transformations, with very few completely correct answers seen. Many attempts were shown with lines drawn from *P* to the trapezium but few were able to draw the correct enlargement. A scale factor of 0.5 proved particularly challenging with many enlargements of scale factor 2 seen.

(d) Identifying an obtuse angle proved to be challenging for a large number of candidates. Often this was left unanswered or wrong angles identified. Some candidates were unsure how to mark an obtuse angle and often compasses were used to construct their own angle rather than drawing an arc at the correct corner.

Answers: **(a)(i)** Trapezium **(a)(ii)** 16 cm² **(b)(i)** Rotation, 90° [anti-clockwise], [centre] (–2, –8)

Question 3

Candidates were given the opportunity to show their understanding of scatter diagrams in this question. Part **(a)(v)** proved the most challenging as candidates were asked to give a worded description of the results shown in the scatter diagram.

(a) (i) Candidates scored well on this question as most were able to correctly plot 3 out of the 4 points. The point which caused most difficulty was K which was often plotted at (11.8, 6.8) instead of (11.8, 6.85).

(ii) Most candidates drew a ruled line of best fit in the correct position in relation to the points. The most common error was to not use a ruler or to join up all the points.

(iii) Candidates who were able to draw a correct line of best fit generally were able to read off a correct value from their graph.

(iv) The majority of candidates were able to identify the correlation, with few candidates giving further embellishments, like weak negative etc. A large proportion of candidates did not attempt this or the next part of the question.

(v) This part proved to be the most challenging as candidates were required to write a worded answer explaining the results in the scatter diagram. Good answers linked the speed and distance correctly, e.g. faster athlete can jump further, or time and distance, e.g. shorter time means longer jumps. Few candidates who attempted to link the correct measurements got it wrong but a large number of candidates simply gave a numerical comparison, e.g. distance jumped is less than time or time is half distance jumped. These do not describe the relationship between the two measurements.

(b) (i) Most candidates attempted this question with some success. Fewer candidates calculated median or mode than in previous years and good answers showed calculations in full. Most lost marks were due to incorrect rounding. Answers of 11.6 were very common which was an incorrect rounding of the correct answer. A number of candidates gave 11.6 as their answer with no working and therefore lost all marks.

(ii) This part proved more challenging for candidates as many felt they had to identify the 5 athletes whose times were less than 11.5 seconds and then to find an average of these values. A number of less able candidates found 3, 4 or 6 athletes or used a total of 11 instead of 12 athletes to calculate their percentage. As in part **(b)(i)** a number of candidates used the correct method but missed out on full marks due to poor rounding. 41.6 was a very common incorrect answer.

(iii) Most candidates showed a good understanding of range. However a number gave the range for the 100 m rather than the range for the long jump. Candidates should be reminded to reread the question once they have answered it to check they have answered it correctly. Some candidates gave the longest and shortest jumps but did not subtract them.

Answers: **(a)(iv)** Negative **(b)(i)** 11.7 **(b)(ii)** 41.7 **(b)(iii)** 2.45

Question 4

This question tested the candidate's understanding of perimeter, area and volume and required candidates to be able to convert between units of measurement.

(a) Very good answers for this question showed the candidate's ability to form and solve an equation. As it was a 'show that' question it also required candidates to show all lines of working out. To gain full marks candidates had to form an equation in x and then solve it showing all lines of working. Many candidates however approached this question using a purely numerical method and only gave x=150 at the end. This very common method gained one of the two marks. Again a large number of candidates used the 150 in their answer and therefore gained no marks.

(b) Most candidates showed an understanding of perimeter but the majority of candidates did not score on this question because they did not add all the sides of the shape together. It was very common for candidates to miss out the two sides without any markings on the diagram.

(c) (i) More able candidates gave very detailed answers to this question, clearly showing the three calculations of area and their addition. Less able candidates calculated it as one rectangle, often giving 24 000 from 50×480.

(ii) Many candidates correctly followed through their previous answer and gained full marks. A large proportion of candidates chose not to attempt this question or to restart without using their previous answer, usually ending in no marks scored.

(iii) This part was the most challenging of the question as it tested candidate's ability to convert between cm^2 and m^2. Most candidates incorrectly divided by 100 instead of 1 000 000 although many were able to gain one mark for correctly multiplying their previous answer by 16. A common error however was dividing by 16 instead of multiplying.

Answers: **(b)** 1060 **(c)(i)** 16 500 **(c)(ii)** 2 805 000 **(c)(iii)** 44.9

Question 5

Many aspects of number work were examined in this question.

(a) Candidates of all abilities found this question challenging. Writing large values in figures proved difficult because of the number of zeros required in the answer and many candidates misread the number given in the question. Very common errors were 63076, 603076, 6300076.

(b) (i) Candidates were more successful in correctly calculating the answer to this sum. A number of candidates chose to round their answer from the calculator to –0.38 without showing the full answer of –0.375 in their working. Another error was to miss out the minus sign from their answer.

(ii) Candidates found this negative number sum easier with the majority of candidates giving the correct answer. Few errors were seen but the most common was a missing decimal point, misread from the candidate's calculator.

(iii) Candidates found choosing the correct inequalities sign more difficult when having to deal with negative numbers. Many candidates who had correctly answered parts **(i)** and **(ii)** chose the incorrect direction for the inequalities sign.

(c) This question proved challenging to most candidates with few gaining all marks. More able candidates identified the lower or upper bound but rarely both. Common errors were to add and subtract 10 or 0.5 instead of 5.

(d) Most candidates found this fractions question challenging. More able candidates found the correct fraction but most then made errors in rounding their answer to 4 significant figures. The most common incorrect answers were 1.67, 1.666 or 1.6667. Many less able candidates had difficulty with the fractions calculation.

(e) (i) This part was very well answered with the vast majority of candidates understanding that any number to the power zero will be 1. The most common error was 8.

(ii) More able candidates gave the correct fraction for this negative indices question. A number of candidates showed some understanding of indices but did not fully process their fraction and gave the answer of $\frac{1}{5^3}$. Some candidates used their calculator but did not convert the decimal answer back to a fraction, so leaving 0.008.

(iii) Candidates showed a good understanding of simplifying algebraic terms with the majority of candidates gaining full or part marks on this question. Common part marks were given for $24x$ or $11x^9$.

Answers: **(a)** 6 003 076 **(b)(i)** –0.375 **(b)(ii)** –2.2 **(b)(iii)** > **(c)** 3945, 3955 **(d)** 1.667 **(e)(i)** 1 **(e)(ii)** $\frac{1}{125}$ **(e)(iii)** $24x^9$.

Question 6

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

(a) (i) Most candidates were able to attempt this question and many were successful. The most common incorrect answers were those for $x = –2$, given as 12 and $x = –1$, given as 9.

(ii) Points were generally plotted correctly and curves were drawn accurately with smoother shapes and less “sketching” than previously. The most common plotting errors were at $x = –3$ and $x = 3$ where $y = +1$ was plotted instead of $y = –1$.

(iii) This proved to be the most challenging question on the whole paper. Candidates seemed to think that the equation should involve x and y, or 8. $y = 8$ was common as candidates recognised that the answer involved $x = 0$ and substituted this into the original equation. Many candidates gave co-ordinates as their answer. $y = 0$ was also a common error. Many less able candidates chose not to attempt this question.

(iv) Of the candidates who attempted this question most attempted to read from the graph, but some solved the equation algebraically. A large number of candidates read the negative co-ordinate as –3.(...) and some gave 2 positive values e.g. 2.8 and 2.9. Those that attempted to solve it algebraically generally went wrong.

(b) (i) Candidates were successful in plotting the two points correctly and drawing a line which extended beyond their points in both directions. A large number of candidates plotted the second point incorrectly at (2.5, 1) or (–2, –1).

(ii) This question proved very challenging to all candidates. Common errors were to give the gradient as –0.5. Many candidates could give the y intercept as 4. A significant number of candidates gave purely numerical answers or ones involving m and/or c.

(iii) Most candidates attempted this but a large number did not recognise that the scales were different on each axis, giving the y co-ordinate as 6.2 instead of 6.4.

Answers: **(a)(i)** 4, 7, 4 **(a)(iii)** $x = 0$ **(a)(iv)** –2.7 to –2.9, 2.7 to 2.9 **(b)(ii)** [y=] $–2x + 4$ **(b)(iii)** (–1.1 to –1.4, 6.3 to 6.6)

Question 7

This construction and measuring question was well answered by those who attempted it. The vast majority of candidates used the correct equipment to construct a perpendicular bisector and angle bisector, and most candidates made their construction arcs clear.

(a) This part was the most attempted part in this question and those who gave an answer involving degrees were generally successful. 70–90 degrees was most common for those who gave an incorrect angle measurement. A large number gave an answer in centimetres or kilometres, measuring the distance *AB*.

(b) (i) Those who drew a correct bisector within the tolerances generally scored two marks as candidates left in clear construction arcs. A number of candidates drew the correct arcs, but then did not draw in the bisector. Some candidates used a broken line - the locus must be a continuous line. Where the bisector was missing there was often a line drawn from *A*.

(ii) Again those who drew an accurate bisector generally showed construction arcs and scored two marks. The arcs on the lines *AB* and *BC* are often not left clearly enough. A number drew a line from *A* to *C* and appeared to find a midpoint of that, then drew a line from that to *B*.

(iii) Candidates found this part the most challenging. Many had not drawn the bisectors long enough and therefore could not mark *T* at the intersection. A large number whose bisectors did not meet put *T* on one or other of them. Some marked *T* at the intersection of their arcs, or on the midpoint of *AB*.

(c) Candidates did very well at this part with most candidates successfully measuring the distance from *A* to their *T* and correctly using the scale factor to convert to kilometres.

(d) The candidates who recognised the need to draw a circle were successful at drawing a continuous circle, of the correct radius, and centred on their *T*. Some candidates drew a large arc meeting the line *AB* and *BC* but not a complete circle. There were a large number of candidates who did not attempt the question.

(e) Candidates were required to explain why the transmitter's signal did or did not reach town *C*. To earn the mark candidates needed either to refer to the circle in part **(d)** or refer to their correct distance *TC*. Those who just stated that it was "too far" or "not strong enough" did not score. In referring to the circle, use of words such as "range", "area", "radius", "locus" etc. were acceptable. When the candidate referred to their distance *TC* this had to be correct within the tolerances either in centimetres or kilometres.

Answers: **(a)** 106 to 110 **(c)** 24.0 to 25.6

Question 8

Candidates demonstrated a good understanding of probability in this question.

(a) (i) The bar chart was drawn well by the vast majority of candidates. Most candidates chose a scale of 1 square to 1 unit, and were able to accurately draw the heights. Most candidates chose bars 6 squares wide, but some left gaps between bars. The mark was awarded providing the bars and the gaps between the bars were equal, which they generally were. Candidates who did not draw a linear scale could only gain one mark for bars of equal widths.

(ii) The majority of candidates correctly identified the modal group.

(iii) This question was also completed well by most candidates. Most gave the answer as a fraction. However some converted to a percentage and lost the mark if they did not write the percentage sign with their answer.

