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. Candidates are reminded of the need to read the question carefully, focussing on key words or instructions.

General comments

Candidates must check their work for sense and accuracy as there were answers in context that made little sense, for example in **Questions 1**, **10** and **18**. Candidates must show all working to enable method marks to be awarded. This is vital in 2 or multi-step problems, in particular with algebra, where each step should be shown separately to maximise the chance of gaining marks in, for example, **Questions 11**, **13**, **16**, and **20**. Candidates must take note of the form or units that are required, for example, in **Questions 6** and **10**.

The questions that presented least difficulty were **Questions 7**, **12**, **14**, **17**, **21(a)(i)** and **22(a)** and **(b)**, Those that proved to be the most challenging were **Questions 6, 9, 14(b)**, most of **21**, and **22(c)** and these along with **Question 19** were the ones that were most likely to be left blank. It is likely that the blank responses were due to the syllabus areas being tested rather than lack of time.

Comments on specific questions

Question 1

This question on time was reasonably straightforward and about half the candidates gave the correct answer. What made this question on time slightly more challenging was that the period goes over midnight. Workings were useful here for candidates to check they had the correct time for each day. Candidates got confused with the number of minutes so 8 rather than 52 was seen frequently. There were some answers that had a number of hours and more than 59 minutes.

Answer: 8 (h) 52 (min)

Question 2

The most common incorrect answer was 26.67 as candidates divided 80 by 3 instead of using the correct method. Others gave 24 or 2.4 derived from 80 multiplied by 3. Some that showed the correct method gave their answer as 4 as they rounded 3.75.

Answer: 3.75

Question 3

The form of the probability was not specified so candidates could give a fraction or percentage instead of a decimal if they wished. If candidates choose to give a percentage, they must include the percent-sign. Candidates did well here but some gave fractions based on 28 rather than working out 1 – 0.28.

Answer: 0.72

Question 4

The most frequent error was for candidates to give 127 000. Often, those that realised that this was a number less than 1, made errors in the number of zeros to include.

Answer: 0.00127

Question 5

Some candidates gave an answer numerically larger than 60 000. Candidates need to know that if you change from metres to larger units, kilometres, the actual number decreases.

Answer: 60

Question 6

The power of the bracket was large but should not have been a problem with a calculator. If candidates did not round to 4 significant figures but showed the full value of their calculator display then they gained a mark. In this question, if candidates were able to successfully round their incorrect calculated value then a mark was available but it should not be assumed that a mark for rounding will always be available in these circumstances.

Answer: 157 900

Question 7

Many candidates were successful in this question. For **part (a)**, many were able to answer correctly with incorrect answers such as isosceles and hypotenuse seen. Many more candidates left **part (b)** blank or gave incorrect answers such as quadrilateral or hexagon.

Answers: **(a)** Acute **(b)** Pentagon

Question 8

Many candidates understood what to do and what form the answers should take but made errors dealing with the directed numbers. Some candidates tend to treat a vector as a fraction, including a horizontal line between components.

Answers: **(a)** $\begin{pmatrix} -6 \\ 4 \end{pmatrix}$ **(b)** $\begin{pmatrix} 10 \\ -40 \end{pmatrix}$

Question 9

Many candidates incorrectly answered 6 to **part (a)** as they did not take into account the shading of three of the vertices. For **part (b)**, often candidates drew six lines of symmetry or the correct three but with an extra vertical line.

Answers: **(a)** 3

Question 10

This was one of the harder types of conversion questions. At the start of conversion questions candidates need to decide whether to multiple or divide by the exchange rate. The incorrect answer of €10 174 was often seen. Some candidates didn't round as required by the question but they gained a mark if 393.159... was left unrounded.

Answer: 393

Question 11

Candidates often confuse highest common factor with lowest common multiple and that was the case here with 12 being a frequent answer. One approach is to list the multiples of each number until the lowest common one is reached, which relies on accurate calculations. Another approach is to find each number as a product of prime factors and then to use these to formulate the product that will give the LCM.

Answer: 144

Question 12

In general, candidates could substitute into the equation but were not so successful at resolving the directed numbers.

Answer: 11

Question 13

Many candidates gave no workings and if their answer was even slightly incorrect, gained no marks. This question was best answered in two steps so credit could be given for one step correct. It is vital, as stated in the general comments, that workings are shown so candidates are able to gain marks for correct method.

Answer: $\frac{py}{q}$

Question 14

Candidates needed to recall three pieces of information; alternate angles are equal, angles in a triangle equal 180° and two angles in an isosceles triangle are equal. Some candidates assumed *a* or angle *CAB* was equal to 40. A few candidates used a protractor even though the diagram was marked not to scale.

Answers: **(a)** 70 **(b)** 40

Question 15

Some candidates found this ratio and proportion question challenging. The common error was to think the sides of the larger triangle can be found by addition, so 17.4 (from 15 – 6 + 8.4) was the common incorrect answer. As with the previous question, some candidates measured rather than calculated. Some candidates did not show their working so it was difficult to know where many of the incorrect answers came from. The easiest way to proceed was to work out that the lengths in the larger triangle are 2.5 times the size of those in the smaller.

Answer: 21

Question 16

This question was answered well by candidates, many of whom showed complete and convincing working. The first step was for candidates to convert to an improper fraction and the majority went on to show a correct method for division. Some candidates made arithmetical errors. A few candidates arrived at a correct answer, but showed spurious or no working, suggesting that they had resorted to using their calculators to arrive at the solution and then worked backwards. Candidates were required to leave their answer as a fraction in its lowest terms and a decimal fraction was not acceptable.

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

Question 17

This was the question where candidates performed the best on the whole paper and there were very few answer lines left blank. The errors in **parts (a)** and **(b)** were mainly due to arithmetical slips such as 18 instead of 19 or –1 instead of –2. **Part (c)** was a different type of sequence and some did not recognise that the terms were the odd numbers squared so that the next term is 81 from 9^2. Most who got this incorrect tried to do it by finding the sequence of the differences – in this case 8, 16 and 24 leading to the next difference being 32, then adding this 32 to 49 giving 81. This method is longer and has more places where arithmetical slips can be made. It is worth looking at a sequence as a whole rather than rushing in to find the difference between adjacent terms.

Answers: **(a)** 19 **(b)** –2 **(c)** 81

Question 18

As the scatter diagram had many plots, the negative correlation was very clear. Incorrect answers to **part (a)** included, down, indirect, positive and descriptions such as, price and distance from the city. Quite a few candidates left this blank. **Part (b)** required candidates to read from the diagram and many were able to give the correct answer of 4 km. Many drew an acceptable line of best fit in **part (c)(i)**. Candidates should use a ruler and pencil and not go over in pen afterwards. **Part (c)(ii)** was the best answered part of this question with a large majority giving an answer in the required range.

Answers: **(a)** Negative **(b)** 4 **(c)(ii)** 250 000 to 380 000

Question 19

In general, this question was not answered very well and very often left blank. In **part (a)**, many understood what they were supposed to do as there was only one angle marked. There was a lack of accuracy in some drawings as some did not draw the proper construction with pairs of arcs but instead measured the angle with a protractor and drew the arcs in afterwards. Some just marked the angle. For **part (b)**, some used a ruler to find the centre of the line and then a protractor. However, some candidates did produce very neat well executed constructions.

Question 20

This was one of the more complex questions on simultaneous equations as both equations needed to be multiplied to be in a position to eliminate one variable. There are various methods to solve simultaneous equations and candidates should be aware that sometimes, depending on the structure of the equations, one method might be quicker or involve fewer opportunities for arithmetic slips to spoil good method. Candidates should check their values in both equations.

Answer: (x =) –3, (y =) 7

Question 21

This area of the syllabus is often considered difficult by candidates. **Part (a)(i)** was a straightforward lead in to the work on the equation of a line and was answered well. Candidates struggled more with **part (a)(ii)**. They knew to use rise ÷ run but often ignored the scale of the grid giving, for example, 6 ÷ 6. Candidates who used the co-ordinates of two points on the line, $\frac{y_2 - y_1}{x_2 - x_1}$, were more likely to be correct. Many omitted the equation of the line in **parts (a)(iii)** and **(b)** entirely. Some candidates in **part (b)** wrote $y = 5x + c$. Whilst this is written in the mark scheme, candidates must choose a value for c so answers such as $y = 5x + 3$, $y = 5x$ or even $y = 5x - 100$ are all acceptable.

Answers: **(a)(i)** (0, 1) **(ii)** 2 **(iii)** (y =) $2x + 1$ **(b)** $y = 5x + c$

Question 22

In general, candidates did well on the first two parts with fewer blank answers than some of the previous questions. **Part (a)** was a straightforward volume question, especially as there was a diagram. In **part (b)** candidates had to divide the volume by the given dimensions to find the third. This was slightly more challenging because of the lack of a diagram but **part (a)** should have led the candidates into the question. The very common error in **part (c)** was to treat this as a rectangular prism rather than a triangular one so a common incorrect answer was 1080, double the correct value.

Answers: **(a)** 672 **(b)** 12.5 **(c)** 540

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

Basic knowledge formed in earlier years needs more attention. Answering precisely what the question asks and checking that answers are realistic for the context of the question.

General comments

The paper could be tackled confidently by all candidates who had covered the syllabus for core level. It is of concern however that many were weak on basic knowledge of mathematics which would have been covered in years prior to the final two years to the examination.

Marks were often lost through rounding calculations too soon when a further operation was needed.

Candidates did not seem to have any problem completing the paper in the time but some of the writing and figures needed better clarity.

In most cases necessary working was shown but some candidates should be reminded that when more than 1 mark is awarded for a question or part question, then at least 1 mark is awarded for method or partial progress seen in the working.

Comments on specific questions

Question 1

With all the items as decimals it was more straightforward than many ordering questions. However, many candidates made a variety of errors. 0.304 and 0.57 the wrong way round was common as was writing them in order of the length of a number. A few lost the mark by miscopying one or more items.

Answer. $0.008 < 0.2 < 0.304 < 0.57$

Question 2

The common error of $3.07 + 2^4 \div 5.03 - 1.79$ without regard to the order of operations was evident a significant number of times. For those not confident in finding the answer in one operation it would have helped to work out the numerator and denominator separately before dividing. No specific accuracy was required but many gave the answer 5.9 without a more accurate one quoted. The general instructions state 3 significant figures and less than that is not acceptable. Some of those who did attempt 3 figures gave the truncated 5.88 even though the longer answer suggested rounding up.

Answer. 5.89

Question 3

This was not answered well for a straightforward rounding question. The most common error was to write the answer 3.59 which, although equal in value to the correct answer, did not have the 4 figures required in the question. Other candidates wrote too many 0's at the end, possibly confusing with 4 decimal places. Some rounded up each digit to give 4.690. Other common incorrect responses were 3.60, 3.599, 3.589 and 4.000.

Answer. 3.590

Question 4

Candidates found it extremely difficult to identify a quadrilateral from a description of its symmetries. There were in fact quite a number of responses which were not even quadrilaterals. There was an almost total absence of attempts to sketch a shape with these symmetries and the most common incorrect quadrilaterals seen as answers were rhombus and trapezium.

Answer. Parallelogram

Question 5

This question was answered very well with the vast majority of candidates understanding what to do and applying it successfully. A few seemed convinced that they had to give 3 figure accuracy, which does not apply to an exact answer, so a whole number of dollars was seen at times. Otherwise the only significant error was calculating the amount earned in a month or a year.

Answer. 284.2[0]

Question 6

This standard question on percentages was answered well but a few candidates showed a lack of understanding of percentages by giving a response of 0.36. Some candidates multiplied 600 by 216 and then divided by 100 which gave a totally unrealistic answer to the question.

Answer. 36

Question 7

Both parts of this question were answered very well with few errors made. In **part (a)** some candidates arrived at $7f - 2f$ but did not complete the subtraction while others reached 5 but squared the f. Again in **part (b)** there were cases of incomplete answers with an index left as 5 + 3. Only a few did not know the rule and multiplied the indices while $2g^8$ was also seen. It is worth noting here that figures are often not clear and in particular candidates should be very clear when writing indices since these have to be smaller, but clarity is vital.

Answers: **(a)** $5f$ **(b)** g^8

Question 8

Although the response to this question was quite good, there were many responses showing lack of understanding of the wording. The phrase 'in one year' seen twice in the question led to the erroneous use of 365 being common. Rounding during the working stage also led to a few incorrect responses, for example rounding $6 \div 45$ to 0.133 leads to 23.94.

Answer. 24

Question 9

Many candidates struggle finding an algebraic expression for a sequence and this question was no exception. Here it was perhaps a little more challenging since there was not a lead in part of finding further terms. Use of the basic formula, $a + (n - 1)d$ was common but many did not know how to apply it. More successful were the candidates who went straight to the difference of 7 indicating the $7n$ term. Some realised the numbers 3 and 7 came into the expression but gave $3n - 7$. A significant number simply gave a numerical answer, usually the next term, 39. Otherwise $n + 7$ was a common incorrect response.

Answer. $7n - 3$

Question 10

This question on similar triangles proved to be very challenging for the majority of candidates. The main error was finding the difference of the corresponding sides and adding it to the other given side on the first figure. Another error was to assume the triangles had a right angle and so Pythagoras' theorem was applied.

Answer. 15

Question 11

A significant number of candidates clearly did not understand the topic of standard form. Common errors seen in **part (a)** were 26×10^5, 0.26×10^7 and an index of −6. Calculator language, 2.6^{06} and writing in words were also seen. **Part (b)** was less well answered with a missing, or unclear, decimal point spoiling an otherwise correct response. The fraction form, $\frac{29}{5000}$, was often seen as was an answer of 0.006 from rounding to 1 significant figure. Negative answers also showed a lack of understanding of standard form.

Answers: **(a)** 2.6×10^6 **(b)** 0.0058

Question 12

The conversion between fractions and decimals was well understood and this was one of the best answered questions on the paper. The few errors seen included missing out the fraction equivalent to 0.25, writing 0.333 for $\frac{3}{10}$ and 0.8 for $\frac{2}{25}$.

Answers: $\frac{1}{4}$ 0.3 0.08

Question 13

Although quite well answered, **part (a)** needed a probability to be worked out and shown on a probability scale. This caused problems for some candidates and either an arrow was missing or placed inaccurately. Some misunderstood the question and seemed to think it was 'not blue' by putting the arrow at 0.75 while others had little idea and guessed a place for the arrow, even at 1. The more straightforward probability question, **part (b)**, was answered very well although some could not count the total number of counters correctly. Some did not give a probability but the number of counters as their answer. For those giving a probability it was rare for them not to gain the **part (b)(ii)** mark for 1 – their answer to **part (b)(i)**.

Answers: **(a)** Arrow indicating the probability 0.25 on the scale **(b)(i)** $\frac{8}{20}$ **(ii)** $\frac{12}{20}$

Question 14

Part (a) was well answered with very few errors or omissions. The only significant error was to misread the scale and give the response 40.4. As the graph was clearly shown, only an exact answer was acceptable so slightly inaccurate readings did not score the mark. By contrast **part (b)** was answered poorly with many candidates seemingly confused by a value in the question not on the scale. A common error was to assume the graph could give an accurate conversion of \$2 = £1. Many tried to write \$10, \$20, \$40, etc. equal to an amount in pounds, rather than working from an amount in pounds to multiply by an appropriate constant, for example £20 = \$36 and then multiplying by 5. Others converted the wrong way and found answers around \$50.

Answers: **(a)** 44 **(b)** 180 to 184

Question 15

Those candidates who understood vectors had little difficulty in gaining the first 2 marks. However, errors were made at times in the multiplying by 3 and adding directed numbers, the latter being the more common of these errors. Fraction lines are penalised and were more noticeable this series and a few just gave one component in their vectors. **Part (b)** was very poorly answered with the vast majority of candidates not realising that point *B*, and not point *A*, was given on the grid. Consequently a point *A* marked 3 to the right and 2 down of point *B* was the most common response. Many other incorrect positions were given for point *A*, although the most common of these was to place it 2 left and 3 up of point *B*.

Answers: **(a)(i)** $\begin{pmatrix} 12 \\ -6 \end{pmatrix}$ **(ii)** $\begin{pmatrix} 7 \\ -2 \end{pmatrix}$

Question 16

This question showed a lack of understanding of lines and their equations for many candidates, as evidenced by the large number of no responses, particularly for **part (c)**. **Parts (a)** and **(b)** required candidates to know how the constants in the equation relate to gradient and intercept. Very few could relate crossing the *y*-axis to the appropriate part of the equation but more did identify the gradient for **part (b)**. The tendency in **part (a)** was to write (4, −3) or (−3, 0) and few recognised that crossing the *y*-axis meant that $x = 0$.For **part (b)** the response $4x$ and $\frac{1}{4}$ were common errors. Often gradients were attempted as if a graph had been shown by trying to use two points, which was always unsuccessful. **Part (c)** was very rarely correct with many repeating the equation of the question. A few missed the required '$y =$' at the start of their equation.

Answers: **(a)** (0, −3) **(b)** 4 **(c)** $y = 4x$ [+0]

Question 17

Many candidates did not attempt the polygon question and few made any significant progress. It is unusual to have a polygon with so many sides so even some who calculated the number could not accept such an answer, often responding with 8 sides. Many did receive a mark for 8 since that was certainly from 180 – 172 but did not know how to progress from that point. Some attempted the use of the general formula but very rarely could they apply it correctly. The few successful candidates generally found the answer from 360 ÷ 8.

Answer. 45

Question 18

The multiplication of fractions question was answered quite well with many good, full solutions. However, there were many candidates who were clearly uncertain about the method. A significant number of candidates either could not correctly change a mixed number to an improper fraction or decided that the improper fraction had to be inverted. Some added numerators instead of multiplying or didn't reduce to the lowest terms mixed number.

Answer. $1\frac{1}{8}$

Question 19

Although many candidates understood how to solve simultaneous equations, marks were lost due to basic errors. In particular, $4y = 2$ followed by $y = 2$ was seen many times. Candidates need to show an acceptable method to find the solution. Without working or no clear method seen the candidate cannot achieve full marks. Most candidates sensibly used the elimination method, usually multiplying both equations although only one was necessary. Subtraction of the new equations was required but a common error was to add or perform a mixture of both operations.

Answer. [x =] 4 [y =] 0.5

Question 20

Part (a) was straightforward but was not answered well. Some candidates did not understand that angle *ABC* meant the angle at point *B*. Some bisected a line rather than an angle or made up arcs to fit the bisector line. Other arcs were very small and close to point *B* producing poor bisector lines. **Part (b)** had only a few correct responses. A few candidates had the idea of a parallel line but included the section outside the triangle.

Question 21

This statistical measures question was quite well answered although marks were often lost by careless calculation and lack of knowledge of the meaning of statistical measures. Some lost the mark in **part (a)** by writing the temperature −4 instead of the night as asked in the question. The response Sunday was a common response indicating a lack of understanding of a number scale. **Part (b)** was answered better than the others but manipulation of directed numbers was often performed incorrectly leading to responses of 2 and −2. The greater number of errors in **parts (c)** and **(d)** showed a lack of knowledge of the statistical measures. In **part (c)** the answer −4 to 5 was often seen. There was also a problem with the subtraction of directed numbers, with answers of 1 and −1 or −4 from −1 used as the lowest value, in particular. Others gave an answer of −9. The usual error of not writing the items in order was evident in the responses to **part (d)** as well as some confusing median and mean.

Answers: **(a)** Wednesday **(b)** 4 **(c)** 9 **(d)** −1

Question 22

The trapezium area and associated volume of the prism was poorly answered although it was a straightforward trapezium with just the required measurements shown to calculate the area. The knowledge of the trapezium formula was poor and many candidates seemed to just combine the given data in all sorts of additions and multiplications. Those who split it into triangles and a rectangle often made errors, usually by not dividing by 2 for the triangle areas. Many did not know that they just had to multiply by 12 to find the volume of the prism and **part (b)** was often missed completely. Many did not read or apply the request for units, even though a split answer line was there to remind them. However, the candidates who did give the units were most often correct.

Answers: **(a)** 51 **(b)** 612 cm^3

Question 23

The reading of the time from the travel graph in **part (a)** was very well answered. 16 04 was often seen and some gave 16h 04 which indicated a period of time. **Part (b)** was poorly answered, often from dividing 40 by 8 instead of 8 by 40. Others took 16 04 as their time instead of 40 minutes. Premature rounding in the calculation lost a mark when 0.6 or 0.66 was used from 40 divided by 60 where change to hours was done first. The completion of the graph did not depend on the previous parts and was answered quite well. Some candidates, however, were careless in working out or applying the 9 square horizontal distance for staying at the sports centre and also in working out the further 30 minutes to return home.

Answers: **(a)** 16 10 or 4.10pm **(b)** 12

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key messages

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

General comments

The standard of performance was generally good. The vast majority of candidates could tackle all questions. The majority of higher achieving candidates showed working with stages that could be easily followed. However many of the less able candidates missed stages, or didn't show their calculations at all. Consequently there were many cases where candidates scored no marks at all on questions, where some indication of method could have been credited.

There were a number of questions set in context where incorrect answers that were completely implausible were seen very frequently. Examples included modest interest rates leading to returns that were multiple times the value of the original investment, or suggestions that a student could walk tens or even hundreds of kilometres to a friend's house in the space of half an hour. In the overwhelming majority of cases there was no evidence that candidates had checked their answer to see if it was reasonable within the context of the question.

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

Comments on specific questions

Question 1

This proved to be a challenging question for a significant proportion of candidates. Many struggled to interpret the place values of the components of the number, so answers featuring additional zero digits in intermediate positions were very common.

Answer: 9 082 507

Question 2

There were many correct answers seen, but this proved to be a highly challenging question, with answers of 71, 71.5 and 71 500 being seen very frequently.

Answer: 71 000

Question 3

There were many good answers seen, but this proved to be a highly challenging question, particularly for the less able candidates. Only a small minority gave the answer 17^3. Taking the square root was the most common error, although a wide variety of answers was seen, usually with no indication as to how they had been obtained.

