MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key Message

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

General comments

Many candidates made a good attempt at answering this paper. As in previous years, this paper was fairly straightforward with many part questions worth only 1 mark. With those parts that carried more marks, workings needed to be shown in order to access the method marks if the final answer given was incorrect. Along with this request for workings to be shown, candidates must check their work for sense and accuracy. Candidates must take notice that, if a question asks for the answer to a fraction calculation as a mixed number then a vulgar fraction is not correct. On this paper there were two questions that had answers as sums of money. Money should be given to the nearest cent if not a whole dollar amount. Candidates should be made aware of what kind of answer needs to be rounded and which should be left unrounded, for example 87.5% (**Question 1**) and 2.25 (**Question 8**) should be left unrounded as they are exact values. The answer to **Question 10** should be given as 23.2(cm) not as 23 as many did. The number from the calculator in **Question 4**, 495.3648008…, is not exact so needs rounding. Moreover, as this is money it should be rounded to 495.36 (euros)

The questions that presented least difficulty were 2**(a)**, 5, 8, 9**(a)**, 17**(a)** and 18**(c)**. The questions that proved to be the most difficult were 3, 6, 7**(a)**, 9**(b)**, 18**(a)**, 20**(b)** and 20**(c)**.

The greatest number of part questions that were left blank were all in **Question 20**. Time does not appear to have been an issue over the whole paper as blank responses were scattered, in much lower numbers throughout the paper. These blank responses point to areas of the syllabus where candidates have difficulty. Apart from **Question 20**, the part questions over the whole paper that were the most often omitted were 9**(b)**, 15**(b)**, 17**(c)** and 18**(a)**.

Comments on specific questions

Question 1

Often candidates who found the required 87.5% rounded this to 87% or 88%. A common wrong answer was 80.64 from the erroneous calculation $\frac{84\times96}{100}$. Also seen were 0.875 (the decimal form) and 84 (from the question).

Answer: 87.5

Question 2

The occasional answer of ‘equal triangle’ was not given credit. The number of lines of symmetry was given as 1 or 2 with the majority of candidates giving the correct answer of 3 lines. Some candidates matched their answer to **part (a)** of isosceles with 1 line of symmetry but this was not awarded credit as the question stated the triangle had 3 equal sides.

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

Question 3

This time calculation was poorly done with some candidates using 100 minutes in an hour. Others subtracted the figures in the question, 1827 – 319, giving 1508 as their answer. Another wrong method was to say 24 – 18.37 + 3.19 = 8.92. Many who used the correct process to solve this question ended up with 9 hours and various minutes rather than 8 hours and 52 minutes. Sometimes candidates split the time period into many sections rather than the time before midnight and the time after midnight. A step on from finding the number of hours was the conversion to minutes. Sometimes candidates just wrote 852; whether this was meant to be the number of hours and minutes or another use of 100 minutes to an hour was not clear.

Answer: 532

Question 4

This exchange calculation was of the more complex sort where the sum to be converted is divided by the exchange rate. Candidates should stop to reflect whether the answer should be lower or higher than the original number. Gregor has handed over more than 1 dollar to get 1 euro so the $700 must be divided by the exchange rate and this exchange rate should be used exactly as it is given in the paper with no rounding. Answers to money calculations such as this where the euro (or dollar) figure is not exact should be given to the nearest cent (or hundredth part of a whole for other currencies).

Answer: 495.36

Question 5

In common with previous sessions, some candidates found directed numbers challenging. Candidates gained some credit for substitution into the expression or for finding one of the two terms. It was common for candidates to give 6 – 15 = –9 as their answer. Also, –21 was another common final answer.

Answer: 21

Question 6

This was poorly done by some candidates with answers such as ($)8.35, a cost rather than an algebraic expression. Some did not change the bracelet cost from cents and gave $7.5n + 85b$ as their answer. A small number swapped the costs over giving $7.5b + 0.85n$.

Answer: $7.5n + 0.85b$

Question 7

The correct answer, 'Rhombus' was generally not known. In common with **Question 2**, candidates limited themselves to names of shapes with four sides with some simply reiterating the word quadrilateral from the question. Some 3D shape names were seen. Far more candidates got part **(b)** correct than part **(a)**.

Answers: **(a)** Rhombus **(b)** 131

Question 8

This algebra was generally well done but when candidates got to the answer of 2.25 they then proceeded to round this to 2 or 2.3. It is not correct to round this type of answer that terminates as stated before in the general comments.

Answer: 2.25 or equivalent

Question 9

This question called for knowledge from two sections of the syllabus and candidates found that part **(a)** presented almost the least difficulty on the paper while part **(b)** presented the most. The directed numbers caused some problems for a few with 6 being a common wrong answer from 18 – 12. Finding the upper and lower bounds is often a concern for candidates. The lower bound, 17.5, or 18.4, a value heading towards the upper bound, 20 or both bounds were seen as alternative wrong answers.

Answers: **(a)** 30 **(b)** 18.5

Question 10

Candidates did well here and many got both marks. Some rounded their answer to 23 (cm). Occasionally candidates used the wrong trigonometric ratio of cosine instead of sine.

Answer: 23.2

Question 11

Part **(a)** was generally well answered. The common errors were to miss out a factor, most often it was 1 or 15, or to show 1 x 15 and 3 x 5. This was not a list of factors so it did not get any marks. Sometimes a list of multiples was given but this was not common. Part **(b)** was not so well done as part **(a)** as the difficulty had been stepped up. About half of all candidates got this correct but some tried to combine the correct answer into one term giving $39p^2t$ (from 3 x (5 + 8)) or using the question to get $249pt$ (from $15^2 + 24$) as their answer. Very few candidates only got as far as taking out one factor.

Answers: **(a)** 1, 3, 5, 15 **(b)** $3p(5p + 8t)$

Question 12

This question combined construction with applying a scale. Most candidates dealt well with the scale part of the question but many were reluctant to use compasses to draw the triangle. Some candidates reversed the triangle so *AC* was 25 m instead of 35 m. Point *C* sometimes seemed to be found by trial and error using a ruler and protractor with a few candidates adding poorly drawn arcs. Constructions such as this one, and that in **Question 20**, must be drawn showing all construction lines and arcs.

Answer: Triangle drawn correctly with ruler and arcs

Question 13

This was a simple interest question but some candidates treated it as compound interest which did not gain any marks. The interest after 5 years had to be calculated then added on to the principal of ($)750. This answer was exact at ($)843.75 and as such should have been left unrounded. Many candidates calculated the interest as ($)9375, failing to divide by 100 and then did no more. Some used the interest percentage as 25% rather then 2.5%.

Answer: ($)843.75

Question 14

This was mostly done well by candidates, but the final instruction to give the answer as a mixed number in its simplest form was not always carried out. Most candidates worked in sixtieths rather than thirtieths but either was acceptable. It did not matter whether candidates included the 1 from the start or added it in at the end when they converted to a mixed number. This fraction question appeared better done that those in previous sessions. Candidates that did not show all the steps lost marks. Candidates should be reminded that in questions where the paper says, ‘without using a calculator’, an answer without workings scores zero marks. Zero marks were also awarded to those candidates who did the whole calculation in decimals and turned that back into fractions at the end.

Answer: $2\frac{11}{15}$

Question 15

Part (a) was the best done of the three parts. Here, the wrong answers of 39° or 129° were occasionally seen. In **part (b)**, candidates were put off by the angle of 63° in the triangle when all that was needed was the fact the angle in a semicircle is 90° regardless of the other two angles. Incorrect answers included 117° and 63°. Quite a few candidates left this part blank. With **part (c)**, candidates did well but a few gave 132° (the sum of the base angles) or 84° (from thinking that the equal angles were 48°).

Answers: **(a)** 51 **(b)** 90 **(c)** 66

Question 16

There were many correct responses to this question with just under half of all candidates getting full marks showing their confidence with the topic and methods of solving simultaneous equations. Many candidates used the substitution method which can lead to sign errors which were penalised. However, some produced a value for x or y that was not a simple number but still went on to the end of their method. This is one situation where candidates can check their work (by the method of substituting their values into both equations) and then try to go through their working again.

Answers: (x =) –7 (y =) 9

Question 17

Part **(a)** was one of the best answered questions on the paper but occasionally reversed co-ordinates were seen. Part **(b)** had many sign errors and reversed components. Some tried to give a 2x2 matrix made up of the co-ordinates for A and B. Errors in understanding column vectors fed into part **(c)** but more got this correct than part **(b)**.

Answers: **(a)** (–1, 2) **(b)** $\begin{pmatrix} 4 \\ -5 \end{pmatrix}$ **(c)** (1, 5)

Question 18

Part **(a)** was quite poorly done with many candidates writing answers such as 33 or 326.41 (mixing up significant figures with decimal places). Answers such as 330.000 are incorrect – the trailing zeros are saying there are 6 significant figures in the number.

Parts **(b)** and **(c)** were better done than part **(a)**. With part **(b)**, the problem was to decide how many zeros in one million and most incorrect answers of 316 or 316.2 implied that the starting number was 100,000, a factor of 10 out. For part **(c)**, candidates had to realise that the best method to proceed was to work out the numerator and denominator separately without any rounding, then do the division. When done correctly, this resulted in an exact, 3 significant figure answer, so there is need to round. If candidates input the calculation without considering BIDMS the result is 62.08557…, pressing = after 7.465 but before dividing gives 10.15096…

Answers: **(a)** 330 **(b)** 1000 **(c)** 46.3

Question 19

Most candidates were correct with this simplification, although some candidates reduced it further to a single term. Quite a number of candidates gave the simplification of the terms involving q, as $10q$ or $+ - 4q$.

Part **(b)** was generally well done but errors in the signs led to $\frac{y-g}{2}$ or $\frac{y+g}{2}$.

Answers: **(a)** $9p - 4q$ **(b)** $\frac{g-y}{2}$

Question 20

This question was generally not well answered by candidates. Compasses were often not used to draw the perpendicular bisector and often arcs were added afterwards. There were however some very good bisectors drawn. Many circles were incomplete and again drawn without compasses. Some circles had the wrong radius. Part **(c)** depended on the two previous parts to set up the correct area. Even when the diagrams had the correct area it was not shaded completely, for example, shading only above the line *AB*.

Question 21

For part **(a)**, a common wrong answer was 16 (from 29 – 13). Sometimes the mean 19.2 or 19 were given here or in part **(b)**. Candidates were more successful with part **(b)** showing evidence of ordering. Difficulties finding the midpoint lead to 18 or 19 as answers. Only using one of each value led to a median of 20 being chosen. Part **(c)** was a change of syllabus area to find a number that is not a prime. 29 and 31 were the most common wrong answers.

Answers: **(a)(i)** 18 **(ii)** 17 **(b)** 21

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key Message

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

General comments

Even though some 'no responses' were evident, it was felt that all questions were able to be tackled by candidates who were familiar with all topics in the syllabus. There were questions which required more interpretation than basic knowledge and although these were not well done overall, many candidates managed to gain at least some of the credit available. Questions at the end of the paper were left out by some candidates, but it was not felt that this was due to a lack of time to complete the paper.

Presentation of work was again quite good but clarity of figures and words is of utmost importance in order that the Examiners can clearly follow the intended solution. In particular, quite a lot of candidates are working in pencil and over-writing in ink. This often produces very difficult to understand scripts and particularly when the candidate has over-written with a different value from that in pencil. A very adequate amount of working space is provided, even for a corrected solution. If a candidate wishes to cancel some working, one line through it and then the separate intended solution made clear is the ideal way to communicate to the Examiner.

Although equipment was generally seen to be used, there were cases of candidates not having (or using) a ruler and protractor, both essential for certain questions on the paper. Some candidates need to use their calculator correctly, particularly on complex arithmetic calculations when order of operations needs to be observed. Correct use of the trigonometry functions was also lacking at times.

For questions with a context, it was common to see unreasonable answers for the situation and candidates should look at the question again once their answer has been found to see if it is reasonable.

Working shown for questions with more than 1 mark is getting better but is still lacking from a significant number of candidates.

Once again, many cases were seen of over-approximating values. Inexact answers should be given to 3 (or more) significant figures and angles to 1 decimal place. For any working leading to an answer, more than 3 figures or the value on the calculator will ensure that accuracy is not lost in the final answer.

Comments on specific questions

Question 1

Most candidates were successful on this calculator question. A common error was $48 \div 19.1 - (3.5 \times 4.6)$ to give -13.5. Also seen a number of times was the denominator worked as $(19.1 - 3.5) \times 4.6$.

Answer. 16

Question 2

The question was done well with most candidates realising that the decimal equivalents were needed for the fractions. However, errors were made by quite a number due to only giving 2 decimal places which meant that for instance the first two items appeared to be equal. A few lost credit for putting them in the reverse order.

Answer. 82% < $\frac{23}{28}$ < 0.83 < $\frac{5}{6}$

Question 3

It was common to see Thursday, as well as the number, 1 or next day, rather than the correct day of the week. The time was poorly done with many incorrect answers, or putting letters or words between the hours and minutes or after the minutes. 10 15 was common but only gained credit with pm present. Few candidates took the step of subtracting 24 hours to work out the time of arrival.

Answer. Wednesday 22 15 or 10 15 pm

Question 4

Many candidates were confused by this question and several of the letters were offered in both parts. While the inclusion of 'O' in one or both parts was not correct, it was not penalised. Part **(a)** was better done than part **(b)**, but 'N' was often included. Many candidates in that part only gave 'O' due possibly to confusion about the 'I'. Rotational symmetry was clearly not generally understood with the main fault 'I' being missed. It seemed that some candidates felt there had to be just one letter for each part.

Answers: **(a)** I **(b)** I N

Question 5

Part **(a)** was not well done to a large extent due to many candidates giving −1.9. Candidates must pay attention to the wording which was 'how many degrees higher' indicating that a negative answer was incorrect. This was probably also due to regarding −4.6 as a higher temperature than −2.7. Otherwise, 2.1 was a common incorrect answer. The average of the temperatures, 11.5 was also seen at times. Part **(b)** again was not well done with 25.8 – 4.6 = 21.2 being common. Also seen was 25.8 and −2.2, resulting in 28. Those candidates who identified the correct values often did not work out 25.8 −(−4.6) correctly.

Answers: **(a)** 1.9 **(b)** 30.4

Question 6

This question was quite well done by candidates. A 2 × 2 matrix was often given as an answer. As in **Question 5**, manipulation of negative numbers presented problems for quite a number of candidates.

Answer. $\begin{pmatrix} 13 \\ -2 \end{pmatrix}$

Question 7

This was quite well done by candidates, even though it was an unfamiliar style of the fractions question. A minority of candidates ignored the instruction about showing their working which resulted in no credit being awarded. Some who worked the question correctly gave the answer with the denominator 12 and lost credit, whilst the whole number was missed at times resulting in an answer of 13.

Answer. (p =) 25

Question 8

Changing between square units is a very demanding topic at core level and consequently few candidates gained full credit. Partial credit from seeing the figure 64 in the answer was often gained. A few candidates obtained 63 800 but then did not round to 2 significant figures.

Answer. 64 000

Question 9

Both parts of this question were done well showing that the rules for indices were well known by candidates. Only a small number gave just 5 in part **(a)** and there were some who gave an index of −24.

In part **(b)**, 25, −25 and $\frac{1}{5^2}$ were the most common wrong answers.

Answers: **(a)** a^5 **(b)** 0.04 or $\frac{1}{25}$

Question 10

The question on bounds was more accessible this year and consequently there were a higher percentage of correct solutions. 12 500 and 12 700 were common wrong answers while some candidates ignored the accuracy statement, giving answers to the nearest integer or 10. Reversed answers were again seen and still there was a significant number of candidates who gave the upper bound as 12 649.

Answer. $12\,550 \le n < 12\,650$

Question 11

The vast majority of candidates worked out part **(a)** correctly but then many decided to round what was an exact answer. Only a few divided instead of multiplying.

In part **(b)** many candidates ignored the instruction to put their answer into standard form and again rounding lost credit. Often standard form was incorrectly done with negative indices, usually −5, or numbers such as 10 and 109 instead of 1 in front of the decimal point.

Answers: **(a)** 109 681 **(b)** 1.09681×10^5

Question 12

Many errors were made on finding the perimeter of the rectangle, usually 48 (the area) or 14 (half the perimeter). The second step saw many candidates using the formula for the area of a circle rather than the circumference. Of those who did the first steps correctly, it was common to see an answer of 4.45 from truncating or using π as $\frac{22}{7}$, an unacceptable form.

Answer. (r =) 4.46 or 4.456 to 4.459

Question 13

Both parts of this question were done well by candidates, although **(b)** was better than **(a)**.

In part **(a)**, some combined a correct answer to a single term or used y^2 as the common factor.

In part **(b)**, a few candidates did 12 – 7 as the first step and 4.8 was seen without the correct answer a number of times.

Answers: **(a)** $y(x - y)$ or $y(-y + x)$ **(b)** (x =) 4.75

Question 14

Having a question on the understanding of correlation rather than recognising a type from a scatter graph was found to be very challenging for candidates. Some did not know the terms for types of correlation and many did not attempt the question. Those who did make progress almost always got **(a)** correct but most had negative for part **(b)** and positive or none for part **(c)**.

Answers: **(a)** Positive **(b)** Zero **(c)** Negative

Question 15

Most candidates got part **(a)** correct but there was a significant minority who gave trapezium, diamond or rhombus.

The area was not well done with 28 being a common response. The units were often omitted and two numerical answers were seen in the answer space. Whilst many did understand area units there was quite a variety of other ideas.