(b) This part proved to be the most challenging of the question as candidates were asked to explain why the probability given in the question was wrong. Most understood that the numerator should not be higher that the denominator, but did not explain that probability must be between 0 and 1, or not exceed 1. Many put the answer in terms of not being able to take more yellow beads than the number of beads, or that you could not have 7 yellow beads in a bag of 5 beads implying they understood the physical position, but not demonstrating that the numbers in probability do not necessarily tie into the real numbers e.g. could be cancelled down etc.

(c) (i) Candidates were successful in giving the correct probability.

(ii) Most candidates gave a correct numerical answer or (less common) a word to describe zero probability. A large number gave a fraction $\frac{0}{20}$. A significant number gave $\frac{11}{20}$ by taking their answer in part **(i)** from 1, i.e. answering the question they thought it would be. Another common incorrect response was $\frac{9}{11}$.

Answers: **(a)(ii)** 10 to 12 **(a)(iii)** $\frac{19}{120}$ **(b)** Probability must be between 0 and 1 **(c)(i)** $\frac{9}{20}$ **(c)(ii)** 0

Question 9

Candidates of all abilities were able to gain marks on this question about sequences.

(a) (i) This question was the best answered of the whole paper with most candidates able to continue the sequence correctly.

(ii) This required a very basic answer of “add 5”. However candidates had a tendency to over-complicate their answer, often trying to give it as an expression in n. Those who referred to “the difference” without saying what to do with the difference did not earn the mark. Many gave “n+5” as an incorrect response.

(iii) Successful candidates were able to give the correct expression. However many candidates did not attempt this part or repeated their incorrect answer from the previous part of ‘n+5’.

(iv) Many candidates gained the mark in this question despite not scoring on the previous two parts. Most continued to add 5 to the sequence given in the table, with many showing evidence of this in their working. Candidates who had made errors in part **(iii)** generally still gained the mark in this part.

(b) (i) Candidates were successful in continuing the sequence having recognised it increasing by four. A common mistake however was to increase by three and give the values of 9 and 12.

(ii) Candidates who had shown understanding of the nth term earlier in the question were able to answer this successfully. Again many less able candidates did not attempt the question or gave the answer as ‘n+4’

Answers: **(a)(i)** 18, 23, 28 **(a)(ii)** Add 5 **(a)(iii)** $5n – 2$ **(a)(iv)** 73 **(b)(i)** 10, 14 **(b)(ii)** $4n – 2$

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 continued to improve and was generally good. Working was considered essential in **Questions 1(a), 1(b), 1(c), 1(d)(i), 1(e), 2(b), 5(b)(i), 8(c)(ii), 9(a)(i)** and useful in **Questions 1(c)(iii), 2(c)(iv), 4(a)(iii), 4(b)(i), 5(b)(ii), 5(d), 7(a)(i), 7(a)(ii), 9(a)(ii), 9(c)**. 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. If a question asks for a particular degree of accuracy the accuracy mark is lost if this is not done. In “show that” questions, full working must be shown. 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.

Comments on Specific Questions

Question 1

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 and numeracy involving conversions, percentages, ratio, fractions and compound interest. A number of candidates seemed unaware of the strict requrements of a “show that” question and so were not precise enough in their working and calculations for parts **(a)**, **(b)**, **(c)(i)** and **(d)(i)**.

(a) This part required knowledge of converting square kilometres to square metres and required working of $4 \times 1000 \times 1000$ or 4×1000^2 or $2 \times 1000 \times 2 \times 1000$ to be shown. Responses such as $4 \times 1\,000\,000$ or 4000×1000 are not deemed to be sufficient.

(b) Candidates performed better on this part which involved finding a percentage of a quantity and required working of $0.95 \times 4\,000\,000$ or $4\,000\,000 - 0.05 \times 4\,000\,000$ to be clearly and precisely shown with the latter being the most common method used. Responses such as $4\,000\,000 - 20\,000$ and $4\,000\,000 - 5\% \times 4\,000\,000$ are not deemed to be sufficient. A common error was to use 38 000 000 instead of 4 000 000.

(c) **(i)** Candidates generally performed well on this part which involved the use of a given ratio and required working of $3 \div 19 \times 3\,800\,000$ to be shown although this could be done in stages. Responses such as $3 \times 2\,000\,000$ are not deemed to be sufficient. A common error was to use 600 000 instead of 3 800 000.

(ii) Again this part on using the ratio was answered well by the majority of candidates.

(iii) This part was not answered as well with a significant number of candidates not appreciating that the required calculation was $2\,200\,000 \div 140$. A number did not give their answer correct to the nearest 10 as required with common errors being 15 714, 15 700 and 1571. The other common error was in erroneously using upper and lower bounds for 140 or 10 leading to answers of 135, 145, 5 and 15.

(d) **(i)** This part required knowledge of using fractions and required working of $1 - (\frac{24}{40} + \frac{5}{40})$ to be clearly and fully shown. Responses such as $1 - \frac{29}{40}$ and $40 - 29$ are not deemed to be sufficient. Many candidates found this calculation without the use of a calculator as specified in the question to be difficult. Those candidates who used decimals or numerical values rarely showed sufficient and adequate working. Common errors included $\frac{29}{40}$, $\frac{19}{40}$ from $\frac{24}{40} - \frac{5}{40}$, $\frac{3}{40}$ from $\frac{3}{5} \times \frac{1}{8}$, $\frac{4}{13}$ from an incorrectly attempted $\frac{3}{5} + \frac{1}{8}$ and $\frac{9}{13}$.

(ii) This part was generally answered well particularly with a follow through answer being allowed.

(e) Those candidates who used the correct formula for finding compound interest generally did well and were able to score full marks although a significant number spoilt their method by giving just the interest rather than the total amount repayable. Those candidates who used a year on year method in stages were less successful and often lost the accuracy mark or just added the 3 interest amounts together. A common error was in using simple interest which scored zero marks.

Answers: **(c)(ii)** 2 200 000 **(c)(iii)** 15 710 **(d)(i)** $\frac{11}{40}$ **(d)(ii)** 165 000 **(e)** 281 216

Question 2

This question tested the candidate's knowledge of polygon properties and also sequences.

(a) The eight sided polygon was generally correctly named as an octagon although common errors included hexagon, heptagon, with a number of other responses also seen.

(b) Calculating the interior angle proved challenging for many candidates. Those who found the exterior angle first and then used the straight line property to find the interior angle tended to do better than those who used the formula for the interior angle. Common errors were to give 45° and 1080° as the final answer.

(c) **(i)** The sequence was generally correctly answered although a common error was 8, 15, 23, 32, 42.

(ii) There did seem to be an improvement in the number of candidates who were able to give a correct expression for the nth term of the sequence, although '$n + 7$' was still a very common error.

(iii) This part was generally answered well although the majority extended the sequence to obtain the answer rather than using the nth term.

(iv) This part was generally answered well although the majority again extended the sequence to obtain the answer rather than using the nth term. Common errors included the incorrect calculation of $\frac{92}{7}$ and the use of $n = 92$.

Answers: **(a)** Octagon **(b)** 135° **(c)(i)** 22 29 36 **(c)(ii)** $7n + 1$ **(c)(iii)** 71 **(c)(iv)** 13

Question 3

This question on transformations was generally answered well. 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) The fact that the given diagram was on a square grid rather than a co-ordinate grid appeared to cause problems for a number of candidates. Whilst the majority were able to identify the two transformations as a reflection and a rotation, few were able to give a full description by stating the correct mirror line or centre of rotation. A small but significant number were unable to attempt this part or simply gave a description of the given shape.

(b) (i) The correct image for the given translation was generally seen.

(ii) Candidates were less successful in drawing the correct image for the given enlargement with many answers of the correct size but from an incorrect centre of enlargement.

(c) Those candidates who had a symmetric enlarged triangle were generally able to draw the line of symmetry in the correct position.

Answers: **(a)** Reflection in the line *AB*, rotation of 180˚ about the midpoint of *AB*

Question 4

This question tested the candidates' ability to draw and use a travel graph and to use the distance, time, speed formulae.

(a) (i) This part was generally answered well with most candidates able to score at least two of the available three marks. Marks were lost by the inaccurate plotting of the points whilst others didn't show the train at rest at Cordoba. A small but significant number of candidates appeared unfamiliar with the concept and simply plotted points or drew a series of vertical and horizontal lines.

(ii) This part was generally answered well although common errors of 2hr 30min and 1hr 40min were seen; the first not including the time the train was stationary and the second suggesting that the candidate only found the time taken for the first part of the journey.

(iii) Candidates generally used the correct formula for speed although few fully correct answers were seen. The common errors included not converting the time accurately enough and using 2.6, 2.67 or 2.7, converting incorrectly as 2.4, or misreading the distance scale and using an incorrect distance such as 452 and 454.

(b) (i) Again but to a slightly lesser extent candidates generally used the correct formula for time although few fully correct answers were seen. The common errors were not correctly converting 2.35 hours to 2hr 21min and using an incorrect distance.

(ii) The majority of candidates were able to correctly plot the first point at (07 45,470) but many were unable to correctly plot the point to show when the train arrived at Madrid even allowing for a follow through from the previous part. This suggests that a significant number had difficulty adding their time interval to the start time of 07 45.

(c) Those candidates with two intersecting lines on their travel graph generally scored the mark as correct or follow through answers were credited. A wide variety of other answers were seen suggesting the use of the drawn travel graph was not always appreciated.

Answers: **(a)(ii)** 2hr 40 min **(a)(iii)** 176.25 **(b)(i)** 2hr 21 min **(c)** 290 to 300

Question 5

This question on geometric shapes, area and perimeter proved a good discriminator and the full range of marks was seen. Candidates would have benefitted by adding the given value of 48 from part **(b)(i)** to the diagram as this would have helped with the subsequent parts.

(a) (i) Roughly half the candidates correctly named the given quadrilateral as a trapezium. Other answers included all the other standard quadrilaterals, a variety of triangles, a variety of polygons and some numerical answers.

(ii) This part was not answered as well with less candidates able to name the given shape as a pentagon. Again a full variety of answers were seen.

(b) (i) This part proved to be quite challenging and few candidates were able to recognise the need for Pythagoras' theorem and then successfully obtain and use 20 from $70 - 50$. Only the more able candidates could then show with sufficient clarity the correct method to obtain 48, which was required in this "show that" question. Common errors included the use of Pythagoras' theorem with incorrect values, often 70 and 50, and more often attempts to simply manipulate the values given to get 48 such as $52 - 4$, $24 + 24$ and $180 - 132$.

(ii) This part on finding the area of a rectangle was generally answered well although a significant number did not appreciate that the length of the rectangle had to be found first. Common errors were $70 \times 48 = 3360$, $82 \times 52 = 4264$, and a variety of incorrect formulae were also used.

(c) (i) This part on finding the perimeter of the stated quadrilateral was again generally answered well. Although most realised that addition of the dimensions was required candidates did not always know which lengths or how many lengths they needed to add.

(ii) This part on finding the area of a trapezium was not generally answered as well and although many attempted to use the formula a significant number did not appreciate that the height of the trapezium was 48. Common errors were $0.5 \times (50 + 70) \times 52$ and $0.5 \times 50 + 70 \times 52$. Evenly favoured by candidates was the equally valid method of treating as a compound area and calculating $50 \times 48 + 0.5 \times 20 \times 48$ or $70 \times 48 - 0.5 \times 20 \times 48$. Common errors here were again incorrect use of 52 not 48, incorrect triangle area calculation (often 0.5 omitted), and not adding/subtracting the triangle area. A variety of other incorrect formulae and calculations including $52 \times 50 \times 48 \times 70$ were also seen.