Answer: 17

Question 4

Most were able to answer this question correctly. The less able candidates often didn't appreciate that this was a question about correlation; answers describing changes in speed, or describing the shape of the scatter diagram, such as 'decreasing' or 'line' were seen.

Answer: Negative

Question 5

There were many correct answers, but this proved to be challenging for a significant number of candidates. The answer 5.15[777…] was fairly common, suggesting that candidates had not understood the required order of operations and had simply entered $17.85 - 7.96 \div 18 - 3.5^2$ into their calculators. A number of candidates arrived at answers that suggested a mis-key on their calculators. Re-doing the calculation to check the result would be a helpful strategy. In other cases, candidates elected to round or truncate the exact answer.

Answer: 1.72

Question 6

Both parts proved to be challenging; the most common errors involved the handling of negative values.

(a) Some candidates gave two numbers when the question specifically asked for three. Sometimes a number not from the list was included. The answer −8, −4, 2 was seen quite frequently.

(b) This part was less well answered with −6, −4 and −8, −4 being common incorrect answers. Several candidates did not attempt to answer the question which may suggest they did not understand the term 'product'.

Answers: **(a)** 2, −6, −8 **(b)** 3, −8

Question 7

There were many correct answers, but a wide variety of errors were seen. Many were unable to manage the first step correctly. Solutions beginning with $6y + 1 = 9$, or an attempt to subtract 6 were very common. A number of candidates showed some understanding of inverse operations, but were unable to apply them correctly, for example offering $6y = 9 - 1$ as a first step. Solutions that involved incorrectly adding a term in y to a number, for example 'simplifying' $6y + 3$ to give $9y$ were also common amongst the less able candidates. Of those candidates who managed to deal with the brackets correctly, the most common error was to arrive at $6y = 3$ but then calculate $6 \div 3 = 2$.

Answer: 0.5

Question 8

(a) There were many fully correct answers in this part. A common error from those who showed some understanding of vectors was to multiply −2 by 3 but omit the multiplication of the second component, leaving 1 in their final answer. The less able candidates often attempted to combine all the numbers, in many cases into a single digit, using a variety of calculations.

(b) This part was answered well, with the majority plotting the correct point. Most candidates were able to perform at least one component of the required translation correctly.

Answers: **(a)** $\begin{pmatrix} -6 \\ 3 \end{pmatrix}$ **(b)** Point plotted at (−3, 2)

Question 9

This question was poorly understood. The most common error from those who showed some understanding was to divide the area by 6 rather than 5. Many candidates seemed to have little or no idea how to find the area of a parallelogram, with the formula for the area of a trapezium being used frequently (and invariably incorrectly, although this could have been used to arrive at a correct answer). The area of a triangle was also implied in many cases, but most candidates seemed to simply multiply numbers from the question so a multiplication or division by 30 was seen in very many cases. A significant number ignored the given area and attempted Pythagoras' theorem or trigonometry. Those who realised what the required calculation was almost always successfully arrived at the correct final answer.

Answer: 10.3

Question 10

A large number of candidates showed some understanding of bounds, but many were unable to deal with the interval given in this example. Answers that added and subtracted 0.1 or other incorrect values were very common.

Answer: 4.95 5.05

Question 11

There were many correct answers seen. These generally involved the simplest and most efficient option of cancelling as soon as the mixed number had been converted. Of those who were able to correctly convert the mixed number into the required form, the most common error was then to evaluate $\frac{1}{12} \times \frac{6}{5}$ as $\frac{5}{60} \times \frac{72}{60}$ but then to evaluate this as $\frac{360}{60}$. A few candidates who opted to use common denominators did so correctly, but most who attempted this method went on to make errors in subsequent steps. A common error was to simply rewrite $\frac{1}{12}$ as $\frac{1}{2}$. Some candidates gave the answer without showing any method.

Answer: $\frac{1}{10}$

Question 12

Only a minority of candidates were able to calculate the length correctly. Those who realised the need to use cosine were usually able to gain at least one mark. There were a few attempts involving the sine rule, but these were often unsuccessful. Most attempted incorrect methods, usually using sine rather than cosine. Attempts at Pythagoras' theorem were also seen. A further problem was that a number of candidates lost accuracy marks by giving 22 as their final answer; a number of these candidates did not show any method at all and so were unable to gain any marks.

Answer: 22.1

Question 13

This was generally answered well and there were many correct answers. Most identified the correct calculation, but a significant number of candidates overlooked the requirement to round to the nearest dollar. A minority rounded incorrectly, usually giving $130 as their final answer.

Answer: 128

Question 14

Many produced good work here, although candidates should be reminded to read the question carefully. A significant number offered the total interest rather than the total amount as a final answer. A variety of errors were seen. Finding simple interest was a common error; candidates need to understand and distinguish between simple and compound interest. Many attempts to use the formula for compound interest were hampered by either the formula being misremembered or candidates being unclear how to substitute the interest rate into it; this often led to utterly implausible answers. Step by step calculations were attempted by many with the total for one year being used to find the interest for the next year. These often contained intermediate errors in calculations, some of which were arithmetical, but many involved adding the second year's interest to $4500, rather than to their new total. A number of less able candidates found the first year's interest correctly, but then attempted to find 3.5% of the interest rather than of the new total for subsequent years. Many answers were reasonable within the context of the question, but a number of candidates arrived at extraordinarily high figures that were many times the original sum invested, in some cases returns of millions or even billions of dollars were suggested. This should suggest to the candidates that their answer cannot be correct and needs to be checked.

Answer: 4990

Question 15

(a) Candidates who realised that they simply needed to divide 360° by 5 were able to arrive at the correct answer. Many felt that the required angle was either equal to or the supplement of one of the given angles. 42 was a common incorrect answer.

(b) Many appeared to be under the impression that angles in a quadrilateral add up to 180°. Those who knew the correct total were usually able to arrive at a solution which was followed through correctly from their answer to **part (a)**. A significant number of candidates showed little understanding and just attempted to subtract one or more angles from 180°.

Answers: **(a)** 72 **(b)** 123

Question 16

There were many good attempts at this question, with a significant number of candidates gaining full marks. Many didn't use efficient methods, multiplying both equations by a constant. This often led to arithmetical errors with negative values or subtractions. A number of candidates arrived at a negative value for y, then gave a positive value as the final answer or used a positive value when substituting. Only a small minority attempted to use substitution, but whilst most candidates who opted for this method were able to make the substitution correctly, almost none were able to go on to solve the resultant equation correctly, usually because of errors in their handling of algebraic fractions.

Answer: $x = 3.5$, $y = -4.5$

Question 17

(a) This was either done very well or very poorly. There were many excellent answers, with candidates going on to simplify their fractional answers. Some gave the answer 24 indicating they did not know the basic property of probability has to be between 0 and 1.

(b) It was very rare for one mark to be awarded because most candidates either showed no method, or offered an incomplete method. Many did not realise they had to add the three items.

(c) A significant proportion of candidates showed no understanding of probability and gave frequencies rather than relative frequencies as their answers. Consequently the final part of the question was often the only part that they got right, although whether they knew that the probability was zero or were just stating a frequency of zero was unclear.

Answers: **(a)** $\frac{24}{100}$ **(b)** $\frac{78}{100}$ **(c)** 0

Question 18

(a) In many cases it was not possible to award method marks because little method was shown. The most successful candidates drew a triangle or indicated two points before going on to use rise over run. A large number of candidates muddled x and y co-ordinates, or divided a change in x by a change in y, or appeared to be using numbers obtained from the co-ordinates of a single point in their division.

(b) This part caused real challenges for candidates. Many showed working in which they attempted to substitute values into $y = mx + c$, but a significant number substituted for x and y and calculated c rather than realising that they could simply write the equation using their value for m and the value for c implied in the question.

Answers: **(a)** 2 **(b)** $y = 2x + 6$

Question 19

(a) Most realised the need to use Pythagoras' theorem in **part (a)**, although many started by writing $82.5^2 + 93.5^2$. There was no indication that answers were checked to see whether they were reasonable, so answers that were longer than the hypotenuse were offered with no attempt to check or correct these.

(b) There were fewer correct answers to **part (b)** than to **part (a)**, although a number of candidates were able to use their values from **part (a)** correctly in this part.

Answers: **(a)** 44 **(b)** 33

Question 20

(a) (i) Whilst the majority of answers were correct, there were some answers which were excessively high for this context.

(ii) The first part of the graph often started from an incorrect point, usually where the axes crossed. Another common error was to show the initial journey taking place over 15 minutes rather than 30 minutes. Those who had obtained an incorrect answer in **part (a)(i)** often struggled to use the scales correctly.

(b) (i) Most realised the need for a horizontal section, but this was not always the correct length. The most common problem in the final part was to show Alice's return home over an incorrect time interval, usually 30 minutes. Whilst there were some errors, most graphs were plausible, with a correct general shape.

(ii) This part was generally answered well. A number of less able candidates knew that they needed to divide a distance by a time, but used a time of day, such as 10 30, rather than a time interval.

Answers: **(a)(i)** 2400 **(b)(ii)** 160

Question 21

(a)(i) There were many correct answers seen, reflecting highly accurate measuring. The most common error involved reading the wrong scale on a 180° protractor, with 60° a common answer.

(ii) There were many good attempts at this part. Errors generally involved incorrect proportional reasoning or attempts to use 100 in the calculation.

(b) Many candidates correctly calculated the sector angle.

(c) The vast majority of candidates were able to either complete the pie chart correctly, or draw a sector that followed on correctly from their value in **part (b)**.

(d) This part caused real problems for many candidates. There were some excellent clear answers, but many candidates ran into difficulties. A common problem was to use an incorrect pie chart to conclude that green was in the majority, despite being given the figures relating to blue and the total in the question. Some candidates simply restated this data but did not offer any interpretation, for example stating that '24 chose blue' but with no indication that 'most chose blue'. Many candidates did not understand what was required at all. Some of these offered answers that implied the goal was to make the distribution uniform, suggestions included 'green', with the reason being 'to make it even'. Others interpreted the question as being about availability, with suggestions that either red, or green, or another colour not included in the given data, should be chosen because it was least popular or least widely used, for example 'red' with the reason 'there are lots left'. A significant number of candidates offered subjective evaluations of a variety of colours rather than using the data from the question to draw a conclusion; consequently answers such as "gold because it is a winning colour" were seen fairly frequently.The wide variety of misconceptions seen suggests that many candidates would benefit from increased opportunities to interpret data.

Answers: **(a)(i)** 120 **(a)(ii)** 15 **(b)** 192 **(d)** Blue with an acceptable reason

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 and variety 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 most parts of the last few questions.

Candidates showed some good number work in **Questions 3** and **5** and were adept at dealing with negative numbers in **Question 7**. The rearrangement of the equation in **Question 8** was extremely well handled.

Questions which caused significant problems were **Question 14** which involved describing loci, factorising in **Question 24b** involving the difference of two squares and **Question 25**, finding the equation of a perpendicular bisector of a line.

Candidates were generally good at showing working although sometimes this was hard to follow. Working should be set out in a logical manner, especially in an unstructured question. This was particularly prevalent in **Questions 18**, **20, 25** and **26**.

Premature rounding part way through calculations caused some candidates to lose accuracy marks in **Questions 18**, **20**, **23** and **26**.

Comments on specific questions

Question 1

Most candidates could deal with finding the time difference. Errors were commonly made in the number of hours, where 7, 9 and 12 were often seen. Many candidates treated the hours as if they contained 100 minutes and simply subtracted 732 from 2240 or 1040 leading to the commonly seen answers of 15 h 08 min and 3 h 08 min.

Answer: 8 (h) 52 (m)

Question 2

Most candidates found this percentages question straightforward. The most common incorrect method was to divide 80 by 3, leading to an answer of 26.6(6...). Some candidates rounded to 3.8 or 4. Some turned the question around and gave an answer of 96.25%.

Answer: 3.75

Question 3

The vast majority of candidates were able to convert the number from standard form. The most common error was to multiply rather than divide by 1000.

Answer: 0.00127

Question 4

This calculation was usually carried out successfully and the majority of candidates gained at least 1 mark. The second mark for rounding was often lost, either because candidates did not read the question carefully and did not round at all or because of rounding errors; the most common being answers of 1579 and 157 800. If candidates did not write down their calculator answer and then rounded incorrectly, they were unable to gain any marks in this question.

Answer: 157 900

Question 5

Candidates were usually successful in this question and the vast majority gained at least 1 mark. Some did not read the question carefully enough and did not round to the nearest euro. There was a minority who multiplied rather than divided by the exchange rate.

Answer: 393

Question 6

There was much confusion between factors and multiples in this question, with 2 and 12 commonly seen as answers. A common starting point was to list the factors of each number. A mark was often gained for making a correct first step of finding the prime factors of the numbers and sometimes for giving a multiple of the numbers which was not the lowest. A successful method employed was to draw up a table with both numbers at the top and then divide prime factors into each.

Answer: 144

Question 7

The overwhelming majority of candidates dealt with substituting negative numbers correctly. If an error was made it was generally because –14 was arrived at from –2 × –7 leading to an answer of –17.

Answer: 11

Question 8

This was a straightforward rearrangement which was dealt with completely correctly by the vast majority of candidates. There were various misconceptions, for example $\frac{y}{x} = \frac{q}{p}$ followed by $x = \frac{qy}{p}$. Occasionally a subtraction was seen in place of a division.

Answer: $\frac{py}{q}$

Question 9

A sound knowledge of angles in triangles and parallel lines was demonstrated in this question with the majority gaining both marks. The most common misconception was to treat the isosceles triangle incorrectly and give both angles as 40°. Occasionally both angles were given as 70° and sometimes 50° or 140° were seen as subtractions of 40 from 90 or 180.

Answer: (a =) 70 (b =) 40

Question 10

This question caused some difficulty amongst candidates. There were many who did not take bounds into account at all and simply gave the answer of 28.2 from 9.4 × 3. Others then went on to add 0.05 to this value to give 28.25. Incorrect bounds used were 9.44 and 9.49. Candidates should be aware that any rounding in a bounds question is incorrect; many found the correct value but then went on to spoil it by rounding to 28.4.

Answer: 28.35

Question 11

The majority of candidates knew the circle theorems involved in this question, with **part (a)** resulting in slightly more correct answers than **part (b)**. 56° was sometimes seen as the answer to **part (a)** demonstrating some confusion in the theorems. Other answers seen to **part (a)** were 236° (180 + 56) and 124° (180 – 56). The only common incorrect answer for **part (b)** was 28°. There was evidence of some measuring of angles from a minority of candidates, resulting in answers a few degrees out from the correct values. There was a fairly high proportion of answer lines left blank in this question, especially in **part (b)**, indicating that many candidates were unfamiliar with circle theorems.

Answer: **(a)** 112 **(b)** 56

Question 12

There were a good number of candidates who could simplify the expression correctly and many gained 1 mark for a correct simplification of one part of it, commonly giving $4p^4$ or $16p^4$. There were a range of other incorrect answers which stemmed from combining the indices and 16 in a variety of different ways.

Answer: $2p^4$

Question 13

Solving the inequality was well attempted with many correct answers seen. There was also a large proportion who gained 1 mark either for collecting like terms on each side of the inequality or solving the equality and having the incorrect or no inequality sign in the answer. Those who rearranged to $–4n < –15$ often dealt with the negatives incorrectly, arriving at $n < 3.75$. Some spoilt their correct solution by choosing to write $n = 3.75$ or just 3.75 on the answer line.

Answer: $n > 3.75$

Question 14

This loci question proved to be the most challenging question on the paper. There were many different descriptions and the most common responses were to give individual points, as in the first statement given which describes points above the horizontal line *FG*. Common responses seen were closer to *C* than *E*, *C* than *A*, *H* than *E* and *H* than *J*. It was more common to see the correct description of more than 20 m from *D* than nearer to *CD* than *CB*. Sometimes candidates just described the line of 20 m from *D* rather than the shaded region beyond.

Question 15

Almost all candidates could give the next term in the sequence for **part (a)**. Far fewer could give the *n*th term of the sequence required in **part (b)**. The most common incorrect response was to give the term-to-term rule $n – 2$. A common response which gained 1 mark was $7 – 2n$. Candidates should be aware of the correct use of brackets with a decreasing terms sequence as some lost marks due to answers such as $7 – 2 \times n – 1$.

Answer: **(a)** –3 **(b)** $9 – 2n$

Question 16

The majority of candidates demonstrated that they were adept at handling fractions and gained all 3 marks by showing full working. Where full marks were not scored, 1 mark was usually gained by turning the mixed number into an improper fraction. The most common misconception was to invert the incorrect or both fractions. Candidates should be aware that simply drawing lines from one figure to another in the fractions does not constitute full working and credit cannot be awarded in these instances.

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

Question 17

The majority of successful candidates employed the method of internal angles, finding the sum of angles of a hexagon and subtracting 5×115. Many candidates multiplied 5 by 115 correctly but then had no strategy for finding the sum of angles of a hexagon, with many thinking it was $6 \times 180 = 1080$. Incorrect answers generally involved working with 115° or multiples of this, and then adding or subtracting multiples of 180 or 360. Some candidates did try to work with the external angle and calculated 180 – 115 = 65 but then could get no further and gave 65 as their answer. 245 was also fairly common from 360 – 115. A significant number of candidates simply assumed that the polygon was regular and gave 115 as the answer.

Answer: 145

Question 18

Only the most able candidates scored full marks on this question. It was also often difficult to follow working as it jumped around the answer space. Including the length of the car and the bridge caused some confusion with many not taking the length of the car into account, adding 2 lengths of the car, subtracting the length of the car, dividing or multiplying the length of the bridge by the length of the car. Other errors involved the use of an incorrect formula linking distance, speed and time, often leading to speed/distance, and errors in conversion between km and m or hours and seconds; the conversion was often done the wrong way or only one of the conversions was considered. Many candidates scored 1 mark for showing a clear distance divided by a speed. It would have been prudent for candidates to consider how realistic their answer was on this question.

Answer: 1.38

Question 19

It was evident that many candidates were not familiar with the use of tree diagrams and many appeared to have no strategy for answering the question. There were many cases of adding fractions along the branches, picking out fractions to add and multiplying 3 fractions together. Some candidates did not seem to worry if their answer was greater than 1. Of those who did use the tree diagram correctly, a common error was to omit the win, win option, giving the answer $\frac{7}{12}$. The most successful candidates used the most efficient method of 1 minus the lose, lose option.

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

Question 20

The crucial step to solving this problem was to find the sector as a fraction of the circle using the length of the arc and radius. Those who made this connection usually went on to find the correct answer. Some lost the final accuracy mark through multiplying out π throughout the question unnecessarily. Many candidates did not show anything which was worthy of any credit, including statements and calculations about the circumference and area of the whole circle. This often involved multiplying and dividing by π and ending up where they began, with answers of 81, 18 and 54 for example. There were a significant percentage of candidates who did not attempt this question.

Answer: 27

Question 21

Some candidates were clearly proficient at questions on proportionality and were able to work through this question with relative ease. There were other candidates who made a good start and found that $y = 4\sqrt{x}$, but then forgot the square root when substituting $\frac{1}{4}$ and obtained the answer 1. Some candidates were aware of proportionality, but worked with inverse proportionality or proportional to the square of *x* or proportional to *x* rather than the relationship given in the question. In other cases candidates did not know how to attempt this question and a wide range of incorrect answers were seen.

Answer: 2

Question 22

Part (a) proved to be the most challenging part of the question and answers displayed various misinterpretations of the notation. The common answer of 1 also showed that the sentence describing the Venn diagram had not been carefully read. There were as many incorrect as correct answers given for **part (b)**, the most common of these being $\frac{12}{27}$ i.e. not taking the intersection into account. Another popular answer in both **parts (b)** and **(c)** was $\frac{1}{2}$, indicating a very simplistic interpretation of the situation. Other common incorrect answers to **part (c)** were $\frac{10}{27}$ and $\frac{7}{27}$. **Part (d)** was the best attempted part of the question with the majority of candidates shading the correct region.

Answer: **(a)** 3 **(b)** $\frac{19}{27}$ **(c)** $\frac{7}{10}$

Question 23

This was well attempted with many candidates scoring full marks. Most found the height of the trapezium using the expected method of Pythagoras' theorem although some successfully used trigonometry. Some candidates used Pythagoras' theorem incorrectly and added the values rather than subtracting, but many who did get an incorrect height gained a mark for using this correctly to find the area of their trapezium. Some candidates assumed that the height was 4 but as long as this was clearly marked on the diagram, could gain the mark for correctly finding the area of their trapezium. Others incorrectly used the slant height of 8. Candidates must ensure that they do not round workings prematurely as the use of 6.9 or even 7 for $\sqrt{48}$ meant that they lost the final answer mark for accuracy. It should also be understood that rounded values do not imply that the correct method has been used and so the use of 6.9 or 7 without showing $\sqrt{48}$ also meant that some candidates lost a method mark.

Answer: 69.3

Question 24

In **part (a)** a large number of candidates were able to fully factorise the expression, and there were also a good number who gained 1 mark for a partial factorisation, but then did not realise that they could combine the terms outside each bracket into another bracket, or made an incorrect attempt. Some believed that the expression could not be factorised or made an incorrect attempt at collecting together the terms. In **part (b)** it was rare to see full marks. A reasonable number of candidates were able to gain 1 mark for a partial factorisation, usually for $2(81-4t^2)$, but did not recognise that it could be factorised further as the difference of two squares. There was a fairly high number of nil responses for **part (b)**.

Answer: **(a)** $(a + 2)(2 + p)$ **(b)** $2(9 + 2t)(9 – 2t)$

Question 25

It was rare to see a fully correct response to this question, but there were many candidates who were able to gain some marks. A good number were able to find the gradient of the line but far fewer went on to find the negative reciprocal of their gradient with some inverting but not making it negative and others vice versa. Where candidates found a gradient which they believed was for a perpendicular line they often did not find and use the midpoint in attempting to determine the constant term and instead substituted one of the two points given. Many substituted a point into a linear equation using the gradient of the original line rather than the perpendicular, even though they often gave this inverted gradient within the final answer. A smaller number of candidates found the midpoint of the line, but then did not progress from this point. An error in finding the midpoint was to subtract the co-ordinates and divide by 2, resulting in (3, 7). Other common errors included attempts to draw a graph (despite the lack of graph paper), calculations for gradient being inverted and a range of incorrect calculations using the values in the co-ordinate pairs given, including finding the length of the line. A relatively high proportion of candidates did not attempt the question at all.