Answers: **(a)** Kite **(b)** 14 cm^2

Question 16

This question was well done but some candidates tried to measure the given angles, usually leading to inaccurate values for blue shirts. The angles in part **(b)** were usually measured correctly, even when part **(a)** was missing or incorrect.

Answers: **(a)** 126°

Question 17

Simultaneous equations are one of the more demanding topics at core level but there was an improvement seen this time. Most candidates attempted the elimination method but errors were often made in the multiplication of terms or by not multiplying all of them. The problem of manipulating negative numbers again caused problems. Those using the substitution method were nearly always unsuccessful. Those who did gain the method credit nearly always went on to a fully correct solution.

Answers: (x =) 2 (y =) 5

Question 18

Many candidates did not correctly understand what was required in part **(a)** of the question. Subtracting 3 from 9 was not often seen as the first step and even if it was, not all then divided by 0.4. Consequently answers of 22.5, 3.6 and 7.5 amongst others were often seen. Candidates should consider the context of the question and realise in this case that the fare indicated quite a significant number of kilometres travelled.

In part **(b)**, the context and wording should have indicated an answer of a fare greater than the daytime one of $9. Whilst many found 30% of 9 (2.7) it should have been clear this could not be the final answer. Others tried to increase 0.40 by 30% and add it to 3 or increased 3 by 30%.

Answers: **(a)** 15 **(b)** ($) 11.7(0)

Question 19

This was quite well done but a significant number of candidates did not know the two right angle properties associated with the circle tested in the question.

In part **(a)**, many thought that angle *ACB* was also 58° and gave an answer of 64°. Whilst diagrams are intentionally not accurately drawn, the angles are close to their correct value. Consequently the common answer of 122° had to be wrong. Quite a number of candidates could not interpret angles given with 3 letters, a vital part of knowledge required in order to answer these questions. The common error in part **(b)** was to regard the triangle as isosceles. This resulted in an angle of 74° or 58° from an incorrect 64° for *x*. Correct answers from wrong working did not gain credit.

Answers: **(a)** (x =) 32° **(b)** (y =) 58°

Question 20

The question was not well done by many candidates as it required a proof, rather than simply finding the third side of a right angled triangle. Those choosing the method of Pythagoras almost always gained at least partial credit. Many however, did not make statements that both 34^2 and $16^2 + 30^2$ were equal to 1156. For an angle solution, both angles at *A* and *C* had to be calculated. Also, all 3 sides had to be used in the two calculations before giving a clear statement that they added to 90 and hence the angle at *B* was 90° to complete the triangle angles.

Part **(b)** was done much better by candidates and the main error was in relating the chosen ratio to the correct sides. This often resulted in the wrong angle being found. Many rounded to a whole number but most gained credit from their result in the working. Candidates should be reminded that angles, if not exact, should be given to 1 decimal place.

Answers: **(b)** 61.9°

Question 21

There were a number of possibilities for the proof of this result, but a common incorrect solution was 540 ÷ 5 = 108, then 108 × 5 = 540. As this was a regular pentagon, the exterior angle solution was expected but done by relatively few candidates. When a formula method was used, it was essential to show the algebraic formula as a first step before the substitution of values. The triangle method needed an explanation or a sketch showing 3 triangles. A quadrilateral plus a triangle given by some candidates was not acceptable. However, many did give a full and correct solution.

In part **(b)**, wrong working was often evident in finding 135° for angle *y* with a split into 90° and 45°, which was penalised. A common error for angle *x* was 76°, whilst many took 360° to be the sum of the angles. Another error seen was regarding *x* and *y* as supplementary angles.

Answers: **(a)** 360 ÷ 5 = 72, then 5 × (180 – 72) = 540 **(b)** (x =) 104 (y =) 135

MATHEMATICS

Paper 0580/13

Paper 13 (Core)

Key Message

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

General comments

Many candidates were able to access most of the questions.

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

General errors were made on conversions of units, vectors and geometric reasoning. There was also some confusion between area and perimeter. Careful reading of what the questions asked was not always evident and candidates should ensure they check they give sensible answers. For example **Question 6** asked for 2% simple interest on $750 over 8 years and some candidates gave answers which were more than the amount invested.

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

Comments on specific questions

Question 1

Most responses were correct, the common incorrect answers being 4 or 0.4.

Answer: 40

Question 2

Candidates struggled with this question in which the unit change involved square units. 520 was the common incorrect answer but other 52's with varying incorrect amounts of zeros occurred frequently.

Answer: 52 000

Question 3

This was well answered with very few candidates attempting a division. A few rounded the exact value and a small minority inserted a decimal point in the wrong place.

Answer: 11 109

Question 4

(a) Many correct answers were seen, although the majority gave an incorrect answer. The common incorrect answers were 49 and 51.

(b) This part was mainly correctly answered.

Answer: **(a)** 53 **(b)** 64

Question 5

(a) This was mainly correctly answered. The most common error was >.

(b) The majority of answers were correct.

Answer: **(a)** < **(b)** =

Question 6

Many correct answers were seen. Some confusion with compound interest was seen but only in a few cases. Some candidates found the amount, rather than the interest.

Answer: 120

Question 7

A lot of correct responses were seen. Some candidates calculated 85°, but left this as their answer. 98° was a common incorrect answer from 180 – 82.

Answer: 95

Question 8

(a) Nearly all candidates who attempted this got it correct but a few of the usual sign errors were seen, with -1 being a common answer for the bottom number. Some candidates did not attempt to start this question.

(b) Again, those who attempted the question were generally correct.

Answer: **(a)** $\begin{pmatrix} -1 \\ 5 \end{pmatrix}$ **(b)** $\begin{pmatrix} 15 \\ -20 \end{pmatrix}$

Question 9

(a) A standard result which the majority of candidates got. Common errors were responses of *a* and 0.

(b) Again this part was very well answered although a few indices of 8 and -15 were seen.

Answer: **(a)** 1 **(b)** b^{-2}

Question 10

Several candidates scored full marks but quite a few were confused with the various stages in this question. Many candidates gained 1 mark, almost always for $39.50, but then didn't subtract 8 before dividing by 4.5.

Answer: 7

Question 11

(a) Mainly correct answers were seen to this part. Common incorrect answers were triangle, equilateral, and pyramid. Some candidates gave numerical answers and a few did not attempt this question.

(b) This part was mainly correctly answered. Common incorrect answers were 32 and 128.

(c) Some candidates gained the mark for 'Z' angle but very few gave the word 'alternate'. Many candidates referred to the parallel lines or the isosceles triangle which seemed to detract from the property involved.

Answer: **(a)** Isosceles **(b)** 64 **(c)** Alternate (angle)

Question 12

With all positive terms, this simultaneous equations question was a straightforward one that most candidates got correct. There were only a few arithmetic errors in elimination so nearly all on that method gained 3 marks. Those who attempted substitution very often made errors. Some less able candidates added or subtracted the two equations without finding a common coefficient; others appeared to write 2 random numbers on the answer line without any working.

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

Question 13

(a) Those candidates who knew standard form nearly always got this correct, although some gave the incorrect index with 6.4.

(b) A lot of all-figure answers were given, which was fine, and nearly all gained at least 1 mark for 1.4×10^k. Converting to the correct standard form caused problems for several candidates.

Answer: **(a)** 6.4×10^{-4} **(b)** 1.4×10^{3}

Question 14

(a) This was mainly correctly answered.

(b) This was often given correctly. Some gave 3 or 4 or 3 to 4 after putting them in order and a few confused this with the mean.

(c) This was mostly correctly answered. A few candidates gave 1 to 8. Others again confused this with the mean and median.

Answer: **(a)** 3 **(b)** 3.5 **(c)** 7

Question 15

(a) This was a straightforward fractions question and most candidates were successful. A few did not show working and were not awarded any marks as it clearly stated "show all the steps of your working". Some less able candidates subtracted the numbers without a common denominator, leading to the answer $\frac{10}{9}$.

(b) Again many fully correct answers were seen. Some inverted the $\frac{1}{4}$, others found a common denominator, often 52. Only a small number of candidates made arithmetical errors or tried to convert to decimals.

Answer: **(a)** $\frac{7}{12}$ **(b)** $\frac{13}{44}$

Question 16

(a) Many correct answers were seen. The most common errors were to subtract 15 from 21 and then give the answer 1.2, or not to multiply the 3 in the brackets, giving $5x - 3 = 21$.

(b) This part was less well answered than part **(a)** but only a few candidates were completely confused by this topic. Occasionally $\frac{y-2}{3}$ was seen.

Answer: **(a)** 7.2 **(b)** $x = \frac{y+2}{3}$

Question 17

(a) Overall, candidates found this question challenging. Some confused area and perimeter. Some only added the six given lengths to give an answer of 98. Very few found the missing length of 10 with a variety of values given, 4 and 12 being the most common.

(b) Few candidates used a subtraction method for area. Division into areas limited the marks due to errors in the missing lengths. Some candidates multiplied all the numbers together and gave the answer 6345216. Had candidates worked out the area of the complete rectangle first, they would have realised the answer had to be less than 612.

Answer: **(a)** 112 **(b)** 564

Question 18

(a) This was mainly correctly answered, with 41 being the common incorrect answer.

(b) Again this was mainly answered well, with only 1 mark awarded in a small number of cases. Some less able candidates did not understand the question and produced a 1-term answer.

Answer: **(a)** 71 **(b)** $3v(u + 3w)$

Question 19

(a) Many candidates found this part challenging. Although quite a few indicated the required angle they could not find it from the information on the diagram. Some did score 1 mark for correctly identifying angle *BCA* as 28°. Several candidates had worked out 180 – 28 and given 152 as the answer; others gave the answer as 28. Some measured the angle, despite the fact the diagram stated 'not to scale'

(b) Most candidates knew straightforward Pythagoras and so did well on this part. There were just a few subtractions of squares seen and occasionally trigonometry was attempted, which was usually unsuccessful.

Answer: **(a)** 332 **(b)** 78.4

Question 20

(a) Mostly correct answers were seen but some candidates made an error in subtracting 0.85 from 1, with 99.15 being given as an answer. Some gave answers which resulted in the sum of probabilities being greater than 1.

(b) (i) Many candidates calculated the relative frequencies correctly. Some did not understand the term 'relative frequency'.

(ii) Many candidates did not realise they had to use 0.16 and some used the frequency of 20 with the 800 for their attempt.

Answer: **(a)** 0.15 **(b)(i)** 0.12, 0.28, 0.44 **(ii)** 128

MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key Message

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

General comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates are showing evidence of good work in trigonometry, working with the mean and simultaneous equations. Candidates particularly struggled this year with map ratios (particularly the area conversions), rearranging formulae and probability.

Not showing clear working and in some cases any working was occasionally a problem although this was less of an issue this year than in previous years. Giving answers to an incorrect degree of accuracy remains an issue with some candidates. The instructions to candidates on the front of the exam paper is to round to 3 significant figures when the answer is not exact. In many cases exact answers were unnecessarily rounded to 3 significant figures. This was particularly evident in **Questions 1**, **7** and **10**. Premature rounding part way through calculations was less of a problem this year although still evident.

Candidates should check their answers are sensible. In particular in **Questions 10** and **15** there were a number of numerical answers that made no sense in the given context.

Comments on specific questions

Question 1

Part **(a)** was a well answered question by the majority of the candidates. The most common incorrect answers arose from candidates rounding the exact answer of 9486000 to 9490000 or 9500000 or an incorrect number of zeros. Occasionally in part **(b)** the incorrect answer 9486×10^3 was seen arising from the common misconception that the number of zeros determines the power of 10. Also 9.486×10^{-6} was occasionally seen. Having had a correct answer to part **(a)** some candidates went on in part **(b)** to round or truncate this figure. Common incorrect answers were 9.48×10^6 or 9.5×10^6.

Answers: **(a)** 9486000 **(b)** 9.486×10^6

Question 2

The majority of candidates were successfully able to complete this money conversion question obtaining full marks. The most common incorrect answer was 989.17 arising from the incorrect method of multiplying 700 by the exchange rate rather than dividing. Sometimes candidates did not divide by the full exchange rate, occasionally $700 \div 1.41$ was seen. The incorrect truncated answer of 495.3 was sometimes seen but usually the candidates did still score the method mark in this instance.

Answer: 495.36

Question 3

Many candidates were able to completely factorise this expression with a large number obtaining full marks. Common incorrect answers arose from partial factorisation $3(5p^2 + 8pt)$ and p(15p + 24t) which still scored 1 mark. A common incorrect answer was $39p^3t$ demonstrating both a lack of understanding of how to add two algebraic terms and how to factorise. Other incorrect answers occasionally seen were 3p(5p + 8pt) and $3p(5^2 + 8t)$.

Answer: $3p(5p + 8t)$

Question 4

Many candidates were able to successfully answer this question with the majority obtaining full marks. The most successful candidates wrote decimal conversions to a minimum of 3 significant figures and were therefore able to order them. The majority correctly placed the first two in order, with the fraction $\frac{8}{17}$ and decimal 0.47 being sometimes reversed. This was particularly the case from those candidates who rounded all decimal conversions to 2 significant figures writing $\frac{8}{17}$ as 0.47.

Answer: $\tan 25 < \sqrt{0.22} < 0.47 < \frac{8}{17}$

Question 5

Candidates were generally very successful using trigonometry to answer this question. The most common errors arose from those using the incorrect ratio (cos or tan) or using the sine rule, wrongly, rather than the sine ratio. Occasionally answers to less than 3 significant figures were seen or evidence that the candidates' calculators were not set in degree mode. Candidates were still able to obtain the method mark provided they showed their working.

Answer: 23.2

Question 6

This question was generally answered well with nearly all candidates obtaining at least 1 mark. The best working showed the equation $\frac{8+4+8+9+y}{5} = 7.2$ being correctly solved although some candidates adopted a 'trial and error' approach. Some candidates misunderstood how to deal with the *y* in the equation with a minority using $29y$ instead of $29+y$ for the numerator. A common incorrect answer was 7.25 arising from the working $\frac{8+4+8+9}{4}$.

Answer: 7

Question 7

Upper and lower bounds remains a topic that causes problems for some candidates. Candidates made less errors this year than previous years working out area (they occasionally found perimeter). Those with the most success were candidates who subtracted half the unit to which figures were rounded to, i.e. if numbers are rounded to 1 decimal place (or the nearest 0.1) adding half of this (0.05) to find the upper bound. There are still candidates who find the area and then apply the bound to the answer i.e. the wrong working occasionally seen in part was 6.3 x 4.8 = 30.24 followed by adding 0.5, 0.05 or 0.005 to this answer. There were also errors due to candidates rounding the correct value of 30.7975 too much. The upper bound is an exact answer and should be written in full. The most common incorrect answer was 30.8. Candidates were generally showing their working therefore obtaining the method mark for identifying upper bounds even if they made errors in the calculations or rounding.

Answer: 30.7975

Question 8

This question was generally answered well with many candidates obtaining full marks. The best working showed candidates' awareness of the need to have the base number the same on both sides of the equation. Those candidates writing $5^3 = 125$ were generally successful. There were occasional attempts to solve the equation using incorrect inverse operations. $125 \div 5 \times 3 = 75$ was a common incorrect method and answer.

Answer: 9

Question 9

Candidates were often able to correctly draw an angle of 67° in part **(a)** with the most successful candidates making sure that they had labelled *C* or made sure that their line *BC* did not extend beyond AD. Quite often the angle of 113° was drawn by those reading the incorrect scale on their protractor or not reading the question carefully. Angles of 67° were also sometimes seen in various other places on the diagram demonstrating a lack of understanding of the terminology 'angle *ABC* = 67°'. There were a large number of inaccurate drawings - candidates were either drawing with insufficient regard for accuracy or did not have the correct equipment. In part **(b)** candidates often understood what the perpendicular bisector was, however were unable to construct it or had insufficient accuracy. Problems arose when candidates used a ruler to measure half way and then drew one set of intersecting arcs to join to this point. When the question specifies to use a 'straight edge' candidates need to understand this means no measuring. Two sets of intersecting arcs are required to construct a perpendicular bisector. Some candidates did not read the question carefully and either constructed the perpendicular bisector of *AD* or *BC* or bisected one of the angles in the triangle *ABC*.

Question 10

Candidates performed well on this question with the most success from those using $750 + \dfrac{750 \times 2.5 \times 5}{100}$ for their method. Occasionally just the interest was given as the answer, or compound interest was calculated. Candidates should check their answers are sensible. There were a few very large answers or very small answers which made no sense given the context of the question. For example $750 + 750 \times 2.5 \times 5 = 10125$ demonstrates an implausible answer that was sometimes seen.

Answer: 843.75

Question 11

This was one of the best answered questions on the paper. The most success came from those who multiplied the second equation by 3 and then subtracted the first equation from it, eliminating *x*'s and keeping all values positive. Those subtracting the other way round occasionally had problems dealing with the negatives. Consequently this resulted in $-16y = -144$ not always being solved correctly. Some candidates preferred to eliminate *y*, generally successfully but there was more potential for error in this. Some candidates chose to use the substitution method. Those who recognised that it was easiest to made *x* the subject in the second equation, tended to be more successful.

Answer: $x = -7 \quad y = 9$

Question 12

Most candidates obtained at least one mark on this question. Candidates were generally able to use equivalent fractions to correctly convert the given fractions to those with a common denominator. Nearly always denominators of 30 or 60 were used and there were very few arithmetic slips in this step. The most successful then went on to correctly add these and convert their fraction to a mixed number in its simplest form. Some candidates either did not read the instructions in the question carefully enough or did not understand this instruction and common answers given in an incorrect form were $\frac{41}{15}$, $\frac{82}{30}$ and $2\frac{22}{30}$.