(d) This part on finding the area of a triangle was generally answered well with a large number of fully correct answers seen. However a significant number did not appreciate that the required length *AE* was half of 48. Common errors were $0.5 \times 9 \times 48$, $0.5 \times 9 \times 52$, $0.5 \times 9 \times 26$, 9×24, 9×26 and $0.5 \times 9 \times 9$. A variety of other incorrect formulae and calculations including $9 \times 24 \times 26$ were also seen.

(e) This part proved challenging for many candidates with few appreciating that the required shaded area could be found by using their previous answers in 'area of the shaded polygon' = 'area of the rectangle *ABCD'* – 'area of the trapezium *BCHG*' – 'area of the triangle *AEF*' i.e. parts **(b)(ii)** – **(c)(ii)** – **(d)**. Candidates who attempted to start again from scratch were rarely successful with a number of incorrect formulae and incorrect values used. Common errors were 52×12 and $0.5 \times 52 \times 12$. A significant number of candidates did not attempt this part.

Answers: **(a)(i)** Trapezium **(a)(ii)** Pentagon **(b)(ii)** 3936 **(c)(i)** 220 **(c)(ii)** 2880 **(d)** 108 **(e)** 948

Question 6

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) **(i)** The table was generally answered well with the majority of candidates giving 4 correct values for 2 marks although common errors of a missing negative sign were seen.

(ii) The graph was generally plotted very well with two distinct branches. The majority were able to draw correct smooth curves with very few making the error of joining points with straight lines.

(iii) This part was generally answered very well with many candidates scoring one mark for a correct solution to the equation. However many candidates had solved the equation algebraically and so only relatively few scored the second mark for drawing the required line of y=6 which needed to be seen. Other common errors included drawing the line x=6 or giving solutions of 120, 14 and 3.

(b) **(i)** The table was generally answered well with the majority of candidates giving 3 correct values for 2 marks although common errors of −2.5, 0, 2.5 and −4, 0, 4 were seen.

(ii) A large number of correct lines were seen although a small number lost the mark by not using a ruler. Straight line graphs are required to be drawn using a ruler. A common error was to plot the point (0,−1) at (−1,0).

(iii) Those candidates who understood the $y=mx+c$ form for a straight line were generally able to write down the correct value for the gradient. Those who attempted to calculate the value were less successful with common errors being $-\frac{1}{2}$, −1, −5, 2 and (1, 2).

(c) The majority of candidates were able to score both available marks for accurately reading values from their graphs for the intersection of their curve and their line, although a significant number had some difficulty with the negative value with common errors of 5.4 and −6.6. As the question asked for the values of x, answers in co-ordinate or vector form were not acceptable.

Answers: **(a)(i)** −5, −8, 5, 2.5 **(a)(iii)** 3.1 to 3.6 **(b)(i)** −5, −1, 3 **(b)(iii)** $\frac{1}{2}$ **(c)** 7.2 to 7.6, −5.2 to −5.6

Question 7

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

(a) **(i)** This part asking for the calculation of the mean was generally answered well. Common errors included 155, 16 (the median calculated) and 15. A small number misused their calculator usually by the omission of brackets leading to the incorrect answer of 142.4.

(ii) This part asking for the calculation of the median was less successfully answered. Common errors included 14 and 18, 15.5 (the mean calculated), 14 or 18. The most common error however was to not order the values leading to answers of 11.5, 3, 20, 3 and 20. A small number misused their calculator usually by the omission of brackets leading to the incorrect answer of 23.

(iii) This part asking for the calculation of the range was generally answered well. Common errors included 3, 29, 29 − 3 and 3 − 29, and a number of no responses.

(b) **(i)** This part asking for the completion of the bar chart was generally answered very well. Common errors included the odd mis-plot or incorrect reading of the scale.

(ii) The majority of candidates were able to identify August as the modal month although the common errors included 363, February (lowest value), 336, and March/June (as same values).

(iii) This part asking for a probability was less successful. Common errors included 4, $\frac{4}{340}$, $\frac{4}{3672}$, $\frac{3}{12}$, or listing another month.

Answers: **(a)(i)** 15.5 **(a)(ii)** 16 **(a)(iii)** 26 **(b)(ii)** August **(b)(iii)** $\frac{4}{12}$

Question 8

This question on bearings, scale drawings, trigonometry and construction with a common theme running through the question proved challenging for a number of candidates though it proved a good discriminator with the full range of marks being seen.

(a) **(i)** Those candidates who were familiar with the term bearing were usually able to measure the angle correctly within the accuracy limits allowed. However many candidates appeared to struggle to find the correct bearing and were either measuring the incorrect angle from *P* to *Q* to give 115˚, the reverse bearing of 245˚, or the reflex angle of 295˚. Another common error was to state the distance of 48 or 6 as the answer.

(ii) More candidates were able to find the correct scale from the calculation of $\frac{48}{6}$. However a significant number did not appreciate that the given diagram could be used in this way resulting in common errors of 6, 10,100 and 1000.

(b) This part required candidates to complete the scale drawing to show the given second stage of the journey and although many good answers were seen the errors and problems outlined above were often repeated. The main error was in drawing the correct angle for the bearing with common errors of using the line *PQ* rather than the North line, simply extending the line *PQ*, and using angles of 55˚ or 235˚. The drawing of the correct length was more successful although the scale from part **(a)(ii)** was often not used and lines of length 7.6cm were drawn.

(c) **(i)** This part required knowledge of angle properties and required working of 297 – 270 or 90 – (360 – 297) to be shown though this working could be done in stages. Responses such as 90 – 63, 360 – 297 – 90 and 207 – 180 are not deemed to be sufficient.

(ii) Candidates found this part on trigonometry to be very demanding with a significant number either offering no response or giving an answer with no reference to trigonometry. Common errors included not finding the required length even after a correct ratio was seen, tangent ratio used and the attempted use of 297˚. A very common further error was in the accuracy of the answer as the instruction of “Give your answer correct to 2 significant figures” was often ignored or done incorrectly.

(d) This part on the construction of the perpendicular bisector was generally done well although candidates should be reminded to show clearly all necessary arcs and to draw the bisector as a continuous ruled line.

Answers: **(a)(i)** 063° to 067° **(a)(ii)** 8 **(c)(ii)** 7.6

Question 9

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 and numeracy involving cost calculations, percentages and the correct use of a number of mathematical operations within a themed context.

(a) (i) The majority of candidates recognised the three necessary operations and a good number of correct answers for full marks were seen with incomplete or inaccurate answers usually scoring one or two of the available method marks. A common error was in not converting the 24 cents into \$0.24 with working of $5 \times 36 + 660 \times 24$ giving the unrealistic answer of \$16 020. Other common errors included $(36 + 24) \times 5$ or $(36 + 24) \times 660$.

(a) (ii) This part was generally answered well with a follow through permitted. The common method used was to find 15% and then add on although those candidates who calculated 115% were more successful and less likely to lose the accuracy mark. The common error was \$50.76 from just finding 15%.

(b) (i) This part was generally answered well although a significant number could not pick out the required information from that given resulting in common errors of $\frac{660}{1.80}$, $\frac{660}{11} \times 1.80$, 660×1.80, and 660×11.

(ii) This part was generally answered well with a follow through permitted, although again a significant number could not pick out the required information from that given.

(iii) This part caused more problems for candidates with many not appreciating that the total cost could be found by adding together their answers to parts **(a)(ii)** and **(b)(ii)**.

(c) This part proved challenging for all but the more able candidates and also had a fairly high no response rate. Unrealistically high costs in the previous part also caused problems for many candidates and possibly led them into incorrect methods. Few candidates appreciated that they could find the fraction first of $\frac{\textbf{(b)(iii)}}{1600}$ and then convert to a percentage by multiplying by 100.
Common errors included $\frac{1600}{\textbf{(b)(iii)}} \times 100$, $\frac{1600 - \textbf{(b)(iii)}}{1600}$, $\frac{\textbf{(b)(iii)} - 1600}{1600}$.

Answers: **(a)(i)** 338.40 **(a)(ii)** 389.16 **(b)(i)** 60 **(b)(ii)** 108 **(b)(iii)** 497.16 **(c)** 31

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, some candidates just provided answers or did not carry out calculations to sufficient accuracy and consequently lost marks. Candidates should be encouraged to give all necessary detail in descriptions, especially in transformations.

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.

Candidates should take the time to read the questions carefully to understand what is actually required in each part.

Comments on Specific Questions

Question 1

Candidates showed a good grasp of statistics, especially with regard to frequency and bar charts. They could improve further by identifying carefully the difference between mean, mode etc., showing all their working and where necessary using the correct number of significant figures.

(a) (i) Candidates were able to provide very accurate frequency tables with only a few slips. The tally column was rarely used but when it was, normally it was for the frequency with the relative frequency in the frequency column.

(ii) The bar chart was usually drawn accurately. The common errors were to not label the vertical axis and very occasionally to draw bars of different widths.

(b) More than half the candidates gave the correct fraction. If a decimal was given many candidates gave an answer to 3 significant figures but those who only used 2 significant figures lost the mark.

(c) Candidates were fairly equally divided between whether the statement was correct or not. Candidates who said the statement was false tended to give the correct reason that the group sizes were different. Candidates who said the statement was true suggested this was because the same number of girls and boys liked comedy.

(d) (i) Candidates who gave the correct answer and showed working recognised that the frequency for 0 and 1 together was the same as that for 3, 4, 5 and 6 together so the answer must be 2. Some candidates wrote out all the numbers. The common error was to take the midpoint of the number of movies, 3.

(ii) Many candidates understood how to calculate the mean but a proportion of them made mistakes. These included $0 \times 4 = 4$ and/or $5 \times 0 = 5$. The other common error was to divide by 7.

Answers: **(a)(i)** 4, 5, 3, 6, 2 **(b)** $\frac{14}{24}$ **(d)(i)** 2 **(d)(ii)** 2.28

Question 2

Many candidates showed a good understanding of money and interest calculations.

(a) All candidates understood what was required in this part. The common error of a few candidates was to round their answer as it was an exact answer.

(b) A large majority of candidates completed this "show that" part correctly. The common error was to either not show that 20% = 0.2 or 80% = 0.8 or to use the answer to show the original earnings.

(c) (i) Many candidates gave the correct answer. Occasionally candidates found one of the other amounts, such as savings.

(ii) Although some candidates recognised that $\frac{9}{15}$ can be found via the 9:4:2 ratio, many went back to the amounts of money. In such cases many candidates lost marks for premature approximation.

(d) (i) Very few candidates used a multiplier of 1.15 to obtain the answer. Many candidates found 15% and then added it on. Again marks were lost through premature approximation or not giving the full exact answer.

(ii) Candidates found this part challenging. A common error was premature approximation and/or not giving the full exact answer. Some candidates were also unable to distinguish between whether to multiply or divide by 0.52.

(e) (i) Candidates understood how to start to calculate percentages. However, common errors of leaving incomplete answers of $\frac{1}{8}$ or 0.125 were seen.