Answer: $y = -\frac{3}{7}x + 11$

Question 26

Both parts of this question were impacted by candidates incorrectly making one of two assumptions, the first being that the triangle was right-angled. In **part (a)** this led to candidates attempting to use $\frac{1}{2}$base x height with their value of *AC*. Also commonly seen was $\frac{1}{2} \times 7 \times 10$. In **part (b)** this assumption led to attempts using Pythagoras' theorem. The second incorrect assumption made was that the triangle was isosceles and so the perpendicular height cut *BC* at 5 cm. Pythagoras' theorem was then used to find the height and subsequently the area in **part (a)** and to find *AC* in **part (b)**. There were, however, a good number of candidates who recognised the need to use the efficient formula involving sine for **part (a)** and the cosine rule in **part (b)**. There were a significant number of candidates who substituted correctly into the cosine rule but then didn't use the 'bodmas' rules correctly, treating it as $(b^2 + c^2 - 2bc) \cos A$. Once again, premature rounding during calculations caused candidates to lose accuracy marks in both parts. When using the longer method of finding the height in **part (a)** followed by a second calculation using this height it was often rounded to 4 rather than the accurate value of 7 sin35. In **part (b)** cos35 was often written as a value rather than leaving it as the exact value on the calculator.

Answer: **(a)** 20.1 **(b)** 5.86

MATHEMATICS

Paper 0580/22

Paper 2 (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. A number of candidates did not answer the last two part questions but it is unlikely that this was due to lack of time as in many cases they wrote "?" on the answer line or the two blank answer spaces followed an answer in **Question 24(a)** that clearly demonstrated a lack of understanding of vectors. Candidates showed evidence of good number work with particular success in **Questions 1**, **2**, **5a** and **14**. As well as the two part questions previously mentioned, candidates found **Questions 7**, **13**, **17b**, **18b**, **19** and **20** particularly challenging. The topics covered in these questions were using map scales, bounds, finding the locus of points, the exponential sequence, exponential growth and histograms. In the majority of cases candidates were very good at showing their working, gaining method marks more frequently than in previous years.

Comments on specific questions

Question 1

This was answered well by very many candidates. The most common error was to have a positive power of 10. Some made incomplete attempts using powers of 10, e.g. 574×10^{-7}. A few candidates made the error of rounding by missing off the 4 or using 6 instead of 5.74. Candidates are advised they should always be giving exact answers when the answer is a terminating decimal and they have not been asked to round.

Answer: 5.74×10^{-5}

Question 2

The majority of candidates answered this question well showing a good degree of competence with a calculator. Not many showed their stages of calculation, e.g. $\frac{19.07}{3.24}$, as it was more frequently entered into the calculator in one attempt. 5.88 (truncating or rounding incorrectly) and 5.9 (rounding too much) were common errors. It was rare, but there were candidates who were unable to find a value or gave an answer of 4.46, arising from entering $3.07 + 2^4 \div 5.03 - 1.79$ into the calculator without any brackets.

Answer: 5.89

Question 3

This was well answered by a large number of candidates. The most common errors were to keep the number to 4 decimal places in the answer by filling in with zeros, i.e. 3.5900 or to drop the zero to give 3.59. Other errors commonly seen were truncating to 3.589 or rounding to lower degrees of accuracy e.g. giving values of 4.0(00) or 3.6(00). Some were not sure how to round and also seen were answers of 3.5810, 3.5890 and 0.3590.

Answer: 3.590

Question 4

A great variety of answers was seen, such as rhombus, trapezium, kite, rectangle, square, cyclic quadrilateral, pentagon, hexagon and circle. However the correct answer was also often seen. Spelling errors were common, however in most cases the meaning was clear.

Answer: Parallelogram

Question 5

Part (a) was generally well answered with a high proportion of correct answers. Some candidates included 8 as an extra and a few less able candidates listed the even numbers rather than the square numbers or only gave one of the correct answers. **Part (b)** was slightly less well answered although almost everyone included 11 in their response. However it was very common to include a second incorrect answer. 9, 11 was a fairly common incorrect answer and less so was 3, 11. Candidates also sometimes wrote 99 as a product of its prime factors and $3^2 \times 11$ was also commonly seen.

Answer: **(a)** 9 and 16 **(b)** 11

Question 6

Fully correct answers were often seen. However it was common to see either an incorrect power for x or an incorrect coefficient. The most commonly seen incorrect coefficient was $\frac{1}{2}$, when the cubing was applied to $x^{\frac{2}{3}}$ only. The most commonly seen incorrect power was $\frac{8}{27}$, when the power was cubed rather than multiplied by 3. A few candidates did not simplify fully giving a power of $\frac{6}{3}$.

Answer: $0.125\,x^2$

Question 7

The idea of applying scale factor to an area was not well executed by a large number of candidates. Most common was simply applying a linear scale factor, not always correctly. Some forgot to convert the units or incorrectly converted the units. 46 and 4600 were common incorrect answers along with a wide variety of answers involving the figures 4 and 6 either with too many zeros or in a decimal. Candidates are advised to consider whether they have sensible answers when the area of a forest works out to be billions (or more) of square kilometres or e.g. $0.000046\,km^2$. Some candidates realised that squaring was involved in the question, but incorrectly squared or square rooted 4.6.

Answer: 460

Question 8

A large number of candidates were able to gain at least one mark on this question with many gaining two. A method mark was often awarded for the correct first step $\frac{x}{3} > 2 - 5$ or for reaching $x > -9$ then spoiling this on the answer line with an answer of e.g. just –9 or $x = -9$. The candidates with the most success subtracted 5 as their first step. Common errors following the correct first step $\frac{x}{3} > -3$ were $\frac{x}{3} > \frac{-3}{3}$ giving the answer $x > -1$; $x > -3 \times 3$ giving the answer $x < -9$ or $x < 9$. Also commonly seen was an incomplete attempt to multiply through by 3, with $x + 5 > 6$ being a common incorrect first step. Also sometimes seen was $x + 15 > 2$. Some candidates attempted common denominators on the left hand side as their first step but usually made conceptual errors as their manipulation of fractions was not good. A small number of candidates gave a list of integers as their answer.

Answer: $x > -9$

Question 9

Many candidates made a correct start here taking 172 from 180 and these candidates usually continued to divide this into 360 to get the correct answer. Some candidates mistakenly thought that 8 was the answer. A large number of candidates chose to set up and solve an equation with the starting point $\frac{180(n-2)}{n} = 172$ frequently seen and this was often solved correctly. The most common error for those taking this approach was omitting the division by n, giving $180(n - 2) = 172$, leading to the answer 2.95. For the occasional candidate this number clearly indicated an error and they could be seen correcting their work. For the majority this was not the case and this value, or the rounded answer 3, were common incorrect answers.

Answer: 45

Question 10

This question was answered well by a large proportion of candidates. Many candidates knew to start by collecting terms with p on one side of the formula and terms without p on the other. The most common error at this stage was to write $rp - 3p = 8r + 5$. Many who made this error still went on to gain two marks by continuing with correct factorising of their equation and correct dividing. There were a significant number of candidates that did not realise that factorising was required in order to change the subject with $rp = 3p + 8r - 5$ being a common incorrect starting point. This was often followed by dividing by r and not realising that p was not the subject because it was still on the right hand side of the equation.

Answer: $p = \frac{8r-5}{r-3}$

Question 11

This question proved challenging for some and produced a wide range of answers and scores. The correct four figures were seen by about half of the candidates. Of the three averages, it was the median that proved to be the most difficult. Many candidates were able to gain one or two marks on this question. Many were able to score a mark for the mode by writing 78 twice and a similar number realised that the total should be 300. Answers such as 67, 77, 78, 78 with a correct mode and mean were therefore seen quite often. Less frequent, but also seen was 68, 77, 77, 78 gaining two marks for a correct median and mean. A few did not list four numbers and scored no marks. Another fairly common incorrect response, which scored no marks, was 75, 76, 77, 78.

Answer: 68 76 78 78

Question 12

Many correct answers were seen, sometimes without any supporting calculations. Those that presented full working often reached $\frac{33}{90}$ forgetting or not seeing the instruction in the question to give the answer in its simplest form. Others with correct working provided solutions that were equivalent fractions containing terminating decimals, such as $\frac{3.3}{9}$. Some candidates appeared to correctly multiply by powers of 10 and subtract, but treated the decimals they were working with as terminating rather than recurring when performing the subtraction. Another common error was for candidates to treat the question as if the recurring decimal was 0.363636… rather than 0.3666… or to treat the question as if the decimal to be converted to a fraction was the terminating decimal 0.36.

Answer: $\frac{11}{30}$

Question 13

This question proved to be a good discriminator. The most common error was due to incorrect identification of the upper bound for the area as 45 or 40.5 rather than 42.5. The other common error was to use upper bounds for both area and the given base i.e. 9.5 instead of 8.5, forgetting that this should not be the case as they were using it for a division. A significant number of candidates performed the calculation with the figures 9 and 40 then applied a 0.5 error to the answer. Another problem for some candidates was not correctly applying the formula for the area of a triangle, sometimes area ÷ base was calculated instead of 2 x area ÷ base.

Answer: 10

Question 14

This question was well answered with most candidates showing complete working and achieving full marks or at least two out of three marks. A common error was to leave the answer as $\frac{9}{8}$ or occasionally $1\frac{7}{56}$ or 1.125. Only a few made errors converting the mixed number to $\frac{21}{8}$, the most common errors in this case being $\frac{10}{8} \times \frac{3}{7}$ or $\frac{10}{16} \times \frac{3}{7}$. Some made the error of cancelling the whole number 2 by the 8 in the denominator. Some had the misconception that common denominators were required to multiply. In those cases it was common to see arithmetic errors in reaching or dealing with $\frac{147}{56} \times \frac{24}{56}$. Working was sometimes less detailed than it could have been.

Answer: $1\frac{1}{8}$

Question 15

This question proved challenging for quite a few candidates. About half of candidates wrote $(x + \frac{7}{2})^2$ and many went on to successfully complete the question. A large number were unsure of a next step to find *b*. A common error after squaring 3.5 to give 12.25 was to subtract 5 arriving at *b* = 7.25 or –7.25. A number of candidates had the correct equation but then mistakenly transposed one or both of the signs, most commonly resulting in an incorrect answer of 17.25 for *b*. A few also spoilt their exact answer by rounding to –17.3. Some did not progress beyond expanding $y = (x + a)^2$. Some went on to equate the two equations which led them into a wide variety of responses which they were unable to make further progress with. Answers of *a* = 7 and *b* = –5 or 5 were very common. A few used the quadratic formula to solve $x^2 + 7x - 5 = 0$ resulting in answers of 0.65 and –7.65.

Answer: *a* = 3.5 and *b* = –17.25

Question 16

Excellent answers to this question were frequently seen, with the majority of candidates solving the simultaneous equations correctly and showing sufficient and clear method. A few arithmetic slips were seen, such as $14y = 7$, so $y = 2$, but almost all candidates knew to eliminate one of the variables at the start. The method of elimination was by far the most popular and successful method.

Answer: *x* = 4, *y* = 0.5

Question 17

Part (a) was answered successfully by many showing good use of compasses skills. One mark was not awarded very often as those who understood what was needed were able to construct the angle bisector correctly. There were a few who did not understand what was being asked of them, in some cases bisecting the wrong angle or constructing the perpendicular bisector of one of the sides, frequently *BC*. **Part (b)** was less well answered with many not realising that the answer should be a line parallel to *AC* inside the triangle. Of those that did draw a parallel line, many continued it beyond the triangle or sometimes completely around the line *AC*. Some shaded either side of the line, presumably expecting a region as the answer to this type of question. An arc centred on point *A* was seen as a common incorrect answer and there were many who did not attempt this part.

Question 18

Part (a) was answered well by many candidates. Able candidates found the common difference and then worked backwards to the "zero term" to find the +13 part. Some were able to do this in their heads and showed little working. It was also common to see candidates using the formula $a + (n - 1)d$. Occasionally these candidates were less successful as they made errors in expanding and simplifying. A few gave the next term rather than the *n*th term. **Part (b)** was less well answered. Many candidates had begun by trying to find successive differences in the terms. This approach led many to give a quadratic or a cubic expression for the *n*th term. The most able candidates gave a correct power of 3, whilst some others scored part marks by giving 3^n as the answer. $3n$ was a common incorrect answer from those who had spotted that the term-to-term rule was to multiply by 3. A greater number of candidates than in **part (a)** gave the next term rather than the *n*th term as the answer.

Answer: **(a)** $3n + 13$ **(b)** 3^{n-1}

Question 19

The vast majority of candidates attempted this question and if they used the correct formula in **part (a)** they generally received both marks. Many candidates applied the formula PRT/100 in this question, rather than exponential increase. Common incorrect working was equivalent to $7.23 \times 0.0114 \times 6 + 7.23$ leading to the frequent incorrect answer of 7.72. Also often seen was 7.23×1.14^6 and another common incorrect answer of 15.9. The candidates with this answer did not seem to realise that more than doubling the world's population in 6 years was unlikely. Very few candidates achieved full marks in **part (b)** although a few were able to score one mark for an answer of 2043. Many candidates did not have any idea of a method. The increase in population was often divided by the first year's increase leading to a 33 (or 34) year interval. Also commonly seen was $(10 - 7.23) \div 0.0114 = 243$. Some candidates wrote the formula with *n* for the power but then did not know how to find *n*. Quite a few realised that a trial and improvement approach could be used and a few used methods beyond the syllabus, such as logs, often correctly. There were a significant number of candidates who made no attempt to answer this question.

Answer: **(a)** 7.74 **(b)** 2042

Question 20

Less than half the candidates obtained the correct answer in **part (a)**. Many did not seem to know where to start. A significant number gave an answer of 65, 67 or 96, thinking that the vertical axis represented frequency and not frequency density. Another incorrect answer seen was 5, from counting the number of bars as trains. A few had the answer 26 (highest frequency density). Using cumulative late times as bar widths, i.e. widths of 5, 10, 15, 20, 25, 30 was also encountered as were mid-points of class intervals, the latter often leading to decimal answers. Candidates are advised to consider the context of the question and the suitability of their answer, i.e. that a decimal answer is not appropriate for a number of trains. A few took the sum of widths (or heights) and then multiplied them all by one singular number to get an answer. Of those with the correct approach there were some arithmetic errors, with most not showing their product calculations. Those that answered **part (a)** correctly often had a correct answer for **part (b)**. A few gave the answer for trains less than 10 minutes late and some did not complete the percentage calculation correctly or gave an answer to 2 significant figures instead of 3, so were not able to obtain the accuracy mark. Many gained a method mark, often from the follow through.

Answer: **(a)** 240 **(b)** 29.2

Question 21

A good proportion of candidates gave a well-presented, articulate solution, demonstrating a good knowledge of circle theorems. Most went down the route of recognising that *AOB* was isosceles and then used the angle at the centre being double that at the circumference. Candidates lost marks by not giving reasons, thinking that the calculation was sufficient; this was particularly the case for the second reason after 124° had been found. Some misinterpreted the isosceles triangle to give *AOB* as 76°, others marked *AOB* as a right angle and others incorrectly placed 124° at the intersection of *AC* and *OB*. A common error was to think that angle *AOB* = angle *ACB*, giving angles in the same segment as the reason. The most common misconception was to think that angle *ABC* was a right angle, as it touched the circumference, without being aware that this is not the case because *AC* is not a diameter.

Answer: 62

Question 22

Some good attempts at these matrix questions were seen, although arithmetic errors were common. Almost everyone was able to multiply by 4 correctly in **part (a)**. Occasionally candidates would forget to multiply one of the elements in the matrix but that was very rare. **Part (b)** was also answered well by the majority of candidates. There were a few who lost a mark due to arithmetic slips, or sign errors and some who were not sure how to answer this question with the two most common incorrect answers being $\begin{pmatrix} 25 & 1 \\ 9 & 4 \end{pmatrix}$ and $\begin{pmatrix} 25 & 1 \\ -9 & -4 \end{pmatrix}$ arising from an attempt to square each element of the matrix. In **part (c)**, most candidates could find the inverse matrix. There were arithmetic slips sometimes seen, with 13 or 7 as common incorrect determinants or the occasional error in the adjoint matrix, often a sign error. Some candidates chose to use the less efficient route of solving four simultaneous equations resulting from $\begin{pmatrix} 5 & 1 \\ -3 & -2 \end{pmatrix}\begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and usually these candidates were less successful.

Answer: **(a)** $\begin{pmatrix} 20 & 4 \\ -12 & -8 \end{pmatrix}$ **(b)** $\begin{pmatrix} 22 & 3 \\ -9 & 1 \end{pmatrix}$ **(c)** $-\frac{1}{7}\begin{pmatrix} -2 & -1 \\ 3 & 5 \end{pmatrix}$

Question 23

A good range of marks were scored in this question with many scoring three or more. The quality of the drawing was generally fairly good with most using rulers and (reasonably) sharp pencils. Only a very small number used dashed or dotted lines. The part marks were for drawing correct lines of which $x = 3$ was the most commonly seen. The line $y = 2x$ was more difficult, with many drawing $y = 2$ or $y = \frac{1}{2}x$. Some had problems with accuracy with the line being in tolerance between (0, 0) and (2, 1), but when this was extended to the vertex of the required area, (3, 6), the accuracy was lost. Of the three boundary lines it was $3x + 4y = 12$ that was least well done with quite a few less able candidates not drawing a line at all and others who drew $4x + 3y = 12$. Most of those who drew the three correct lines also shaded correctly but there were a fair number who misunderstood the inequalities and shaded the wrong region. In this question there were very few who did not score a mark or who offered no response at all.

Question 24

In **part (a)** the vast majority found **a** + **b** – **c** as required. A few gave $\overrightarrow{BC}$ rather than $\overrightarrow{CB}$. Some left **part (a)** blank or guessed an answer that was nothing to do with vectors. In both **parts (b)** and **(c)** the most able candidates showed clear method by writing their route from start to finish and if subsequent working went wrong were able to gain the method marks. In all three parts there was evidence of candidates not realising that $\overrightarrow{BC}$ and $\overrightarrow{CB}$ are different. In **part (b)** the concept of a position vector was clearly not known by quite a few candidates. A common incorrect answer was to see $\frac{1}{2}\overrightarrow{CB}$ and there were also a significant number of candidates who offered no response to this question. In **part (c)** many attempted to use $\overrightarrow{PB} + \overrightarrow{BQ}$ but did not use $-\frac{1}{2}$ of their solution to **part (a)** with quite a few trying $\frac{1}{3}\mathbf{b} + \frac{1}{2}$ their answer to **part (a)**. Some attempted more complex routes with sign errors often preventing a correct result.

Answer: **(a)** **a** + **b** – **c** **(b)** $\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b} + \frac{1}{2}\mathbf{c}$ **(c)** $\frac{1}{2}\mathbf{c} - \frac{1}{2}\mathbf{a} - \frac{1}{6}\mathbf{b}$

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key messages

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

General comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions.

The candidates are advised to read the questions carefully and to ensure that they know exactly what is required of them. There were instances when many did not give the information requested despite using the correct methods. When a question requires a calculation it is good practice to first write down the full result from the calculator before rounding the answer to an appropriate degree of accuracy. When there is more than one step in the calculation, it is important to not round or truncate prematurely at intermediate stages.

Comments on specific questions

Question 1

This question was answered correctly by most candidates. On rare occasions, candidates wrote $17\sqrt{17}$ as their answer.

Answer: 17

Question 2

The majority of candidates wrote the correct answer of 71 000 or written in standard form as 7.1×10^4. Those candidates who scored 0 on this question did not show understanding of significant figures or rounded incorrectly. Common incorrect answers seen were 71, 72 000 and 7.1496×10^4.

Answer: 71 000

Question 3

A common error was using an incorrect formula for the area of a parallelogram. $6x = 51.5$ was seen often instead of using the perpendicular height. Some candidates used the formula of a trapezium to try and work out *x* whilst other candidates tried to split the shape into triangles and in general this led to an incorrect answer.

Answer. 10.3

Question 4

This was answered correctly by most candidates using the method of expanding to $6y + 6 = 9$ and then rearranging. Occasionally candidates incorrectly expanded the brackets to $6y + 1 = 9$.

Answer. 0.5

Question 5

Occasionally an answer of 0.1 was given instead of the required fraction, which meant that candidates did not read the question carefully. Most candidates converted $1\frac{1}{5}$ correctly to $\frac{6}{5}$ then either simplified before multiplying numerators and denominators or multiplied to $\frac{6}{60}$ first and then simplified. Some candidates found a common denominator of 60 then multiplied numerators and denominators leading to an incorrect answer but still gaining credit for the first step of $\frac{6}{5}$.

Answer. $\frac{1}{10}$

Question 6

The majority of candidates answered this question well and included the correct perpendicular line and arcs. Some only drew the arcs and did not draw in the perpendicular line, therefore only gaining partial credit. It was clear that a small amount of candidates measured the line and drew in a line half way without any construction at all.

Question 7

The biggest confusion was over applying the rules of indices to both a number and power. As a result, $32x^6$ was quite common. A very small number of candidates left the 32 as 2^5.

Answer. $8x^6$

Question 8

Some candidates were confused between terminating and recurring decimals. Therefore $\frac{1611}{5000}$ and $\frac{161}{500}$ were quite common incorrect answers. The most successful method included multiplying by 10 and subtracting to reach $\frac{2.9}{90}$ which was converted to the correct answer. Some used an infinite geometric series which was also usually successful.

Answer. $\frac{29}{90}$

Question 9

The most common error was a misunderstanding with the vectors, often finding $\overrightarrow{KG}$ rather than $\overrightarrow{GK}$ but labelling it as $\overrightarrow{GK}$. Some used $\overrightarrow{GL} = \frac{1}{3}\overrightarrow{GK}$ instead of $\overrightarrow{GL} = \frac{1}{4}\overrightarrow{GK}$. Some candidates made an incorrect assumption that the shape was a trapezium so that *JH* was parallel to *KG*.