Answer: $2\frac{11}{15}$

Question 13

Many candidates answered this correctly. The candidates with the most success on this question began with $y = \frac{k}{x^2}$ followed by correct substitution of $x = 4$ and $y = 3$ to find $k = 48$. A small number of candidates lost the final mark because of the error of writing $y = \frac{48}{5}$ instead of $y = \frac{48}{5^2}$. The four most common incorrect answers were 4.6875 (using $y = kx^2$), 3.75 (using $y = kx$), 2.4 (using $y = \frac{k}{x}$) and the number 4 (assuming the relationship y = x – 1 from the given values of $y = 3$ and $x = 4$). Some candidates attempted the method which does not require the constant k to be found directly first, namely $y_1 x_1^2 = y_2 x_2^2$. However this method was far less successful as it was rarely correctly used

Answer: 1.92

Question 14

Nearly all candidates obtained at least one mark on this question with many obtaining at least 2 marks for their region *R*. The most common incorrect answers seen arose from being unable to deal with the two inequalities $y \le \frac{1}{2}x + 4$ and $x + y \ge 6$. It is worth advising candidates to shade diagrams in pencil as many shaded in pen and then could not easily correct errors. There were a number of unclear regions due to this. Occasionally candidates were seen to be labelling particular points on the graph as *R*, rather than labelling a region.

Question 15

In part **(a)** the majority of candidates realised that they needed to divide the distance of 172 km by the second figure in the ratio thus obtaining at least one mark in this question, with the most success coming from candidates who began by converting the ratio to 1 cm:5 km. A common incorrect answer was 3.44×10^{-4} arising from those candidates who did not convert to cm. Candidates are advised to check their answers are sensible. Most problems arose from attempts to convert between cm and km although some candidates were also seen to be multiplying rather than dividing. Part **(b)** was one of the most challenging questions on the paper with the most success coming from those candidates who began by converting the map length ratio of 1 cm:5 km to an area ratio of 1 cm^2:25 km^2. Many candidates used the length scale factor in their calculations and consequently a common incorrect answer was 60. There were also additional problems with the conversion between cm^2 and km^2 here too.

Answers: **(a)** 34.4 **(b)** 300

Question 16

The majority of candidates obtained at least one mark in both parts of this question. In part **(a)** there were occasional arithmetic slips preventing some from obtaining full marks. The most common incorrect answer seen was $\begin{pmatrix} -5 & -4 \\ -6 & 24 \end{pmatrix}$ arising from simply multiplying corresponding elements from each matrix. Part **(b)** proved to be more challenging. Of those who scored 1 mark there was almost an even split between the two main reasons for this mark, namely for the determinant correctly used or the adjugate of **M** correctly found. For those who had some idea where to start the most common cause of lost marks were due to arithmetic slips in calculating the determinant or errors in writing the adjoint matrix.

Answers: **(a)** $\begin{pmatrix} -1 & 2 \\ 11 & 30 \end{pmatrix}$ **(b)** $\frac{1}{26}\begin{pmatrix} 4 & -2 \\ 3 & 5 \end{pmatrix}$

Question 17

Many candidates were unsure how to deal with the fact that w appeared twice in the formula. Those candidates with the most success began by multiplying c by $w + 3$ and then collecting terms in w on one side and terms without w on the other side. Sometimes the first step was completed as c x w+3 rather than c x (w+3). The next step of factorising the expression to ensure that w only appeared once was the most challenging and many candidates proceeded with less success from here. It was common to see $cw - w = 4 - 3c$ followed by an attempt to divide through by c often arising with the incorrect expression $w - w = \frac{4 - 3c}{c}$. Consequently candidates were then unsure how to deal with the $w - w$ part. There were a large number of incorrect starting points with candidates adding or subtracting terms that should be multiplied or divided (and vice versa). On occasions, when attempting to divide through by a value, many candidates did not apply this to all terms in the expression. Half of the candidates were able to obtain one mark or more. Of those scoring no marks many had expressions with w on both sides still. A very common incorrect answer was $w = cw + 3c - 4$.

Answer: $w = \frac{4-3c}{c-1}$

Question 18

In part **(a)** the majority of candidates obtained 1 mark for working out the gradient using rise/run for acceleration. In part **(b)** the majority of candidates also realised they needed to calculate the area under the graph for the total distance and obtained at least 1 mark. Candidates chose to divide the area into many different triangles, rectangles and trapeziums with varying degrees of success. From those who did realise the area was required, the most common incorrect errors arose from misreading the vertical scale (assuming two small squares were worth 10 as in the horizontal scale) or drawing a rectangle/trapezium using the vertex (20, 15) wrongly assuming that the graph went through this point.

Answers: **(a)** 0.8 **(b)** 1850

Question 19

Candidates had the most success in part **(a)** of this question with many correct answers seen. To have more success candidates need to be aware that the direction is vital to the sign of the vector since **p** + **t** and **p** – **t** were common incorrect answers. A few candidates did not understand the concept of vectors, and angles of 60° and 120° were sometimes seen used. In parts **(b)** and **(c)** candidates with the best working made it clear which route they were taking, for example by writing $\overrightarrow{PR} = \overrightarrow{PS} + \overrightarrow{SR}$, or $\overrightarrow{OR}$, respectively, for their method. The most common misconception was that $\overrightarrow{PQ}$ and $\overrightarrow{TS}$ were both **t**. Consequently 2**t** was a common incorrect answer for part **(b)**.

Answers: **(a)** −**p** + **t** **(b)** **p** + 2**t** **(c)** 2**p** + 2**t**

Question 20

Many candidates obtained two or more method marks but few obtained full marks on this question. The most commonly awarded method marks were for correctly calculating the lengths PT and PR using trigonometry. Candidates were very good at recognising tangents meeting a radius at right angles and that tangents from the same point are equal in length. Fewer candidates were able to find the correct arc length. The three most common errors were to find the minor arc length RT, to use a fraction of the circle area formula or to simply halve the circumference. Another very common error was to add the four straight lengths PR, RO, OT and TP. Consequently the most common incorrect answer seen arising from this method was 57.

Answer: 64.8

Question 21

About half the candidates scored 1 or more marks but again, few obtained full marks. Part **(a)** was the most successfully answered. Often candidates wrote no working in this question, for example $\frac{3}{9}$ or $\frac{1}{3}$, with no method, were common incorrect answers for part **(a)**. Common incorrect methods throughout all three parts were to add probabilities instead of multiplying (and vice versa) and sampling with replacement. Candidates very occasionally incorrectly added 3+2+4 to find the total number of pencils. Part **(c)** was generally the most challenging part with the most success from those working out P(GG´)+P(G´G). Many candidates chose instead to work out P(RG) + P(BG) + P(GR) + P(GB) and it was common to not have considered all of the correct outcomes. The most common incorrect answer was $\frac{5}{18}$. Occasionally probability answers greater than 1 were seen, particularly in parts **(b)** and **(c)**. Candidates are advised to check the sense of their answers.

Answers: **(a)** $\frac{1}{12}$ **(b)** $\frac{5}{18}$ **(c)** $\frac{5}{9}$

MATHEMATICS

Paper 0580/22

Paper 22 (Extended)

Key Message

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

General Comments

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

Questions 2, 6 and **14** proved to be good discriminators between the most able candidates. There was no evidence at all that candidates were short of time.

Giving answers to the correct degree of accuracy continues to be a problem.

There seemed to be a general improvement in presentation. Many excellent solutions with neat working were seen.

Comments on specific questions

Question 1

This was one of the best answered questions on the paper. Those candidates who lost marks either miscounted the days and gave Thursday, or arrived at 10 15 and failed to give the 24 hour clock answer.

Answer: Wednesday 22 15

Question 2

This question was not well answered by many candidates. Line symmetry was better known than rotational symmetry. Candidates were allowed to include O in their answer without penalty.

Answers: **(a)** I **(b)** I, N

Question 3

This question was very well done by most candidates. Those that didn't score full marks used the value $\frac{1}{2}$, 1 or 2 to evaluate the terms, none of which were in the given range.

Answer: $x - 5$, $\frac{x}{5}$, $\frac{5}{x}$, $5x$

Question 4

This was well done by most candidates. The main error was not showing enough working.

Answer: 25

Question 5

This question was not well answered by many candidates. The most common error was dividing by 1000 instead of 1000^2. Many candidates did not give the answer to 2 significant figures.

Answer: 64 000

Question 6

This question was well done by many candidates. Full marks were rare. Many candidates solved the inequality correctly but ignored the fact that *x* had to be a positive integer.

Answer: 1, 2, 3, 4

Question 7

Most candidates knew what was required but some had difficulty distinguishing between area and perimeter. The other major cause of lost marks was the rounding to three significant figures as required by the rubric, with 4.5 and 4.45 being the common errors. Some candidates used $\frac{22}{7}$ for π which can produce inaccurate answers and should not be used.

Answer: 4.46

Question 8

This question was generally not well answered. Most candidates did not realise that area and volume scale factors were the square and cube of the length scale factor.

Answers: 13 500, 408

Question 9

This question was generally very well done by candidates. Those that lost marks either had the wrong trigonometric ratio, ignored the 170 m or subtracted 170 m from *PB*.

Answer: 452

Question 10

This question was very well done by the majority of candidates. There was considerable use of distance = speed × time which is not appropriate when acceleration is involved and candidates should be finding the area under the graph.

Answers: **(a)** 50 **(b)** 15

Question 11

Most of the candidates had a clear idea of how to do this question. Common errors were to ignore the square or to introduce their own inverse relationship.

Answer: 196

Question 12

This question was generally very well done by candidates. Common errors were to use $\frac{1}{2} \times 5 \times 8$ or to assume that the triangle was isosceles.

Answers: **(a)** 10 **(b)** 210

Question 13

This question was reasonably well done, but some candidates had difficulty accessing the question.

Answers: **(a)** 15 **(b)** 11.7(0)

Question 14

The more able candidates were scoring full marks on this question. Most other candidates gave stretch instead of shear or didn't give a full accurate description. A few tried to work out the matrix using simultaneous equations and often made an error along the way.

Answers: **(a)** Shear, scale factor 2, *x*-axis invariant **(b)** $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$

Question 15

Large numbers of candidates scored full marks on this question. Those that did not usually made an error on the last part and answers greater than one were common.

Answers: **(a)** 29 **(b)** 20 **(c)** 14 **(d)** $\frac{13}{15}$

Question 16

Many of the candidates scored full marks on this question. A large number of candidates used algebra to solve the equation instead of reading the graph. The concept in part **(b)** was well understood, but some candidates were drawing a tangent from (1, 0) instead of at (1, 2.5) on the curve. The accuracy of the drawing was generally good and most got their gradient in the allowed range. The most common fault was to ignore the fact that the gradient was negative.

Answers: **(a)** 0.7 to 0.8 and 5.2 to 5.4 **b)** –2 to –1 but must have a tangent at $x = 1$

Question 17

Parts **(a)** and **(b)** were very well done by most candidates. The common error in part **(a)** was mistakes with the directed numbers. In part **(b)** the common error was $6 = 8 + c$ leading to $c = 2$ or $\frac{3}{4}$.

Part **(c)** was not well done by many candidates. Most knew that they had to equate gradients but very few candidates correctly read them from the equations and even then could not find *k* correctly. A common incorrect answer was $-\frac{5}{4}$.

Answers: **(a)** (–5, 0) **(b)** –2 **(c)** $2\frac{1}{2}$

Question 18

Most candidates knew what was required but found the algebra challenging. This question proved to be a good discriminator and only those with clear logical answers performed well in both the algebra and arithmetic.

Answers: **(a)** $2(x + 2)^3$ **(b)** $\sqrt[3]{(x + 5)} - 2$ **(c)** 0

Question 19

This was a well answered question by many candidates whilst others scored no marks because of incorrect assumptions made initially. In part **(a)**, $2x - 7 = 1$ was a very common error instead of $2x - 7 = 0$. In part **(b)**, $x^2 - 8 = 0$ instead of $x^2 - 9 = 0$ was a very common error. In part **(c)**, $x - 2 = 1$ instead of $x - 2 = 3$ was a very common error.

Answers: **(a)** $3\frac{1}{2}$ **(b)** 3 and –3 **(c)** 5

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key message

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

General comments

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

Candidates not giving answers to the correct degree of accuracy continued to be an issue this year. The general rubric needs to be read carefully at the start of the examination and candidates need to ensure that they have noted the accuracy requirements of particular questions in their checks at the end of the paper.

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

Comments on particular questions

Question 1

This question was correctly answered by nearly all candidates. The most common incorrect answer was 120°, which resulted from candidates thinking that opposite angles in the quadrilateral added up to 180°.

Answer: 95

Question 2

This question was well answered. A common error resulted from finding the total amount after eight years and not just the interest. Some candidates applied compound interest to the question.

Answer: 120

Question 3

This question was well answered. Some candidates did not write down all the figures in part **(a)** but then answered part **(b)** correctly. In part **(b)**, some candidates confused significant figures with decimal places hence giving a four decimal place answer. The most common incorrect answer for part **(a)** was 18.79604457 and the most common incorrect answers for part **(b)** were 3.260 and 3.2608.

Answers: **(a)** 3.26077… **(b)** 3.261

Question 4

This question was generally well answered. It was quite common, however, to see a correct answer in the working followed by just $-\frac{5}{4}$ or –1.25 on the answer line. Other common errors were to see $4y \le -5$ in the working followed by $y \le -0.8$ or $y \ge -1.25$ on the answer line.

Answer: $y \le -1.25$

Question 5

There were mixed responses to this question. Some candidates found it very easy to score full credit, whilst others used incorrect upper bounds such as 9.4, 9.45 and 9.49. Some candidates thought they were being asked to calculate the area of the trapezium. Another incorrect method that was often seen was to use the lengths from the diagram to find the perimeter and then add on 0.5 at the end giving a common incorrect answer of 31.5.

Answer: 33

Question 6

This question was generally well answered. Most candidates used the area formula $\frac{1}{2}ab\sin C$ correctly. A small number of candidates calculated the height of the triangle before applying the area formula $\frac{1}{2}$ base × height, which often resulted in accuracy errors due to premature rounding. Other errors arose from the use of $\frac{1}{2}\times 9\times 15\times\cos 28$ or $9\times 15\times\sin 28$.

Answer: 31.7

Question 7

This was one of the least well answered questions on the paper. A significant number of candidates seemed not to understand the concept of frequency density. Common incorrect answers were 48 and 0.9.

Answers: $u = 24, v = 0.6$

Question 8

This was one of the best answered questions on the paper. Incorrect answers were rarely seen and usually came from calculating $\frac{50-10.5}{8+4.5}$ or $\frac{50+10.5-8}{4.5}$.

Answer: 7

Question 9

This was well answered by many candidates. The most common wrong step was the multiplication by *a* leading to $at = 2-3w$. The other two steps were usually completed correctly.

Answer: $\frac{a(2-t)}{3}$

Question 10

As in previous years, a significant number of candidates wished to set their own question when setting up a relation between *T* and *l*. $T = kl^2$, $T = \frac{k}{\sqrt{l}}$ and $T = kl$ were common incorrect starting points. An incorrect answer of 16.7 (resulting from the use of direct proportion) was offered by many candidates. Those who correctly started with $T = k\sqrt{l}$, more often than not, went on to gain full credit.

Answer: 10

Question 11

This was one of the least well answered questions on the paper. It was quite common to find the total value of the investment after two years ($297.05) presented in the answer space. A number of candidates applied simple interest principles to this question. A final answer of 17.1 with and without 17.052 was also quite common.

Answer: 17.05

Question 12

This question was one of the best answered questions on the paper. In both parts of the question, the method was required and it was normally shown. Decimal calculations, earning no credit, were very rarely seen. In part **(a)**, using a common denominator of 12 usually gained full credit, whereas using a multiple of 12 sometimes led to errors in offering a final answer as 'a fraction in its simplest form'. In part **(b)**, those who inverted the fraction $\frac{11}{13}$ and then multiplied almost always gained full credit.

Answers: **(a)** $\frac{7}{12}$ **(b)** $\frac{13}{44}$

Question 13

This was the best answered question on the paper. Very few candidates did not score full credit in part **(a)**. In cases where this was not achieved, the candidates' error usually resulted from subtracting 15, rather than adding 15, to 56. Part **(b)** also appeared to be a very straightforward question for the majority of candidates. Only a few showed a partial factorisation and the most common incorrect answer was $3v(u + w)$.

Answers: **(a)** 71 **(b)** $3v(u + 3w)$

Question 14

Working with index numbers was challenging to a number of candidates. In part **(a)**, a response gained full credit for both 64 and p^3q^6 in the answer space. The majority of candidates were correct but sizeable numbers obtained 64 but with incorrect powers of *p* and/or *q*. The most common incorrect answers were $64pq^6$ and $64p^3q^5$. The most common incorrect answers seen in part **(b)** were $\frac{1}{2}x^{-\frac{1}{2}}$, $-4x^2$ and $\frac{1}{2}x^2$.

Answers: **(a)** $64p^3q^6$ **(b)** $0.5x^{-2}$ oe

Question 15

The most popular method of solving this quadratic equation was by formula. A significant number of candidates did not write the formula down correctly. The double negative within the square root caused difficulties for some candidates. Having successfully navigated the substitution of numbers into the formula, some candidates lost credit by not giving their answers 'correct to 2 decimal places'. Some candidates chose to leave their answers in surd form, which meant that the maximum that they could score was half credit. A small number of candidates gave correct answers but with no supporting method, that meant that the maximum that they could score was again only half credit.