(ii) Very few candidates attempted to use the simple interest formula. Occasionally 1.45 was used instead of 1.045 as the multiplier. When candidates worked on a year by year basis they generally understood to use the correct degree of accuracy.

Answers: **(a)** 249.75 **(c)(i)** 230.4[0] **(c)(ii)** $\frac{3}{5}$ **(d)(i)** 488.75 **(d)(ii)** 19.15 **(e)(i)** 12.5 **(e)(ii)** 172.93

Question 3

Candidates were able to demonstrate that they understood travel graphs, timetables and distance = speed $\times$ time. They could improve their responses by careful reading of the question to ensure that the correct times and places are being used.

(a) The vast majority of candidates understood how waiting time is portrayed on a travel graph and could read off times.

(b) Although many candidates gave very good explanations, some candidates appeared to misunderstand the question and wrote yes or no instead of before or after.

(c) Almost all candidates gave the correct answer.

(d) (i) Candidates understood the concept of distance=speed x time. The main error was to give an answer of 1 hour 50 minutes.

(ii) A majority of candidates could draw the remainder of the travel graph accurately. The common error was to miss out the part of the travel graph relating to staying at the lake.

(e) (i) Many candidates could read a timetable and provide the correct answer. The two most common errors due to misreading the question were 1027 (bus arrives at Country Park just before 11 30) or 1127 (bus leaves High Street just before 11 30).

(ii) A small majority of candidates demonstrated how to find the difference of two times. The common error was a misread of the start and destination points. A few candidates assumed there were 100 minutes in an hour.

(f) The majority of candidates who drew a line either gave the correct length or bearing but few gave a completely correct answer.

Answers: **(a)** 10 **(b)** Before, steeper gradient **(c)** 11 20 **(d)(i)** 1 hour 48 minutes **(e)(i)** 10 57 **(ii)** 24

Question 4

Candidates demonstrated some knowledge of trigonometry. However, there is a need for further practice on which formulae and theorems should be used in particular circumstances.

(a) (i) Candidates generally gave the correct answer.

(ii) Candidates generally understood that the sum of the angles of a triangle equals 180.

(iii) Very few candidates gave the correct answer. Many candidates appeared to misread the question and gave the value of angle *ABC,* not the reflex angle.

(iv) Most candidates understood that angles on a straight line add up to 180.

(v) Many candidates gave the correct answer or the correct follow through from previous answers.

(vi) Most candidates gave the correct answer or the correct follow through from previous answers.

(vii) Few candidates gave one of the correct answers. Some candidates used triangles involving the angle *A,* or gave one of the similar triangles in clockwise order and the other in anticlockwise order.

(b) (i) Although some candidates understood the need to use a formula, many did not use a correct one. A common error was to use a formula for the interior angle.

(ii) Some candidates were able to obtain the follow through from the previous part. A common error was to assume the interior and exterior angles added to 360 not 180.

Answers: **(a)(i)** 85 **(a)(ii)** 10 **(a)(iii)** 320 **(a)(iv)** 95 **(a)(v)** 95 **(a)(vi)** 55
(a)(vii) *BCE* and *GCF* or *BCD* and *GCH* or *CED* and *CFH* **(b)(i)** 30° **(b)(ii)** 150°

Question 5

Candidates continue to improve in their calculations of values, the plotting of the points and drawing of neat, continuous curves. They could improve by being careful when reading different scales on the x-axis and y-axis.

(a) (i) Only a very few candidates gave the correct answer. Where candidates did not show any working they generally lost all the marks. When working was shown some candidates achieved part marks, although in many cases the formula for the gradient was inverted or the difference in the x co-ordinates was inverted to the difference in the y co-ordinates.

(ii) Some candidates used their gradient to form an equation but several did not recognise that the constant term came from reading off the intersect of the line with the y-axis.

(b) (i) Nearly all candidates obtained the correct points.

(ii) Many candidates demonstrated a good understanding of plotting points and drawing neat continuous curves. There were only a few cases of straight lines being used.

(iii) Most candidates demonstrated an ability to read values of intersections. The common error was to misread the negative solution, writing –3.6 as –4.4 for example.

(c) Most candidates demonstrated an ability to read values of intersections. The common error was in the y co-ordinates where the scale is different to the x co-ordinates.

Answers: **(a)(i)** –2 **(a)(ii)** $-2x + 3$ **(b)(i)** 6, 7, 6, –9 **(a)(iii)** –3.8 to –3.5 and 1.5 to 1.8
(c) (1.7, –0.4) and (–1.7, 6.4)

Question 6

Candidates were able to demonstrate an understanding of expressions and simplifications. Their answers would be improved by careful reading of the question and attention to detail in simplification. This includes multiplying out of brackets correctly and ensuring negative signs are used correctly.

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

(b) Nearly all candidates understood and wrote down a correct expression for the perimeter of a triangle. The main errors were slips in the subsequent simplifications especially with regard to the minus signs.

(c) (i) Many candidates understood and correctly wrote down an expression for the perimeter of the rectangle. Some did not multiply the sum of the two given sides by two. The main error was in the simplification with incorrect multiplication of brackets.

(ii) Candidates who did equate their two solutions usually did so correctly although some added the two solutions instead of equating them. Full marks were often awarded for correct follow through from the previous parts.

(d) Candidates found this part challenging with some omitting it completely. When answers were seen they followed an attempt to place their x-values into the expressions for the two sides. However, when this gave a negative answer the minus sign was often ignored.

(e) Where candidates had given answers to the previous part they generally multiplied them together correctly.

Answers: **(a)** $2x - 3$ **(b)** $5x - 4$ **(c)(i)** $4x + 4$ **(c)(ii)** 8 **(d)** 12, 6 **(e)** 72

Question 7

Candidates showed a good understanding of sequences in this question. Most used a counting on method rather than attempting a formula. Candidates should continue to be encouraged to show all their working and formulae that they use.

(a) Almost all candidates gave the correct answer. The only error was in the answers for the final column where some candidates just continued the sequences to the next term rather than the 8th term.

(b) (i) A small majority of candidates gave the correct answer. The common wrong answer was $n + 2$.

(ii) Quite a few candidates gave the correct answer. The common wrong answer was $n + 4$.

(c) Many candidates showed no working. Those that did showed that they were counting up and did so accurately. The most common error was to say that pattern B with 16 tables was the answer, mostly with no supporting working.

Answers: **(a)** 10 12 20 **(b)(i)** $2n + 4$ **(b)(ii)** $4n + 2$ **(c)** B [by] 15 [tables]
14 18 34

Question 8

Candidates found this question challenging. They can improve their answers by more practice on accuracy of drawing nets, converting between cm and mm and finding upper and lower bounds.

(a) (i) Many candidates identified the shape correctly as a prism. Some added the word rectangular instead of triangular losing them the mark. A common error was to write pyramid.

(ii) Some candidates gave fully correct nets. The common error was the triangles being the wrong height. Some candidates attempted to draw 3D shapes.

(iii) Most candidates understood that the answer would be the original multiplied or divided by ten or tens. Only a few candidates did this correctly. Some candidates then went on to round the answer.

(iv) Candidates generally thought that "correct to the nearest" meant the bounds were found by adding or subtracting this number rather than half of it.

(b) (i) Many candidates identified the correct formula required. Some used the given diameter instead of the radius. Common wrong formulae used were $2\pi r^2$ and $2\pi r$.

(ii) Many candidates identified that the label was a rectangle. However, some did not recognise that one side was the circumference.

Answers: **(a)(i)** [Triangular] prism **(a)(iii)** 109.86 **(a)(iv)** 115 **(b)(i)** 70.7 **(b)(ii)** 37.7

Question 9

Candidates showed a good understanding of transformations. They were generally able to draw accurately. Describing the transformations could be improved by further practice on what information is required for each type of transformation and ensuring that a single transformation is given.

(a) (i) Most candidates were able to draw the correct line.

(ii) Many candidates drew the correct reflection. The common error was to make a reflection in the y-axis instead of their drawn line.

(iii) Some candidates drew the correct rotation. More candidates gave a correctly orientated rotation about another point such as the base of the original flag or their drawn reflection. A few candidates gave an incorrectly orientated rotation about the correct point.

(b) (i) Generally candidates were able to give a good description of this transformation.

(ii) A common error was to not fully describe the enlargement by missing out either the scale factor or centre of enlargement.

Answers: **(b)(i)** Translation by $\begin{pmatrix} -3 \\ -4 \end{pmatrix}$ **(b)(ii)** Enlargement, [scale factor] 2, [centre] (6, 0)

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key message

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

Work should be clearly and concisely expressed with answers written to an appropriate level of accuracy. It is important that candidates do not prematurely round numbers in calculations. In questions where the answer is given candidates must ensure the solution leads directly to the given result and the given result should not be used as part of a solution.

In parts worth more than 1 mark, if an incorrect answer is given then marks are available for written methods.

General comments

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

Candidates generally 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.

Candidates' recall of formulae particularly the cosine rule and the quadratic formula contained a few more errors than seen in previous years.

There continue to be a significant number of candidates losing unnecessary accuracy marks by either approximating values in the middle of a calculation or by not giving answers correct to at least three significant figures.

Candidates should take care with how they write numbers and mathematical symbols. There is no need for candidates to completely erase incorrect working, a neat single line would be better. It is difficult and often impossible to decipher responses when the candidate has overwritten a previous attempt.

The questions on ratio, simple transformations, algebraic manipulation, graphing functions, cumulative frequency, and predicting next terms of sequences were very well attempted. The questions involving problem solving with speed/time graphs, calculations with bounds, completing the square, unstructured probability, similarity, vectors and generalising sequences proved to be the more challenging aspects on the paper.

Comments on specific questions

Question 1

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

(a) (i) This part was well answered by the vast majority of candidates.

(ii) Although most candidates gave the correct answer, there was quite a large number who could not do this part. Some multiplied 13.5 by $\frac{3}{12}$ and others incorrectly used 72 in their calculation.

(iii) Answers to this reverse percentage problem were mixed. Quite a large number calculated 12% and then subtracted this from \$8.40, or calculated 88% of \$8.40, to arrive at \$7.392 or \$7.40. A smaller number gave \$9.408 or \$9.41 from calculating 112% of \$8.40. Those that associated \$8.40 with 112% as their first step almost always went on to complete the method correctly.

(b) (i) Many candidates found this part challenging. There were some good solutions obtained by splitting the hexagon into 6 equilateral triangles, or by slighter longer methods such as two triangles and a rectangle or two trapeziums. As the answer was given in the question it was necessary for the candidates to give a more accurate answer but not all did so, an example being: area of trapezium = 0.5(2 + 4)√3 = 5.196 = 5.2, hence area of hexagon = 2 x 5.2 = 10.4. Some with incorrect attempts to find the area of cross section used the height of 45 cm.

(ii) Most found the volume by multiplying the area of cross section by the height. There were a large number who did not use consistent units and so did not convert 45cm into 0.45m. Some had little idea on how to use the area of the cross section to find the volume.

(iii) There were very few fully correct answers. In the vast majority of cases candidates correctly multiplied their volume by 1250 and divided by 1000 to obtain the number of tonnes required. Those who reached an exact number of tonnes such as 585 from a volume of 468 m^2 could only score 2 marks. Of those who had a mass which was not an integer few appreciated the need to round up to a whole number so simply multiplied their unrounded value by the cost per tonne, and a small number rounded down. Many didn't fully understand the table and gave the cost of just one tonne from the appropriate range. Others combined costs, for example mass = 5.85 tonnes so cost = 5 × 47 + 0.85 × 45.5.