Answer. $\frac{1}{4}\mathbf{a} - \frac{1}{4}\mathbf{b} - \frac{1}{4}\mathbf{c}$

Question 10

Most candidates found the correct answer of 14. A common error was to not evaluate 2 x 7 or to give a factor, such as 7, as the answer. Many candidates used repeated division or factor trees. However the correct answers were not always selected from their workings.

Answer. 14

Question 11

(a) This was usually answered correctly. Sometimes 0.4 or 0.8 was given as the answer.

(b) This was often correctly answered. A few candidates gave 20 as the number of red pens and answers of 0.6 and 0.2 were seen for the probabilities.

Answers: **(a)** 0.6 **(b)** 20
0.3 0.3

Question 12

Many candidates approached this question by finding *AEC* using opposite angles in a cyclic quadrilateral rule. They then went on to find angle *CAE* by using the angles in triangle *ACE*, then they used the isosceles triangle *ACD* to find angle *CDE*, and then the required angle by considering the triangle *ACD*, from 180 − 25 − 25 − 20 = 110, or from 180 − 45 − 25 = 110. An error which sometimes occurred was for candidates to assume that triangle *ACE* was isosceles leading to an answer of 120°.

Answer. 110

Question 13

(a) The correct method to use was angles around a point $\frac{360}{5}$ = 72. Candidates sometimes incorrectly assumed that *x* was equal to the given angle of 42°.

(b) To find angle *y*, candidates could correctly use the angles in a kite and calculate $\frac{360-42-72}{2}$ =123. Some candidates split the kite into two isosceles triangles. Follow through marks were available to candidates who had made an error in calculating *x.*

Answers: **(a)** 72 **(b)** 123

Question 14

(a) (i) The notation n(*M*) challenged many candidates who didn't understand that the notation refers to how many are in the set.

(ii) A common error was to include 1 as well as 9 and 15.

(b) This part was well answered. When candidates use double shading they must indicate which shading is their final answer.

Answers: **(a)(i) 8** **(ii)** 9, 15

Question 15

For this question, candidates needed to subtract the volume of the hemisphere from the volume of the cube. The most common error was to subtract the volume of a sphere, radius 2.5 cm, from the volume of the cube, leading to an answer of 277.5… cm^3. A radius of 5 cm was also frequently used to calculate the volume of the hemisphere, leading to an answer of 81.2… cm^3. Other errors stemmed from adding the volume of the sphere to their volume of the cube. A very small number of candidates were unable to calculate the volume of the cube or misquoted the volume of the sphere.

Answer. 310

Question 16

A starting point of $y = k(x + 2)^2$ was offered by most candidates, who then went on to correctly determine the value of *k*, though there were instances of errors at this stage, mostly with $(8 + 2)^2$. Other interpretations seen on a number of occasions for a starting point were $y = (x + 2)^2 + k$ and less often, $y = k(x + 2)^{-2}$. The substitution of $x = 4$ in order to determine the value of *y* proved the downfall for a small number of candidates; rather than adding 2 they multiplied by 2 or some did not add 2 at all.

Answer. 90

Question 17

(a) Most candidates were able to offer either, if not both, of the lower bounds of *I* and *R*, $R = 2.65$ being the more likely to be correct. At this stage a final answer of 10.5 or 10.46 were popular answers, despite 10.4675 being often seen in a candidate's working.

(b) This part proved to be less successful. Most candidates attempted to write down an appropriate value for *D* and *T* in order to determine the upper bound for *S*. In doing so, many gained credit for one of the correct values, mostly through a value of 7.65 for *D*. Despite candidates' attention being drawn to an upper bound for *S*, many didn't realise that maximum and minimum values of *D* and *T* respectively were required. Some worked out the division first using the given numbers and then tried to find the upper bound of their answer.

Answers: **(a)** 10.4675 **(b)** 34

Question 18

(a) This question was well answered using co-ordinates to correctly find the gradient and also using rise ÷ run. Most errors made were in trying to find the equation of the line or attempting run ÷ rise.

(b) This part was correctly answered when substituting $x = 0$ or drawing a line on the diagram. Errors were made involving incorrect substitution or stating $y = 6$ or just 6.

Answers: **(a)** 2 **(b)** $y = 2x + 6$

Question 19

(a) Most candidates correctly used the growth formula. Most errors were made by rounding numbers too early or working out 30% four times then adding this on to the total.

(b) Many candidates used trials and some used logarithms, which is not in the syllabus but is accepted. Most errors were made by the use of the wrong formula.

Answers: **(a)** 57 122 **(b)** 15

Question 20

Most candidates recognised the equation of each of the lines but had problems with the correct use of inequalities and often wrote these the wrong way round. On the whole the use of dashed and solid lines seemed to cause the most confusion with candidates unsure when to use the equals sign.

Answers: y < 4, $y \geqslant 3$, $x \geqslant 2$, $y > x$

Question 21

(a) Correct answers were obtained usually from either $\frac{k}{9}=\frac{6}{10.8}$ or 9 : k = 10.8 : 6. Many candidates gave a correct answer without any supporting working. Incorrect answers usually came from not realising that the 4.8 needed to be added to the 6, so common incorrect responses were $\frac{k}{9}=\frac{6}{4.8}$ or $\frac{k}{9}=\frac{4.8}{6}$.

(b) This part was answered well by many candidates. Those that realised that the volume scale factor involved k^3 were successful. Many candidates didn't appreciate this and a common incorrect approach was $\frac{h}{20}=\frac{2592}{1500}$ which led to the incorrect answer of 34.56.

Answers: **(a)** 5 **(b)** 24

Question 22

(a) This was answered well by the vast majority of candidates. Others showed either 2.5 or 1. The usual incorrect answer came from finding the median.

(b) Some identified 114 but read off the value incorrectly. Other candidates missed that the cumulative frequency was out of 120 and used 95 on the cumulative frequency graph which led to the common incorrect answer of 2.7.

(c) Some candidates identified 102 trees but then made arithmetic errors such as 120 – 102 = 8.

Answers: **(a)** 1.5 **(b)** 3.5 **(c)** 18

Question 23

(a) Candidates seemed to cope with this 3-dimensional question well and many correct answers were seen. Those candidates who did not reach the correct answer usually made the error of premature rounding, which often led to 9.1. In the working phase many attempted this in two steps, finding *DE* = $\sqrt{34}=5.8$ or *CH* = $\sqrt{58}=7.6$ and in rounding these too early led to a numerical error in the second stage.

(b) A variety of approaches were seen in this part. $sin\theta=\frac{5}{\sqrt{83}}$ was the most common approach but $tan\theta=\frac{5}{\sqrt{58}}$ and $cos\theta=\frac{\sqrt{58}}{\sqrt{83}}$ were also used with a high degree of success. A few candidates used the cosine rule and again some were successful although many made errors in rearranging the formula. The main error was to use the wrong triangle (some used *ADC*) or to identify the wrong angle.

Answers: **(a)** 9.11 **(b)** 33.3

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time. Few candidates omitted part or whole questions. The standard of presentation was generally good and there was evidence that most candidates were using the correct equipment.

Candidates continue to improve in showing their workings and gaining method marks. Centres should encourage candidates to show their working clearly, explicitly showing, for example, which values they are multiplying or dividing together.

Many candidates were unable to gain marks in the 'show that' question if they used the value they had to show from the beginning.

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 process calculations fully 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

To be successful in this question, candidates had to demonstrate a good understanding of probability, averages and pie charts. This question also contained a 'show that' question which candidates found very challenging.

(a) (i) Very few candidates gave probabilities as ratios (which are not acceptable) and those that chose to express as a percentage or decimal generally were successful. The majority of candidates were able to count the correct number of odd numbers and give their answer as the correct fraction. The most common incorrect answer was $\frac{3}{5}$, from counting even numbers rather than odd numbers.

(ii) Candidates found this question more challenging and often gave the answer of $\frac{2}{5}$, most probably from not recognising 2 as a prime number. A large number of candidates reversed the answers to **parts (i)** and **(ii)**.

(iii) This part was the most successfully answered of this question. The vast majority of candidates recognised that the spinner had no number 7 and gave their probability in the correct form.

(b) (i) Successful candidates identified 4 as the mode. Some candidates however found interpreting the table challenging, often giving 6 as their answer as this is the largest value in the table, or identifying that there was no mode as all values 2 to 6 each appear twice in the table.

(ii) Calculating the mean from the frequency table proved to be one of the most challenging parts of this question. More able candidates showed good working out, demonstrating that they had to multiply and add to find the total of the 20 spins and then dividing by 20. A large proportion of candidates however simply added the frequencies and divided by 5, getting the most common incorrect answer of 4. Candidates who made some attempt to find the total of the 20 spins often gained method marks from showing good working out. Candidates who did not show any working often made errors in their total and therefore gained no marks.

(iii)(a) Candidates were required to show that the sector of a pie chart constructed from the results in the table would have a sector angle of 54° for the number 2. This part was only successfully answered by the most able candidates due to the requirements of a 'show that' question. It is important to emphasise to candidates that in questions of this type, candidates must not use the figure they are trying to show, i.e. 54°. A larger proportion of candidates chose not to attempt this question or to draw the sector angle of 54°. Successful answers were attempted in two parts. Most candidates first calculated that one spin was equivalent to 18° (360 ÷ 20) and then multiplied by 3. Clear and explicit working out is required in these questions.

(b) Candidates who had answered the previous part successfully were generally also able to gain full marks in this part. Candidates who had not attempted **part (iii)(a)** often did not attempt this part also. Some candidates seemed to answer this part after continuing with the question and used the value of 168° which came from the second pie chart given in **part (c).** Candidates should be aware that all information required to answer a question will be provided in the part they are answering or in previous parts, not in subsequent questions. Another common incorrect answer was 108°, which came from misreading the frequency table and multiplying 18 by 6 rather than the frequency of 5.

(c) (i) A number of correct methods were seen, the most common finding the fraction or percentage of the pie chart and then multiplying by the total number of students. The most common incorrect answer was 28, found by dividing 168 by 6.

(ii) This part of the question also proved to be challenging for candidates. Many did not use the information given in bold in the question and often attempted the percentage of candidates guessing a number less than 6. Successful solutions showed the total angle for sections 2, 3 and 4 and a correct conversion from an angle to a percentage. This was often done in individual parts for 2, 3 and 4 and then added together.

(iii) Candidates were more successful in identifying that the sector for number 5 represented 10% of the students. However, more commonly, candidates showed that 10% of the students was 3 but often then concluded that this was the sector for the number 3 rather than continuing to work out the angle for 3 students. Similarly, candidates often found 10% of the circle as 36° (gaining a method mark) but then did not measure the pie chart to find which sector this was. Often, less able candidates simply guessed at a sector, showing no working, and the majority choosing the sector for the number 2 as this was the smallest.

Answers: **(a)(i)** $\frac{2}{5}$ **(ii)** $\frac{3}{5}$ **(iii)** 0 **(b)(i)** 4 **(ii)** 4.3 **(iii)(a)** $\frac{3}{20}\times 360$ **(iii)(b)** 90 **(c)(i)** 14 **(ii)** 43.3 **(iii)** 5

Question 2

Many aspects of number work were examined in this question. It gave all candidates an opportunity to show their understanding of number, including factors, multiples, percentages and fractions. All candidates were able to attempt all or parts of this question.

(a) (i) The majority of candidates were able to choose the correct number from the list. A large proportion of candidates however confused multiples for factors and gave the most common incorrect answer of 30. Some candidates did not read the question carefully enough and gave a factor of 15 which was not in the list, often 5.

(ii) The majority of candidates gave the correct multiple from the list. Sometimes those that had confused factor for multiple in **part (i)** gave the answer of 6, a factor of 18.

(iii) Candidates demonstrated their understanding of square numbers well, with the majority of candidates giving the correct answer. However the importance of rereading the question is emphasised here as some candidates gave 36 as their answer.

(iv) Candidates were more successful in finding the cube number from the list with the majority giving the correct value. The most common incorrect answers were 3 and 49.

(b) (i) Candidates were very successful in this part with the vast majority gaining full marks.

(ii) Candidates again found this question straightforward with the vast majority of candidates giving the correct answer. Some less able candidates gave their answer as a decimal.

(c) All candidates were able to attempt this question with the majority correctly simplifying the fraction to its lowest terms. All candidates showed some understanding of simplifying although many less able candidates did not gain full marks as they did not simplify to the lowest terms, often leaving their answer as $\frac{14}{21}$.

(d) (i) A wide range of methods were used successfully to write 45 as a product of its prime factors. The most common and successful was using a table or tree to find the prime factors and then give the answer as a product of these factors. Often correct tables and trees were seen but then answers were not given as a product; the most common was lists, e.g. 3, 3, 5. Some candidates scored one mark for a correct product that equalled 45, e.g. 3×15 or 5×9.

(ii) Few candidates found the LCM, however 315 and 4725 (45×105) were seen as answers from some candidates. The most common successful solutions wrote 105 as a product of prime factors and then used their answer to **part (i)** to find the HCF. However a large number of candidates who had not gained marks in **part (i)** still gained full marks in **part (ii)** by listing factors of 45 and 105. Although these lists were often not complete they were able to identify 15 as the HCF or gained one mark for identifying 5 or 3 as a common factor.

Answers: **(a)(i)** 3 **(ii)** 36 **(iii)** 49 **(iv)** 27 **(b)(i)** 43 **(ii)** 50 **(c)** $\frac{2}{3}$ **(d)(i)** $3 \times 3 \times 5$ **(ii)** 15

Question 3

Understanding of speed, time, money and ratio were essential skills tested in this question.

(a) Good solutions to this question were given in stages. The most common method was to calculate the cost of the 14 nights for 2 people (237 × 14 × 2), then find 6% of this total and finally add it. This method could have been done in any order and all possible combinations were seen. Often candidates found calculating the 6% difficult with many incorrect methods seen. However these candidates often gained one mark for completing the other multiplications correctly. The importance of showing working is again highlighted here, as many candidates simply gave a final answer which would have gained a part mark if they had shown the multiplications used.

(b) Calculating the change was the most successfully answered part of this question. Often this was seen with no working. A common incorrect answer was $12.11, from only subtracting one bottle from $20. Again candidates should be encouraged to reread questions after they have given their answer to check they have read all given information correctly.

(c) The key to answering this question successfully was the knowledge that 1 hour = 60 minutes and therefore $\frac{3}{4}$ hour = 45 minutes. Many less able candidates used 75 minutes and therefore gave the incorrect answer of 16 38. Equally important to gain full marks was the ability to work in 24-hour times. Many candidates gave their answer as 4 08 which only gained one mark as the required answer had to be in 24-hour time or, if given in 12-hour time, had the appropriate pm. Many candidates used a column method of adding times and then converting times over 60 minutes to hours and minutes. This proved a successful method for some candidates but many errors were seen when converting from minutes to hours and minutes to gain the final answer.

(d) Good solutions gave clear workings out, showing a calculation of time from the correct formula, converting this time in hours to hours and minutes, and then finally adding this time correctly and giving the solution in 24-hour time or 12-hour time with am included. Only the most able candidates could complete all parts successfully with the majority of candidates making one or more errors. The most common error was converting their time to hours and minutes. The majority of candidates calculated the time to be 8.3 hours or 8.33 hours. However, depending on the degree of accuracy, these values often became 8 hours 30 mins or 8 hours 33 mins. The accuracy was vital in gaining full marks as often candidates used a correct method in converting hours to hours and minutes but because they had only used 2 significant figures, their answer of 8.3 hours became 8 hours 18 minutes and subsequently a final solution of 02 58 was seen often.

(e) The majority of candidates showed good understanding of ratio and were able to find the correct number of male passengers. This was commonly found by dividing by 9 and then multiplying by 5. The most common incorrect methods used were dividing 1800 by 5 (giving 360 as the final answer) or dividing by 5 and then multiplying by 4 (giving 1440 as the final answer).

Answers: **(a)** 7034.16 **(b)** 4.22 **(c)** 16 08 **(d)** 03 00 **(e)** 1000

Question 4

All candidates were able to attempt all or part of this question which assessed candidates' ability to work with negative numbers, rounding, upper and lower bounds and area of circles in context.

(a) (i) This part was one of the most successfully answered in the whole paper. The most common incorrect answer was –3°C, the temperature instead of the day.

(ii) This part again proved to be successful, with the vast majority of candidates finding the difference as 5 °C or –5 °C (both answers were acceptable).

(iii) This part was also one of the most successfully answered in the whole paper. Nearly all candidates successfully wrote the temperatures in the correct order. The only common error seen was candidates starting with the highest temperature instead of lowest as instructed in the question.

(iv) The majority of candidates correctly subtracted 4 °C from –2 °C. Common incorrect answers were 10 °C (from adding 6 °C and 4 °C) or 2˚C (from adding 4 °C to –2 °C).

(b) The correct answer was given by most candidates in acceptable forms, two million or 2 000 000. The most common error was rounding to a higher degree of accuracy, often to the nearest 1000 or 100.

(c) Giving the lower and upper bounds proved to be one of the most challenging questions on the paper. Many less able candidates did not attempt the question with only the most able candidates achieving any marks. The most common incorrect answers were 110 and 130, by adding and subtracting 10 m.

(d) Candidates were challenged in this question to calculate areas of circles in the context of a cross section of a circular tunnel. The best solutions were completed in stages clearly showing workings out throughout. The most successful candidates quoted the formula for the area of a circle and gave the radii of both circles before calculating the respective area. Very few candidates lost marks for using 3.14 or $\frac{22}{7}$ for their value of π, with the vast majority of candidates using the π button on their calculators. Some candidates however lost a mark for rounding prematurely, before subtracting, and therefore found an answer outside the accepted range. Many candidates were able to gain some of the marks for calculating the area of the inside circle using the radius of 4 m. However many candidates then calculated the radius of the larger circle to be 4.5 cm (from 8 m + 1 m) and found an incorrect second area. Very few candidates did not know or use the correct formula for the area of a circle.

Answers: **(a)(i)** Wednesday **(ii)** 5 **(iii)** –3, –2, –1, 0, 1, 2, 5 **(iv)** –6 **(b)** 2 million **(c)** 115 125 **(d)** 28.3

Question 5

This angles and scale drawing question offered candidates the opportunity to show they could measure and draw bearings on a scale drawing, calculate a missing angle and use Pythagoras' theorem to calculate a missing length in a right-angled triangle.

(a) (i) Candidates continue to find measuring bearings very challenging. The majority of candidates showed little understanding of bearings with the most common answer being a measurement of length (9 cm) rather than an angle. Very few candidates showed the ability to use a protractor accurately when measuring a bearing.

(ii) Candidates were far more successful at measuring the length of port *A* to port *B* and using the scale to find the actual distance. A few candidates did not convert from 9 cm to 135 km, although they still gained one mark for a correctly measured length in cm.

(iii) Drawing bearings proved equally challenging for nearly all candidates. However in this part candidates generally gained one mark for correctly drawing port *C* 6 cm away from port *B*. This was however drawn in a variety of directions from port *B* and very rarely on a bearing of 146°.

(b) (i) Candidates demonstrated their knowledge of angles in a triangle adding to 180°. The vast majority of candidates successfully found the correct answer.

(ii) Calculating a bearing from a diagram proved to be the most challenging question on the whole paper, with only a few correct answers seen. A variety of incorrect answers were seen, using a variety of angles given on the diagram. Many candidates used correctly the 43° and 29° but subtracted these from 360° instead of adding to 180°. The answer of 255° was seen from measuring the diagram. Candidates should be reminded that this diagram was clearly labelled NOT TO SCALE and a calculation is required rather than a measurement.

(c) Candidates have shown an improvement in identifying the use of Pythagoras' theorem from previous years. The majority of candidates correctly squared, added and then square rooted. Good solutions showed all steps of the working. Very few candidates subtracted instead of added. Candidates who did not use Pythagoras' theorem generally added or subtracted the lengths hence giving the incorrect answers of 623 km or 89 km.

Answers: **(a)(i)** [0]67 **(ii)** 135 **(b)(i)** 29 **(ii)** 252 **(c)** 445

Question 6

This algebra question was the most successfully answered of the whole paper. Candidates showed very good ability to form and solve equations.

(a) (i) Solving this one-step equation proved to be one of the most successful questions of the whole paper. Very few candidates needed to show working out and nearly all candidates found the correct answer.

(ii) This more complex equation was more difficult to solve but the vast majority of candidates solved it correctly. Many gave the correct answer with no working. However the majority showed good algebraic skills, successfully expanding the bracket, subtracting 40 from both sides and then dividing by 15. Few candidates attempted the other possible method, divide by 5, subtract 8 and finally divide by 3. Candidates who attempted this method were generally more able candidates who did it correctly.

(b) (i) Candidates were able to form the correct expression from the information given in the question. Good reading skills were shown and the example given in the question helped the less able candidates form the correct expression. Very few incorrect answers were seen and even fewer candidates chose not to attempt this question.

(ii) This part was the most challenging part of this algebra question. The best solutions equated the two expressions in **part (i)** and gave a thorough algebraic solution. The most common error was to start incorrectly by not equating the expressions but to form two separate equations and attempt to solve simultaneously. This often led to errors, by adding the x terms and forming an incorrect equation of $34x = 742$. Candidates who correctly solved this equation were able to gain one mark for a correct solution of a wrong equation.

Answers: **(a)(i)** 8 **(ii)** –2 **(b)(i)** 19x + 117 **(ii)** 127

Question 7

This question assessed candidates' ability to perform an enlargement and translation of an image on a grid and to describe fully a reflection and rotation.

(a) This part was the best attempted by candidates. Most candidates gained at least one mark for correctly translating the original shape 2 to the left or 6 down. The best solutions did both with a clear image drawn with a ruler. Some less able candidates rotated the shape or reflected it.