Answers: –3.44, 0.44

Question 16

This question caused difficulties for a number of candidates. Some did not realise that there were three areas to consider. Calculating the volume of either the full cylinder or of half a cylinder was fairly common as was adding full circles instead of semi-circles. A few candidates forgot to add on the flat top area of 120.

Answer: 359

Question 17

This question was generally well answered with candidates usually being more successful in part **(a)** than in part **(b)**. In part **(a)** the common incorrect responses were to give an answer of $\begin{pmatrix} 4 \\ 10 \end{pmatrix}$ or to give a square matrix as their final answer. In part **(b)**, when full credit was not awarded, it was mainly due to a missing determinant value or an incorrect adjoint matrix.

Answers: **(a)** $\begin{pmatrix} 4 & 10 \end{pmatrix}$ **(b)** $\frac{1}{2}\begin{pmatrix} 3 & -4 \\ -1 & 2 \end{pmatrix}$

Question 18

Part **(a)** of this question was well answered but candidates were much less successful in answering part **(b)**. It is advisable for candidates to start a vector question by writing down a correct route, e.g. in part **(a)** this would be $\overrightarrow{QR} + \overrightarrow{RX}$. In part **(b)**, a significant number of incorrect solutions usually resulted from dividing $\overrightarrow{QX}$ by 2 rather than finding $\overrightarrow{OM}$.

Answers: **(a)** $\mathbf{p} - \frac{1}{3}\mathbf{q}$ **(b)** $\frac{1}{2}\mathbf{p} + \frac{5}{6}\mathbf{q}$

Question 19

This question was answered correctly using a variety of different approaches. Nearly all candidates recognised that they had to determine an area. Some tried to use "speed = distance × time" rather than the area under the graph. Errors in area calculation or in unit conversion meant that partial credit was awarded fairly often. The neatest solutions involved finding the area of the given rectangle and subtracting the area of the trapezium (at the top of the diagram) from it or finding the area of the smaller rectangle (when travelling at constant speed) and adding the area of the two vertical trapeziums. A number of candidates lost full credit due to inaccuracy in their calculations. Those who used fractions and not decimals were generally more successful. Not all candidates realised the different units and left their answer as 360.

Answer: 6

Question 20

This was generally well answered with only a small minority of candidates giving weak responses to this question. For those who factorised both numerator and denominator, progress was substantial provided they remembered to cancel common factors. However, the cubic expression did present some difficulty with common incorrect factorisations for the denominator being $(x^2 - 5)(x - 5)$ and $(x - 5)(x - 5)$. Where the factor *x* was extracted, on occasions it disappeared resulting in an incorrect final answer of $\frac{x+4}{x-5}$.

Answer: $\frac{x+4}{x(x-5)}$

Question 21

In part **(a)**, most candidates scored at least minimal credit, usually for $4^2 + 5^2$. It was quite common to see a final answer of 7.54 on the answer line due to premature approximations or incorrect rounding. In part **(b)**, a few candidates attempted to find the wrong angle; some did not realise that there was a right-angled triangle present and attempted complicated cosine rule or sine rule calculations, frequently incorrectly.

Answers: **(a)** 7.55 **(b)** 41.5

MATHEMATICS

Paper 0580/31

Paper 31 (Core)

Key Message

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time, and many were able to make an attempt at most questions. Few candidates omitted part or whole questions. The standard of presentation was generally good. There were occasions where candidates did not show clear workings and so did not gain the method marks available. Centres should encourage candidates to show formulas used, substitutions made and calculations performed. In questions where candidates are asked to 'explain', they should be encouraged to answer in sentences, give all required information, and show all workings in order to fully answer the question. This was particularly important in **Questions 3(c)**, **4(a)** and **6(e)** where full explanations and correct information was required to gain full marks.

Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to fully process calculations and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set. The use of correct equipment was evident and should be emphasised by Centres.

Comments on specific questions

Question 1

The first three parts of this question were generally well answered by candidates of all abilities. The final part required candidates to calculate compound interest which many candidates found challenging and a large number calculated simple interest by mistake.

(a) Most candidates attempted this question however many candidates divided by 19 or 21 and not by the total of 40. Some candidates calculated Wendy's share instead of Vince's. Candidates should be encouraged to check they have answered the question set once a solution has been found.

(b) This was very well answered by candidates of all abilities. Nearly all candidates attempted division by \$37 or repeated addition of \$37. However leaving an answer of 7.162 or rounding to 8 meant some candidates did not gain full marks.

(c) This was well attempted by most candidates with nearly all candidates gaining one mark for calculating 27% correctly. Many candidates misread the question and calculated $\frac{2}{5}$ of the remaining amount, leading to common answers of \$86.70.

(d) The majority of candidates were able to calculate the result of 2 years compound interest, using the compound interest formula. A significant number did not find the amount of interest, forgetting to subtract \$500. Answers of 540.8, 540.80 and 541 were therefore common. Fewer candidates gave their answer to the nearest dollar, with the majority leaving their answer to one or two decimal places. A large number of candidates incorrectly calculated simple interest by mistake, giving an answer of 540 or 40.

Answers: **(a)** 950 **(b)** 7 **(c)** 66 **(d)** 41

Question 2

Candidates demonstrated a good understanding of reflection and rotation. Candidates showed improvement from previous years in giving the correct number of pieces of information required to fully describe a particular transformation. Candidates found enlargement more challenging. Candidates were required to describe fully a transformation which was dependent on their correct initial transformation. Although follow through marks were available, few candidates who made mistakes in part **(a)** gained full marks in part **(b)**.

(a) (i) Candidates could generally draw a correct reflected shape but often reflected in the *x*-axis instead of the *y*-axis.

(ii) Most candidates could rotate the shape through 180° although not always about the correct centre of rotation.

(iii) Candidates could draw the shape in the correct size but again many could not locate it correctly. Most commonly, candidates enlarged the shape by the correct scale factor of 2 but from centre of enlargement (0,0).

(b) (i) Most candidates understood that only a single transformation should be given and despite reflecting in the wrong axis in part **(a)(i)**, were able to give the correct description. In order to improve, candidates need to know the equation for the *y* and *x*-axes, as many candidates gave $x=0$ for the *x*-axis and $y=0$ for the *y*-axis.

(ii) A large number of candidates did not give the correct answer of ‘translation’. Many derivations of the word were given including ‘translocation’ and ‘transition’ which were not acceptable. Of those candidates who did identify a translation, many did not give a correct vector, either giving no answer, co-ordinates or incorrect values.

Answers: **(b)(i)** Reflection, $y=0$ or *x*-axis **(b)(ii)** Translation, $\begin{pmatrix} 4 \\ 8 \end{pmatrix}$

Question 3

This statistics question was attempted by all candidates. The probability part of the question was more successfully answered than the averages part, however the ‘explain’ question was challenging to all candidates. It was evident that candidates were able to use protractors and rulers to construct the pie chart, with very few non-ruled attempts.

In part **(a)**, probabilities were generally given in a correct format. There were very few candidates who gave their answers as ratios or ‘out of’. Those candidates that gave their answers as percentages were generally successful, however Centres should emphasise the correct number of significant figures required in all answers (3).

(a) (i) This part was attempted by all candidates and generally very well done.

(ii) This part was attempted by nearly all candidates but less successfully. It was clear that some candidates were unaware that 2 is a prime number and an answer of 0 or $\frac{0}{6}$ was common.

(iii) Most candidates answered this question, however the vast majority of candidates gave the answer of $\frac{6}{6}$ which did not score. The candidates were required to simplify this to 1 to gain the mark.

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

(c) This part of the question was the most challenging. Candidates were aware that they were required to compare the probabilities of Jon and Felix. However the vast majority used the probabilities given in the question without changing to common denominators or a common form (decimals or percentages), which was required for a complete answer. Those candidates that used percentages or decimals to compare probabilities were more successful.

(d) (i) Many correct angles for both sections of the pie chart were seen. A small number of candidates were able to gain a single mark for realising the sum of the two angles to be found was 120°.

(ii) The required pie chart was generally well drawn although common errors were inaccurate measurement and drawing of the angles. The 30° angle was achieved by most candidates.

(iii) The mode was found correctly by the majority of candidates.

(iv) Most candidates knew that they had to add and divide to calculate the mean; however most candidates chose to calculate the mean of the frequencies or angles. Those candidates who did 'multiply and add' were successful but a number then divided by 5 instead of 60.

Answers: **(a)(i)** $\frac{1}{6}$ **(ii)** $\frac{2}{6}$ **(iii)** 1 **(b)** 4, 4, 4, 4, 5, 5, 7, 7, 9

(c) Felix has probability $\frac{3}{12}$ and Jon has probability $\frac{4}{12}$

(d)(i) 72°, 48° **(iii)** 4 **(iv)** 4.85

Question 4

This question proved challenging to many candidates. Again the 'explain' question was the most difficult with candidates not giving enough information to gain full marks. Parts **(b)** and **(c)** followed on from each other, and candidates who were unable to answer **(b)** found difficulty in scoring in part **(c)**. However, some candidates found success by restarting the question in part **(c)** following an incorrect attempt at part **(b)**.

(a) This was the most challenging part of the question. Most candidates were able to explain that a side would be zero or negative but were not specific enough, and did not explicitly say which side this would be. Identification of the side $11-x$ was required to score the mark. A large number of candidates believed this side to be the hypotenuse, despite the triangle not being right angled.

(b) Most candidates were aware that the sides of the triangle had to be added and gained one mark. A common mistake was to add all x values with the result of $6x + 14$. It was clear that the vast majority of candidates understood the term perimeter.

(c) (i) This part was the most successful of the question with many candidates able to score two out of the three marks. Candidates who had incorrect answers to part **(b)** were more successful by restarting this part and forming the correct equation and then solving. The vast majority of candidates who formed an equation were able to correctly reduce it to the form $ax=b$ by choosing the correct operation.

(ii) Candidates were aware that they had to substitute their value for x into one of the sides of the triangle. However, because the diagram had side $2x + 3$ drawn the shortest, the majority of candidates substituted into this side only. Candidates who substituted into all three sides were more successful in identifying the shortest side. Candidates demonstrated increased confidence in substituting and more candidates showed their substitution and working than in previous years.

Answers: **(b)** $14 + 4x$ **(c)(i)** 4.5 **(ii)** 6.5

Question 5

The first two parts of this sequence question were well answered. The parts involving algebra proved more challenging for candidates, particularly as the n^{th} term was a quadratic.

(a) The diagram was generally drawn correctly.

(b) The vast majority of candidates correctly identified the number of crosses.

(c) (i) Many candidates were not able to write down an expression for the number of crosses in n rows. Common answers were n or +2.

(ii) Some candidates were able to follow through from their previous answer. However most candidates did not perform well with the quadratic nature of this sequence. Of those that did multiply by n, a large number used incorrect algebraic notation and did not gain the mark, e.g. $n \times n + 2$ or $n.n + 2$ instead of $n(n + 2)$.

(iii) This part was more successful. Some candidates followed through correctly from their part **(ii)**, although the majority did start again and calculated 20×22. A large number of candidates calculated it from the beginning and gained full marks even if they had not earned marks in part **(ii)**.

Answers: **(b)** 35 **(c)(i)** n+2 **(ii)** $n(n+2)$ **(iii)** 440

Question 6

Candidates found this question challenging, especially the 'explain' question, the calculation of the gradient and forming the equation of the straight line in the form $y=mx+c$. Candidates were more confident at identifying co-ordinates.

(a) The question on calculating the gradient was challenging for many candidates; however an improvement was seen from previous years. The position of the line in the diagram led most candidates to use the triangle *ABE* and give some indication of change in y/change in x. Some candidates managed to get to a correct fractional value but did not simplify to 2, or a correct numerical figure but gave the answer as a negative instead of a positive.

(b) This part also proved challenging to candidates. Many gave a numerical answer, without an x term or no x present, e.g. $y = -0.5 + 6$. A number of candidates confused 'm' and 'c' in the equation of a straight line. A significant number of candidates did not give an answer to this part.

(c) More candidates were able to answer this ratio question. Common errors were 3:12, –1:4, 1:–4 (which did gain a method mark) and –3:12. Some candidates measured the length inaccurately with a ruler instead of using the scale on the axes.

(d) Candidates were confused with the notation for the angle *ABE* and a large number measured *ABC*, with the common incorrect answer of 90° seen. Those candidates that identified the correct angle were able to give an accurate answer. It was evident that candidates had the correct equipment to attempt this question.

(e) This 'explain' question proved challenging to most candidates. Candidates were unaware of the amount of information or the level of description needed to gain full credit. Common correct answers identified the 'same angles' but significantly fewer candidates could explain the 'lengths in the same ratio' in enough detail or accuracy. The most common answer was 'same shape different size' which did not gain credit. Candidates should be encouraged to write as detailed an answer as possible.

(f) Candidates who calculated the area of *ABC* in one calculation using *AC* and *EB* were more successful than those who used two triangles *ABE* and *BCE*, or sides *AB* and *BC*. The vast majority of candidates showed they understood how to calculate the area of a triangle, an improvement on previous years. Candidates should be encouraged to use information given in the question rather than measure their own lengths, as an exact answer of 45 was required to gain full marks.

(g) (i) This part of the question was more successful with many candidates correctly identifying the correct position on the diagram. Some candidates tried to form a rectangle with D in the first quadrant.

(ii) This part was the most successful of the question with candidates giving the correct co-ordinate or gaining a correct follow through from their point in part **(i)**.

Answers: **(a)** 2 **(b)** $-0.5x + 6$ **(c)** 1:4 **(d)** 25°–29°
(e) Equal angles and lengths in same ratio
(f) 45 **(g)(i)** (9,–6) correctly marked **(ii)** (9,–6)

Question 7

Some parts of this travel graph question were challenging to a number of candidates. However most candidates could interpret some basic features of the graph. Calculations of speed showed an improvement from previous years with candidates showing an understanding that speed is calculated by dividing distance by time.

(a) (i) This was answered well by most candidates.

(ii) Candidates could correctly explain that this was the point Toni and Poppy passed each other. This was the most successful of the 'explain' type questions on the paper.

(iii) Clear workings were shown by most candidates showing they understood that they had to divide distance by time. However, premature rounding of the time value, 10/60 given as 0.16 or 0.17, led to answers of 18.75 and 17.6, which only scored one method mark. Few candidates appeared to use the simple ratio method of 3 km in 10 minutes; 18 km in 60 minutes; speed is therefore 18 km/h. Some candidates wrote 10 minutes as 0.10 hours and gave the answer of 30 km/h.

(b) (i) The drawing of the journey showed a general awareness of what was required. Candidates found the horizontal line easier than the line travelling to Sasha's house. Some candidates omitted the horizontal line but were able to draw a line of correct length and gradient and gained one mark.

(ii) This part proved more challenging to candidates. Many candidates could draw the first part of the journey, correctly using the information given in the question. The second part of the journey was far more challenging. Most candidates knew that the line had to return to the time axis but were unable to use the correct gradient. A few candidates thought the line had to return to (0,0).

(iii) This part proved to be the most difficult for candidates*.* Again the majority of candidates showed awareness of speed = distance/time and offered some working. However, many candidates took an average of the two parts of the journey to and from home, e.g. using their answer to part **(a)(iii)** and the return journey. The expected method of 3 ÷ 25/60 was rarely seen.

Answers: **(a)(i)** 10 **(ii)** Toni passes Poppy **(iii)** 18
(b)(iii) 7.2

Question 8

This question discriminated well between candidates of differing abilities. It gave more able candidates an opportunity to demonstrate their knowledge of trigonometry but also gave less able candidates the opportunity to demonstrate their understanding of Pythagoras' theorem and speed. Only the most able candidates were able to gain full marks on part **(e)**.

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

(ii) Most candidates recognised this as a Pythagoras' theorem question and it was successfully answered by the majority of candidates. The use of $a^2 + b^2$ was quoted and substituted into, by candidates of all abilities. However some went on to double this value or incorrectly evaluate 50^2 or 120^2.

(b) Candidates again showed good understanding of the relationship between speed, distance and time with the most able candidates writing the correct speed = distance/time formula. The most common errors came from incorrect answers to part **(a)** or candidates who used the distance ran by Said instead of Bill.

(c) Following a correct answer to part **(b)**, most candidates could identify Said as arriving first. However less candidates could calculate by how many seconds. This question highlighted the importance of candidates showing their workings as a significant number could have scored method marks if they had shown how they reached their answer. Some candidates also tried to calculate Bill's time to reach *R* and made mistakes which led to an incorrect time in this part.

(d) (i) This question gave the more able candidates the opportunity to demonstrate their understanding of trigonometry. Of those that attempted the question, most used a trigonometric ratio and the majority correctly chose the tangent ratio. However a significant number of candidates used adjacent/opposite instead of opposite/adjacent.

(ii) Most candidates found the calculation of the bearing challenging, with many candidates quoting a length instead of an angle. A common misunderstanding was to subtract the previous answer from 360° instead of 180°. A large proportion of candidates did not attempt this question indicating a common misunderstanding of the word 'bearing'.

(e) This part was challenging to all candidates, however candidates of all abilities were generally able to gain two of the four marks for correctly multiplying 50 and 120 to calculate the area of the field in m^2. Only the most able candidates were able to convert this value to square kilometres. The most successful candidates started with the values of 0.05 and 0.12. Most candidates understood standard form, the most common answer was 6×10^3 from 6000. However very few candidates were able to gain the final mark for conversion to standard form as most did not have an answer that led to a negative index value.