Answers: **(a)(i)** 42 **(a)(ii)** 54 **(a)(iii)** 7.50 **(b)(ii)** 4.67 **(c)** 273

Question 2

This question involving algebraic manipulation, speed-time graphs and calculations involving bounds had a full range of answers.

(a) Many were able to change the subject of the formula correctly. A number interchanged u^2 and v^2 without changing a sign and so finished with $u = \sqrt{v^2 - 2as}$. A common incorrect answer was $u = v + \sqrt{2as}$ usually following a correct first step or even after a correct answer shown in the previous step. A number gave an incorrect first step such as dividing both sides by $2as$.

(b) (i) Some candidates found this part challenging which was often as a result of using time = distance × speed rather than time = distance ÷ speed, leading to $60x$ and $45(x + 4)$. Those using the correct formula nearly always wrote down the correct equation and often carried out the correct algebraic steps to obtain the required equation. A small number did not earn the final mark as a result of an omission, such as an equals sign, in the working.

(ii) The quadratic was solved correctly by the majority. Although some used the factorisation method, it was more common to see the quadratic formula used. Quite a large number made errors when substituting into the quadratic formula usually involving an incorrect sign. A significant number didn't realise that the answer needed to be positive and so gave both 16 and −2.5.

(c) (i) The majority of candidates earned the mark but a number gave $\frac{v}{20} = 0.75$ without showing the required next step of 20 × 0.75. A small number arrived at the given answer from using incorrect numbers.

(ii) A large number simply calculated 1800 ÷ 15 = 120. Of those who realised that it is necessary to consider the speed-time graph, many calculated the area of the right-hand triangle as 300 but then only divided by 15 and reached a total time of 130 seconds. Those who were able to write down the area of the whole trapezium rather than breaking it down into smaller regions usually found the correct answer. Many did find the area of the rectangle, and this was given some credit, with fewer finding the area of the left hand triangle, with quite a number calculating it as 20 × 0.75.

(d) This was a challenging question with very few obtaining the correct answer. Most did divide a distance by a time and many gave the upper bound for the distance as 22.5. The most common error was then to give the upper bound of 2.75 for the time rather than the lower bound of 2.25 that is required to give the upper bound for the speed.

Answers: **(a)** $\sqrt{v^2 + 2as}$ **(b)(ii)** 16 **(c)(ii)** 150 **(d)** 10

Question 3

This question on transformations and matrices was answered well by some candidates.

(a) There was a mixed response to this part. Nearly all gave a reflection but many reflected in the x-axis rather than the line $x = 0$.

(b) There were a large number of completely correct rotations. Most candidates rotated the triangle through 90˚ anticlockwise with only a small number rotating clockwise. Some, however, used an incorrect centre of rotation, quite often with one vertex at (−4, 0).

(c) (i) Most candidates gave the name of the transformation as an enlargement and although some did not give a scale factor, those who did usually gave it correctly. Not all candidates gave a centre of enlargement and there was a mixed response from those who did. Some gave it as (0, 0) but many did draw the construction lines through the corresponding vertices of triangles *A* and *B*. Most did this accurately enough to obtain the correct centre but it was quite common to see a centre such as (−6.5, 6.5) given.

(ii) There was a mixed response to this part with correct answers of 1 : 4 or occasionally 3 : 12 seen often. The incorrect answer of 1 : 2 was given more often however.

(d) It was quite common to see this part omitted. Those who did attempt it were either able to recall the matrix correctly or not as there was little evidence of candidates attempting to draw a diagram to help find the transformation matrix. Many were able to do this correctly but answers such as $\begin{pmatrix} 1 & 0 \\ 0 & 4 \end{pmatrix}$ for which partial credit was given, $\begin{pmatrix} 0 & 1 \\ 4 & 0 \end{pmatrix}$ or $\begin{pmatrix} 1 & 0 \\ 4 & 1 \end{pmatrix}$ were given.

(e) (i) This part was also omitted by some and others drew an incorrect image without attempting to write down a matrix multiplication. Some of those using matrices were not always able to write down the vectors representing each vertex of triangle *A* correctly, with the x and y elements often reversed. Another error seen regularly was the 2 by 2 transformation matrix placed behind the 3 by 2 matrix instead of in front. Generally if the matrix multiplication was written down correctly the multiplication was carried out well but a few candidates made a sign error. The plotting was also carried out accurately with just the occasional mis-plot seen, usually involving (0, 1).

(ii) Many were able to give the name of the transformation as a shear although other transformations were given with a stretch being the most common incorrect answer. If the scale factor was given it was nearly always correct. Some gave the x-axis as the invariant line and a few wrote down 'y is the invariant line' omitting the word axis, which is essential.

(iii) This was answered well with many able to calculate the determinant as 1 and then write down the correct answer. Some gave the determinant as −1 and some made a sign error or interchanged the wrong pair of elements when writing down the inverse.

Answers: **(c)(i)** Enlargement, scale factor 2, centre (−7, 7) **(c)(ii)** 1 : 4 **(d)** $\begin{pmatrix} 4 & 0 \\ 0 & 1 \end{pmatrix}$ **(e)(ii)** Shear, factor 2, y-axis invariant **(e)(iii)** $\begin{pmatrix} 1 & 0 \\ -2 & 1 \end{pmatrix}$

Question 4

This question on algebraic manipulation, inequalities and completing the square was answered well initially but candidates generally lacked the skills and knowledge in the final part.

(a) (i) This was answered well with most candidates giving the correct answer. Some made a sign error when multiplying out the second set of brackets and others made an error when simplifying $8x - 9x$.

(ii) This was answered well with many scoring full marks. Some made an error such as writing $6x$ instead of $6x^2$ when carrying out the initial expansion. Some who carried out the multiplication correctly made an error when simplifying $-9xy + 8xy$ and a few having obtained the correct simplified expression then attempted to re-factorise it.

(b) This was nearly always answered correctly with just an occasional incorrect answer seen such as $x^2(x - 5)$.

(c) There was a good response to this question. Most candidates successfully eliminated the fractions and multiplied out the brackets correctly. Many then went on to give the correct answer although some gave the answer as $x \le 4$ usually as a result of not reversing the inequality when dividing by a negative number.

(d) (i) Candidates found this part very challenging. Many attempted to expand $(x - p)^2$ and did not recognise the form required from the quadratic. In doing this errors such as $x^2 - 2px - p^2$ were made. Those that did expand the bracket correctly generally did not make any further progress. Some attempted to 'complete the square' on the left hand side which was the more efficient method and a small number did this correctly and were able to give at least one of the correct values for p and q.

(ii) This was often omitted and it was rare to see a correct answer. Some calculated the roots of $x^2 - 9x + 12 = 0$ and incorrectly gave the smallest of these for the minimum value of the function.

(iii) This was rarely answered correctly, and only a few made the link between the line of symmetry of the curve and the value of p from part **(d)(i)**.

Answers: **(a)(i)** $11 - x$ **(a)(ii)** $6x^2 - xy - 12y^2$ **(b)** $x(x^2 - 5)$ **(c)** $x \ge 4$ **(d)(i)** 4.5, 8.25 **(d)(ii)** –8.25 **(d)(iii)** $x = 4.5$

Question 5

The graph drawing part of the question was done well by many but solving the related equations proved more challenging.

(a) Most candidates gave the correct values although some made an error when $x = -1$ giving instead -4 from $(-1)^2 + \left(\frac{3}{-1}\right) = -1 - 3 = -4$.

(b) The plotting was generally good although many candidates made an error in plotting at least one of the points. The errors were usually with the value at $x = -2$ plotted at 3 rather than at 2.5 or the plots at 0.4 or 0.6. The overall quality of the curves was very good although there are still a number of candidates that join the two branches of the curve together and do not appreciate that there is no value for $x = 0$ for this function.

(c) The readings from the graph were mostly within the accepted range and errors that occurred were often as a result of a curve not drawn quite accurately enough. It is advisable when solving an equation using a graph to draw the relevant line, in this case $y = 5$, but many candidates did not do this.

(d) Those candidates who were able to draw the line $y = x + 5$ accurately almost always scored well on this part. There were some who omitted this part and others who were not able to draw the line required to solve the given equation.

Answers: **(a)** – 2, 5.5 **(c)** −2.6 to −2.4, 0.6 to 0.7, 1.8 to 1.9 **(d)** **−**2.2 to −2.0, 0.5 to 0.6, 2.4 to 2.6

Question 6

This question on statistics and probability was well received by most candidates.

(a) The best solutions showed working involving clear calculations for mid-values multiplied by the frequencies. The main errors were to use the group widths (or half the group widths) as mid-values. A few candidates used the class boundaries and a small number who used correct mid-values did not use the correct mid-value for the final class often choosing 2750 instead of 3000.

(b) (i) Most candidates were confident with completing the cumulative frequency table although a significant number just replicated the frequencies from the table.

(ii) The graph was drawn well by most candidates, although a number drew a cumulative bar graph rather than plotting points at the upper bound joined by a curve or line. Those that attempted to plot points occasionally made errors with the plotting of 167 in particular or plotted the end point at 3000.

(iii) It was rare to see evidence on the diagram with many candidates not knowing what to do. A line on the graph at 2200 would have led to the opportunity to gain 2 marks.

(c) Many candidates found this probability question challenging. Very few candidates used a tree diagram although there were many concise accurate answers showing the addition of the correct pair of products. The manipulation of fractions was usually correct. The most common error was to work with $\frac{9}{10}$ and $\frac{3}{5}$ only and to find the product of these two fractions. There was minimal evidence of incorrect notation such as ratio. Some candidates did not make the operation clear and confused addition and multiplication.

Answers: **(a)** 2000 **(b)(i)** 10, 40, 95, 167, 200 **(b)(iii)** 68 to 80 **(c)** $\frac{21}{50}$

Question 7

This question on similarity and trigonometry had a range of responses and mixed success for candidates.

(a) (i) This part was not well understood. The best answers clearly stated the three pairs of equal angles. Reasons were not required but some of the most able candidates gave reasons as well. There was evidence of some candidates mistakenly believing that angle *A* = angle *B* and angle *C* = angle *D*. Care should be taken as a minority of candidates used 3 letters such as angle *AXB* which is a straight line. This question was frequently left blank or an incorrect attempt at comparing side lengths with ratios when lengths were not given.

(ii) (a) The best solutions showed a clear matching of corresponding sides. This was a weak area for many candidates with the usual error to associate 12.5 with 3.2 as the corresponding length in the smaller triangle rather than 4. Some incorrectly attempted methods involving trigonometry were seen.

(ii) (b) Candidates were instructed to use the cosine rule here and almost all attempted to do this but some could not recall the cosine rule formula correctly. There was considerable evidence of premature approximation and an inability for some to process the negative value for cos110 correctly. Candidates are advised to show each step of their method and any intermediate values before the square root is taken as some gave incorrect answers of 5.91 or 5.9 and did not show the stage before which cost 2 marks.

(ii) (c) The majority of candidates used the method ½ ab sin *C*. Some candidates incorrectly used sin70 with no explanation as to why. Attempts to find a base and height frequently stalled. Credit was given to candidates that used their value to part **(ii)(a)** in an otherwise correct method.