(b) (i) Fewer candidates attempted this question with many incorrect answers seen. Most candidates enlarged from the correct point and drew at least 2 points correctly but few candidates gave the fully correct answer. The correct image was seen but in the incorrect position by a small number of candidates who gained one mark for an enlargement of scale factor 2.

(ii) This part proved to be one of the most challenging of the whole paper with a large proportion of candidates choosing not to attempt it. The most common answer seen was –2.

(c) Candidates found describing a reflection easier than a rotation in **part (d).** Most candidates identified the transformation as a reflection but few candidates could then go on to correctly describe the mirror line as $x = -1$. The equation of the mirror line was often given as the y-axis or $y = -1$.

(d) Good answers contained all three parts to describe a rotation, including angle and centre of rotation. The most common error was to omit the centre of rotation. Less able candidates could correctly identify the transformation as rotation but did not include the direction or centre.

Answers: **(b)(ii)** $\frac{1}{2}$ **(c)** Reflection, $x = -1$ **(d)** Rotation, [centre] (0,0), [angle] 180°

Question 8

This question challenged many candidates as it assessed some more complex parts of the syllabus, including trigonometry, compound interest and percentage change. Candidates who showed thorough working were more successful in all parts.

(a) (i) The best solutions seen gave clear and thorough working out. Candidates who made markings on the diagram were generally more successful in finding the three separate areas and then adding. Candidates should be encouraged to write on the diagram to mark in missing lengths and to draw lines to split the compound shape into separate rectangles. A variety of methods were successfully used, all with clear workings out. A few candidates gave the correct answer with no working but this was very rare; most answers with no working were incorrect. Candidates who did not find one of the two missing required lengths gained no marks. The most common error was to calculate two correct rectangles (usually $7.5 \times 3.2 \times 2$) but then to make errors on the third (usually 11.8×4.7 instead of 5.4×4.7).

(ii) Candidates were able to gain full marks even if they had not calculated the area correctly in **part (i)**. Good answers showed their area from **part (i)** multiplied by 2175 and then this figure correctly rounded to 3 significant figures. However often only the answer was given, with no multiplication seen, and if the candidate had incorrectly rounded then no marks were given. This question emphasises the need to show all stages of working out as an incorrect rounding could still gain one mark if the correct multiplication had been seen. Most candidates were able to gain one mark for a correct multiplication. However rounding to 3 significant figures was only completed correctly by more able candidates.

(b) Candidates have shown an improvement, compared to previous years, in the use of trigonometry. A greater number can identify the correct trigonometric ratio to use and then substitute correctly into it. More able candidates can then generally go further and find the angle by using the inverse tangent button on their calculators. A large proportion of candidates could identify and substitute into the tangent ratio but left their answer as 1.02… ($1.8 \div 1.75$). Few candidates used the incorrect trigonometric ratio or substituted the lengths incorrectly (e.g. $1.75 \div 1.8$). Less able candidates generally chose not to attempt this question.

(c) Good solutions to this question quoted and substituted values into the formula for compound interest or each year was calculated separately. Some correct answers were spoilt by rounding to the nearest dollar but this was rare. The most common error was to calculate simple interest, common incorrect answers being 53 000 or 3000.

(d) An improvement was seen in calculating percentage profit compared to previous years. This could be because the percentage profit was 10% which many able candidates could spot without showing any working out. Most candidates were able to gain one mark for showing the profit was $18 000, however the most common error was then to divide by $198 000 instead of $180 000.

Answers: **(a)(i)** 73.38 **(ii)** 160 000 **(b)** 45.8 **(c)** 53 060.4[0] **(d)** 10

Question 9

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

(a) Most candidates correctly calculated the missing values in the table. Very few candidates did not attempt this part.

(b) Candidates showed good skills of plotting points correctly from their table in **part (a)**. Most candidates gained three of the four marks available for correctly plotting all nine points. The most common error which lost candidates the final mark was to join the points with line segments or to draw a smooth curve but join the top two points with a straight line.

(c) Giving the co-ordinates of the highest point on the curve proved to be one of the most challenging questions of the whole paper. Candidates needed to recognise the symmetry of their graph to realise that the x co-ordinate had to be 3.5. Many candidates quoted the highest value from their table (3, 20) or (4, 20) or had drawn a straight line at the top of their curve which resulted in the same incorrect answers.

(d) (i) Many correct ruled lines were seen. However a large proportion of candidates did not gain the mark as the line was not drawn with a ruler or did not go across the whole grid. Candidates should be reminded that straight line graphs should always be drawn with a ruler.

(ii) Good solutions to this question followed an accurate drawing of the line $y = 16$. Some candidates misread the scale and used 1 square = 0.1 instead of 1 square = 0.2. A large number of candidates attempted to use the quadratic formula or factorisation despite the question requiring the line to be used. Very few correct answers were found using the formula or factorisation due to the need of rearrangement first.

Answers: **(a)** 14, 20, 20, 14, 0 **(c)** (3.5, h) where $20 < h \leqslant 20.4$ **(d)(ii)** 1.4 5.6

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key messages

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

General comments

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

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 drawing a bar chart from given values, interpreting this information, conversion of units, fractions, best value and limits.

(a) (i) The majority of candidates were able to find the correct frequencies from the given information although common errors included writing the frequencies in the tally column, or converting their figures to a fraction or percentage although this was usually corrected in the next part.

(ii) Candidates were asked to draw the bar chart and were largely successful with many answers gaining full marks. A small number omitted the scale or started at 1 rather than 0, with a very small number of nonlinear scales seen. The required heights of the bars were generally correct or a correct follow through. A small number of candidates had inconsistent gaps between their bars.

(iii) This part was generally answered well although common errors included fractions such as $\frac{3}{20}$, or answers of 1 or 2, coming from omitting the two apple drinks or the one tropical drink.

(b) Again this part was generally well answered although common errors were giving an unsimplified answer such as $\frac{550}{1000}$ or $\frac{55}{100}$, confusing units with answers such as $\frac{550}{100}$, $\frac{1000}{550}$, or erroneously using the 7 from **part (a)(ii)** in $\frac{7}{550}$ or $\frac{550}{7}$.

(c) This part on finding the best value proved demanding for many candidates although a number of fully correct answers were seen from the more able candidates. The preferred successful methods were converting the given information into litres/$ giving answers of 0.375, 0.397 and 0.386 or into $/litre giving answers of 2.67, 2.52 and 2.59. However a significant number of candidates who did the correct divisions then chose the incorrect figure for the best value possibly because they rarely wrote down the units they were working with. Common errors included multiplying the size and cost, or attempting to compare differences in size and cost. No marks were given for the correct answer with no or incorrect working.

(d) This part on limits was generally answered well with a significant number of correct answers seen. Common errors included 140 with 160, 149.5 with 150.5, 10 with 150, and a small number of reversed answers.

Answers: **(a)(i)** 4, 7, 3, 5, 1 **(iii)** 3 **(b)** $\frac{11}{20}$ **(c)** 1.25 litre bottle **(d)** 145, 155

Question 2

All candidates were able to attempt all or part of this question as it offered a wide range of questions on various areas of mathematics and numeracy involving multiples, square and cube numbers, primes, irrational numbers, use of brackets, indices, prime factors and the lowest common denominator.

(a) (i) This part was generally answered well with the majority of candidates able to identify one of the two possible multiples of 7. Common errors included 17, 67 and 87.

(ii) This part was generally answered well with the majority of candidates able to identify one of the two possible square numbers. Common errors included 12, 86 and 27.

(iii) This part was generally answered well with the majority of candidates able to identify the only possible cube number. Common errors included 16, 81 and 12.

(iv) This part was generally answered well with the majority of candidates able to identify one of the four possible prime numbers. Common errors included 11, 27 and 87.

(b) This part was less successful with only the more able candidates appearing to know the definition of an irrational number.

(c) The majority of candidates were able to correctly position brackets into the given calculation to make it a true statement with many stating that they had used the rule of BIDMAS or BODMAS. However a full range of incorrect answers were seen with the most common error of $7 \times (5 - 2) + 3$.

(d) (i) This part was generally answered well with the majority of candidates able to calculate the required cube root. Common errors included 0.3874 (cubing) and 0.8538 (square rooting).

(ii) This part was generally answered well with the majority of candidates able to calculate the required value. Common errors included 20 and 5555.

(iii) This part was generally answered well with a significant number of candidates able to calculate the required value. Common errors included –16, 16, –8 and 0.06.

(e) (i) This part was generally answered well with the majority of candidates able to calculate the required factors often by the use of a factor tree or factor ladder, although not all were then able to write the answer as a product of these prime numbers. Common errors included $2 \times 3 \times 5$, products such as 4×15, and additions such as 37 + 23.

(ii) This part was not as successful with many candidates mixing up the required lowest common multiple (LCM) with the highest common factor (HCF). Those candidates who wrote down the prime factorisation of 36, or listed multiples of both 36 and 60, tended to be more successful. Common errors included 2, 6, 12 and 120.

Answers: **(a)(i)** 21 or 28 **(ii)** 16 or 81 **(iii)** 27 **(iv)** 17 or 61 or 67 or 71 **(b)** $\sqrt{2}$ and π **(c)** $7 \times (5 - 2 + 3) = 42$ **(d)(i)** 0.9 **(ii)** 625 **(iii)** 0.0625 **(e) (i)** $2 \times 2 \times 3 \times 5$ **(ii)** 180

Question 3

This question on a variety of mathematical concepts with a common theme proved a good discriminator and the full range of marks was seen. Topics covered included reading a timetable, calculation of speed, use of scale drawings, bearings and circles.

(a) (i) This part was generally answered well although 10 64, 10 36 and 11 24 were common errors.

(ii) This part was generally well answered although a significant number gave the time of the first bus, or the time the bus left, with 11 10 and 11 12 being the common errors.

(iii) This part was generally well answered.

(b) This part was less successful as although the majority of candidates were using the correct formula, a number of numeracy or approximation errors were made. Few candidates appeared to use the given time of 20 minutes as $\frac{1}{3}$ of an hour to calculate 1.5 x 3 as 4.5 km/h. The approximations of 0.3 and 0.33 were often seen and lead to the inaccurate answers of 5 and 4.55. The other common error was not converting the given time in minutes into hours, leading to the incorrect answer of 0.075.

(c) (i) The required measurement from the given scale drawing was generally correctly selected and measured. The common error was in converting the actual distance into kilometres with incorrect answers of 2200, 22 and 0.022 seen.

(ii) The majority of candidates were able to correctly measure the bearing showing a continued improvement on previous years. Some candidates however clearly measured the bearing anticlockwise from North or read the wrong scale on their protractor.

(iii) The majority of candidates were able to correctly mark the position of the point *P*. The common error was to use an incorrect bearing with the same errors as mentioned in **part (c)(ii)**. A small number of candidates thought that this point had to be along the boundary or one of the paths in the question.

(iv) This part proved more challenging for candidates with a number not appreciating that the required distance was simply the circumference of the given drawn circle. Common errors included using the area formula, finding the distance of the straight paths or the boundary. Centres should encourage candidates to read the front cover of the examination paper carefully and to use the correct value for π, either 3.142 or the value in their calculator.

Answers: **(a)(i)** 11 04 **(ii)** 11 50 **(iii)** 38 **(b)** 4.5 **(c)** **(i)** 2.2 **(ii)** 150° **(iv)** 3770

Question 4

This question tested the candidates' ability in algebra with a number of concepts, and also in shape and space with perimeter, area, volume and nets all tested.

(a) (i) The majority of candidates were able to select the correct formula and perform the correct calculation. However common errors included answers of 9, 36 and 45 (from surface area).

(ii) Many candidates found the drawing of a net to be demanding although a significant number of fully correct diagrams were seen. Common errors included the addition of flaps, the use of triangles, incorrect heights and incorrect faces.

(b) (i) Many candidates did not appreciate the algebraic techniques and values required in this question. Very few candidates realised that the perimeter could be found using the given lengths by $2 \times (5x + 4) + 2 \times (3x) = 16x + 8$. The majority simply added the four given sides together to get $11x + 5$. Those candidates who attempted to evaluate the two missing sides often couldn't reach $3x + 4$ and $2x - 1$ due to numerical or algebraic errors.

(ii) Generally this part was answered much better and with follow through allowed, the majority were able to score the two marks available. The majority appreciated the need to equate their expression from **part (i)** to 72, with most able to solve the resulting equation.

(iii) The follow through answers did make this part numerically more difficult, although still possible. It was difficult at times to distinguish the method used to calculate the area of the given compound shape, and combined with numerical and algebraic errors as in **part (i)**, meant that full marks were rarely awarded although candidates were able to pick up method marks. The more successful candidates were those who took their *x*-value from **part (ii)**, and having then evaluated the given sides correctly, added these values to the original diagram before calculating the required area. The common methods used were then $12 \times 8 + 5 \times 16$, or $24 \times 5 + 7 \times 8$, or $24 \times 12 - 7 \times 16$. A small number attempted to find an algebraic expression for the area and then substitute their value of *x* but this was rarely successful.

Answers: **(a)(i)** 18 **(b)(i)** $16x + 8$ **(ii)** 4 **(iii)** 176

Question 5

This question on a variety of mathematical concepts with a common theme proved a good discriminator and the full range of marks was seen. Topics covered included statistical values, drawing and using a scatter graph, ratio and percentages.

(a) (i) This part on the calculation of the mean was generally answered well, although common errors of 8 (from median), 9 (from range), 5 (from mode) and calculations using incorrect or incomplete data were seen.

(ii) The scatter graph was generally completed well with the correct and accurate plotting of the remaining four points. However a small yet significant number misread the given scale often when plotting the point (9,138). There were a small number of candidates that were unable to attempt this part.

(iii) This part was generally answered well although common errors of negative, increasing and scattered were seen.

(iv) This part asked for the line of best fit to be added to the scatter graph and was answered well with the majority able to draw an acceptable ruled continuous line within the bounds of reasonable accuracy. Common errors however included curved lines, joining all points in a zig-zag fashion, and the insistence that the line must go through the origin.

(v) This part was generally well answered with the majority of answers within the acceptable limits for accuracy or correct on a follow through basis.

(vi) Many candidates did not appreciate that all that was required was the simple statement that "the point is below the line of best fit" and tended to over-complicate their answer. Common errors were then attempting to compare the given values or comparing car G with the other cars.

(b) (i) This part on ratio was generally answered well although the answer was not always given in the required simplest form. Common errors included 15 : 9 : 6, 25 : 15 : 10, 0.5 : 0.3 : 0.2, and 2 : 3 : 5 (from dividing into 150).

(ii) This part on finding a reduced percentage value was answered reasonably well. Common errors included 306 (reduction only), 2856 (increased value), $\frac{2550}{12}$, and 2550 – 0.12.

(iii) This part comparing forms of payment was answered reasonably well although a significant number of candidates did not appreciate the various components particularly for Plan B. Common errors included use of $36 \times 120 \times 0.15$, final answer of 4995, and the incorrect calculation of 15% of 4500.

Answers: **(a)(i)** 7.5 **(iii)** positive **(v)** 84 to 96 **(vi)** point is below the line of best fit **(b)(i)** 5 : 3 : 2 **(ii)** 2244 **(iii)** 495

Question 6

This question gave candidates the opportunity to demonstrate their ability to calculate missing values and to draw straight lines and a quadratic curve. Candidates continue to improve at plotting points and drawing smooth curves. However it was noticed that a small yet significant number of candidates joined their plotted points in a series of straight lines.

(a) (i) The drawing of the straight line $y = 3$ was generally done well although common errors of $y = –3$, $x = –3$ and lines not drawn the full width of the grid were seen.

(ii) This part was less successful with the common errors including drawing the parallel line, the line $x = –1$, and drawing the line joining (1, 0) to (0, –4).

(b) The table was generally answered well with the vast majority of candidates giving four correct values for full marks.

(c) The graph was generally plotted well. The majority were able to draw a correct smooth curve although a significant number made the error of joining points with straight lines particularly the two points at (–2, 4) and (–1, 4).

(d) This part proved challenging with incorrect answers seen even from candidates who scored full marks on the curve. The common error was stating (–2, 4) and/or (–1, 4).

(e) The majority of candidates appreciated that the *x* co-ordinates from the intersections of the quadratic curve and the line $y = 3$ were the required values. However a common error was to mis-read the horizontal scale and thus give inaccurate values, such as –2.4 not –2.6. Another common error was to read off the intersections of the curve with the x-axis. A small but significant number of candidates attempted to solve the given equation but this was very rarely successful.

Answers: **(b)** –8, 4, 4, –8 **(d)** (–1.5, 4.1 to 4.4) **(e)** –2.6 and –0.4

Question 7

This question assessed candidate’s ability to use angle facts, circle theorems, trigonometry and Pythagoras’ theorem. Less able candidates found the majority of this question extremely challenging, usually only gaining marks on **part (a)**. However more able candidates could show their understanding of trigonometry and Pythagoras’ theorem. **Part (b)** proved to be the most difficult question on the paper; however the majority of candidates did attempt it.

(a) (i) There were some candidates who reversed the angles in **parts (i)** and **(ii)** and some used 360 for the angles on a straight line instead of 180, but these were few.

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

(b) This part was designed to test candidates' understanding of the circle theorem for angles in a semi-circle. Very few candidates gained marks for their reason and although most candidates showed that they knew that the angle had to be 90° very few showed the sum required to gain the mark. Without using the angles given to show the missing angle was 90° then candidates were demonstrating a circular argument by then concluding it must be the diameter because the angle at *C* was 90°. A small minority of candidates showed that 41 + 49 = 90 but often then went on to say that angle *ACB* was 90° but didn't show why. Again some candidates indicated that angle *ACB* was 90° and *AB* was a diameter but not with enough clarity to satisfy the criteria in the mark scheme. The vast majority of candidates used the fact that the line *AB* went through the centre (although centre not shown) or justified that it was the diameter because it went from one side to the other.

(c) A large number of candidates scored well on this question. Candidates lost marks either because of the accuracy of their final answer, e.g. 14.5 or for using the incorrect trigonometrical ratio, sine instead of cosine. Good answers showed all working out including the rearrangement of the original trigonometrical ratio.

(d) Another question that was very well answered by many candidates. There were some who tried to find the angle using cosine and then the side *KL* using sine or tangent but these were few and far between. The majority recognised that Pythagoras' theorem was needed and were able to apply this successfully. The most common error was to add after squaring rather than subtracting, although many of these candidates often gained one mark for a correct first statement.

Answers: **(a)(i)** 25 **(ii)** 57 **(b)** 180 – 49 – 41 = 90 angle in a semi-circle **(c)** 14.6 **(d)** 19.3

Question 8

Candidates were given the opportunity to demonstrate their understanding of transformations. The majority of candidates scored well on this question showing their understanding of reflections, translations, rotations and enlargements. Good answers contained all relevant parts to describe a transformation. However most candidates were able to gain at least part marks for recognising which transformation had occurred. Drawing the correct enlargement proved to be the most challenging part of this question.

(a) (i) The vast majority of candidates correctly drew the reflection. Common misunderstandings occurred when candidates did not know the line $y = -2$ and reflected it in the x-axis or the line $x = -2$ which took the image off the grid.

(ii) To gain full marks on this question the candidate had to identify the transformation as a translation and give the correct column vector. This was done correctly by the majority of candidates. Very few candidates did not recognise it as a translation or used the incorrect term of 'translocation'. The majority of candidates attempted the vector, with few worded explanations of the translation given. However some included a fraction line in the vector or gave values of 7 instead of –7 and 5 instead of –5.

(iii) A full description of a rotation, including angle of turn, direction and centre was required for full marks. Most candidates were able to gain one or two marks for giving a partial description but most candidates did not gain full marks because often they missed out the centre of rotation. Candidates must be reminded of the parts required to describe fully a transformation. Few candidates gave the alternative answer of 270° clockwise. Very few double transformations were seen.

(b) Candidates showed their understanding of enlargement, with most candidates gaining part marks for correctly enlarging by scale factor $\frac{1}{3}$. However few gained full marks as this was often drawn in the wrong position. A large number of candidates drew correct ray lines from the centre of enlargement but went no further to draw the image. A small proportion drew an image after an enlargement of scale factor 2 or 3.

Answers: **(a)(ii)** Translation $\begin{pmatrix} -7 \\ -5 \end{pmatrix}$ **(iii)** Rotation, 90° [anticlockwise], [centre] (0,0)

Question 9

Candidates showed good algebraic skills throughout this question. Candidates were required to demonstrate their ability to substitute, rearrange, expand brackets and simplify and factorise expressions. All candidates felt confident to attempt the majority of the parts.

(a) (i) Successful candidates showed their working out, giving the full substitution before multiplying the values together. Of the candidates who didn't score full marks, most were able to score one mark either for 20 or for the correct substitution. The most common incorrect answer was 2 (from 20 – 18) which gained no marks if no working was shown.

(ii) Candidates generally scored full marks or no marks for this rearrangement question. The first step required candidates to add $3t$, however, many less able candidates subtracted $3t$. Many incorrect attempts involved dividing by 4 first but not also dividing the $3t$ by 4. The use of letters common to **part (i)** caused some candidates to calculate a value for r using the values given in **part (i)**.

(b) In this part candidates again had to demonstrate their ability to multiply two negative values together to gain full marks. This caused the most difficulty for candidates, with 9x – 7 and 9x – 23 the most common incorrect answers. The vast majority of candidates demonstrated their understanding of expanding brackets (and thereby gaining one method mark) by multiplying the first bracket out successfully, although most candidates then made errors in the second bracket because of the need to multiply two negative values together.

(c) Candidates demonstrated their understanding of factorising in this question, although in a large proportion of attempts, candidates only partially factorised the given expression. The most common partial factorisation was $2a(6b - 10a)$ which was seen as often as the correct answer. Very few candidates did not attempt this question and it was felt that although the expression was quite complex the candidates made very good attempts.

Answers: **(a)(i)** 38 **(ii)** $\frac{p+3t}{4}$ **(b)** $9x + 7$ **(c)** $4a(3b - 5a)$

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. Many 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.

Centres should continue to encourage candidates to show all working clearly in the working space provided. The formulae being used, substitutions and calculations performed are of particular value if an incorrect answer is given. Further, Centres should continue to explain when premature approximation can and cannot be used and the extent of the approximation, for example, approximating to one decimal place in the working when an answer to two decimal places is required is not suitable.