Answers: **(a)(i)** 170 **(ii)** 130 **(b)** 5 **(c)** Said, 1.5
(d)(i) 67.4° **(ii)** 112.6 **(e)** 6×10^{-3}

Question 9

Candidates were challenged by this question and a large number of them did not attempt parts of it. Candidates were more successful at quoting the formula for the volume of a cylinder than the relationship between circumference and diameter. The question on surface area challenged those who did not read the question carefully and who did not know the difference between surface area and volume. A significant proportion of candidates did not attempt part **(d)** and of those that did, very few were able to gain credit.

(a) (i) Candidates were able to quote the correct formula for the volume of a cylinder although fewer were able to substitute the correct values. All values of π were seen and most responses fell within the range of acceptable answers. A large number of candidates did not give the units. Correct units seen were cm^3, ml and litres (where candidates had successfully divided by 1000). However units of ml^3, cl, and cm^2 were common mistakes.

(ii) This question challenged the most able of candidates and many candidates were unable to attempt it. Common mistakes included incorrect conversion of 1.5 litres to cm^3, dividing by the answer to part **(i)** and misinterpretation of the value 8.8419.., giving the final answer as 9 instead of 8 glasses. This question again highlighted the importance of candidates showing their working as some candidates could have gained follow through marks if they had shown their working.

(b) Many candidates did not know the relationship between circumference and diameter. Many candidates could quote $C=2\pi r$ and found the radius believing this to be the diameter. A significant number of candidates divided 16 by 2. This question highlighted the importance of giving answers to the required number of significant figures. Many candidates gave answers of 5.1, instead of 5.09, which only gained the method mark.

(c) Candidates who knew the difference between surface area and volume were able to score some marks on this question. However a significant number of candidates multiplied all values to calculate volume. Most candidates were able to calculate the area of one face and score one mark by understanding that there were two of these faces. However, many candidates believed that four of the six sides were identical. This question again highlighted the importance of candidates showing their working.

Part **(d)** proved to be the most challenging of the paper for candidates of all abilities. A large proportion of candidates did not attempt it.

(d) (i) Of those candidates who attempted this part, many were confused by the units given in the question. Very common mistakes were to include the units leading to answers of vm^3 or vm^4 or $m \times v \times m^3$. Many candidates wrote their answer as an equation instead of an expression.

(ii) This part was more successfully answered as candidates appreciated that they had to multiply their answer to part **(i)** by *s*. However, very few candidates gave the correct answer of *msv* and most candidates who scored on this question did so as a follow through.

(iii) This part of the question was omitted by a significant number of candidates. Those who did attempt it did not understand the relationship between grams and kilograms with the majority dividing by 1000 instead of multiplying.

Answers: **(a)(i)** 226 cm^3 **(ii)** 8 **(b)** 5.09 **(c)** 148
(d)(i) *mv* **(ii)** *msv* **(iii)** 1000 *msv*

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 necessary working clearly and use a suitable level of accuracy. On construction questions, candidates should clearly show all construction lines and arcs.

General comments

The paper gave most candidates an opportunity to demonstrate their knowledge and application of Mathematics. The majority of the candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates answered all of the questions with some omitting parts of a question on a particular topic. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show clear working in the answer space provided; the formulae used, substitutions and calculations performed are of particular value if an incorrect answer is given. Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to fully process calculations and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set.

Comments on specific questions

Question 1

Candidates generally found this question a good start to the paper. They can improve their answers by showing all of their working and by reading the question carefully. Answers should be checked to see if the answer obtained is a sensible response to the question asked.

(a) The majority of candidates recognised the operation to perform and obtained a correct answer.

(b) A number of candidates misunderstood the meaning of the 3%. Those who performed the expected calculation of 15 000 ÷ 3 × 100 generally obtained the correct answer of $500 000; a sensible answer for the cost of the hotel. The common error was $450, found by calculating 3% of $15 000. Other common errors were finding 97% of $15 000, 103% of $15 000, and calculating 15 000 ÷ 3 × 97.

(c) This part was generally well answered.

(d) This was generally well answered although common errors were finding the surface area or simply adding the 3 given dimensions.

(e) (i) This was generally well answered although a common error was to add/subtract $\frac{3}{8}$ or more usually 0.375.

(ii) A number of candidates did not realise that the calculation required was (total hotel income) – (staff wages + food) and often omitted one of these values.

(iii) This was generally well answered although a small minority did not give their answer correct to 1 decimal place as required.

(f) This was generally well answered although a significant number used compound interest in error. A common error was to leave the answer as 630 and not to calculate the total amount repayable as 3500 + 630.

Answers: **(a)** 15 000 **(b)** 500 000 **(c)** 35 **(d)** 40.3 **(e)(i)** 372 000 **(ii)** 200 000 **(iii)** 42.3 **(f)** 4 130

Question 2

Candidates demonstrated a good understanding of reflection and rotation. Candidates showed improvement from previous years in giving the correct information required to fully describe a particular transformation. Candidates found the translation and the drawing of the enlargement more challenging. They can improve their answers by using lines of enlargement in their diagrams.

(a) (i) Candidates could generally identify reflection but often gave the line of reflection as the *x*-axis, the *y*-axis, $y = 0$, or *y*-axis – 1.

(ii) Most candidates could identify the rotation, and through 180°, although not always about the correct centre of rotation.

(iii) Candidates could generally identify the translation but less successfully. Candidates were less successful in stating the correct column vector, with inaccurate values, fractions and co-ordinates being common errors.

(b) Candidates did seem to find the enlargement of the **F** more difficult to draw then the usual shape. Common errors included using a scale factor of $-\frac{1}{2}$, using a different centre of enlargement, and inaccurate drawing usually of the middle short line of the **F**.

Answers: **(a)(i)** Reflection in y = –1 **(ii)** Rotation of 180° about (0, 0) **(iii)** Translation $\begin{pmatrix} 7 \\ -9 \end{pmatrix}$

Question 3

Candidates demonstrated a good understanding of numeracy and mathematical terms. Improvements to answers could come from appreciating the difference between the lowest common multiple and the highest common factor.

(a) (i) This part was generally well answered with only a very few answers of 9 seen.

(ii) This was also generally well answered although a very small minority left the answer as $\frac{144}{9}$.

(iii) This was generally well answered although a common error was to take the square root of 4 913 giving 70.09.

(b) (i) This was generally well answered by candidates although common errors included the omission of one or more values, extra square numbers outside of the requested range, a list of even numbers, a list of odd numbers, 3^2, 4^2, 5^2, 6^2 or 3, 4, 5, 6.

(ii) This was generally well answered, although common errors included writing 76 as the product of prime factors as 2 × 2 × 19, listing 2, 2, 19, and listing products such as 1 × 76, 2 × 38, 4 × 19.

(iii) This part was generally well answered although common errors included 1, 35, and 70.

(iv) This part was generally well answered although a very common error was an answer of 2.

(v) This was generally well answered although common errors included 7, 2, and 3 920.

Answers: **(a)(i)** 27 **(ii)** 16 **(iii)** 17 **(b)(i)** 9, 16, 25, 36. **(ii)** 4 from 1, 2, 4, 19, 38, 76. **(iii)** 5 or 7 **(iv)** 24 **(v)** 14

Question 4

Candidates in general understood how to complete tables and to draw and use graphs. The standard of drawing was very good, with few straight lines or thick curves observed. A small minority of candidates plotted points but did not join them; this caused problems in answering later parts of the question. However, a significant number of candidates had difficulty with working with the gradient and intercept of a given line. Candidates can improve their answers by appreciating the value and use of the expression $y = mx + c$.

(a) (i) Most candidates could work out the values of the reciprocal function.

(ii) Candidates generally were able to plot their points. A number of candidates had problems with the given scale when plotting (8, 1.25) and (–8, –1.25). Some candidates did not draw a curve through their points.

(b) (i) This was generally well answered by candidates with the majority drawing correct straight lines of a suitable length. A small but significant number drew horizontal and/or vertical lines passing through one of the points.

(ii) This part was well answered with the majority of candidates able to score full credit. Common errors included omitting a – sign, getting the x and y co-ordinates the wrong way round, and inaccurately reading the scales.

(c) (i) This part was not so well answered with only the more able candidates scoring full credit, although a number were able to score the method mark available. Candidates tended to use either the 2 given points or the 2 intersection points found in the previous part. Common errors included using change in x / change in y, or using points that were not on the line. A significant number were unable to attempt this part of **(c)**.

(ii) Many who correctly calculated the gradient in the previous part went on to give $y = 2x + 1$ in this part, although a common error was leaving the answer as $y = 2x + c$. However, a significant number of candidates did not appreciate that they could use their gradient from the previous part with the intercept value from their graph and substitute these values into $y = mx + c$.

Answers: **(a)(i)** –2, –2.5, –10, 5, 2.5, 1.25. **(b)(ii)** (–2.5, –4), (2, 5) **(c)(i)** 2 **(ii)** $y = 2x + 1$

Question 5

This question tested a number of algebraic skills and although the majority of candidates scored credit in parts (**a**), **(b)** and **(c)**, part **(d)** proved to be more challenging.

(a) This part was generally well answered with the majority of candidates able to correctly substitute the given values for a, b and h into the given formula. Common errors included not dealing with the bracket first, halving both values, or adding the 7.5 leading to the incorrect value of 18.5.

(b) (i) This was generally well answered with the majority of candidates able to correctly expand the brackets although the first term of x^3 proved more difficult.

(ii) This was also generally well answered with the majority of candidates able to correctly expand the brackets and at least attempt to collect like terms in order to simplify their answer. Common errors included $13w + 22$, $3w$ +/- 22, $13w$ +/- 2, and $13w – 5$.

(c) (i) This was generally well answered with the majority of candidates able to appreciate that the 4 given sides had to be added together to obtain a formula for the perimeter. Common errors included multiplying the sides to get $2x^2 + 3y^2$, $6x^2y^2$, or $6xy$.

(ii) This part was challenging for many candidates not starting with a formula and simply trying to rearrange the expression $3x + 4y$. Other common errors included the incorrect first lines of working as $4y = p + 3x$ or $4y = 3x – p$.

(d) (i) Many candidates did not appreciate the algebraic approach needed and the use of the expressions n, $3n$, $n + 5$, $3n + 5$ to set up the equation $3n + 5 = 2(n + 5)$.

(ii) Although a number of candidates were able to demonstrate they could solve their equation, the correct answer was rarely seen. A number gave the correct answer possibly from a trial and improvement method, although working was often omitted.

Answers: **(a)** 82.5 **(b)(i)** $x^3 - 3xy$ **(ii)** $13w - 22$ **(c)(i)** $p = 3x + 4y$ **(ii)** $y = \frac{(p-3x)}{4}$
(d)(i) $3n + 5 = 2(n + 5)$ **(ii)** $n = 5$

Question 6

This question tested candidate's knowledge of statistics and in particular calculating the mean, median and mode. Candidates can improve their answers by appreciating the value and use of the different types of average.

(a) (i) This was generally very well answered with candidates able to complete the frequency table correctly.

(ii) This was generally very well answered with candidates able to identify the mode.

(iii) This was also generally well answered with candidates able to find the median although many chose to list all the data in order again rather than using the frequency table.

(iv) This part was generally well answered with candidates able to find the mean, although a significant number did not appreciate the meaning of the frequency table and the method of using this table to calculate the mean. This lead to the common error of simply adding the 7 given distances together and then dividing by 7 to obtain $\frac{835}{7} = 119.3$. Other common errors included errors in the total of 2496, omission of one or more values, and division by 7 not 24. The lack of working on this part was particularly evident.

(v) This part was poorly answered with the vast majority of candidates not recognising the effect of the 250 value in distorting the mean and therefore making the median the best representative of their average for the data given. In many cases, the reason for their choice was an attempt to describe the method used to find the average rather than an interpretation of it. Others commented on a perceived accuracy, while others mentioned that the distances travelled were nearer to the median than the mean.

(b) This was generally well answered with candidates able to find the probability required. However, a very common error was $\frac{5}{24}$, the probability that the distance travelled was exactly 98 km and not 98 km or more. Careful reading of questions should be encouraged to avoid this type of mistake.

Answers: **(a)(i)** 2, 3, 6, 5, 4, 3, 1. **(ii)** 97 **(iii)** 98 **(iv)** 104
(v) median plus comment referring to the extreme value of 250 **(b)** $\frac{13}{24}$

Question 7

This question tested candidates' knowledge of bearings, constructions, and the calculation of speed. Candidates can improve their answers by drawing clear and labelled diagrams with all construction lines and arcs left visible.

(a) The majority of candidates measured the bearing correctly, although due to the common errors of reading the wrong scale on the protractor, angles of 35°, 55°, 325° and 235° were seen. A significant number gave the bearing as the distance *BA* of 85 km.

(b) The required line bisector was generally drawn accurately with arcs seen. A number of candidates only drew the line to where it cut *AB*, whilst others attempted to draw the line with only one set of arcs or without arcs at all; these attempts were rarely accurate. A number of candidates misinterpreted the meaning of equidistant from *A* and *B* and drew a parallel line to *AB*. A small but significant number were unable to attempt this or the following part.

(c) (i) This part was generally answered well with the majority of candidates able to draw an angle of 20°. However this was not always drawn in the correct place with common errors being lines drawn at bearings of 070°, 110° or more commonly at 340°, and lines drawn at 20° either side of *AB*.

(ii) The majority of candidates were able to mark a point *D* and measure the distance *AD* to score full credit usually on a follow through basis. Other common errors were leaving the answer in cm, or incorrectly multiplying by 10 or 1000.

(d) Most candidates recognised that they needed to divide a distance by a time and those who correctly converted to 2.75 hours generally scored full credit. Calculations involving 2.45 and 165 were equally common errors and whilst able to score the method mark, usually lost the accuracy mark. The lack of working on this part was evident.

Answers: **(a)** 153° to 157° **(c)(ii)** 550 to 590 **(d)** 447

Question 8

This question tested candidate's knowledge of 3D shapes, area of triangles, surface area and total length of a pyramid and nets. Candidates can improve their answers by reading each part of the question carefully and to recognise the follow through nature of some parts.

(a) This was generally well answered although the common errors of triangle, equilateral, scalene, rectangular triangle, prism and pyramid were all seen.

(b) (i) This part was generally well answered with correct triangles drawn with clear construction lines. However, common errors were inaccurate construction arcs, lack of arcs suggesting a compass had not been used, lengths of 5.5 cm, and equilateral triangles drawn with either 6.5 cm or 5 cm used.

(ii) Many candidates did not score any credit here as they incorrectly used 6.5 cm as the height of the triangle rather than measuring from their diagram as suggested in the question. Those who did measure the height of their triangle were generally correct. A small number attempted to use Pythagoras' theorem or trigonometry to find the height but were less successful in obtaining an accurate answer.

(iii) Many candidates followed through correctly to get the surface area by using their triangle area from part **(ii)**, commonly 90 cm^2 after a triangle area of 16.25 cm^2. A number of candidates did not appreciate that the method required was simply (4 × their triangle area) + (the square base of 5 × 5). A number of complicated formulae were seen including the use of π.

(iv) This part was generally well answered and if the correct answer was not reached, sufficient working showing either 20 cm (the total length of the base) or 26 cm (the total length of the sloping edges) was enough to earn half credit. Common errors were to add an incorrect number of the 6.5 cm sides, 8 × 6.5, or 20 × 26. A smaller number of complicated formulae were seen including the use of π.

(c) Many accurate nets were seen including some constructed with the use of arcs. The majority of candidates realised that a square and four triangles were required, although there was often inaccuracies in the drawing of the triangles, usually in the height or position of the top vertex. A number attempted to draw or reproduce a three dimensional sketch. A small but significant number were unable to attempt this part.

Answers: **(a)** Isosceles **(b)(ii)** 0.5 × 5 × 6 = 15 **(iii)** 85 **(iv)** 46

Question 9

This question on sequences was generally answered well. Candidates can improve their answers by using a recognised method to find the n^{th} term of a sequence.

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

(ii) This was also generally very well answered.

(b) More candidates than usual were able to give the n^{th} term of the sequence, either as $2n + 2$ or the unsimplified version of $4 + 2(n - 1)$. However the common errors of $2n$, $n + 2$, 2, and a variety of other numerical answers were seen.

(c) This was generally well answered with candidates either using their rule from part **(b)** or by starting again and using the pattern of the sequence. A very small number misunderstood the question and worked out the value of *n* that would give a diagram with 48 dots.

(d) This was generally well answered with many candidates answering correctly, probably from having pictured the fifth diagram rather than using the sequence 1, 3, 6, 10, 15 or $1 + 2 + 3 + 4 + 5 = 15$. The common errors of 12, 10 and 18 were seen and it was noted that a significant number were unable to attempt this part.

Answers: **(a)(ii)** 8, 10, 12 **(b)** $2n + 2$ **(c)** 98 **(d)** 15

MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key Messages

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

General comments

The paper gave the opportunity for candidates to demonstrate their knowledge and application of mathematics. The majority of the candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates answered all of the questions with some omitting parts of a question on a particular topic. The standard of presentation and amount of working shown was generally good. In particular candidates showed improvement in their drawing of curves. Few instances of joining points with straight lines were evident. Candidates would improve if they read the questions carefully and understood the meaning of 3 significant figures. There were still a few instances of candidates rubbing out construction lines and/or working in questions, losing marks for themselves. Centres should continue to encourage candidates to show clear working in the answer space provided; the formulae used, substitutions and calculations performed are of particular value if an incorrect answer is given.

Comments on specific questions

Question 1

All candidates attempted this question with many scoring well. Some candidates appeared to misread some parts of the question. This was most prevalent in parts **(b)(i)** and **(c)**.