(b) The best solutions were concise involving two separate right-angled trigonometry methods. Not working with full calculator displays cost some candidates the final mark for a loss of accuracy.

The following common errors were seen:

- treating triangles *ABC* and *ABD* as similar which produced working such as $\frac{37}{31} = \frac{BD}{30}$
- working with a tangent version of the sine rule in triangle *ACD*
- working with the sine rule straight away but with the angles 31° and 37°
- using right-angled trigonometric methods in triangle *ABC*

The very concise method of $\frac{\tan 37}{\tan 31} = \frac{BD}{30}$ led to the correct answer although candidates would be advised to show additional working to support a method when a large number of marks are at stake.

Answers: **(a)(ii)(a)** 10 **(a)(ii)(b)** 5.92 **(a)(ii)(c)** 58.7 **(b)** 7.62

Question 8

The first two parts of this vectors question were answered better than the final two parts but many candidates are not confident with this topic.

(a) The candidates who were able to identify the position vector of *Q*, either by writing down $\overrightarrow{OQ}$ or giving a correct route, such as $\overrightarrow{OB} + \overrightarrow{BQ}$, usually went on to obtain the correct answer. Some candidates made a sign error with the vectors.

(b) (i) Many gave the correct answer. A number gave the correct answer in the working but then divided it by 3 and gave a final answer of **c** – 2**a**. A number gave 6**a** – 3**c** and others 6**a** + 3**c**.

(ii) There were many correct answers. Again a number with the correct answer divided through by 2 to leave **c** – 2**a** as their final answer. Of those who did not get the correct answer, the ones who gave a valid route such as $\overrightarrow{PQ} = \overrightarrow{PA} + \overrightarrow{AO} + \overrightarrow{OQ}$ first were more likely to score the method mark than those who went straight to combinations of **a**, **b** and **c**. This was usually because of sign errors very commonly from $\overrightarrow{PA} = -(3\mathbf{b} - 2\mathbf{a}) = -3\mathbf{b} - 2\mathbf{a}$.

(c) In order to score marks in this part it was necessary to have answers in parts **(b)(i)** and **(b)(ii)** from which two correct statements could be made. Some of those who did not have this requirement made statements that did not fit their two answers and thus they did not score. A minority scored marks here and, of those who did, most just got 1 mark for stating that the lines were parallel.

Answers: **(a)** 2**c** + 3**b** **(b)(i)** 3**c** – 6**a** **(b)(ii)** 2**c** – 4**a** **(c)** $PQ = \frac{2}{3}AC$, *PQ* is parallel to *AC.*

Question 9

Parts **(a)** and **(b)** of this sequences and patterns question were reasonably well answered. Candidates found the parts where an expression had to be established more challenging.

(a) The numeric entries to the table were usually, but not always, correct. For the white squares $n + 8$ was often seen, but many were able to give the correct expression. For the grey squares the correct answer was given by more able candidates but there were many omissions of this entry. A few gained a method mark for giving a quadratic expression in n^2.

(b) Many wrote down $(n + 1)(n + 5) = 480$ as a first step. Some were able to obtain the correct answer by solving this equation either by factorisation or by using the quadratic formula and selecting the positive root. As this was quite a difficult equation some abandoned trying to solve it but many reached the correct answer by using trials with $(n + 1)(n + 5)$ to find an integer to give 480.

(c) (i) This was not answered very well. Many substituted $n = 1$ to reach $\frac{1}{3} + p + q$ but then did not equate this to 12 from the table in part **(a)**.

(ii) This part was frequently omitted. Those that attempted it often made the correct substitution but, as in part **(c)(i)**, did not then make the connection with the table in part **(a)** and the instruction that it was the **total** number of squares was overlooked by the majority. Those candidates using the table generally used 21, rather than 12 + 21. A very small number did use 33 and earned the marks.

(iii) This part was also again often omitted. Those who did attempt it understood that the two equations needed to be solved simultaneously. Some used substitution but most used the elimination method. Many found the multiplication of $11\frac{2}{3}$ by either 2 or 4 difficult and made an error. Some used decimals but did not always use an accurate enough version to give the correct answers. Candidates should be advised to use the most accurate values i.e. fractions in their calculations here.

Answers: **(a)** 36, 9, 45, $8n + 4$, $(n - 1)^2$ **(b)** 19 **(c)(iii)** $\frac{7}{2}, \frac{49}{6}$

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 and be able to apply their knowledge in unfamiliar situations. 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. Straight lines in graphs should be accurately ruled with the correct intercepts on the axes. Curves should be drawn with a single curved line. Candidates should be aware that an inaccurate answer with no working scores 0.

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.

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.

Comments on Specific Questions

Question 1

(a) (i) This part was often well answered. The common error was to find the required fraction of 75 or (75 – 16.50). Many did the question in stages by finding the amount spent on films and books and adding these to $16.50.

(ii) This was usually correctly answered using the answer to part **(a)(i)**. Some candidates found 75% of their answer to part **(a)(i)**.

(b) Nearly all candidates calculated a correct value for the time, often as 159.75 minutes, but then some could not correctly convert this to hours, minutes and seconds. The popular incorrect answer was 2 hours 40 minutes 15 seconds when candidates treated 0.75 minutes as 1 minute 15 seconds. Some candidates rounded the value of their calculation to 3 significant figures, e g 2.66 hours, and consequently lost accuracy marks.

(c) There were many correct solutions seen to this reverse percentage question. The usual errors of finding 88% or 112% of 16.50 were seen a significant number of times.

Answers: **(a)(i)** 49.5(0) **(a)(ii)** 66 **(b)** 2 hours 39 minutes 45 seconds **(c)** 18.75

Question 2

(a) This part was often very well answered with consistent use of the inequality sign. Some candidates still prefer to work with = throughout and some of these left this in their answer. Others gave the answer 2 and others, after reaching $22x > 11$ gave the answer as $x > 2$.

(b) (i) The majority of candidates did not appreciate that when grouping into pairs it is necessary to have the same expression in each bracket; $q(p - 2) - 4(2 + p)$ was often seen in the working with no further work or with incorrect factors.

(ii) A number of candidates thought that this expression was equal to $(3p - 5)^2$. Of those who did recognise the difference of two squares some did not factorise the expression and gave the answer as $(3p)^2 - (5)^2$.

(c) Most candidates found correct solutions to this equation but in many cases it was by using the quadratic formula despite the instruction to solve by factorising. Some tried to work backwards from their solutions to find the factors but they were nearly always unsuccessful.

Answers: **(a)** $x > 0.5$ **(b)(i)** $(p - 2)(q + 4)$ **(b)(ii)** $(3p - 5)(3p + 5)$ **(c)** $\frac{9}{5}$ and -2

Question 3

(a) This part was usually answered correctly. The few errors seen were to state the mid-value or the interval length. There were few answers of 19 seen (the frequency of the modal time interval).

(b) This part was very well answered. Working was clearly and concisely shown in the vast majority of cases. Occasionally candidates made errors with the mid-values, e g 23, 28, 33 etc. were used and also the ends of the intervals. Less able candidates ignored the frequencies and divided the sum of the mid-intervals by 6.

(c) (i) The correct frequencies were almost always seen.

(ii) By far the most common error was to extend the last block to the edge of the grid. Some candidates found the frequency densities by dividing by 5 or 10 in each case.

Answers: **(a)** $35 < t \leq 40$ **(b)** 37.3 **(c)(i)** 15, 19, 16

Question 4

(a) Most candidates recognised the enlargement and centre at (2, 5) but only the most able gave the correct scale factor. The vast majority treated the transformation as from *B* to *A* and consequently gave 2 or –2 as the factor. It was rare to see two transformations stated.

(b) (i) There were many correct triangles seen. However some candidates did not plot the point (−2, 6) and thus had an incomplete image. A few reflected in a different vertical line.

(ii) Candidates found this transformation to be the most challenging. Both the angle and/or centre of rotation were often incorrect. Some candidates seemed not to appreciate that the image should be congruent to the object.

(iii) Candidates often correctly interpreted the vector as 1 unit left and 5 units down but many misread the scale of the grid and they translated through ½ left and 2½ down.

(c) (i) This matrix question proved challenging for the majority of candidates. Many matrices included the numbers 0, 1 and –1 but usually in the wrong positions. Matrices of sizes 2 × 3 or 3 × 2 and 2 × 4 were often seen from the less able candidates.

(ii) Few candidates linked the effect of $\mathbf{M}^{-1}$ with the effect of **M** in part **(b)(ii)** and instead tried to interpret their incorrect matrix in part **(c)(i)**. Those who did recognise the connection often omitted one of the elements required to fully define the transformation.

Answers: **(a)(i)** Enlargement, centre (2, 5) with scale factor – ½ **(c)(i)** $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ **(ii)** Rotation through 90° anticlockwise with centre (0, 0)

Question 5

(a) (i) This part was very well answered.

(ii) Those candidates who chose the simple method of evaluating g(17) and substituting this into h(x) were invariably successful. Many candidates complicated the question by trying to use the algebraic expression for hg(x) and often this had differing values for x used.

(b) Again candidates made this much more difficult than it needed to be. Many were unable to correctly expand and simplify the equation to $x^2 = 16$ as the difference of two squares was again confused with a perfect square. Less able candidates after reaching $7 = (x - 3)(x + 3)$ went on to use $7 = x - 3$ and $7 = x + 3$ for their answers.

(c) Full working was given by the vast majority of candidates and it was unusual to see sign errors. Some did not give the solutions to the required accuracy. Some more able candidates used the completion of the square method and were mostly accurate.

(d) Most candidates gained full marks for this question. The most common error was to write $y - 2 = 5x$ after the initial equation.

(e) Again only a few candidates recognised the connection between $g^{-1}(x) = -0.5$ and g(–0.5). Of those who did give the correct solution the vast majority solved $3 + \frac{7}{x} = -0.5$.

Answers: **(a)(i)** 8 **(a)(ii)** 4 **(b)** 4 and – 4 **(c)** – 4.68 and 1.18 **(d)** $\frac{x+2}{5}$ **(e)** –2

Question 6

(a) This part was very well answered. A few candidates used their calculator without regard to the need for brackets when using $x = -0.5$ thus obtaining the incorrect value 11.375. A similar error when $x = -1$ led to $y = 13$ but this was less common.

(b) Points were generally plotted accurately. Common errors included plotting (2, 18) at (2, 19) and omitting the point (0.75, 7.6) or plotting it at (0.85, 7.6). Curves through the correct points were generally good but some candidates used a ruler to join at least two points.

(c) (i) This part was often correct except when candidates did not give an integer value.

(ii) This part was often correct except when candidates did not give an integer value.

(d) Candidates who attempted this question did well. Many values in range coming from an accurate line $y = 15x + 2$ were seen. Occasionally a good line with one accurate value was seen but the value at –1.4 was misread or given as –0.4.

(e) The majority of candidates drew good tangents and usually gave a gradient in range. The errors mainly came from incorrectly reading the co-ordinates of the points used to find the gradient.