Candidates should read the front cover of the examination paper carefully and use the correct value for π, either 3.142 or the value in their calculator.

Candidates should take the time to read the questions carefully to understand what is actually required in each part, for example, giving a ratio in its simplest form when asked to do so.

Comments on specific questions

Question 1

Generally candidates showed a reasonable grasp of ratios, money, time and percentages. Their work would be improved further by having a clearer understanding of calculations involving hours and minutes and always setting out all their working in a clear and logical manner.

(a) (i) Most candidates showed correctly that the area was 6.6 hectares. The most common error was attempting a reverse argument, i.e. attempting to use 6.6 in their calculation.

(ii) The majority of candidates gave the correct answers.

(b) Although many candidates gave the correct answers some calculated 4.2 for mammals then assumed that the remaining area was for reptiles so used 6.6 – 4.2 = 2.4 as their answer. Some candidates could improve by showing all their working as occasionally candidates rounded 1.98 to 2. If there was no working to show this rounding, no marks could be awarded.

(c) (i) Some candidates gave the correct answer. The most common error was the incorrect usage of time, for example 1715 – 0930 = 785 = 7 hours 85 minutes = 8 hours 25 minutes. It would help such candidates to have further practice on the difference between decimal calculations and calculations requiring 60th's as required for work with time.

(ii) Fewer candidates gave the correct answer in this part. Besides the error of incorrect usage of time as detailed above many candidates did not set out the problem well. Some candidates treated Monday to Friday as 4 days, others multiplied their previous answer by 7. It was also common to see just 7 h 45 m + 8 h 30 min. Some candidates gained a mark for calculating 17 hours of opening at the weekend where working was shown.

(d) (i) Few candidates scored part marks for this question although many candidates did give the correct answer. The most common error was to use the incorrect number of people in the calculations. An answer of 26 was very common where the two adults had been missed. Of those candidates who included the two adults, many reached the correct answer. Candidates would benefit from further examples where reading the question carefully is required to ascertain the total number of people being considered.

(ii) Candidates who gave the correct answer to the previous part often got this part correct. A fairly common error was to only give a partial method with 87.5% or 6 seen. Some candidates divided by 42 rather than 48. Those candidates who had 26 as the answer in **part (i)** could not score here and perhaps they might have realised that the previous answer needed to be greater than 42.

Answers: **(a)(ii)** 8.4, 3[.0] **(b)** 4.2, 1.98 **(c)(i)** 7 [h] 45 [min] **(ii)** 55 [h] 45 [min] **(d)(i)** 48[.00] **(ii)** 12.5

Question 2

Candidates found this question challenging. Whilst many showed a clear understanding of angles in shapes and transformations they were often let down by a misunderstanding of how to calculate interior and exterior angles of different shapes. There were clear indications that candidates understand what a single transformation is but would benefit from further experience of how to obtain and write translation vectors.

(a) (i) Few candidates gave the correct answer. Many different answers were seen in this part, with 8, 3 and 2 all being reasonably common with no calculation seen. The most frequent incorrect calculation seen was $\frac{180}{36} = 5$. Some candidates gave the interior angle 144 in this part.

(ii) A small majority of candidates gave the correct answer for this part.

(iii) Some candidates realised that they needed to multiply the interior angle by the number of sides and gained the mark. The most common incorrect answers were 180 and 360 with no working.

(b) (i) A few candidates gave the correct answer. Many candidates did not realise that this area could be found by counting squares but attempted calculations using formulae including area of a triangle which often led to incorrect answers.

(ii) Most candidates only gave one transformation with translation often correctly identified. The values of 3 and 8 were often used in a vector, but frequently with one or both negative signs missing or the values reversed. Some candidates wrote the vector as co-ordinates or included a division sign. Some candidates gave a description instead of a vector with 3 left, 8 down although a few used –3 left and –8 down. A few candidates correctly identified the vector but used an incorrect word such as move or translocation in place of translation.

(iii)(a) Although many candidates gave the correct answer some gave reflections in $x = k$ or $y = 2$. Most showed a shape in the correct orientation, but not positioned as a reflection. Candidates would benefit from further experience of drawing reflections in both $x = k$ and $y = k$ and being able to differentiate between them.

(b) This part proved challenging for many candidates. Some gave the correct enlargement but in the wrong location. A few candidates drew an attempted enlargement which had several correct vertices but had the bottom vertex positioned incorrectly. Others used the correct centre but a scale factor of –2 instead of +2.

Answers: **(a)(i)** 10 **(ii)** 144 **(iii)** 1440 **(b)(i)** 5.5 **(ii)** translation $\begin{pmatrix} -3 \\ -8 \end{pmatrix}$

Question 3

Candidates showed a good understanding of the mathematics for parts of this question, in particular substitution of values into formulae. However, in order to improve their answers, candidates would benefit from further work on re-arrangement and factorisation of formulae. Attention to reading the question fully to ascertain what is required in the solution is also an important exercise needing to be practised.

(a) (i) The majority of candidates gave the full correct answer. Some candidates did not give the units as required or were incorrect with cm^2 being a common answer, but also cm, ml, l were seen. A few candidates used 3.14 or $\frac{22}{7}$ for π which led to an inaccurate answer and lost marks. A minority of candidates worked out the surface area in this part or used their own formula.

(ii) Slightly fewer candidates gave the correct answer in this part. There were similar inaccuracies from using incorrect values of π or not using the formula given in the question. Many of these candidates just found the area of the circular base or simply multiplied 4 by 15. A number of candidates quoted the correct formula but squared *r* in the first term as well as the second.

(b) Many candidates found this part challenging. A small number of candidates knew how to approach this rearrangement but simply swapping the *A* and *h* was common. Those candidates who attempted a step-by-step approach to the rearrangement occasionally divided by $2\pi r$ first rather than subtracting πr^2 often leading to inaccuracies. Some candidates did not read the question correctly and substituted values into the formula to give a numerical answer.

(c) More candidates made a correct attempt at this part than the previous part with fewer cases of numerical values being substituted into the formula. A very common error was to misread the last term in the expression as $(\pi r)^2$ leading to $\pi r(2h + \pi r)$. Few candidates gave a correct partial factorisation.

(d) (i) Many candidates gave both of the correct ratios. Some candidates simplified the first ratio to 2 : 3 but did not fully simplify the second and answers such as 5 : 7.5 were seen. Some candidates did not read the question and didn't give their answers in their simplest form with answers given as 0.4 : 0.6 or fractions.

(ii) Very few candidates gave the correct answer. Some candidates did not give an answer and others used words such as equal, same, different, cylinder.

Answers: **(a)(i)** 754 cm^3 **(ii)** 427 **(b)** $\frac{A - \pi r^2}{2\pi r}$ **(c)** $\pi r(2h + r)$ **(d)(i)** 2 : 3 2 : 3 **(ii)** similar

Question 4

All candidates showed an understanding of bar graphs and statistics with many giving full complete answers. It is important that candidates are shown the difference between the statistical terms mean, mode, median, range etc. and how to calculate them as occasionally the answers were given in the wrong space, for example the mean being correctly worked out but in the working space and answer line for the median.

(a) Almost all the candidates drew the correct bar chart using bars of the same width as the one provided. Occasionally the final bar was the wrong height or the gaps between the bars were not consistent.

(b) A large majority of candidates gave the correct value for the modal year. A few candidates gave the number of cars in the modal year.

(c) (i) Many candidates gave the correct range. Some candidates stated the range incorrectly as 920–3100.

(ii) Although a good majority of candidates gave the correct answer a few candidates just selected the middle pair of values, 3100 and 2240, to give a median of 2670. Some candidates did order the values and gained a mark but occasionally subtracted instead of added prior to dividing by 2. Occasionally an answer of 200 was seen without working which may have arisen from this subtraction error and could have gained a mark if working had been shown.

(iii) Many candidates stated the correct mean. The common error was to find the total and forget to divide by 6. Some candidates incorrectly added the six values but when working was shown obtained a mark for dividing their total by 6. A small number of candidates attempted to find a mean of grouped data using the values in the table at the top of the page.

Answers: **(b)** 2010 **(c)(i)** 2180 **(ii)** 2040 **(iii)** 1970

Question 5

Candidates continue to improve in calculating values of equations for inclusion in a table, plotting these points and drawing good curves. Answers to this question would be improved if further work was undertaken on order of symmetry of a curve. Careful reading of the questions would provide the candidates with further marks, for example which line of symmetry to draw.

(a) (i) Almost every candidate completed the table correctly. Very occasionally a candidate made a slip with a minus sign, usually for the value at $x = -1$.

(ii) Nearly all candidates plotted their points correctly and made a reasonable attempt at the correct curve. Very few candidates joined the points with ruled lines or joined the two branches of the curve together. Where points were plotted incorrectly, they were usually one or all of (–16, –1), (–1, –16), (1, 16), (16, 1).

(b) Many candidates gave the correct order of rotational symmetry. Common errors were to give an answer of 1 or 180°.

(c) (i) Many candidates drew the correct line, and often also drew $y = -x$. Some candidates did not read the question carefully and just drew $y = -x$.

(ii) A large number of candidates had difficulty with writing down the equation of the line of symmetry. A few candidates did give the correct answer. Common incorrect answers seen included $y = 0$, $x = 0$; $y = mx + c$ either written with no values given for m and c or sometimes, for example, $y = 1x + c$. Some candidates gave sets of co-ordinates where the line of symmetry crossed the graph, that is (4, 4) and (–4, –4). There were quite a number of candidates who did not give a response for this part.

(d) Most of the candidates gave the correct answer by using an algebraic method. A common incorrect answer using this method was 112 from 16×7. Few candidates drew the line $y = 7$ on their graph.

Answers: **(a)(i)** –4 –15 8 1 **(b)** 2 **(c)(ii)** $y = x$ **(d)** 2.1 to 2.5

Question 6

Many candidates did not perform well on this question, mainly because they did not read the question properly and did not give answers in the allowed range of 40 to 70 to all parts of **part (a)**. Frequently the candidates demonstrated a good understanding of the concepts required although they would benefit from further examples of the terms multiple, factor, prime factor.

(a) (i) Many candidates gave the correct answer. Candidates who did not read the question properly often gave answers outside the allowed range with 19 and 38 often seen.

(ii) Again many candidates gave the correct answer. Candidates who did not read the question properly often gave answers outside the allowed range with 24 being common.

(iii) Almost all candidates gave the correct answer of 50. Sometimes candidates gave an answer of 50^2.

(iv) Quite a few candidates did not show an understanding of the term factor or did not read the question properly so gave an answer outside the allowed range. Some candidates did give the correct answer 53 but an answer of 2 was often seen.

(v) Few candidates gave the correct answer. Often candidates gave an even number so an answer of 42 was common. Some candidates who did give an answer which was an odd number again gave answers outside the allowed range with 21 being common. A few candidates gave an answer of 49 or 55 or 101. Several candidates did not give an answer.

(vi) Some candidates gave the correct answer. Some candidates appeared to misunderstand the question and gave a square number and a cube number, usually 49 and 64.

(vii) Candidates found this part challenging and a substantial number did not give an answer. There were very few correct answers seen. A few candidates recognised that the answer had to be a square number if it had 3 factors.

(viii) Many candidates gave at least two correct prime numbers in the range. Numbers 51 and 69 were commonly included in the lists. Some candidates gave answers outside the allowed range with 3, 5, 7 being common.

(b) Many candidates showed a correct method for finding the prime factors, either a factor tree or repeated division. Some answers had products omitting one of the factors, usually the final one from the division. In some cases a candidate would give a product including non-prime factors such as 117×2 or 6×39 as their answer. Occasionally a list of factors was given instead of a product.

(c) (i) A majority of candidates gave the correct answer, although answers of 11 and 9^{11} were also common.

(ii) Many candidates clearly did not understand what was meant by integer with many candidates not giving an answer. Answers in some other form were often given, such as 3^{11} or 81×2187.

(iii) Some candidates gave the correct answer here, even after **part (ii)** had been omitted or was incorrect. On some occasions the answer of 1.77147×10^5 was truncated too far to 1.7×10^5. Alternatively some candidates made errors from incorrect powers of 10, often 1.77147×10^{-5} or 17.7147×10^4 being given. An answer of 3×10^{11} was common.

(d) (i) A substantial number of candidates gave the correct answer, but $\frac{1}{3^2}$, $\frac{3}{-2}$ and $\frac{-2}{3}$ were also common answers.

(ii) A small majority of candidates gave the correct answer. A substantial number of candidates gave answers which involved the incorrect usage of the power of zero with incorrect answers of 0, 1, 15 frequently being seen.

Answers: **(a)(i)** 57 **(ii)** 48 **(iii)** 50 **(iv)** 53 **(v)** 63 **(vi)** 64 **(vii)** 49 **(viii)** any 3 from 41, 43, 47, 53, 59, 61, 67
(b) $2 \times 3^2 \times 13$ or $2 \times 3 \times 3 \times 13$ **(c)(i)** 3^{11} **(ii)** 177 147 **(iii)** $1.77[147] \times 10^5$ **(d)(i)** $\frac{1}{9}$ **(ii)** 3

Question 7

Candidates were generally challenged by this question. Most candidates showed a reasonable understanding of how to draw an angle bisector and a perpendicular bisector. Occasionally accuracy was poor. It would benefit candidates to have further work on constructions to include using construction arcs of sufficient size and the shading of regions.

(a) A small majority of candidates gave the correct answer. Common incorrect answers seen were 40, 130 and 310. An answer of 160 was also seen from measuring and scaling the line *AB*.

(b) (i) Many candidates constructed the bisector correctly. Most showed the construction arcs although many just drew the correct line without any construction arcs or simply drew the line *BE*. Common alternative lines drawn were a line from the midpoint of *BC* to *E* or the perpendicular bisector of *BC*.

(ii) A small majority of candidates gave the correct answer following the correct construction in **part (i)**. Some candidates gained a mark for showing the measurement of their line. Some candidates used the incorrect scale, often 1 cm to 10 m. Where these candidates showed the actual measurement of their line they gained a mark but if no working was shown they did not score. A noticeable number of candidates calculated the perimeter of the shape.

(iii)(a) Candidates found this part challenging and a substantial number did not give an answer. The most common error of those candidates who made an attempt at this part was to start with 9000 instead of showing that 9 km is 9×1000 m.

(iii)(b) A few candidates realised that they needed to use the 2.5 from the previous part and their answer to **part (b)(ii)** and reached the correct answer. The common error was to multiply by 2.5 or divide their answer to **part (b)(ii)** by 9. Some candidates did not realise that they needed to use the value they had calculated in **part (ii)** but used their measured length instead.

(c) Although some candidates constructed the bisector correctly with arcs, many appeared to measure the midpoint of *ED* and then attempted to draw a line parallel to *EA* or draw a line to the midpoint of *AB*.

(d) (i) Most candidates realised that an arc was required centred on *A*. However, some candidates did not draw an arc with the correct radius from *AB* to *AE*. A few candidates drew an arc of the wrong radius but showed no working as to how they obtained the value of their radius.

(ii) Very few candidates shaded the correct region. Frequently candidates who had constructions where follow through could be applied shaded an area more than 150 m from *A* rather than less than 150 m. More candidates demonstrated that they understood the concept of closer rather than further. A sizeable minority of candidates misunderstood which of their arcs were construction arcs as opposed to the arc for this part so shaded the wrong area.

Answers: **(a)** 48 to 52 **(b)(ii)** 270 to 278 **(iii)(a)** $9 \times 1000 \div (60 \times 60)$ **(iii)(b)** 108 to 111.2

Question 8

Although a sizeable number of candidates gave correct answers, it was common for them to misinterpret the diagram forgetting that it is not drawn to scale. So, for example, in many cases lines *FG* and *BD* were assumed to be parallel. Further work on showing what can be assumed and what needs to be derived before starting a calculation would benefit the candidates.

(a) (i) The correct answer of isosceles (with varied spelling) was often seen. Common incorrect words were equilateral, right angled and triangle.

(b) (i) Many candidates recognised that angle *BDA* equalled angle *ABD* as triangle *ABD* was isosceles. A common incorrect answer was 88, from missing out angle *CAD* from the triangle.

(ii) Most candidates gave the correct answer or identified that the sum of *a* and *b* was 88 from the angle sum of the triangle *ABD*. The most common error was assuming that line *AC* bisected the angle *BAD* giving the incorrect answer of 19.

(iii) Candidates often gave the correct answer of 90.

(iv) Few candidates gave the correct answer. The most common error was to assume that angles *CAD* and *ACE* were the same so 15 was often seen.

(v) Most candidates gave the correct answer. The most common error was assuming that lines *FG* and *BD* were parallel leading to an incorrect answer of 73. Some candidates attempted to identify a right angle on the diagram for this part; it was more frequently angle *EAB* than angle *CAF*.

(c) Those candidates who performed the correct calculation usually gave their answer correct to one decimal place to gain full credit. It was also common for candidates to use a diameter of 6.5 or 26. Frequently candidates used the area of the circle formula with a radius of 6.5, 13 or 26. In these cases only a small number of candidates showed a calculated value that they then rounded. Some candidates did not read the question carefully so gave an answer to more than one decimal place or to only one significant figure such as 40.

Answer: **(a)** Isosceles **(b)(i)** 73 **(ii)** 15 **(iii)** 90 **(iv)** 19 **(v)** 71 **(c)** 40.8

Question 9

Candidates continue to improve in their understanding of sequences. There is still a tendency to not use expressions but to use an extended table to find results for later terms in the sequence. Further work on recognising that if a sequence increases by 4 between terms this requires a 4n term rather than a n + 4 term in the expression would benefit candidates.

(a) (i) A few candidates gave the correct answer of cube. Common incorrect answers seen were cuboid, square, rectangle and hexagon.

(b) (i) The vast majority of candidates drew the correct diagram. Occasionally a candidate would have one too few squares along the base.

(ii) Almost all candidates gave the correct answers. When an error did occasionally occur it was usually from giving answers of 12 and 16.

(iii) Some candidates found this part challenging. The most common error was to recognise that the number of tiles went up in fours but to write this as n + 4. Other incorrect answers seen included 4n + 3 and 4n + 1.

(iv) A substantial number of candidates had the correct answer even following an incorrect answer in the previous part. There was clear evidence that many candidates did not use their formula but continued the table up to Diagram 19 to obtain the answer.

(v) (a) Few candidates gave the correct answer. Many candidates recognised that they needed to equate their expression for Diagram n to 98. However, many candidates then gave a decimal result, or rounded up rather than down. There were a few examples of incorrect simplifications when an expression was written down.

(b) Candidates found this part challenging. Some candidates gave an answer in the previous part leading to more than 98 tiles being required for the pattern. For example, an answer of 26 in **part (b)(v)(a)** following the correct nth term would require 101 tiles so candidates gave an answer of 3, ignoring that they only had 98 tiles.

Answers: **(a)** Cube **(b)(ii)** 13 17 **(iii)** 4n – 3 **(iv)** 73 **(v)(a)** 25 **(v)(b)** 1

MATHEMATICS

Paper 0580/41
Extended

Key messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus. The accurate statement and application of formulae in varying situations is always required. Work should be clearly and concisely expressed with an appropriate level of accuracy.

General comments

Candidates appeared to have sufficient time to complete the paper and any omissions were due to lack of familiarity with the topic or difficulty with the question rather than lack of time. More able candidates could attempt all the questions and solutions usually displayed clear methods. However, some candidates provided solutions with little or no working or didn't carry out calculations to sufficient accuracy and consequently lost marks. Centres should continue to encourage candidates to show all working clearly in the answer space provided. Some candidates risk losing marks by overwriting incorrect working which then becomes unclear. For questions requiring several calculations candidates are advised to write down the answer to each step using more than 3 significant figures and only correct to the required accuracy at the end of the calculation.

The topics that proved to be more accessible were percentages, interpretation of cumulative frequency graphs, calculation of a mean from grouped continuous data and drawing graphs. The more challenging topics were determinant of a matrix, probability based on group data, questions requiring candidates to show a solution, modulus of a vector, equations based on functions and interpretation of a drawn graph.

Comments on specific questions

Question 1

(a) (i) This question was almost always correct. Errors usually involved division by 2 or by 5 and occasionally forgetting to multiply by 2 after division by 3.

(ii) This was another part that was almost always correct. The usual error was to subtract 32.40 from 72 to give the amount left.

(iii) Far fewer candidates reached a correct final answer in this part, often struggling to cancel $\frac{31.2}{72}$ correctly. Common errors usually involved subtraction of 8.40 from 32.40, instead of adding, before finding the result as a fraction of 72.

(iv) Many correct answers were seen. The most frequent error was to increase 19.2 by 20% leading to an answer of 23.04.

(b) There were many correct answers to this question, with the usual formula quoted to find the $110 interest. However some candidates forgot to add this to $550 for the final amount and lost marks. Some were clearly confused and attempted a compound interest method.

(c) Many candidates showed some working and often gained credit for doing so. Those candidates who did year-on-year calculations and wrote down the total at each stage rarely reached a correct answer, largely due to rounding and/or truncation errors.

(d) Although many candidates were able to set up a starting equation of the form $550 \times m^{10} = 638.30$, solving it proved challenging for all but the more able candidates. Understanding of the order of operations proved the downfall of many, often starting by subtracting 550. Those with a multiplier of $(1 + r)^{10}$ experienced the same difficulties, as well as subtracting 1 from both sides. Attempts at a trial and improvement method rarely ended with a correct answer.

Answers: **(a)(i)** 48 **(ii)** 32.40 **(iii)** $\frac{13}{30}$ **(iv)** 24 **(b)** 660 **(c)** 663.90 **(d)** 1.5

Question 2

(a) (i) Most candidates were able to draw the correct image with a few earning one mark for a translation with either the correct horizontal displacement or correct vertical displacement.

(ii) Most candidates earned full marks for a correct reflection. Common errors involved reflection in other horizontal lines, often the x-axis, or in the line $x = 1$.