(a) (i) This part was generally well answered with many candidates understanding the meaning of lowest temperature. The most common error seen was -1.

(ii) Again this part was well answered and many candidates were able to arrange the values in ascending order. There were two common errors seen. Some candidates either wrote all of the numbers in the reverse order or just the negative numbers in the reverse order.

(iii) Many candidates understood how to find a difference in temperature. Some candidates could not handle the negative signs correctly, effectively adding the -3 and 5 to give an answer of 2.

(b) (i) Although many candidates gave the correct answer, a sizeable minority appeared to misread the question. Such candidates gave the time the plane departed as opposed to the time it arrived. Other candidates gave an answer of 11:20.

(ii) This part was the least well answered part of the question. Some candidates continue to assume that there are 100 minutes in an hour when trying to obtain a time of flight.

(c) This part was omitted by many but those candidates who did answer it did well, understanding how to calculate an average speed. Some candidates did not state the units.

Answers: **(a)(i)** -4, **(a)(ii)** -4, -3, -1, 2, 5, **(a)(iii)** 8 **(b)(i)** 1305 **(b)(ii)** 3h 35m **(c)(i)** 488 km/h

Question 2

Overall candidates found this question quite challenging.

(a) The majority of candidates understood what is meant by factors of a number but many did not write down all of them.

(b) This part was generally well answered with most candidates providing a correct multiple.

(c) Almost all candidates gave the correct answer for 18^3.

(d) Many candidates gave the correct answer, although some omitted to answer this part.

(e) (i) Some candidates understood the meaning of lowest common multiple. Other candidates appeared to confuse the term with the lowest common factor, with an incorrect answer of 2 being often seen.

(ii) Candidates found this part challenging. If candidates had understood what a lowest common multiple was they tended to give the correct answer for the time of the next bus. If they had found the lowest common factor in the last part they tended to give incorrect answers although some did recover and working showing all departure times for both buses was seen leading to the correct answer.

(iii) Although a small majority of candidates scored full marks, giving the correct expression, there was a sizeable minority who attempted to find an equation instead of an expression. A common incorrect answer was $84a+36c=120$.

Answers: **(a)** 1, 2, 4, 7, 14, 28 **(b)** 24 **(c)** 5832 **(d)** 2 and 5 **(e)(i)** 56 **(e)(ii)** 08 56 **(e)(iii)** $84a+36c$

Question 3

Candidates also found this question challenging. They could improve their answers by showing all of their construction lines clearly.

(a) Most candidates gave an incorrect answer for the shape. Many gave answers of kite, rhombus etc.

(b) Some candidates gave the correct answer for the type of angle. However, the majority gave an answer of acute or stated it was greater than 90° rather than the name of the type of angle.

(c) A large number of candidates could correctly measure the length and convert it using the scale.

(d) Many candidates read the correct angle and gave an answer within the accepted accuracy.

(e) This part proved challenging for most candidates. Some candidates did show the correct region from construction but the vast majority either just gave two loci of 14m and 12m from *E* and *H* respectively or just a loci from *H*.

(f) A large majority of candidates showed that they could calculate the volume of a cuboid. The most common incorrect answer was to add the sides rather than multiply them.

Answers: **(a)** quadrilateral **(b)** obtuse **(c)** 24 **(d)** 33° **(f)** 6135.36

Question 4

Many candidates demonstrated a good understanding of percentage increases and decreases. However, some candidates lost marks because of not using the correct number of decimal places.

(a) A small majority of candidates gave the correct answer for the total cost of meals. The common error was to miss the fact that 2 adult and 3 children meals were required. The ability to correctly add 12% to the cost was evident in many candidates' work. Some candidates rounded their calculation to 1 decimal place or to whole dollars and when they did not show working they lost marks.

(b) Again a small majority of candidates could increase the price of a meal by 20%. The common error was to misread the question and increase the total cost from part **(a)**.

(c) A similar number of candidates could work out a percentage increase. The common error was to divide by \$3.42 instead of \$3.00. However, many candidates did gain a mark for showing the subtraction of \$3.00 from \$3.42 in their working.

Answers: **(a)** 107.52 **(b)** 28.80 **(c)** 14

Question 5

Candidates in general showed a good understanding of transformations but were less able to correctly create rotational symmetry or enlarge triangles when no axes are given.

(a) Many candidates drew the two correct lines of symmetry. Most used a ruler with very few trying to draw them freehand. The most common error was to draw four lines; the two correct lines and the two diagonals.

(b) About half the candidates shaded the correct square. A few misread the instructions and shaded more than one square to provide a shape with the correct rotational symmetry. Common wrong answers were to shade one square which created a T, C or F shape.

(c) The majority of the candidates gave the correct enlargement somewhere on the grid. A large proportion of the remaining candidates drew one side of the triangle correctly but made an error on the other two sides.

(d) (i) Almost all candidates gave the correct co-ordinates for the point *P*.

(ii) The vast majority of candidates drew the correct reflection. There were few attempts at reflection in the wrong axis but some candidates miscounted and drew the shape as if a line other than $x=0$ was the line of reflection.

(iii) Many candidates drew the correct translation. The most common errors were to either translate x and y the wrong way round or to only translate one of x and y.

(iv) Candidates found this the most challenging part of the question to gain full marks. Although many correct answers were seen an equal number of candidates only gave one or two pieces of information required to describe rotation. Only a few candidates tried to use more than one transformation to describe the mapping.

Answers: **(d)(i)** 1, -5 **(d)(iv)** rotation, centre (0,0), angle 180°

Question 6

Many candidates found parts of this question challenging. In particular candidates did not show a clear understanding of how to use significant figures.

(a) A small majority of candidates gave the ratio in its simplest form. Many candidates did simplify the ratio but did not write it in its simplest form. Common errors seen were 36:48, 3.6:4.8 and 1:1.33.

(b) The majority of candidates showed a good understanding of sharing money in a ratio.

(c) Many candidates found this part challenging. The majority of candidates did not read the question carefully and carried out the division first and then gave their answer to 1 significant figure. A few candidates did give the correct answer but did not show any working.

(d) A large majority of candidates understood that the cost of fuel is found by multiplying the fuel used by the cost per litre. However, some did not give the answer to enough significant figures. A few candidates divided instead of multiplied.

(e) (i) Only a few correct answers were seen. Many candidates gave an answer of 64 or 65, believing these to be the upper bound.

(ii) Candidates found this part challenging. The most common error was for candidates to write an answer of 181.

Answers: **(a)** 3:4 **(b)** 168 **(c)** 300 ÷ 20 =15 **(d)** 68.52 **(e)(i)** 64.5 **(e)(ii)** 1805

Question 7

Candidates showed an ability to plot points from a table with reasonable accuracy, to draw a line of best fit and to use the data. Some candidates would improve if they recognised that this question requires a line of best fit rather than lines joining each of the points.

(a) The vast majority of candidates plotted points correctly.

(b) A small majority of candidates recognised that the scatter graph had a positive correlation. The most common wrong answer seen was negative.

(c) (i) Most candidates correctly worked out the mean. No candidate used the data for Unit B instead of Unit A.

(ii) Slightly fewer candidates provided the correct range. Some candidates just wrote down the upper and lower values of Unit A whilst others left this part blank.

(iii) Although many candidates correctly identified Unit A as being the more difficult of the two units, very few could give a correct reason. Some candidates did not give a reason and many others did not mention that the mean was lower, instead they commented on more marks being lower in Unit A.

(d) (i) A small majority of candidates drew a line of best fit. Some candidates drew a line which was outside a reasonable tolerance. However, the most common error was to join the points.

(ii) Candidates understood how to read values from their line of best fit, although some misread the scale.

(e) In general candidates could read their graph to find the correct number of candidates. The most common error was 6 which is the number of values above 65 in Unit A and Unit B combined.

Answers: **(b)** positive **(c)(i)** 54.8 **(c)(ii)** 46 **(c)(iii)** A and it has a lower mean **(d)(ii)** correct reading from line **(e)** 3

Question 8

Candidates in general understood how to complete tables and draw and use graphs. The standard of drawing was very good with few straight lines or thick curves observed. A small minority of candidates plotted points but did not join them; this caused problems in answering later parts of the question. However, the vast majority of candidates had difficulty with working with a slope and intercept of a given line.

(a) Most candidates could work out values of a quadratic.

(b) Candidates generally were able to plot their points. Some candidates did not draw a curve through their points.

(c) (i) A small majority of candidates drew the correct line of symmetry. However, quite a few candidates did not draw a line at all although this tended to be when they had made a mistake in the previous part to the question producing a curve without symmetry.

(ii) Those candidates who drew a line of symmetry correctly wrote down its equation.

(d) **(i)** Although many candidates drew the line y=12 some did not draw a long enough line or just indicated where it was on the y-axis.

(ii) Because of curves and lines not being drawn in the previous parts of the question many candidates could not give an answer to this part. Many of those candidates who did give an answer gave the correct one for their line and curve. A sizeable minority, however, misread the negative value as -2.2.

(e) **(i)** Very few candidates gave the correct answer for the gradient of the given line. The most common errors were to miss out the minus sign, give the intercept value instead or divide the intercept by the gradient.

(ii) Many candidates drew the line to find the point where it crossed the y-axis. Some candidates did not answer this part.

(iii) Candidates found this the most challenging part on the paper with many not giving an answer. There was no common wrong answer.

(f) A majority of candidates gave the correct answer. Many others correctly expanded one of the two brackets.

Answers: **(a)** 13 5 4 5 13 **(c)(ii)** x=1 **(d)(ii)** -1.8, 3.8 **(e)(i)** -3 **(e)(ii)** (0,6) **(e)(iii)** y=c-3x **(f)** 12x-9

Question 9

Candidates showed some understanding of trigonometry although a proportion of candidates did not attempt this question. They could improve by being more aware of properties of triangles etc..

(a) **(i)** A small majority of candidates gave the correct answer. The common error was to assume the angle at the centre of the circle was 90°.

(ii) Generally candidates understood that this angle was half of the answer to part **(a)**.

(b) A small majority of candidates recognised that the triangle was equilateral and gave the correct answer. Some candidates tried to use Pythagoras' theorem and tended to make mistakes.

(c) This part proved challenging. A number of candidates did not attempt this part. Some of those who did answer gave a correct method from trigonometry or Pythagoras' theorem but immediately went to the final 3 significant figure answer instead of showing a more accurate answer and then rounding to 3 significant figures.

(d) Some candidates recognised the need to use the formula for the area of a triangle. The common error was to half the base and then put this value into the formula instead of the base value itself.

(e) Candidates who answered this did well. Many candidates recognised the need to calculate the area of the circle and subtract the area of triangles. The common error was to subtract five triangles instead of six.

Answers: **(a)(i)** 60° **(a)(ii)** 30° **(b)** 8 **(d)** 27.72 **(e)** 34.7 – 34.9

Question 10

Candidates clearly demonstrated an understanding of the concepts required in this question. Candidates could improve by understanding how n^{th} terms are found and evaluated.

(a) Many correct answers were seen in this part.

(b) (i) Many candidates gave the correct answer. Some found the answer by drawing the next pattern.

(ii) A majority of candidates gave a good explanation of how they obtained the answer in the previous part. A common error was to discuss the formula rather than the pattern of how the dots increase.

(c) Candidates understood what an n^{th} term is with about half of them giving the correct answer. The common error was to assume that because the number of dots increases by 4 each time, the term has +4 instead of $4n$ in it.

(d) The correct answer was seen in the work of about half the candidates. The most common error was to substitute 62 into the formula for n instead of equating the formula to 62 and finding n.

Answers: **(a)** correct pattern **(b)(i)** 22 **(b)(ii)** add 4 **(c)** $4n+2$ **(d)** 15

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key Message

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

General comments

Some candidates presented excellent scripts, neatly written, elegantly reasoned and with all calculations accurately carried out. Others lost marks because they had not prepared for one or more of the specialised topics such as transformational geometry in **Question 7**; set theory in **Question 8**; and functions in **Question 9**. Candidates made errors which lost credit in questions that they were capable of doing correctly, e.g. angle *DBC* for *ABC*; $7 – 2 (x − 3)$ became $7 − 2x − 6$ and $(5x)^2$ became $5x^2$.

Comments on specific questions

Question 1

On the whole this first question was well done by candidates throughout the ability range and it was a good source of credit for the less able ones.

(a) This part was very well done by candidates.

(b) (i) When an answer is a sum of money it is good to show the full answer in dollars and cents. There is no need to round \$468.72 to \$469.

(ii) Many did this correctly but some calculated 123% of \$64.68.

(c) Many candidates used the factor $(1.016)^3$. Just a few calculated the three lots of interest to obtain the result. Some were not sure about the multiplying factor, 1.6^3 and 1.016×3 were seen. Simple interest to get \$262 was not common.

(d) It was common to see the profit as a percentage of the selling price. Many calculated 324/288 × 100 and gave this as 112.5%, not the required answer.

Answers: **(a)** 1134 **(b)(i)** 468.72 **(ii)** 84.00 **(c)** 262.19 **(d)** 12.5

Question 2

(a) Many candidates realised that this was an application of the cosine rule and soon achieved full credit, although some made errors along the way. Many did not know the methods here and some applied Pythagoras to 4 and 9.

(b) (i) The main problem here was the interpretation of “how far *L* is south of *K*”. Some candidates were tempted to draw the south line through *K* to meet *ML* at point *P* for example, then assume angle *KPL* was 90°; then use a simple calculation to lead to the answer. This received no credit. Those who produced a right-angled triangle with an angle of 55° or 35° were successful. Some thought the answer was 9. Many candidates did not attempt this part.

(ii) Some candidates reached the correct answer. A few had 233 as their answer which scored half credit. Many wrong angles appeared; some from thinking the south line through *K* bisected 108.

Answers: **(a)** 10.9 **(b)(i)** 5.16 **(ii)** (0)53

Question 3

(a)(b) This question was well answered by a few candidates, but generally candidates struggled with calculating the missing table values, plotting the points and drawing the curve.

(c)(i) In this part, the graph of $y = 0.8$ was called a line, so those candidates who drew it freehand were penalised.

(c)(ii) This part was well done by the few candidates who had a good curve and the correct line.

(d) For this part, a tangent was required at (−1.5, −0.38). Although this point was already plotted on the answer booklet, attempts were made at many other points on the grid. Many candidates did not know about tangents.

Answers: **(a)** 1, 0.98, 0, −0.98, −1 **(c)(ii)** ranges around −1.15, −0.45, 1.6 **(d)** 4 to 5.5

Question 4

(a) Most candidates knew that angle *ABC* = 90°, but some of these subtracted 77° and wrote the answer as 13°.

(b) Using $\tan^{-1} 0.7$ was the direct way to full credit; many used longer methods involving Pythagoras' theorem and side *AC.* Some incorrect methods appeared assuming angle *CAB* = 55° in order to get 35°.

(c) Phrases like “angles in the same segment” or some reference to “same arc” are the preferred responses.

(d) (i) This required use of the sine rule which many candidates recognised and applied correctly.

(ii) This required use of the formula ½absin*C*, which some candidates could not apply correctly.

(e) (i) Just a few of the more able candidates used the square of the linear scale factor for the area scale factor.

Answers: **(a)** 90 **(d)(i)** 11.9 **(ii)** 38.6 **(e)** 8.69

Question 5

Many candidates could do the whole of this question and scored full credit.

(a), **(b), (c)(i)** These parts were very well answered by those candidates familiar with a cumulative frequency curve.

(c)(ii) Many candidates followed the usual procedure for the mean of a grouped distribution. Some candidates appeared unfamiliar with this method.

(d) There was a full range of responses to the request for the histogram. Full credit was awarded to a few candidates. Some made a good attempt but could not get the heights of the end two bars correct; some could not get the widths right. Many others made attempts using curves and polygons. Many candidates made no attempt to draw the histogram.

Answers: **(a)(i)** 2.8 **(ii)** 3.8 **(iii)** 1.8 **(b)** 6 **(c)(i)** 9,4,4 **(ii)** 2.95

Question 6

(a) (i) This was generally well answered although some candidates did not put the area equal to 1 so the expansion had constant 6, or sometimes 8. In converting $8x^2$ to $4x^2$,many candidates thought the area was ½*bh*.

(ii) This part was answered very well indeed by candidates and many scored full credit. Many lost some credit for not rounding 0.407 to two decimal places.

(iii) Using their answer to the previous part to calculate the height was well done by candidates.

(b) (i) This factorisation was extremely well answered with very few candidates not gaining the mark.

(ii) A few candidates realised that x^2-16 was a good denominator to use; the majority used $(x-4)(x^2-16)$. There followed a lot of algebraic manipulation, some of which did not show that both sides of the equation had been dealt with properly. There was much scope for errors, including missed brackets, and so it was only the more able candidates who reached the correct solution.

Answers: **(a)(ii)** 1.84, 0.41 **(iii)** 0.36 **(b)(i)** $(x - 4)(x + 4)$ **(ii)** -7

Question 7

There were many excellent responses to all parts of this question.

(a) (i) This was well done, many giving correctly all three elements of the transformation.

(ii) Some of the more able candidates did not see that the enlargement factor was negative 3, not just 3.

(iii) Many candidates got two or three of the elements correct with most appreciating that a single transformation was required.

(b) (i) Many candidates had the right idea; a few reversed x and y.

(ii) Those who knew where the line $x = -1$ was drew the image correctly.

(c) (i) This drawing was more challenging. The main errors were (3,5) going to (5,5) partially preserving the shape, and the use of "enlargement, SF2, from (0,3)". Some candidates received credit for a correct drawing with the x-axis invariant.

(ii) This was written correctly by those well prepared for this topic.