Answers: **(a)(i)** –3, 7.375, 8.875 **(c)(i)** Any integer less than 7 or greater than 10 **(c)(ii)** 7, 8 or 9 **(d)** –1.45 to –1.35 and 0.4 to 0.5 **(e)** 7 to 12

Question 7

(a) The vast majority of candidates showed the product 120 x 55 x 75 = 495000 and some clearly then divided by 1000. Many candidates were not rigorous enough in showing how 495 was reached. Candidates needed to go further than stating 1000ml = 1 litre or 1000 cm^3 = 1 litre. The division by 1000 was an essential part of the calculation.

(b) (i) There were many correct answers but also many candidates used 495 litres instead of 495000 ml before dividing by 750. Other candidates evaluated 750 ÷ 60 and did not involve the volume of the tank.

(ii) The common error was again to use 495 instead of 495000 for the volume. Some candidates recalled the formula for the volume of a cylinder incorrectly as eg. $2\pi r^2 h$ or πrh and others used the correct formula but made algebraic errors such as $112r^2 = 495000\pi$. When accuracy was lost it was usually by rounding at various stages of the working.

(c) Many candidates used Pythagoras' theorem twice to efficiently find the height from the base and hence find x from 75 – this height. Errors were sometimes introduced by premature rounding, so x became 14.99 or 15.01. Other candidates offered a complete but less efficient method involving correct trigonometry but again often reached a slightly inaccurate answer. Less able candidates were unable to apply Pythagoras' theorem in this 3D context.

(d) Many correct answers were seen. A significant number of candidates found the angle between the rod and the edge marked 120 cm and some then went on to add this to the required angle.

Answers: **(b)(i)** 11 **(b)(ii)** 37.5 **(c)** 15 **(d)** 24.4°

Question 8

(a) The majority of candidates correctly identified the angle at *P* as 32° and showed good recall of the cosine rule. Many went on to score full marks but a frequent error was to move straight from LQ^2 = 1560.3….. to *LQ* = 39.5 without showing the required accuracy of 4 significant figures to show the rounding was correct. Following errors, some candidates found *LQ* to be a value other than 39.5 and then went on to use their incorrect value in later parts of the question. Candidates should not disregard a given value.

(b) Many correct answers were seen and candidates generally used the sine rule as instructed. Some lost accuracy marks when the angle was given to the nearest degree instead of to 1 decimal place as stated in the instructions.

(c) (i) This bearing was found correctly by many candidates although 180 – 142 = 38 was seen several times. Less able candidates did not attempt this question.

(ii) A very common error was to divide 51.1 by 2.

(d) This part was often well answered. Candidates who were unsuccessful in other parts of the question still accessed this successfully. Some candidates made the error of multiplying by 1.85 instead of dividing by it and others used 2.15 instead of 2.25 for 2hrs 15mins. At times the answer seen was 17.7 with no working which scored 0 since it was inaccurate.

(e) Some found this part of the question a challenge although many correct answers were also seen. Some candidates dropped a perpendicular from *L* to *PQ* correctly but incorrectly assumed this would bisect *PQ*. Others deliberately bisected *PQ* creating a non right-angled triangle which did not lead to the shortest distance from *L* to the path of the ship.

Answers: **(b)** 51.1 **(c)(i)** 322 **(c)(ii)** 013.1 **(d)** 17.8 **(e)** 30.7

Question 9

(a) This part was well answered by most candidates with almost all candidates finding the total number of grey cubes correctly. Some candidates completed the first two rows in the table correctly but not the third, missing the connection that it was the total of the first and second rows.

(b) (i) Many correct answers were seen to this part. The common incorrect answers seen were $n + 4$ and $4n + 1$.

(ii) This part was well answered by those with part **(b)(i)** correct.

(iii) Many correct answers were seen from the algebraic method $4n - 3 = 200$ but also from using a trial and improvement approach. Occasionally candidates using the algebraic approach did not truncate their answer from 50.75 to 50 but rounded up to 51.

(c) This part was omitted by a significant number of candidates or no real progress was made. Methods involving simultaneous equations such as $p + q + 3 = 0$ and $2^2p + 2q + 3 = 1$ were generally well executed to obtain correct values for p and q. Occasional algebraic errors whilst solving the simultaneous equations were seen. Candidates who identified the 2nd difference as 4 usually concluded that $p = 2$ and generally went on to a fully correct solution using a variety of techniques to evaluate q. Some candidates used the expression $pn^2 + qn + 3$ with a variety of values of n to create expressions in p and q but either equated these to 0 or did not form any equations.

(d) Candidates who were successful in parts **(c)** and **(b)(i)** usually completed this part successfully by adding their answers. In addition other candidates worked directly with the sequence for the total number of cubes from the table. A significant number of candidates omitted this part of the question or wrote an expression still containing p and q.

Answers: **(a)** 28 45, 17 21, 45 66 **(b)(i)** $4n - 3$ **(b)(ii)** 237 **(b)(iii)** 50 **(c)** $p = 2$, $q = -5$ **(d)** $2n^2 - n$

Question 10

(a) (i) The correct method $\frac{1}{6} \times \frac{1}{6}$ was seen successfully leading to $\frac{1}{36}$ but also errors such as $\frac{1}{6} \times \frac{1}{6} = \frac{2}{6}$ or $\frac{1}{12}$. Other candidates' clear incorrect intention was $\frac{1}{6} + \frac{1}{6}$ to get variously $\frac{2}{6}$, $\frac{1}{12}$ or $\frac{2}{12}$ showing that basic fraction work is a weakness for some.

(ii) This was not well done as many did not realise that there were 3 ways of getting a score of 10. Two very common incorrect answers were $\frac{1}{18}$ using the combinations (5,5) and (4, 6) and $\frac{1}{9}$ using (4, 6) (6,4) (5,5) and (5,5). A minority of candidates who did correctly reach $\frac{3}{36}$ from the 3 correct combinations sometimes forgot to simplify their fraction to $\frac{1}{12}$.

(b) Many candidates were unfamiliar with the possible outcomes when two dice are rolled and the numbers on the top faces are added. Few candidates knew that the most frequent possibility was 7.

(c) Many candidates omitted this part of the question or made insignificant progress. Few thought logically about the three possibilities of winning:

- getting a total of 3 with one throw
- getting a total of 2 followed by a total of 4
- getting a total of not 3 or 2 on one throw followed by rolling a total of 3 on the second throw.

Candidates were most successful with calculating the P(total of 3) as $\frac{2}{36}$ although some stated $\frac{1}{36}$ from the combination either (1, 2) or (2, 1) but not both.

Candidates did not then realise that there were a further two possibilities to win and often used all remaining totals together giving for example $\frac{34}{36} \times \frac{2}{36}$.

Answers: **(a)(i)** $\frac{1}{36}$ **(a)(ii)** $\frac{1}{12}$ **(b)** 7 because it has the most combinations **(c)** $\frac{141}{1296}$

MATHEMATICS

Paper 0580/43
Paper 43 (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 appeared to have sufficient time to complete the paper and omissions were usually due to lack of familiarity or difficulty with topics covered by the questions. Many candidates demonstrated their knowledge and application of Mathematics and produced work of a good standard. For these candidates presentation of written work was usually clearly set out. As always the standard of work was variable, with the marks covering a wide range. For less able candidates, working tended to be more haphazard and difficult to follow, making it difficult to award method marks when the answer was incorrect. All 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. Centres should continue to encourage candidates to show the formulas they use and the calculations performed.

Comments on Specific Questions

Question 1

(a) (i) Most candidates applied Pythagoras' theorem correctly and obtained both marks. A few lost the accuracy mark by giving their answer to two significant figures only. Some less able candidates attempted to use trigonometry.

(ii) Many candidates were able to draw a perpendicular from *B* to *DC* and apply the tangent ratio correctly to find the required angle. A significant minority preferred to use the sine ratio by calculating the hypotenuse as their first step. Generally candidates were less successful in this part of the question, either by treating the base side as 6 (from 17 – 11) or creating alternative triangles on the diagram and making little progress as a result.

(iii) The majority of candidates used the formula for the area of a trapezium while a small number opted to find the area using two triangles and a rectangle. Many were successful but some lost marks by setting out the calculations incorrectly, such as $(11 + 17 \times 4.7) \div 2$.

(b) Many candidates didn't appreciate the significance of 'similar' in relation to the two trapezia. Most of these simply recalculated the area with 4.7 replaced by 9.4, leading to the common incorrect answer of 131.6. For the rest, most multiplied all dimensions by 2 and recalculated the area correctly. The use of area scale factor = (linear scale factor)^2 was rarely seen.

Answers: **(a)(i)** 5.37 **(ii)** 54.1 **(iii)** 65.8 **(b)** 263.2

Question 2

(a) (i) Many correct answers were seen with most candidates using 920, dividing by 8 and multiplying by 7. A significant proportion opted to calculate the total number of seats before dividing by 26 and multiplying by 7. As it was a 'show that' question it is important that candidates show all steps in the calculation. A few lost the mark by simply showing 115×7.

(ii) Of the two methods available, finding 920 as a percentage of 2990 was preferred by many rather than 8 as a percentage of 26. A significant number of candidates lost a mark for giving their answer to 2 significant figures without showing a more accurate value.

(b) A majority of candidates set out their solutions clearly and many went on to earn all five marks. Some spoilt their solution by rounding the exact answer to 3 significant figures. Others attempted to express 1211 as a percentage of the total number of tickets. Other errors involved confusion between the ticket prices for the three areas.

(c) More able candidates earned all three marks, appreciating that the ticket sales was 95% of the previous concert. Almost as many calculated 105% of the ticket sales.

Answers: **(a)(i)** $\frac{920}{8} \times 7$ **(ii)** 30.8 **(b)** 1211 **(c)** 37720

Question 3

(a) (i) Most candidates obtained 52° with almost as many giving a correct reason too. Of those, most stated 'same arc' rather than 'same segment'. A few stated 'same chord' with no mention of 'same side' and a few stated 'same sector'.

(ii) Again, the correct angle of 104° was identified by most candidates but some lost the mark for the reason through use of descriptors such as edge, arc, perimeter, origin. A small number had the reason reversed.

(iii) Candidates were generally less successful in this part. Identifying the angle was usually correct but many didn't identify at least one of tangent, radius or 90°.

(b) (i) A majority of candidates set out their solutions clearly and earned all four marks. Some gave the final answer as 7.7 and lost the accuracy mark. A small number quoted the cosine rule incorrectly, e.g. $a^2 + b^2 + 2ab\cos 56$ or used sin56 instead of cos56. Less able candidates used right-angled trigonometry and/or Pythagoras' theorem. Others assumed that *BE* was a tangent and gave answers as if the triangle was isosceles.

(ii) Candidates were generally more successful in this part, even when the previous part was incorrect. Both the sine rule and the cosine rule were equally common and it was not rare to award a minimum of two marks for a correct method. Some dropped a perpendicular from *B* to *CE* but tended to lose out on the accuracy mark because of premature approximation at the first stage.

Answers: **(a)(i)** 52 **(ii)** 104 **(iii)** 34 **(b)(i)** 7.65 **(ii)** 49.3

Question 4

(a) (i) Many candidates earned the mark for a correct decision, justified by writing the probabilities as fractions with a common denominator or as decimals or percentages. A few lost the mark because of the lack of justification.

(ii) Many correct answers were seen, usually given as a fraction in its simplest form, but answers as decimals and percentages were also seen. The most common error was adding the two probabilities.