(iii) Candidates were slightly less successful describing the enlargement, largely due to an incorrect centre. There were a significant number of candidates who ignored '**single**' and gave two transformations.

(b) (i) Many correct answers were seen with a few slips losing the mark in some cases.

(ii) Although less successful than the previous part, many still obtained the correct answer. Loss of marks was usually due to arithmetic slips in one or more of the elements. Less able candidates simply multiplied the corresponding elements.

(iii) Clearly many candidates did not know the notation for determinant of a matrix and made no attempt. Quite a number added the two products of the determinant instead of subtracting.

(c) (i) Many candidates realised it was a rotation but only a minority earned all three marks. It was common to omit one of the two properties, usually the centre, or give an incorrect direction for the rotation.

(ii) Only a minority were able to give the correct matrix. Some earned one mark for a correct column or row. A few attempted this by using simultaneous equations from a matrix with 4 unknowns but were rarely successful.

Answers: **(a)(iii)** Enlargement, scale factor = 3, centre (–6, –5) **(b)(i)** $\begin{pmatrix} 2 & 5 \\ 3 & 10 \end{pmatrix}$ **(ii)** $\begin{pmatrix} 10 & 14 \\ 18 & 24 \end{pmatrix}$

(iii) $\frac{1}{4}$ **(c)(i)** Rotation, 90°, centre (0, 0) **(ii)** $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

Question 3

(a) (i) Many correct answers were seen but a number of candidates gave an answer of 300, presumably as it is halfway between the minimum and maximum volumes.

(ii) This part was well answered by the majority with incorrect answers such as 100, 125, 150 and 200 seen.

(iii) This proved to be the most challenging of the four parts as evidenced by the higher number making no attempt. Able candidates had no problems but less able candidates had little idea of where to start reading from the graph with no obvious pattern to the many incorrect answers.

(iv) Candidates were more successful in this part with most candidates earning full marks. There were two main reasons for the loss of marks; misreading the vertical scale and giving the number of students estimating less than $300\,m^3$.

(b) **(i)** This was generally well answered, with marks lost occasionally due to poor arithmetic or not using the correct mid-values. Some had a partial understanding and multiplying the frequencies by the class widths or the bounds of the interval were reasonably common errors. A small number simply added the mid-values and divided by 4.

(ii) A small majority of candidates were able to draw a correct histogram. Others lost marks for incorrect widths of bars, usually the first which was often drawn over the interval 0 to 60. When bars were drawn incorrectly it was very rare to award a mark for 3 correct frequency densities; in most cases no working was shown.

(iii) Many candidates struggled to obtain the correct answer. Many solutions were based on choosing only one student or choosing two with replacement.

Answers: **(a)(i)** 400 **(ii)** 350 **(iii)** 70 **(iv)** 170 **(b)(i)** 106 **(iii)** $\frac{1339}{4975}$

Question 4

(a) Many correct answers were seen. Some candidates didn't use the required values for π in this part and in others, which led to inaccurate answers and the loss of some marks. In a few cases, candidates copied the formula incorrectly. Some clear thinking candidates simplified their working throughout the question by using multiples of π, only converting to a decimal for the answer to a part. Some candidates showed a correct calculation and wrote the answer as 14 140. To earn both marks, the answer that rounded to 14 140 needed to be written down.

(b) **(i)** Candidates were less successful with this part. A majority of candidates realised that the sphere was taking up space where water would have been and proceeded to calculate the volume of the cylinder and subtract their previous answer. Errors arose when a variety of incorrect formulae were used for the cylinder. Some used their incorrect answer from **part (a)** rather than using the volume given in the question.

(ii) Many candidates didn't link the drop in water level to the removal of the sphere resulting in a greater number of candidates making no attempt at this part. For the rest, the most common approach was to equate the volume of water from **part (i)** to the volume of a cylinder of water of height *d*. A smaller number attempted the drop in height when the sphere was removed although not all went on to subtract the answer from 60.

(c) **(i)** A majority of candidates attempted to equate the volume of the cone to the volume of the sphere from **part (a)**. Although a significant number were successful, much of the working was littered with errors. Misreading the formula with $\frac{1}{3}$ becoming either $\frac{4}{3}$ or $\frac{1}{2}$ and r^2 becoming r^3 resulted in lost marks for many. Accurate equations were often not solved correctly, dealing with the fraction or the square, and the order of operations being the common errors.

(ii) Using perpendicular height in place of slant height and not including the circular base were common errors and resulted in only a minority of candidates obtaining the correct answer. There was also a lack of working shown in this part, even when the answer was correct. Throughout the question candidates needed to use answers from previous parts and this often led to the loss of accuracy marks.

Answers: **(a)** 14 137 **(b)(i)** 104 000 **(ii)** 52.8 **(c)(i)** 15.8 **(ii)** 3580

Question 5

(a) The two missing values were almost always correct.

(b) The scales used on the axes made the plotting of the points more challenging and it was common to see the points (1.6, 14.1) and (8, 10.5) and their negative counterparts plotted incorrectly. Also, the tight turns on the two sections of the graph led to less than perfect curves. Candidates would be well advised to use a sharp pencil for plotting points and the drawing of the curve. Many were seen with thick lines. Some candidates plotted two symmetrical curves below the x-axis. However most candidates realised that the value of f(x) tended towards infinity at $x = 0$ and, consequently, most curves did not cross or touch the y-axis.

(c) It was clear that many candidates understood what was required, but correct results depended on the quality and accuracy of the curve in **part (b)**. Consequently, some marks were lost as solutions often fell outside the required range.

(d) This proved challenging for many and a large number of candidates made no attempt. Some fully correct answers were seen but a combination of missing values, extra values and numbers that were not prime, meant that the modal mark was zero. Common extra numbers often included 0 or 1 or both and extra primes usually involved 13 and 17. Some candidates included negative values for k.

(e) A small majority picked up on the symmetry of the two sections of curve and gave the correct point. Some were unsure and answers such as (2, –12) and (–2, 12) were seen along with more random co-ordinates.

(f) (i) All four parts proved challenging for many and a significant number of candidates made no attempt. In this part, some realised the need to equate $\frac{20}{x} + x$ with x^2 and were able to show the given result. Elimination of the denominator often resulted in the very common error of $20 + x = x^3$. Many tried to solve or rearrange the cubic equation using the values –1 and –20.

(ii) Very few fully correct parabolas were seen. Most realised that it was a U shape, but some did not place it through (0, 0). Simple plots such as (1, 1), (–3, 9) and (3, 9) were often missed. A few candidates plotted points at (–1, –1), (–2, –4), etc.

(iii) The accuracy here depended on good curves for the two graphs and, where this was achieved, candidates produced some good answers, clearly understanding that the intersection of these was required.

(iv) Nearly all candidates didn't relate this to **part (iii)**. Some attempts at trial and improvement were seen but were rarely successful. The most common incorrect answer was 20.

Answers: **(a)** 9, 10.5 **(c)** 2.1 to 2.6, 8.5 to 9 **(d)** 2, 3, 5, 7 **(e)** (–2, –12) **(f)(iii)** 2.5 to 3.5 **(iv)** 3.0 to 3.1

Question 6

(a) (i) As with many 'show that' questions, many candidates didn't realise the steps required and, as a result, many did not gain marks. Able candidates had no difficulty in obtaining an expression, in terms of x, for the length of the rectangle, either by considering the perimeter or the area. Once this was found it was usually a couple of steps to obtain the correct equation. Less able candidates often took the given equation and tried, unsuccessfully, to work backwards. Some candidates, wrongly, substituted their own numerical values and tried to 'solve' their resulting equations.

(ii) A majority of candidates were able to obtain the correct solutions, many by using the quadratic formula resulting in a loss of marks. Whether this was a consequence of not reading the question carefully or an inability to factorise was not clear.

(iii) A majority of candidates made a good attempt and usually obtained two correct solutions, though not always written to two decimal places as requested. When using this method some candidates made sign errors, using –40 instead of –(–40) for $-b$. Others squared –40 to obtain –1600 and some shortened the division line so that only the square root expression was divided by 2.

(b) (i) Most candidates correctly gave the times taken as $\frac{200}{x}$ and/or $\frac{200}{x+10}$. Some subtracted correctly and were able to do the algebraic manipulation to obtain the required result. Many, however, lost marks for an incorrect reverse subtraction.

(ii) Two methods were used, substituting 80 into the expression from the previous part or starting fresh and working out the times for the individual journeys. Those opting for the first method made errors such as 80(80+10) = 6410 or in converting their time in hours into minutes and seconds. The conversion also caused many errors for those attempting to find the time for the reverse journey.

Answers: **(a)(ii)** $(x - 30)(x - 10)$ and 30, 10 **(iii)** 5.86, 34.14 **(b)(ii)** 16 min 40 s

Question 7

(a) (i) Many correct answers were seen, usually recognising that opposite sides are represented by the same vector. Some preferred to use a route such as $\overrightarrow{MR} + \overrightarrow{RO} + \overrightarrow{OP}$ to find $\overrightarrow{MQ}$, although not all went on to write it in terms of **p** and **r**.

(ii) Candidates were less successful in this part. Most chose to use the route $\overrightarrow{MQ} + \overrightarrow{QT}$, but obtaining an expression for $\overrightarrow{QT}$ often went wrong, with common errors such as $\frac{1}{3}\mathbf{r}$ and $-\frac{2}{3}\mathbf{r}$. Having obtained the correct expression many continued and applied Pythagoras' theorem, $\sqrt{\left(\frac{1}{2}\mathbf{p}\right)^2 + \left(\frac{1}{3}\mathbf{r}\right)^2}$. Some gave the answer as a column vector which earned no credit.

(iii) A majority of candidates obtained the correct expression, however, just as in **part (ii)**, many continued after obtaining a correct expression and applied Pythagoras' theorem or gave the answer as a column vector.

(b) Many clearly did not know what the term 'position vector' meant. All sorts of combinations of vectors were seen and few of these led to the correct route. Many more might have progressed further if they had shown the point *U* on the diagram. A significant number made no attempt.

(c) Only a few candidates gained all three marks, partly because magnitude was not clearly understood, even by many of the more able candidates. Common errors for $|\overrightarrow{MT}|$ included $2k.(-k)$, $2k + (-k)$ and $2k^2 \pm k^2$. These were sometimes equated to 180 but often they were equated to $\sqrt{180}$. Many candidates made no attempt at all.

Answers: **(a)(i)** $\frac{1}{2}\mathbf{p}$ **(ii)** $\frac{1}{2}\mathbf{p} - \frac{1}{3}\mathbf{r}$ **(iii)** $\mathbf{p} + \frac{2}{3}\mathbf{r}$ **(b)** $\frac{3}{2}\mathbf{p} + \mathbf{r}$ **(c)** 6

Question 8

(a) Most candidates were able to set up the equation and solve it correctly. Some stopped after finding g(1) = 5 and others substituted the 5 into f(*x*).

(b) Again, most candidates obtained the correct answer. Some did not understand the process required for the composite function and treated the question as the product of two functions. A few tried to express the composite function in terms of *x* as a first step but quite often 2×2^x was written as 4^x.

(c) The process of finding the inverse function was well understood and many correct answers were seen. Some candidates made an error with the signs but usually picked up one of the marks for a correct start. A significant number of candidates treated f^{-1} as a reciprocal and $\frac{1}{2x+1}$ was often seen.

(d) Although many correct answers were seen this proved more challenging and many earned the method mark only. Expanding $(2x + 1)^2$ proved the downfall with $2x^2$ often seen instead of $4x^2$ and $4x^2 + 1$ another common error. As in **part (b)**, some treated gf(x) as a product of the functions and $(x^2 + 4)(2x + 1)$ was often seen.

(e) This was a challenging question and only the more able candidates could obtain the correct answer. Few realised that if $h^{-1}(x) = 0.5$ then $h(0.5) = x$ which leads to $2^{0.5} = x$. A variety of errors, such as treating $h^{-1}(x)$ as a reciprocal, were seen. Two common incorrect responses were 2 and $\frac{1}{2}$.

(f) Few candidates seemed happy to work with powers of 2 and many incorrect responses were seen. Some were able to write $\frac{1}{h(x)}$ as 2^{-x} but then went wrong in trying to solve $-x = kx$, sometimes given as $k = -2x$.

Answers: **(a)** 2 **(b)** 17 **(c)** $\frac{x-1}{2}$ **(d)** $4x^2 + 4x + 5$ **(e)** $\sqrt{2}$ **(f)** –1

Question 9

(a) (i) A small majority successfully obtained the equation of the line passing through *A* and *B*. For some, errors arose in calculating the gradient, either from errors with signs or from using change in *x* over change in *y*. Once a gradient was calculated, some realised that the intercept was given on the diagram but others attempted a substitution and did not always reach a correct value.

(ii) As this was a question requiring candidates to show a particular result it was expected that candidates should use the co-ordinates of *A* and *B* to find the values *a* and *b*. Many assumed these values and attempted to show the equation balanced. Those who approached it correctly sometimes struggled with the manipulation of the algebraic fractions and lost their way. A few incorrectly substituted $x = 4$ and $y = 2$ at the same time.

(b) (i) Only the more able candidates made any progress with this question. Many did realise the need to substitute the co-ordinates of *P* or *Q* into the equation of the curve. Some were successful but after reaching $\frac{4}{16} + \frac{k^2}{4} = 1$ the elimination of the fractions resulted in many errors. Other candidates forgot to square *k*. Many others made no attempt.

(ii) This trigonometry question proved a challenge to many. The most common incorrect answer was 90°. Those that realised that trigonometry was needed often attempted to calculate *OP* and then use sine. A valid method but all too often accuracy was lost by premature approximation at intermediate stages. Others attempted the cosine rule for triangle *OPQ* but usually lost accuracy for the same reason. Those that attempted the tangent ratio were usually more successful, apart from when candidates forgot to double their answer. As many candidates had an incorrect or no value for *k*, accuracy marks were rarely awarded in this part.

(c) (i) Although this part was independent of what had gone before many made no attempt. The award of the mark was rare. The most common answer was 64π, simply taking *a* to be 16 and *b* to be 4. A few did work correctly but either gave the answer as 8 or gave the answer as a decimal.

(ii) Very few used an area scale factor to obtain their answer. There was some evidence of using a scale factor of 3 with some of the solutions. A more popular but unsuccessful method was to try and find *b* using *a* as 12. An extremely high number of candidates made no attempt.

Answers: **(a)(i)** $-\frac{1}{2}x + 2$ **(b)(i)** $\sqrt{3}$ **(ii)** 81.8 **(c)(i)** 8π **(ii)** 72π

MATHEMATICS

Paper 0580/42
Extended

Key messages

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 ability to interpret problem solving and unstructured questions.

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

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

General comments

Most candidates were able to attempt almost all of the questions reasonably well. Solutions were usually well-structured with clear methods shown in the space provided on the question paper, but it is noticeable that some candidates are not providing full working in multi-mark parts of questions.

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

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

The topics that proved to be accessible were ratio, percentage increase, reflections and describing a transformation, simple mensuration and Pythagoras' theorem in three dimensions, simple indices, solving quadratic equations and finding equations of linear functions.

More challenging topics included reverse percentage, harder indices, enlargement with negative scale factors, using linear scale factors in an area problem, finding the equation of the perpendicular bisector of a line segment.

Comments on specific questions

Question 1

(a) (i) Candidates used a variety of different methods in this part, some adding the flight time first, others first subtracting the time difference from either the start time or the flight time. An occasional error was to add the time difference. The final answer was correct in many cases but sometimes spoilt by appearing in an unacceptable form such as 12 hrs 45 mins or 12 45 am.

(ii) Nearly all candidates knew that they must divide the distance by the time but expressing the time in a suitable form was a problem for many. Times of 11.1, 11.2 and 11.16, while gaining method marks, all gave answers which were out of the accepted range, while candidates who converted the time to minutes frequently forgot to multiply their answers by 60 to obtain the answer in km / h. It is advisable that candidates consider the context of a question to check, for example, that an answer of 13 km / h for the speed of a plane is unrealistic.

(b) (i) There were many good answers to this part with candidates either going directly for the required answer or first finding the sum of the three types of price. However a few candidates divided 2350 by 16 or 9 rather than by 5.

(ii) This was another part that was usually well answered with the best solutions simply finding $\frac{2}{9}$ as a percentage, while others involved calculating the economy price first. There was the occasional loss of accuracy with some candidates giving an answer of 22 only.

(c) (i) There were many correct answers to this part, with only a few candidates losing the accuracy mark by approximating their answer to 3810. Errors included finding 70% of $2240 and going no further, or sometimes finding 30% of $2240.

(ii) Although there were many correct answers, a large number of candidates thought that the business ticket was 180% **of** the economy ticket, and not 180% **more than** the economy ticket and thus carried out a correct calculation, but using 180 instead of 280 to divide into $2240.

(d) (i) Many clearly presented, fully accurate solutions were given here and a further significant number of candidates completed all steps correctly to find that the number of additional kilometres travelled was 330, but then omitted to add this to the 800 km that were travelled but already included in the price. The error in which candidates incorrectly allowed 800 km travel each day, leading to a total distance of 12 × 800 + 330 was also seen. Some other candidates correctly established that $412.5 was spent on the kilometres above the 800 km included in the price, but calculated 412.5 × 1.25 in an incorrect attempt to find the distance that this represented. Another common error was to include only one day of insurance so that 12 × 28 + 6.50 = 342.50 instead of 12(28 + 6.50) = 414 was used, or neglected to include the insurance at all. Less able candidates did not absorb the detail of the question and simply divided $826.5 by 1.25. Others found the price paid per day but then abandoned this approach. Some candidates misunderstood the information given in the question and used a cost of $1.25 × 800 within their calculations, not appreciating that the 800 km was already included in the price.

(ii) This question part was very well answered, irrespective of success or otherwise in **part (d)(i)**. The vast majority of candidates understood the need to divide their distance from **part (d)(i)** by 10 and multiply by $1.30. A few candidates rounded their answer of $146.9 to $147 which is not appropriate when dealing with an exact amount of money.

Answers: **(a)(i)** 1245 **(ii)** 788 **(b)(i)** 4230 **(ii)** 22.2 **(c)(i)** 3808 **(ii)** 800 **(d)(i)** 1130 **(ii)** 146.90

Question 2

There was great diversity in the ability of candidates to cope with **part (a)** on indices. A number of candidates used their calculators in trial and improvement methods and gave their answers in decimal form. The better method of solving simple equations by expressing the given numbers as powers of either 2 or 3 was significantly less common.

(a) (i) This was nearly always well answered, with most candidates recognising 243 as the 5th power of 3.

(ii) Although most candidates gave the correct value for *x*, answers of $\frac{1}{4}$, 2 and 4 also appeared.

(iii) The majority of candidates gave the correct answer to this part, although many preferred a decimal form of the answer. This was acceptable as long as the decimal was correctly approximated to a minimum of three significant figures, but answers such as 1.6 or 1.66 did not gain the accuracy mark and in many cases appeared with no clear method.

(iv) This part was found significantly more challenging by a large number of candidates. Many realised that the answer was a negative index. Those who had given answers of 1.67 in the previous part assumed that –0.67 would be a suitable value here but this 2 significant figure answer was not sufficiently accurate. A few candidates gave answers in the form $\frac{1}{1.5}$ which was not acceptable.

(b) Many candidates, who ignored the instruction to solve this by factorisation and used the formula to obtain the two values of *y*, gained only partial marks as they were required to use the method asked for in the question. Of those who did factorise, most did this correctly although a few either partially factorised or used incorrect mathematical conventions and gave pairs of factors without a product. A few could not then complete their solution, with $(y - 10) = 0$ sometimes resulting in the answer $y = -10$.

Answers: **(a)(i)** 5 **(ii)** $\frac{1}{2}$ **(iii)** $\frac{5}{3}$ **(iv)** $-\frac{2}{3}$ **(b)** 10 and –3

Question 3

The vast majority of answers seen here were ruled. Very few candidates gave poor quality freehand images.

(a) (i) This reflection was performed accurately by the majority of candidates. A reflection in $x = k$, where $k \neq 1$ was a common error and less frequently a reflection in $y = 1$.

(ii) Many fully correct enlargements were seen but this negative enlargement was more of a challenge than the reflection in **part (a)(i)**. Candidates confused an enlargement of –2 with enlargement by scale factor $\frac{1}{2}$. Others drew an enlargement of scale factor –2 but used the wrong centre of enlargement, even though this sometimes caused the image to go off the grid provided in the question. Less able candidates drew an enlargement of scale factor 2 with no regard for the centre of enlargement and others offered no response at all.

(iii) Candidates who had learnt that this matrix represents a rotation of 90° anticlockwise about (0, 0) scored well in this question. A common error seen was to rotate the shape 90° *clockwise* about (0, 0). Candidates who could not recall the correct transformation attempted the matrix multiplication using one or more points from the object. However, on many occasions the correct order for the matrix multiplication was reversed or errors were made in the matrix multiplication process.

(b) Many fully correct answers were given here with very few candidates stating more than a single transformation. Occasionally the centre of the enlargement was not stated.

Answer: **(b)** Enlargement, scale factor 3, centre (0, 0).

Question 4

The graph was generally plotted accurately and carefully drawn. The latter parts of the question which included interpreting the graph and solving equations using the graph proved more challenging.

(a) (i) This part was answered well but a common error was to evaluate f(–1) as –4.

(ii) The majority of graphs were drawn accurately. Most read the scales carefully but there was some mis-plotting of points, the most common errors being at (–0.1, 6.0) and (0.2, –9.0). Some candidates plot their points with very large blobs which make the accuracy of the points difficult to judge. The points were generally correctly connected with a clear smooth curve. Candidates were penalised for joining the points with a ruler, over thick, double or feathered lines, curves that touched or crossed the *y*-axis and for curves that doubled back on themselves.

(b) Most candidates were able to give 3 correct answers to $f(x) = 0$ within the given ranges. However, some inaccurate graph drawing in **part (a)(ii)** led to some responses being out of range. Occasionally candidates misread the scales or missed off a negative sign, but overall this part was very well attempted.

(c) Many candidates were able to interpret this question correctly and provide a correct negative integer response. A common error was to provide a non-integer negative answer.