Answers: **(a) (i)** rotation, 180°, centre (0,0) **(ii)** enlargement, scale factor −3, centre (0,−3) **(iii)** enlargement, scale factor $\frac{1}{3}$, centre (0,6) **(c)(ii)** $\begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$

Question 8

(a) This was well answered by most candidates, although some included 1.

(b) This was well answered by those who understood the notation. Some candidates just listed the elements.

(c) (i) Most candidates succeeded in this test of algebra. However for some, this basic operation was not totally familiar.

(ii) Some candidates recovered from an incorrect part **(i)** by using the quadratic formula.

(d) Most candidates successfully filled in this Venn diagram. Some scored half credit for five elements correct. A common error was to omit the 1 and the 3.

(e) (i) Many could see that this set was empty but they did not know the usual symbol.

(ii) Very few candidates knew the symbol for an element belonging to a set. Some candidates used the symbol for "is not a subset of".

(iii) Many candidates knew the union symbol but it was also common to see the intersection symbol.

Answers: **(a)** 2,4,6,8 **(b)** 3 **(c)(i)** $(x - 4)(x - 9)$ **(ii)** 4,9 **(e)(i)** $\varnothing$ **(ii)** $\notin$ **(iii)** $\cup$

Question 9

(a) (i) This part was generally well done by candidates.

(ii) Many candidates correctly wrote $7 - 2(x - 3)$ but some did not remove the brackets correctly.

(iii) The question was interpreted well by many candidates with $(5x)^2 - 8$ commonly seen. Some candidates incorrectly worked out $(5x)^2$.

(b) Many candidates knew how to do this operation but made a sign error with $y - 7 = 2x$ or similar being seen.

(c) This was well done by many candidates but a common misinterpretation was $hf(x) = h(x) \times f(x)$.

(d) The same error as in the previous part was common, $ff(x) = f(x) \times f(x)$.

(e) This part was well done by many candidates.

Answers: **(a)(i)** 14 **(ii)** $13 - 2x$ **(iii)** $25x^2 - 8$ **(b)** $\frac{7-x}{2}$ **(c)** $9x^2 + 30x + 17$ **(d)** 7 **(e)** $x < -\frac{3}{8}$

Question 10

(a) Nearly all candidates could substitute into the given formula and nearly all of those correctly calculated the answer.

(b) The first task was to find the radius of the missing top cone. Similar triangles get $r = 3$ almost immediately but many candidates did not use this method. However, many able candidates achieved success in this part. Some employed the efficient method that the heights are in the ratio 1:3 so the volumes are in the ratio 1:27 and the required volume = $\frac{26}{27} \times$ part **(a)**.

(c) This part was well done and often scored full credit. Just a few candidates did not know the volume of a cylinder with $\frac{1}{3}\pi r^2h$, $2\pi r^2h$ and $2\pi rh$ being occasionally seen.

Answers: **(a)** 2036 **(c)** 2.88

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key message

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

It is important that candidates are fully aware of and experienced with the whole syllabus as there is no choice of questions. Certain formulae need to be learned and these include the quadratic equation formulae and trigonometrical formulae. When answering questions candidates should include clear working and use appropriate levels of accuracy. Candidates should also possess the ability to succeed in multi-step and contextual questions. Accuracy in graph drawing and in geometrical constructions is also important and candidates should possess basic geometrical instruments in good condition.

General comments

Almost all candidates were well prepared for this level of paper and were able to attempt all questions in the allotted time. Many candidates attained high credit.

Most candidates set out the work clearly and showed sufficient working in the questions which required proof that a given value was correct. Good calculator skills were demonstrated and appropriate levels of accuracy were usually seen, both in the working and in the answers. A few inaccurate answers were seen and candidates do need to be aware of the need to work to more than 3 significant figures and not to round off during calculations. When several steps of the working can be done on a calculator candidates should write down any methods used, not necessarily with answers, and not take the high risk of losing credit by only giving answers. There is the responsibility of communicating any methods used and this is becoming more important when some calculators can give answers from simple input.

The questions involving percentages, basic algebraic manipulations and equations, constructing loci and trigonometry were well answered. The linear programming question was more successfully answered than normal. More challenging questions were on scatter diagrams and lines of best fit, geometrical reasoning, lower and upper bounds, simplification of algebraic fractions, vectors, probability and surface area.

Comments on specific questions

Question 1

(a) This straightforward question on scatter diagrams proved to be quite challenging.

(i) Most candidates plotted the six points accurately. There were different scales on the two axes and the plotting of the points (39, 37) and (48, 45) was challenging.

(ii) Many candidates identified that there was a positive correlation and any qualifiers such as “strong” and “weak” were ignored. The language for correlation is clear in the syllabus and should be used. Candidates need to be aware that descriptive statements or words such as “increasing” or “linear” will not be accepted.

(iii) Many excellent lines of best fit were seen. Candidates should be aware that a ruler should be used and that best fit will require several plotted points on each side of the line. They should also realise that a set of straight lines connecting consecutive points is not a line of best fit.

(iv) This reading from the line of best fit was usually correctly answered. The challenge of the reading was to use the scale on the vertical axis correctly and a few candidates did use one square to 1 unit instead of one square to 2 units.

(b) Most candidates gained full credit by clearly showing the sum of the 10 values followed by the division by 10 to arrive at the provided answer. The challenge of a "show that" question is to show all the steps and the statement of the sum of 280 without the addition was insufficient.

(c) This question asking for the value of an item of data when the average was given proved to be challenging and discriminating. The more able candidates were generally successful in interpreting and solving the problem. There was an extra challenge in that 2 equal values were involved and a few candidates gave the sum of these 2 values rather than the required individual value.

Answers: **(a) (ii)** positive **(iv)** correct reading from graph **(c)** 46

Question 2

(a) This reverse percentage calculation proved to be challenging in the usual manner. The recognition that the given amount was (100 – 21)% was the demanding aspect of this question. The many candidates who realised this went on to be successful. The common incorrect approaches included finding 21% of the given $351.55 and subtracting or adding it and finding 71% of the $351.55.

(b) This simple and compound interest question was very well answered, with many candidates gaining full credit. The challenge for candidates was to use the appropriate method for each investment and to make sure that either interests or amounts were compared. Some confusion was seen in these respects. For the compound interest most candidates used the formula, even though it was not a requirement of the syllabus. Those who do calculate compound interest year by year must make sure they do find the total of the interests and not just use the final year's interest.

Answers: **(a)** $445 **(b)** Alex by $17.50

Question 3

This linear programming question proved to be more accessible than recent questions of this type.

(a) In parts **(i)**,**(ii)** and **(iii)**, many candidates gave fully correct inequalities from the information given. The challenges to candidates were to give correct inequality signs.

(b) Almost all gave the required inequality that simplified to the given one.

(c) (i) Four boundary lines were to be drawn on the grid provided and many candidates drew all four accurately and using a ruler.

There were a few difficulties in which axis each of the lines $x = 4$ and $y = 9$ was parallel to.

The line $y = 9$ should not have been on a grid line and the adjacent ones $y = 8.8$ or $y = 9.2$ were occasionally used.

The line $x + y = 20$ was usually correctly drawn, but the line $x + 2y = 30$ proved to be more demanding with incorrect intersections between the line and the axes being seen as well as correct but inaccurate intersections.

Many candidates correctly shaded the unwanted regions. A few candidates lost credit by not shading a small triangular part at the top of the region.

(ii) This final part, to find the smallest cost when certain restrictions were given, usually proved to be successfully answered by only those candidates who had a fully correct part **(c)(i)** and who were able to interpret the restrictions within the required region. Many answers were given using a pair of x and y which did not have a sum of 20. This was usually because the question asked for smallest cost and so these candidates looked at the bottom left hand corner of the region.

Answers: **(a)(i)** $x \geq 4$ **(ii)** $y \geq 9$ **(iii)** $x + y \leq 20$ **(c)(ii)** $145

Question 4

There were three quite separate parts to this question and some parts met with good success whilst others proved to be more discriminating, particularly the part on congruency.

(a) (i) Almost all candidates gave the correct value, demonstrating knowledge of parallel line properties. The reason for this answer met with less success and candidates should be prepared to use the vocabulary indicated in the syllabus. Many candidates correctly stated “alternate angles”. Neither “parallel lines” nor “Z” angles were sufficient for gaining credit.

(ii) Again, most candidates gave the correct answer of 90° whilst the reason of “angles in a semi-circle” or “angles subtended by the diameter” proved to be less well known.

(iii) This pattern continued here with “angles in the same segment” or “angles subtended by the same arc” seen much less frequently than the correct value of the angle. “Butterfly angles” or “bow tie” angles were not acceptable reasons, although such descriptions will certainly have assisted candidates in obtaining a correct value for the angle.

(iv) The calculation of this opposite angle of a cyclic quadrilateral proved to be more discriminating, possibly as a result of the diagram having much more than the quadrilateral itself. One common error was to omit the word “cyclic” from the reason.

(b) Many candidates scored full credit in this Pythagoras problem, clearly recognising the tangent/radius property of the circle. As the two given sides were 5 cm and 12 cm, some candidates automatically presumed the situation was a 5, 12, 13 triangle and overlooked the fact that the 12 cm line was the hypotenuse.

(c) (i) This part was one of the most challenging questions in the paper. Many candidates scored well in parts **(a)** and **(b)**, especially with the calculations. Many of these candidates demonstrated the need for more experience in “showing” results in this congruency question. A statement about a pair of sides or a pair of angles being equal needed to be supported by a reason. The other aspect of this type of question is about not using the fact that the triangles were congruent before the congruency had been shown.

(ii) The only acceptable word for this part was “congruent” and frequent answers were “similar” and “equal”.

Answers: **(a)(i)** 42° **(ii)** 90° **(iii)** 42° **(iv)** 138° **(b)** 10.9 cm

Question 5

(a) This money conversion question was extremely well done. A few candidates did not reach the required accuracy, often through using the result of the division as 29.9, which led to a 2 significant figure answer. A few candidates worked in euros instead of pounds and left the answer in euros.

(b) Almost all candidates correctly divided distance by speed and most reached the value of 3700 hours. The conversion into days and hours was much more demanding and the majority of candidates gave answers such as 154 days 10 hours. The challenge to candidates was to multiply the exact remainder from the division by 24, not 60.

(c) (i) This lower bound question was very well answered.

(ii) This part asking for lower and upper bounds of an area proved to be more demanding. Most candidates did find the upper bounds of the lengths of the sides of the rectangle and went on to multiply them. A few gave the correct values of the bounds of the area but the majority of candidates rounded their answers, usually to 3 significant figures. Another incorrect method occasionally seen was to multiply 9.3 by 5.6 and give the lower and upper bounds of this product. Candidates do need to be aware that lower and upper bound questions require exact final answers.

Answers: **(a)** £2.37 **(b)** 154 days 4 hours **(c)(i)** 9.25 cm **(ii)** 51.3375 cm^2, 52.8275 cm^2

Question 6

(a) This algebraic problem on angles in a quadrilateral was generally well done. Most candidates reached the correct answer of 64°, although a few made sign errors after starting with a correct equation. Another error seen occasionally was to treat the quadrilateral as a cyclic one and use the supplementary property of opposite angles.

(b) (i) Almost all candidates inserted the correct numerical value in sequence A. A few omitted this part and only filled in three missing terms in the final column, when the instruction in the question was for 4 missing terms.

Most candidates gave the correct algebraic expressions for the *n*th term in each of sequence A and sequence B. Sequence D was more challenging as candidates were expected to now look at the answers to sequences B and C, or to start again and recognise a more complicated pattern. Many of the stronger candidates were successful.

(ii) This was also a searching question, to find which term had a certain value, and full credit depended on a correct answer for sequence D. Other candidates could have gained a method mark by simply equating their expression to 500. This was often not realised with many candidates omitting this part. The candidates who had the correct expression to sequence D either took a formal quadratic equation approach or intuitively spotted the correct answer and both methods led to a high rate of success amongst these candidates.

(c) This was clearly one of the most challenging questions on the whole paper and proved to be a very good grade discriminator. The stronger candidates had no problem in factorising both the numerator and denominator and then cancelling the common linear factor. A large number of candidates used the quadratic formula and used the roots to give the factors. Many of these gave the factors as $(x-\frac{1}{2})(x+4)$ and lost the 2 from the $2x-1$. Others made sign errors with the factors and a large number of candidates did not factorise before attempting to cancel and either left the question unchanged or cancelled by terms which were not factors.

Answers: **(a)** 64 **(b)(i)** -1, n^2, $5n$, n^2+5n **(ii)** 20 **(c)** $\frac{x-4}{2x-1}$

Question 7

(a) This question involving the addition of a vector to a pair of co-ordinates to give the co-ordinates of another point was expected to be very straightforward. Many candidates did succeed but a large number subtracted the vector. A simple small sketch would have helped these candidates to realise that addition was necessary.

(b)(i) This simple vector geometry addition was generally well answered.

(ii) There were two challenges in this part overall this question proved to be challenging for many candidates. Firstly it was necessary to understand the meaning of position vector and secondly to be able to multiply a vector by a scalar. There was success for the stronger candidates and a method mark was available for realising that $\overrightarrow{OM}$ was the position vector.

(iii) This simple vector geometry addition was generally well answered by candidates.

(iv) This part required the addition of multiples of vectors and proved to be very difficult. A few of the stronger candidates were successful and many others gained a method mark for a correct route or a correct unsimplified answer. This part was often omitted.

(c) This part required a geometrical interpretation of simplified answers to part **(b)(i)** and **(iv)** and depended on these. Candidates with correct answers to these parts usually gave at least one of the properties being asked for. Candidates without these correct answers occasionally guessed at the properties or simply omitted this part. Correct guesses were not accepted as this part was about interpreting properties of vector expressions.

Answers: **(a)** (5, 3) **(b)(i)** 3a + c **(ii)** 3a + $\frac{1}{2}$c **(iii)** a + c **(iv)** $\frac{3}{2}$a + $\frac{1}{2}$c

Question 8

(a) (i) Almost all candidates correctly subtracted the given probability from 1.

(ii) This completion of a tree diagram was very well answered. A few candidates found the positioning of the pairs of probabilities demanding and this had a significant effect on marks in the next two parts. Almost all candidates did sensibly use the tree diagram to answer parts **(b)** and **(c)** and follow through method marks were awarded whenever possible.

(b) This combined probabilities question was generally well answered although a number of candidates need to be more aware of language in this type of question. Raining on at least one of the two days includes raining on both days and this was often overlooked. Many candidates correctly added three products and the more efficient candidates subtracted one product from 1, both methods being equally successful.

(c) Similar comments apply to this part as to part **(b)**. The majority of candidates re-started by adding the two correct products, which was seen as a more accessible method than subtracting one product from the answer to part **(b)**. Candidates who had reversed answers to parts **(b)** and **(c)** made an error through not having a full understanding of "at least" or "only one".

Answers: **(a)(i)** $\frac{2}{3}$ **(b)** $\frac{4}{9}$ **(c)** $\frac{14}{45}$

Question 9

This locus question was generally well answered. Most candidates were able to earn credit for part of the question by drawing at least one of the three loci. The constructions of the perpendicular bisector of a side and of the bisector of an angle were almost always accurate and usually with correct arcs showing. The third locus was simply an arc of radius 5.5 cm, although a surprising number of candidates used a radius of 5 cm. A few candidates constructed the bisector of a side instead of the bisector of an angle and a few seemed to need more experience of working with the three capital letter notation for angles. The shading of a region depended on three accurate loci and was frequently correctly completed, although a small number of candidates missed one of the boundary lines in their shading.

This question clearly depended on candidates being fully equipped with basic geometrical instruments and it did appear that some candidates did not have compasses, pencil sharpeners or erasers.

Question 10

(a) (i) This indices question was generally well answered with most candidates showing a good understanding of the rules for cubing numbers and cubing powers. A few incorrect rules and answers such as $2x^6y^9$, $8x^5y^6$, $6x^6y^9$ appeared.

(ii) Although this question was also on indices, the power of $-\frac{1}{3}$ proved to be very challenging. Many candidates scored partial credit by finding the cube root of 27 and/or the cube root of x^6. The most successful approach appeared to be to deal with the negative part of the power first and then find the cube root of $\frac{x^6}{27}$.

(b) This expansion of two pairs of brackets was the most successful part of **Question 10**. The challenge to candidates was to be careful when expanding and avoid sign errors which were seen. Another perhaps unexpected error was the omission of the power in the first and last terms. A few candidates attempted to partially factorise a correct answer and lost credit by doing this.

(c) (i) This transformation of a formula question was generally well done, with candidates carrying out two steps correctly and in a sensible order, showing good technical skills. A few candidates showed the need for more practice with this type of algebraic manipulation and the ones who divided by $2\pi r^2$ first were more likely to get into difficulty, as the πr^3 term was occasionally not divided by the $2\pi r^2$. Some candidates divided by the 2 and the πr^2 or 2π and r^2 separately, often successfully, but the risk with this approach was to leave the answer as a "triple fraction". The other challenge to candidates was to know when they had arrived at a final answer and not to attempt to cancel when π or r were not factors.

(ii) This second transformation of a formula question was also very well done and only the weaker candidates struggled when the two steps were more straightforward than in part **(i)**. The 3 in the $\sqrt{3h}$ caused some candidates to cube the V instead of squaring.

(d) This collection of three simple algebraic fractions was generally well attempted. Candidates need to know that this type of question may result in a possible cancelling at the end and a common answer was the correct but unsimplified $\frac{10x}{24}$. Other errors were present, the most common being to add the three fractions instead of subtracting the third one.