(iii) This part proved more of a challenge and a wide variety of incorrect methods were seen often involving the correct four fractions but incorrectly combined. Some drew a tree diagram to help and were usually successful.

(b) (i) Many candidates completed the tree diagram accurately and earned all three marks. Most errors were slips in writing one of the probabilities. Only a few seemed unfamiliar with the idea of a probability tree diagram.

(ii) Again, many correct solutions were seen, usually with a fully simplified fraction. A few gave equivalent fractions or sometimes 0.36 or 36%. As in part **(a)(ii)** a common error was adding the correct fractions instead of multiplying.

(iii) Fewer fully correct solutions were seen, with the probability of Yeung finishing exactly one race being a common error. Those who chose the method of 1 – (finishes no race) usually reached the correct answer. Many others attempted to use the longer method that required 7 routes but often without much success. Errors often resulted from slips in the arithmetic or omission of at least one route. As in earlier parts there was confusion regarding when to multiply or add probabilities. Some less able candidates gave the answer as $\frac{7}{8}$ by counting the ends of the branches.

Answers: **(a)(i)** Ariven, $\frac{10}{15} > \frac{9}{15}$ **(ii)** $\frac{2}{5}$ **(iii)** $\frac{7}{15}$ **(b)(ii)** $\frac{9}{25}$ **(iii)** $\frac{172}{175}$

Question 5

(a) (i) The large majority of candidates earned this mark with a few giving their answer as a 1 by 2 matrix by omitting the zeros.

(ii) Candidates found subtracting the matrices with negative numbers more challenging. It was common to see –3 in the top row instead of 1 with an occasional error with another element.

(iii) Many candidates understood that **P** needed to be multiplied by itself and proceeded to write down **P** twice, showed working and successfully carried out the operation. Those candidates who showed little or no working often lost both marks. A common incorrect answer came from squaring the individual elements of **P**.

(iv) Although many correct answers were seen, candidates were generally less successful in this part. A significant number of candidates obtained 2 by 2 matrices as their answer, usually involving –3, 10, 0 and 5. Some achieved one correct element in a 2 by 1 matrix; this was usually the 5 with the negative numbers causing difficulties for some.

(b) This proved a challenging question and less able candidates struggled to pick up any marks. Few candidates seemed to be aware that the inverse matrix was required. Many candidates simply resorted to trial and improvement, trying a matrix they thought would work but often making no progress. For those candidates trying to find the determinant, dealing with the 0 and –2 gave rise to errors. Some attempted to set up some equations but relatively few were able to follow it through to the correct solution.

Answers: **(a)(i)** $\begin{pmatrix} 0 & -4 \\ 4 & 0 \end{pmatrix}$ **(ii)** $\begin{pmatrix} -1 & 1 \\ 1 & -1 \end{pmatrix}$ **(iii)** $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ **(iv)** $\begin{pmatrix} -13 \\ 5 \end{pmatrix}$ **(b)** $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$

Question 6

(a) (i) A large majority of candidates simplified correctly, although it was common to see a wide variety of errors in dealing with the two terms. Some simply cancelled the x^3 and x^5, others inverted correctly but then multiplied the x terms to give x^{15}.

(ii) Most candidates were successful with the multiplication of the two terms, with just a few candidates multiplying the indices.

(iii) Candidates were generally less successful in this part, with some not differentiating between a number to a power and a power raised to another power. It was common to award one mark, either for simplifying the coefficient or for simplifying the algebraic term. It was common to see 64 to the power $\frac{2}{3}$ evaluated as $64 \times \frac{2}{3}$.

(b) Many candidates earned all four marks but for some, poor presentation was an issue. Candidates need to ensure the division line is completely drawn under the numerator and that the root sign encloses all of '$b^2 - 4ac$'. Some were able to recover but many lost marks needlessly. Another common error occurred with negative signs when substituting the values, such as -7^2 instead of $(-7)^2$. Some of those obtaining the correct solutions then wrote their answers to the wrong degree of accuracy.

(c) Many candidates demonstrated their algebraic skills to good effect and earned all three marks. Some didn't recognise the difference of two squares and $(x - 5)^2$ was sometimes seen. Factorising the denominator proved more challenging; sometimes only x was used as a factor and sometimes $x^2(x + 5)$ was given. Less able candidates simply cancelled the x terms and/or the 5s individually without factorising.

Answers: **(a)(i)** $\frac{x^8}{3}$ **(ii)** $15x^7y^3$ **(iii)** $16x^8$ **(b)** 3.48 and –1.15 **(c)** $\frac{x+5}{x^2}$

Question 7

(a) Many candidates were familiar with a method for calculating the area of a triangle, but not always the most efficient. Many were able to write $0.5 \times 8 \times 8 \times \sin 56$ and go on to obtain an answer with at least two decimal places. Some lost the final mark by giving their answer as 26.5 instead of showing a more accurate answer that rounded to 26.5. A significant number used a variety of methods including trigonometry of a right-angled triangle, sine and cosine rules to calculate the base and height and then go on to find the area. These were more likely to lose the final mark as the longer methods tended to be approximated at intermediate stages.

(b) (i) A majority of candidates were able to equate the area of the triangle with an expression for the area of the sector. This was often rearranged correctly and a solution obtained. For a small number there was some confusion between area and circumference. A small number treated the sector as an isosceles triangle.

(ii) Many of those with a correct method in part **(i)** were able to calculate the arc length of the sector. The most common error was to stop with the arc length, not adding on the two radii. Again, there were instances where candidates mixed up the area and circumference formulae.

(c) (i) As with any question involving having to show an algebraic expression, a significant number of candidates attempt to work backwards. Marks were awarded for a correct method leading to the given expression. Those who started with the correct formulae for the area of a sector and a triangle usually gained full marks. Those that were influenced by the given answer often started with $\frac{1}{12}\pi r^2$ rather than $\frac{30}{360}\pi r^2$, or with $\frac{1}{4}r^2$ rather than $\frac{1}{2}r^2$ sin30, and lost the appropriate marks. A significant number of candidates did not attempt this question.

(ii) Not all candidates linked this question with the formula from the previous part. A majority of those that did usually managed one correct rearrangement with many going on to obtain a value for *r*. Those that began by multiplying by 4 were generally more successful than those that started in other ways. Premature approximation of some values, particularly $(\frac{1}{3}\pi - 1)$ often led to a loss of accuracy with the final answer. Those that didn't use the formula from the previous part usually equated the area of the sector as 5.

Answers: **(a)** 26.52 to 26.53 **(b)(i)** 72.0 **(ii)** 21.1 **(c)(ii)** 20.6

Question 8

(a) (i) Most candidates obtained the correct midpoint with some adding the co-ordinates but not dividing by 2. A few reversed the co-ordinates.

(ii) Many correct equations were seen. Where the final answer was incorrect some earned a mark for a correct method for finding the gradient or for a correct method to find the y-intercept. Calculating the reciprocal of the correct gradient and subtracting the co-ordinates in an inconsistent order were the usual causes of error with the gradient. Only a small minority of candidates attempted to set up a pair of simultaneous equations.

(b) (i) Almost all candidates factorised the expression correctly.

(ii) Despite the accuracy of the previous part quite a number of candidates were unable to interpret the quadratic in a graphical context and just produced spurious values. Sometimes the whole answer set was accurate but not inserted correctly into the answer spaces. Other answers were only partly accurate with –10 being the least accurate of the three parts.

(iii) Linking the equation of the line of symmetry with the factors of the expression in part **(i)** or with the co-ordinates of the intercepts on the graph in the previous part was challenging for many candidates. Many incorrect answers were seen, including $y = -1.5$. Several candidates made no attempt at all.

(c) Again, many candidates didn't link the quadratic expression with a sketch of the graph and a large number of candidates constructed a table of values in order to sketch the graph, rather than factorising the quadratic expression. Many were able to draw a parabola but the intercepts were often not labelled or were incorrect.

(d) (i) This proved to be a challenging question for many candidates. The most common approach was to expand $(x + p)^2$ but many seemed unfamiliar with the process of equating coefficients. Very few attempted to factorise the quadratic expression in order to complete the square. It was more common to award marks for finding p than q.

(ii) Several candidates made no attempt at this part and when answers were seen many were incorrect. A common incorrect answer was –7.

Answers: **(a)(i)** (1, 2) **(ii)** $y = 3x - 1$ **(b)(i)** $(x + 5)(x - 2)$ **(ii)** –5, 2, –10 **(iii)** $x = -1.5$ **(d)(i)** $p = 6$, $q = 43$ **(ii)** –43

Question 9

(a) (i) A large minority of candidates formed the correct equation but only some of these were able to solve it using clear algebraic steps. It was common to see attempts at trial and improvement being used to solve the equation. Some of those that could not set up the equation earned a mark for an attempt at the total number of litres or for the correct number of motorists. For the rest, some added the numbers along each row, with 90 a common answer for the number of litres and sometimes $33 + p$ for the motorists. Some common errors included division by 5, 33 or $33p$.

(ii) The two most common answers were 17 and 18, often with little evidence of any working that could lead to the answer. As 18 was the middle number in the top row of the table it was a popular choice for the median.

(b) (i) Almost all candidates obtained the correct cost of the journey.

(ii) Again, many correct answers were seen. Candidates often worked out petrol consumption as either 8 km/litre or 0.125 litre/km. Some used proportion with the distances and the total amount of petrol used.

(iii) Many candidates were able to link the answers from the previous two parts and perform the appropriate division with only a small number dividing in the wrong order. A significant number attempted to make use of the $1.28 from part **(i)** but many struggled to make any worthwhile progress.

(c) Many candidates had an appreciation of how to calculate distance from time and speed but the combination of bounds and changes of units caused many to lose marks. Candidates needed to use the upper bounds of the time and speed but many didn't work with the correct values. Most were content to add on 5 m/s to 30 m/s and 10s to 5 minutes. The fact that the units were incompatible was missed by many candidates. Where attempts were made to change units it was more common to change the time to seconds than the speed to metres per minute. It was rare for candidates to find and use both correct upper bound quantities. Most candidates were proficient at converting m to km, some changing the speed before multiplication took place. A significant proportion of candidates succeeded in finding the correct upper bound of the distance but then spoilt their answer by rounding, usually 9.91.

Answers: **(a)(i)** 7 **(ii)** 17 **(b)(i)** 64 **(ii)** 40 **(iii)** 1.6(0) **(c)** 9.9125

Question 10

(a) (i) Many of the candidates were able to simplify an expression for the perimeter with a few spoiling their answer by further incorrect simplification or attempting to solve an equation. Some earned a mark for a partially correct expression.

(ii) Many of those candidates who were successful in part **(i)** were able to set up an equation, solve it correctly and go on to find the length of the longest side. Simple slips with the rearranging or with the number work were the most common causes of errors.

(b) More able candidates again demonstrated their algebraic expertise and earned all six marks with efficient solutions that were clearly set out and easy to follow. For others, errors usually involved numerical slips or incorrect signs. These errors occurred when setting up the equations, when eliminating a variable or when applying the substitution method (the least popular method for solving the equations). For less able candidates, working was often haphazard, covering most of the page with many restarts at solving the equations.

Answers: **(a)(i)** $5x + 14$ **(ii)** 14.2 **(b)** $a = 3.25$, $b = 2.5$