(d) (i) Many candidates scored full marks for this part. The straight line graph was often drawn accurately with a ruler. Those candidates not drawing a correct graph often scored at least one mark for either the correct gradient or *y*-intercept at –2. The most common incorrect graphs seen were $y = -5x$ and $y = -2$. This part required the graph to be drawn and those candidates who tried to complete the question algebraically were mostly unsuccessful and could only score a maximum of one mark. Candidates who drew the correct line usually went on to give two correct values for *x* although sign errors were sometimes seen. To draw a straight line graph accurately candidates should be encouraged to plot points such as (–1, 3) and (1, –7) rather than points that are closer together such as (–1, 3) and (0, –2), so that when the line is extended small inaccuracies are not magnified.

(ii) Only a few candidates were able to answer this more challenging part of the question successfully. Whilst some candidates started the question correctly, by substituting in f(*x*), they struggled with the algebraic manipulation and could not arrive at a correct cubic. Others substituted their *x* values from **part (d)(i)** into the equation to generate two simultaneous equations and tried to solve these, but this was not a successful approach.

Answers: **(a)(i)** –2, –0.5 **(b)** –1.95 to –1.8, –0.4 to –0.2, 2.05 to 2.2 **(c)** Any integer where $k \leqslant -3$
(d) –0.4 to –0.2 and 0.55 to 0.75 **(e)** $a = 5$ and $b = -2$

Question 5

Many candidates were able to score well on this probability question. There were some, however, who had little knowledge of probability and scored very few marks.

(a) This was answered well by most candidates. It was rare to see any working from those who did not have the correct answer but there were a few cases, such as 0.2 + 0.3 + 0.45 = 0.95 followed by 1 – 0.95 = 0.5, where the working was shown and a method mark could be awarded. Candidates should show working to guarantee a method mark when arithmetic errors are made.

(b) This part was almost always answered correctly. A small number of candidates gave an incorrect answer of $\frac{15}{50}$.

(c) (i) There was a mixed response to this question. Those who identified the relevant probabilities as 0.45 and 0.3 sometimes multiplied them together rather than adding. There were also some candidates who wrote down $\frac{0.45}{2} + \frac{0.3}{3}$ and continued to do this throughout the rest of the question.

(ii) There was a similar response to this part as for the previous part. Those candidates who multiplied the probabilities in **part (c)(i)** invariably added them in this part.

(iii) Many candidates did not appreciate that it is possible to obtain a score of 15 scoring 5 with the first coin and 10 with the second or scoring 10 with the first and 5 with the second. It was therefore very common to see 0.2×0.3 leading to an answer of 0.06.

(d) Some candidates answered this part very well but others found it more challenging. Many attempted to identify the outcomes using a tree diagram but a more effective method in this case was to write down the outcomes in the form 10, 0, 0 and so on. Those who realised that it is necessary to multiply three probabilities together usually gave either $0.45 \times 0.45 \times 0.2$ or $0.3 \times 0.3 \times 0.45$ or both of these to earn 1 or 2 marks. Those who realised that 6 outcomes are possible were then able to complete the method either by addition or multiplying by 3.

Answers: **(a)** 0.05 **(b)** 15 **(c)(i)** 0.75 **(ii)** 0.135 **(iii)** 0.12 **(d)** 0.243

Question 6

(a) A number of candidates did not answer this correctly indicating that knowledge of symmetry of three-dimensional figures needed improvement. Common answers were 2 and 6.

(b) (i) This was generally well answered. A few candidates took the cuboid as having a square cross section and a few others appeared to lack knowledge that the surface area of a cuboid consists of six rectangles.

(ii) There were many correct answers including follow throughs from **part (i)**. The common error was to divide by 100.

(c) (i) The diagonal of the cuboid was quite well answered. A few candidates demonstrated a correct method but rounded during their working and gave a final answer out of the required range of accuracy. This was a challenge to some candidates as a diagonal of a face was occasionally given as a final answer. Some less able candidates added the lengths of two or three sides of the cuboid.

(ii) The angle between the diagonal and the base was a challenging question and this part proved to be a good discriminator. There were many fully correct answers. There were also many answers which were an angle in one of the faces of the cuboid. As in **part (c)(i)**, for some candidates, there appeared to be a lack of experience with three-dimensional shapes. Candidates who added to the diagram often met with more success. Sine and tangent were the most popular approaches whilst a few used cosine. Some less able candidates attempted to use geometry rather than trigonometry.

(d) (i) Almost all candidates demonstrated knowledge of the calculation of the volume of a cuboid.

(ii) Candidates were more experienced in cylinder problems and this calculation of the radius was generally well answered. A few candidates did not use a correct formula for the volume and a few others used $\pi = 3.14$.

Answers: **(a)** 3 **(b)(i)** 9900 **(ii)** 0.99 **(c)(i)** 75.7 **(ii)** 23.3 or 23.4 **(d)(ii)** 22.4

Question 7

This mensuration question was generally answered well although candidates had difficulty with some parts, especially **part (e)**.

(a) Many candidates lost marks here by not showing every required step. They had to show that angle *AOB* was 150° by subtracting 210° from 360°. They then needed to subtract 150° from 180° to find the sum of the other two angles in triangle *OAB* and finally to halve this since the two base angles of the isosceles triangle are equal. There were some alternative methods given and these gained credit as long as they showed an equivalent level of detail.

(b) A large number of candidates preferred to use the sine or cosine rules to find the length of *AB*, rather than the simpler method of dividing the isosceles triangle in half and using cos15 and then doubling the answer. Some, using the sine rule, did not show the explicit version and gave an answer of 15.4 which did not imply the second method step as the answer given is inaccurate. All candidates are advised to show every step of their working.

(c) Most candidates used the sine rule correctly to find this angle. However there were candidates who assumed that *AC* was a tangent to the circle, thus making angle *OAC* a right angle and giving angle *ABC* as 33°.

(d) Most candidates realised that they must find the areas of a sector of a circle and of two triangles. Many found the sector area correctly although some found only the area of a complete circle or of a semi-circle. The area of triangle *OAB* was most easily found using the two radii and the sine of the included angle of 150°, but many candidates chose to use the sides *OA* and *AB* with the included angle of 15°, or to find the vertical height of the triangle using trigonometry and use $\frac{1}{2}$ base x height. The area of triangle *ABC* was slightly more complicated, since candidates knew the lengths of two sides but not the included angle. This was easy to find using their answer to **part (c)** and most candidates showed this working clearly. Another alternative was to find the length of *BC,* again using the sine rule and to use this with side *AC* and the included angle of 72°. Again, most candidates using this method showed their working clearly. An incorrect method for the area of this triangle was to assume it to be isosceles and attempt to find its height. Candidates who approximated prematurely at various stages lost accuracy marks.

(e) This part was answered very poorly. Most candidates used the number 4 to either multiply or divide into the area found in **part (d)**. A few knew that they must use 4^2 but multiplied instead of dividing their area by 16. Correct answers were obtained very rarely by dividing all the dimensions of the shape by 4 and recalculating the entire area, and a needlessly complicated method used by a few was to find the square root of their area in **part (d)**, divide it by 4 and then square the answer.

Answers: **(b)** 15.5 **(c)** 29.5 **(d)** 194 **(e)** 12.1

Question 8

This functions question was found to be a little more challenging than in recent years.

(a) (i) This numerical compound function question was generally well answered. The most efficient method was to find g(1) first. Many candidates did this and then went on to find fg(1) correctly, although a few made an error with the sign of g(1). A large number of candidates, also usually with success, found the algebraic expression for fg(*x*) but this approach did lead to more errors either numerically or algebraically. Another misunderstanding was to treat fg(*x*) as f(*x*)g(*x*).

(ii) This was a straightforward compound function question and there were many correct answers seen. Some candidates did not simplify 5*x* + 7 – 3, others multiplied 5*x* + 7 by – 3, a few gave 5*x* + 7 – 3 as 5*x* – 4 and a few others had a correct answer but then cancelled the 4s. Some candidates changed the question into an equation and found a numerical answer.

(iii) This inverse function was more demanding than usual as there were three steps in the manipulation. The more able candidates succeeded comfortably whilst many could only reach a correct first step and then follow this with algebraic errors. A common error was to write *y*(*x* – 3) = 4 followed by *xy* = 4 + 3.

(iv) Only a few candidates appeared to be aware that $f^{-1}f(x) = x$. Most candidates found $f^{-1}(x)$ and went through the whole working for f(2) and then $f^{-1}(17)$. They reached the correct answer but doing a lot of working for 1 mark.

(b) (i) This 'show that' question was quite well answered with many candidates showing fully clear working with every necessary step without any errors or omissions. A few omitted the first line involving the brackets for removing the fraction, underestimating what is required in this type of question. There were a few careless slips seen and a few candidates omitted this part.

(ii) Almost all candidates were well prepared for this standard quadratic equation and many earned full marks. It is important that candidates show all the working for this type of question. Giving the correct answers will not necessarily score full marks as some marks are allocated for showing correct working. A number of candidates did not show parts of the formula correctly but gave correct final answers. The most common error in the formula was to write -8^2 and then not show, in some way, that this was $(-8)^2$. Some went straight to just $\frac{4 \pm \sqrt{141}}{5}$ without justification, which was not sufficient.

Answers: **(a)(i)** – 3 **(ii)** $\frac{4}{5x+4}$ **(iii)** $\frac{4+3x}{x}$ **(iv)** 2 **(b)(ii)** –1.57 and 3.17

Question 9

(a) Whilst a significant number of candidates did not read the question and found the gradient between the two points, most candidates applied Pythagoras' theorem correctly to find the distance between *A* and *B* by using $\sqrt{(4-(-2))^2+(13-(-5))^2}$. Some made errors with 4 –(– 2) and 13 –(– 5), others subtracted the two terms instead of adding, and others squared all the numbers individually. In addition the third mark was lost by candidates who gave the length as 18.9 instead of 19.0 correct to 3 significant figures.

(b) The equation of the straight line through the two given points was well answered. Almost all candidates demonstrated a correct method.

(c) The line parallel to the line in **part (b)** was also usually correctly found.

(d) The perpendicular bisector was much more challenging and this was a suitable discriminating question at the end of the paper. Many candidates needed more experience in finding a perpendicular gradient as well as combining this with the midpoint. A common answer was to find the gradient correctly but then to find the equation of the perpendicular through one of the two given points. This part was omitted by some candidates.

Answers: **(a)** 19 **(b)** $3x + 1$ **(c)** $y = 3x - 5$ **(d)** $y = -\frac{1}{3}x + \frac{13}{3}$

MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus. The accurate statement and application of formulae in varying situations is always required. Work should be clearly and concisely expressed with an appropriate level of accuracy.

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. Some candidates still confuse the equations of horizontal and vertical lines.

A significant number of candidates gave interim answers as well as final answers to only 2 significant figures. In some cases this proved to be very costly as 2 significant values are not taken to be evidence of correct method so candidates who did not show all the steps in their working lost some or all the method as well as the accuracy marks.

Comments on specific questions

Question 1

(a) (i) There were very few incorrect solutions seen to this question.

(ii) The majority of candidates preferred to give a decimal answer rather than the exact one. This resulted in some losing the mark for incorrect or inappropriate rounding to 16.6 or 17.

(b) Most candidates showed a clear and appropriate amount of working and gave the exact value of the answer. Others rounded the answer to three significant figures and so lost an accuracy mark. The errors seen were due to slips in the calculations rather than a lack of understanding. Candidates occasionally approximated $\frac{2}{3}$ as 0.667 or better but a significant minority used 0.666 or 0.66 for which they lost accuracy marks and/or method marks.

(c) The more able candidates were successful in this question. The main problem was the initial calculation to find the cost before the reduction as many confused the 30% and 20% and consequently divided by (or multiplied by) 0.8 and then multiplied by 0.7. Of the others, many were able to gain 2 marks for the second calculation followed through from their original price.

Answers: **(a)(i)** 36 600 **(ii)** $16\frac{2}{3}$ **(b)** 1 231 708 **(c)** 27.20

Question 2

(a) The algebraic processes were usually correct when working with either an equality or an inequality sign. A significant number of candidates who found the correct solution in the working then went to give $x = 2.4$ as the answer.

(b) (i) Many candidates did not know to pair the terms and find a common factor in each. By far the most common incorrect answer was xy − 3(6 − y + 2x).

(ii) Very able candidates gave the correct answer with no working whilst others partially factorised by either a pair of quadratic factors or merely taking out the common factor of 8.

(c) The initial step of either multiplying by *r* or dividing out the right hand side of the equation was usually attempted but less able candidates multiplied only the 5 by *r*. The less able candidates did not attempt to collect the terms in *r* together and consequently could earn no more marks. The final two marks were available only if the terms in *r* could be factorised.

Answers: **(a)** x > 2.4 **(b)(i)** (x + 3)(y – 6) **(ii)** 8(x – 3y)(x + 3y) **(c)** $r = \frac{1}{p+7}$

Question 3

(a) (i) There were very few errors seen in this part.

(ii) The only errors seen were the misreading of the horizontal scale and/or the omission of negative signs.

(iii) Less able candidates confused the equations of horizontal and vertical lines whilst others thought the tangents were inclined to the axes.

(b) (i) It was extremely rare to see an incorrect value in the table.

(ii) The points were invariably plotted accurately and there were few graphs without smooth curves. The most common errors were to join the two branches or continue one or both branches to reach the *y*-axis. Occasionally candidates did not join their curve to the plotted point (–0.5, –1).

(c) Despite having worked out f(–2) in **part (a)(i)** some candidates did not use it here. Others merely found g(–2) and some made slips with the calculation of $\frac{2}{10}+3$.

(d) The more able candidates read the value from the graph or the table in **part (b)(i)**. Others tried to find the inverse function which wasn't often successful due to slips in the algebraic steps.

Answers: **(a)(i)** 10 **(ii)** –3.4 to –3.3, –0.4 to –0.3, 1.6 to 1.7 **(iii)** *y* = –2.3 to –2.1, *y* = 10 to 10.1
(b)(i) 2, –1, 4 **(iii)** –3.4 to –3.2, 1.8 to 1.9 **(c)** 3.2 **(d)** 1

Question 4

(a) (i) The most common error was to double 0.05 instead of squaring it.

(ii) Many candidates did not realise that the efficient method was to subtract their answer to **part (a)(i)** from 1. Many who started again omitted at least one of the possibilities or merely subtracted 0.05 from 1.

(b) Most candidates considered only one of the four possibilities and evaluated 0.05 × 0.95 × 0.95 × 0.95 to earn partial credit. Only the most able candidates gave the correct solution.

(c) This question about the calculation of an estimated mean was well answered by all but a very small minority of candidates. Occasional slips in the calculations were seen and a few candidates used the interval widths instead of the mid-values.

(d) (i) This question was often well answered with only a few giving a non-integer value or 32 from multiplying the height of 0.16 by the total number of cars instead of by the width of the block.

(ii) Little working was shown in many cases so it was difficult to award any part marks or to see how the answer was obtained. Only the most able candidates gave the correct solution.

Answers: **(a)(i)** 0.0025 **(ii)** 0.9975 **(b)** 0.171 **(c)** 376 **(d)(i)** 16 **(ii)** 33.

Question 5

(a) (i) Some candidates seemed to be unfamiliar with bearings as many did not appreciate that the answer here should be greater than 270°. The marking of appropriate angles on the diagram was rarely seen. Many candidates stopped after 40 + 45 = 85 or 180 – 40 – 45 = 95.

(ii) The correct answer of 095 was seen by only the most able candidates.

(b) Most candidates correctly applied the cosine rule but some did not give enough accuracy in the working to justify the answer rounded to 464.7. A small number of candidates drew the perpendicular from *A* onto *BC* and used Pythagoras' theorem in the two right-angled triangles and if enough accuracy was maintained throughout the working, their solution was correct. Some candidates used the sine rule to find angle *BAC* first but did not consider the possibility that it was an obtuse angle and consequently their final answer for *AB* was inaccurate.

(c) Most candidates applied the sine rule correctly but again the accuracy in the working became an issue for many as premature rounding led to answers of 44.8° or 45°.

Answers: **(a)(i)** 275 **(ii)** 095 **(c)** 44.9

Question 6

(a) (i) This question was usually answered correctly. The only error seen was the reflection in the *x*-axis.

(ii) This question was often answered correctly. Some candidates did not use the correct centre for the rotation.

(iii) This question was often answered correctly. The elements in the vector were occasionally reversed and many candidates described the movement rather than use the vector form.

(iv) The most common correct property of the enlargement was the centre at (2, 1). It was fairly common to see two transformations of an enlargement and a rotation rather than the single transformation as required. The scale factor was often given as 2, –2, or $\frac{1}{2}$.

(b) (i) All possible combinations of the numbers 1, –1 and zeros were seen in a 2 by 2 matrix. Few candidates checked their answer by using the points from the graph. Some gave a matrix of the co-ordinates as the solution.

(ii) Many candidates realised that the transformation was a reflection but few associated the inverse matrix with the inverse of the transformation in **part (a)(i)**. Some who did realise the association stated 'there is no change' instead of repeating the transformation from **part (a)(i)**.

Answers: **(a)(iii)** Translation by $\begin{pmatrix} 1 \\ 9 \end{pmatrix}$ **(iv)** Enlargement, scale factor $-\frac{1}{2}$, centre (2, 1)

(b)(i) $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ **(ii)** Reflection in $x = 0$.

Question 7

(a) (i) Most candidates realised that the times taken were $\frac{10}{x}$ and $\frac{12}{x-1}$ but then associated these with 30 instead of 0.5 as the units of time were not considered. Those who did have the correct initial equation invariably went on to derive the required one.

(ii) The majority of candidates knew the formula for solving the quadratic equation, although some wrote -5^2 instead of $(-5)^2$ and never resolved this term in the working. The two solutions were nearly always correct but very occasionally not given to the required accuracy.

(iii) This part proved to be a little more challenging and only the most able candidates were able to score full marks. The requirement to use $\frac{12}{x-1}$ was usually recognised, with *x* as the positive root from **part (ii)** but converting to the nearest minute was not always accurate as sometimes premature approximation led to 48, not 49 minutes as part of the answer. Sometimes 1.81 hours became the equivalent of 1 hour 81 minutes. Some candidates did not read the question carefully as they left their answer as 1 hour 48.76 minutes.

(b) (i) This question was usually answered correctly.

(ii) There were many correct answers to this question. Occasionally a mark was lost for approximating the exact answer to three significant figures.

Answers: **(a)(ii)** –2.62, 7.62 **(iii)** 1 hour 49 minutes **(b)(i)** 2.5 **(ii)** 1312.5

Question 8

In general this question was not well answered as many candidates were unable to multiply two matrices accurately, often giving answers which were the wrong shape.

(a) (i) Most candidates realised that (2 by 2) × (3 by 2) was not possible.

(ii) Several candidates thought that 2**A** was the same as $\mathbf{A}^2$ and wrote that this was also impossible. There were many instances where –4 in the matrix was misread as 4.

(iii) The product of a (2 by 1) and a (1 by 2) matrix should give a (2 by 2) answer but there were many answers of (14 –20), or the same numbers in a column matrix were seen.

(iv) Again **DC** was rarely found correctly although more realised that the numbers 14 and –20 were involved in the answer which was often given as (14 –20) or even as just –6.

(v) Many thought that $\mathbf{B}^2$ was obtained by squaring each of its elements. Of those who attempted to evaluate the correct product, some made an error with the sign of at least one term in the answer.

(b) This question was answered much more successfully as candidates knew which terms changed sign and which changed position after $\frac{1}{8}$ was found.

Answers: **(a)(i)** Not possible **(ii)** $\begin{pmatrix} 4 & 0 \\ -2 & 10 \\ 6 & -8 \end{pmatrix}$ **(iii)** $\begin{pmatrix} 14 & 35 \\ -8 & -20 \end{pmatrix}$ **(iv)** (– 6) **(v)** $\begin{pmatrix} -2 & 18 \\ -6 & 22 \end{pmatrix}$ **(b)** $\frac{1}{8}\begin{pmatrix} 5 & -3 \\ 1 & 1 \end{pmatrix}$

Question 9

(a) This question was usually well answered as most candidates realised the need to find $\frac{215}{360}$ of the area of the circle.

(b) Only the most able candidates scored well in this question. Many used the height and/or the radius of the cone as 12 cm. The most able candidates realised that the arc length in **part (a)** became the circumference of the base of the cone and hence were able to find its radius. Several stopped there, using the height as 12 cm. However some then went on to correctly use Pythagoras' theorem to find the height but many approximated to 3 significant figures too soon and consequently reached an inaccurate answer for the volume.

Answers: **(a)** 270 **(b)** 518

Question 10

(a) The most common error in this question was to assume that the third row of the table was obtained by the addition of 3 to give 9 and 12 as the answers.

(b) (i) The vast majority of candidates substituted n = 1 into the expression but some did not equate this to 8, the number of 1 unit lengths in the table.

(ii) This mark was earned by most candidates either for the correct value or follow through from their answer to **part (b)(i)**.

(c) Several differing approaches were used. The most common method was to use simultaneous equations which were often concisely solved. The method of differences of the terms was also reasonably popular and a = $\frac{1}{2}$ was easily found but some candidates used an incorrect equation to find b. The very able candidates added the formulae for the nth terms for the number of equilateral triangles and the nth term for the number of rhombus shaped tiles and compared this with the given expression to find the values of a and b.

(d) (i) Many candidates did not carefully read the question as the most common error was to multiply the correct answer by 4 to give the number of glass tiles on all four faces of the pyramid. Some candidates who made errors in **part (c)** started again and followed the pattern to find the correct answer.

(ii) The common errors were to merely subtract 11 from the answer to **part (d)(i)** or to subtract 11 before multiplying by 4 which assumed there was an entrance in each face.

Answers: **(a)** $\begin{matrix}10 & 15\\ 15 & 21\\ 35 & 48\end{matrix}$ **(b)(i)** 3 **(ii)** 143 **(c)** $a = \frac{1}{2}$, $b = \frac{3}{2}$ **(d)(i)** 171 **(ii)** 673