Answers: **(a)(i)** $8x^6y^9$ **(ii)** $\frac{x^2}{3}$ **(b)** $6x^2 + 11xy - 10y^2$ **(c)(i)** $\frac{V - \pi r^2}{2\pi r^2}$ **(c)(ii)** $\frac{V^2}{3}$ **(d)** $\frac{5x}{12}$

Question 11

(a) This area of a circle question was almost always correctly answered. A small number of candidates calculated the circumference and a few gave an answer out of range because they had used $\frac{22}{7}$ for π. It is important to remember that candidates should use their calculator value for π or 3.142 as indicated on the front cover of the paper.

(b) This surface area question was a good discriminating question, allowing the stronger candidates to show their ability and allowing other candidates to collect some partial credit. The correct answer was the sum of a sector area and the area found by multiplying an arc length by a straight length.

Most candidates made a correct attempt at the area of the sector, although a few treated the sector as a triangle and a few others multiplied this area by the height to obtain a volume. The other area was more challenging and the most successful approach appeared to be to find the fraction of the curved surface of a cylinder rather than find the arc length and then multiply it by the height. There was then the challenge of working to sufficient accuracy and a number of candidates found the two areas separately to 3 significant figures and after adding they gave an answer outside of the accuracy range.

This endorses the point about showing working since such candidates were able to still score 4 out of the 5 marks. Although the two areas were shaded on the diagram, some candidates appeared to ignore this and either found only one area or included extra areas.

(c) This trigonometry question was very well answered, considering it was a two stage calculation. Most candidates realised which side of the first triangle was needed for the second triangle and many used the sine rule to find this rather than the $\frac{11}{\cos 50}$ available from a right-angle triangle. The second step was to use the cosine formula and candidates were generally well equipped for such calculations. The points made in part **(b)** about accuracy and showing working also applied in this part as 4 of the 6 marks were available for correct methods.

Answers: **(a)** 452 cm^2 **(b)** 59.9 cm^2 **(c)(i)** 37.9 cm

Question 12

(a) This simultaneous equation problem was very well answered. Most candidates were able to translate the given information into two correct equations and then go on to solve the equations successfully. The most popular method was to multiply the equations and then eliminate one variable. Less popular and less successful was to use the substitution method, especially with the number term being a decimal.

(b) This standard quadratic equation formula question was very well answered and most candidates adhered to showing working and to the 2 decimal places as required in the question. A few candidates appeared to have a facility to obtain answers from their scientific calculator and need to be aware that full credit is not available if correct working is not shown. A few candidates made errors either in substituting in the formula or in the formula itself. Most candidates were clearly aware that this formula usually appears either on paper 2 or paper 4 and were able to state the formula without errors. Correct 1 decimal place answers or more than 2 decimal place answers lost credit with the result that a number of candidates scored 3 of the 4 marks. 3.60 and – 1.10 were incorrect answers to 2 decimal places and lost the 2 answer marks. The $(-5)^2$ was often written as -5^2, with some candidates recovering to + 25 but others leaving it as – 25.

Answers: **(a)** $x = 0.85$, $y = 0.55$ **(b)** – 1.11, 3.61

MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key Message

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

General comments

This paper proved to be accessible to the majority of candidates. Almost all candidates were able to attempt all of the questions. Well-structured answers with clear methods were shown in very many cases. Candidates should record all of their working and solutions inside the question booklet provided.

As in the previous sessions, the questions/parts of questions on arithmetic (percentages, ratio, etc.), calculating an estimate of the mean, general trigonometry and drawing graphs of functions were very well attempted. The questions involving some aspects of functions, the matrix and stretch aspects of transformations, sets and probability, and using given information to verify a quadratic equation proved to be the more challenging aspects.

There were very many excellent scripts, scoring very high credit and virtually all candidates were appropriately entered at extended tier and achieved success on this paper.

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

Comments on specific questions

Question 1

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

(a) (i) This was almost always correctly answered. A few left an answer of 29 38 without converting it to an actual time of the day.

(ii) The majority were successful in dividing the distance, 850 km, by the time in hours. Some prematurely approximated the time in hours to 9.16 or 9.17 instead of using the fraction facility on the calculator or the full decimal value for 9 hours and 10 minutes and this resulted in an inaccurate final answer. A few incorrectly converted the time in hours to 9.1 hours and some incorrectly divided by 5 hours 38 minutes believing there was a link to the time in **part (a)(i)**.

(b) (i) This average calculation proved to be very straightforward to the majority. A significant number of candidates used a correct method but misread the value of 255 as 225 either by writing it down as 225 or by writing it correctly but then keying 225 into the calculator to give the answer of 196. The other common errors were getting a correct total and then dividing by the incorrect frequency, e.g.

$\frac{30500}{625}$, the 625 being the sum of the costs rather than the sum of the passengers, or for the less able candidates doing $\frac{255+190+180}{3}$.

(ii) Most candidates were successful but a few did not show sufficient working using the given ratio to establish the value 240 from the 640 people on the train.

(iii) Most were well prepared for this reverse percentage calculation and showed clear working leading to the answer 150. The most common error was to find either 60% or 40% of 240.

(c) This question proved to be challenging as many candidates were unable to convert a speed in kilometres per hour to metres per second or an equivalent unit conversion calculation. Many others were unable to obtain the distance travelled by the train through the station as the sum of 340 m (length of station) and 210 m (length of train). Common errors in the distances were to use 340 m, 130 m and 760 m.

Answers: **(i)** [0]5 38 **(ii)** 92.7 **(b) (i)** 204 or 203.9[0] to 203.91 **(ii)** correct proof **(iii)** 150 **(c)** 11

Question 2

Most candidates made a very good attempt at this question and showed good understanding of general trigonometry.

(a) The majority of candidates used the sine rule correctly and gave the answer correctly to at least 3 significant figures. A few were economical with their method and only wrote the implicit version of the sine rule before going on to give the solution. In the cases where the full method is not shown, candidates must give their answers to sufficient accuracy to imply the correct rearrangement of the sine rule formula. Answers of 56 alone do not imply this method step. A few candidates used techniques suitable for right- angled triangles only.

(b) The majority of candidates used the cosine rule correctly for this part. There were some that lost credit for premature approximation of either the decimal value of cosine 30 or at the square root stage and gave answers such as 8.9 or 9.94 for example. A few incorrectly evaluated the cosine rule having substituted the values correctly or made an error in quoting the formula such as omitting the '2' from the $2bc\cos A$ part of the formula. Some very able candidates used a longer method dropping a perpendicular from *C* to *AB* for example and then working with two right-angled triangles. Those using this method were invariably successful.

(c) (i) The majority of candidates obtained the correct bearing, and a follow through mark was allowed for those that added 70° to their answer to **part (a)**.

(ii) This was also well answered although fewer were successful than in **part (c)(i)**. A common error was to subtract 126.1° from 360° to give 233.9° or to give an answer of 53.1°. A follow through mark was allowed for those that added 180° to their answer to **part (c)(i)**.

(d) The majority used the sine rule to find angle *BCA* before adding angle *ACD*. A common score was for candidates to get 3 out of the 4 marks. Most did not give the obtuse angle *ACB* but gave the acute angle within an otherwise correct method. Some candidates used a different approach, using the sine rule or cosine rule to find angle *ABC,* and then considered the angles of the quadrilateral *ABCD*. This method usually resulted in all 4 marks as the obtuse angle *BCA* did not have to be considered.

Answers: **(a)** 56.1 **(b)** 8.93 **(c)(i)** 126 or 126.1 **(ii)** 306 or 306.1 **(d)** 137

Question 3

This question on transformations was generally well attempted. Candidates found the work on finding the matrices representing transformations and drawing the stretch the most challenging.

(a) The translation of shape *P* was usually drawn correctly. A minority translated shape *P* by the vector $\begin{pmatrix}3\\5\end{pmatrix}$ instead of $\begin{pmatrix}5\\3\end{pmatrix}$.

(b) The reflection of shape *P* in the line $x = 6$ was drawn accurately generally. The common errors were to reflect shape *P* in the line $y = 6$ or in the line $x = 5.5$ or to reflect the translated shape from part **(a)** in the line $x = 6$.

(c) (i) The majority of candidates scored full credit by describing the rotation in full. A common error was to omit the angle or direction of the rotation or omit the centre of rotation from the description. In this question, the word **single** transformation was in bold and only a very small number attempted to give more than one transformation which negates all of the marks.

(ii) Finding the matrix to represent the rotation was less well done than the previous parts. Many candidates recognised that the matrix had elements of zeros, ones and minus ones but often gave these in the incorrect position within the matrix. An incorrect answer of $\begin{pmatrix}0 & 1\\-1 & 0\end{pmatrix}$ was fairly common. Some weaker candidates attempted to use the co-ordinates of shape *P* or *Q* to form the matrix.

(d) (i) Many candidates did well in drawing the stretch and scored full credit. Others were unsure on how to use the *x*-axis as the invariant line for their drawing. Common errors were to use the *y*-axis as the invariant line to produce a stretch in a horizontal direction rather than a vertical direction or to produce a correct sized triangle but with co-ordinates at (1, 1), (4, 1) and (4, 7).

(ii) A number recognised the form of a matrix representing a stretch and were able to substitute the scale factor of the stretch into the correct position within the matrix. Common errors included giving the matrix representing a stretch with the *y*-axis invariant or an enlargement matrix $\begin{pmatrix}3 & 0\\0 & 3\end{pmatrix}$.

Answers: **(c)(i)** Rotation, 90° anti-clockwise, about (0, 0) **(ii)** $\begin{pmatrix}0 & -1\\1 & 0\end{pmatrix}$ **(d)(ii)** $\begin{pmatrix}1 & 0\\0 & 3\end{pmatrix}$

Question 4

Generally candidates did well in this question on statistics. They were particularly well prepared for the part on finding an estimate of the mean.

(a) (i) Candidates were invariably successful at stating the mode but many found the median more difficult. One mark was available for recognising that the median was to be located in the 10.5^{th} position. Many candidates did not show any method however and common errors were to give answers of 1, 1.5, 3, 10 or 10.5 for the median.

(ii) This was very well answered with the majority showing a clear method of 3/20 × 360° leading to an answer of 54°. For a few, an error was to use 100° or 180° instead of 360°.

(b) This was answered very well by candidates. Most showed clear working of the sum of the products of the frequencies and the mid-interval values to give 3680 before dividing by 20. A few used incorrect mid-interval values of 175.5, 185.5 and 195.5 or even the upper or lower bounds of each class. A few also used the class widths of 10 instead of the mid interval values for the calculation.

Answers: **(a)(i)** median = 2, mode = 3 **(ii)** 54 **(b)** 184

Question 5

Most candidates scored well in this question on mensuration involving cylinders and spheres.

(a) (i) There were many excellent answers where candidates showed clearly the volume of the cylinder by subtracting the volume of the two spheres. The most common error was to misunderstand the problem and simply find the volume of the cylinder as 1206. Other errors included subtracting the volume of one sphere only from the volume of the cylinder or to use an incorrect formula for finding the volume of either the cylinder or the sphere even though the volume of the sphere was quoted on the question paper. For the sphere calculation, a very common error was to use the formula $V = \frac{4}{3}\pi r^2$.

(ii) A follow through mark was allowed here for dividing an incorrect answer from **part (a)(i)** by 1000. There were a number who did not know the conversion from cm^3 to litres.

(b) This was usually well answered by candidates. Follow through marks were allowed again from previous incorrect answers. The majority multiplied their volume from **(a)** by 1.22 grams and then divided by 1000 to convert the mass into kilograms. Many more were aware of the conversion from grams to kilograms than cm^3 to litres in the previous part.

(c) Those candidates who scored well in the previous parts, invariably scored well here and were able to divide their volume from **part (a)(i)** by 64π. A number restarted the problem and were successful. There were some that gave slightly inaccurate answers or answers to two significant figures only. In those cases, it was essential that the full method was shown in order to score the method mark.

Answers: **(a)(i)** 980 **(ii)** 0.98[0] **(b)** 1.2[0] **(c)** 4.87 or 4.88

Question 6

This question caused some problems for most candidates particularly in interpreting aspects of the set notation used and in the probability section of the question.

(a) (i) This was usually correctly answered. Occasionally 30 was given.

(ii) This was usually correctly answered. Occasionally answers of 170, 180, 150 or 60 were given.

(b) Candidates found it difficult to interpret the notation here and correct answers were infrequent. Common errors included answers of 30 or 70.

(c) (i) This was usually correctly answered. A few gave answers such as $\frac{180}{240}$ or $\frac{20}{240}$. Some attempted to convert to decimals and provided they showed the fraction as well, then incorrect conversions were allowed. Those that did not show the fraction must ensure that their decimal answers are given to at least three significant figures.

(ii) This was usually correctly answered. A few gave answers such as $\frac{200}{240}$ or $\frac{180}{240}$.

(d) (i) There were some excellent answers to this part but many candidates did not follow the instructions of giving their answers to four decimal places. The most common incorrect answer was from $\frac{180}{240} \times \frac{180}{240} = 0.5625$. Some candidates saw the probabilities as being independent. Other errors included $\frac{30}{240} \times \frac{30}{240}$ or $\frac{180}{240} \times \frac{179}{240}$ or $\frac{150}{240} \times \frac{149}{239}$.

(ii) There were similar errors here to those described in part **(d)(i)**. Errors also included $\frac{180}{240}\times\frac{60}{240}$ or considering one path only, i.e. $\frac{180}{240}\times\frac{60}{239}=0.1883$ for which a method mark was given.

(e) Many were able to score one mark in this part by recognising that the probability of one passenger being chosen from those on holiday was $\frac{150}{180}$. Common errors included $\frac{150}{180}\times\frac{50}{180}$ or $\frac{170}{240}\times\frac{169}{239}$ or $\frac{150}{240}\times\frac{150}{240}$.

Answers: **(a)(i)** 180 **(ii)** 20 **(b)** 220 **(c)(i)** $\frac{170}{240}$ **(ii)** $\frac{150}{240}$ **(d)(i)** 0.5617 **(ii)** 0.3766 **(e)** 0.6937

Question 7

This question tested the drawing of a simple exponential graph and then questions related to solving related equations and gradients of tangents to the curve.

(a) The majority completed the table correctly. There were occasional errors usually with the first two values, where 0 and 11 were the main errors.

(b) The points were usually plotted correctly and the standard of curve drawing was very good. A small number of candidates plotted the values at (2.5, 5.7) or (3.5, 11.3) inaccurately, and a small number used straight lines to join the points rather than a curve.

(c) This was answered very well, with the majority of candidates giving an answer in the required range 2.3 to 2.35.

(d) Answers were more varied here, and a correct ruled line for $y = 3x$ was required to earn a method mark initially. Those that drew the line $y = 3x$ correctly, were usually able to give the intersections of the line with the curve correctly, although the higher value was occasionally out of the range required. A significant number of candidates either omitted the line $y = 3x$ or drew an incorrect line.

(e) There were a large number of correct solutions here where candidates were able to draw a tangent to the curve with a gradient of 3 and were then able to give the accurate coordinates of the contact point with the curve. Many drew inaccurate tangents however, with some misunderstanding the question by drawing a tangent at $x = 3$. Partial credit was given for candidates drawing any tangent.

Answers: **(a)** 1, 11.3, 16 **(b)** Correct curve **(c)** 2.3 to 2.35 **(d)** $0.4 \le x \le 0.5$, $3.25 \le x \le 3.35$

(e) Correct tangent drawn and coordinates of point of contact given.

Question 8

(a) Three angles were required in this part. Many were successful with all three values. Most used the property ‘angles in the same segment’ to obtain $u = 24$. The angle v proved to be the hardest angle to find and a common error was to give 88. The majority understood the property ‘angle at the centre is twice the angle at the circumference and were able to find w correctly or as follow through for their value of $v \times 2$.

(b) Those that attempted to find the area scale factor by using the linear scale factor squared were usually successful in obtaining the correct answer. A great many candidates made the mistake of using the linear scale factor and multiplied 1.2 by 3 to get 3.6.

(c) (i) Most candidates were able to answer this part well and the fact that $4x + x = 90°$ because of the angle between the tangent and the radius. The most common error was to incorrectly assume that $4x + x + 2x$ lay on a straight line or that angle HGK was also equal to $4x$

(ii) Those that answered part **(i)** correctly usually went on to give correct answers for parts **(ii)** and **(iii)**, and a follow through was allowed from an incorrect answer in part **(i)** where a correct method had been used.

The most common error was to give angle *JKG* as 54° by assuming that triangle *JKG* was isosceles.

(iii) Many candidates were correct, often using the angles in a triangle sum to 180°. The most common error was to give an answer of 72° either from using an incorrect value from part **(ii)** or from mistakenly thinking that the angle was an alternate angle to angle *JGF*.

Answers: **(a)** u = 24°, v = 92°, w = 184° **(b)** 10.8 **(c)(i)** 18° **(ii)** 72° **(iii)** 54°

Question 9

This question on functions was answered well by many candidates who generally showed a clear understanding of the notation used. Part **(b)**, **(d)** and **(e)** proved to be the most challenging.

(a) (i) This was often calculated correctly and most candidates evaluated f(2) = – 3 first before substituting into function g. A few gave decimal answers only for which three significant figure accuracy or better was required. A few obtained f(2) correctly but then tried $\frac{1}{2} \times -3$ at the second stage. Some weaker candidates did g(2) first.

(ii) This was very well answered. Only a few candidates were unable to evaluate h(–2) correctly.

(b) The majority of candidates were able to score a method mark for reaching fg(x) = $1-\frac{2}{x}$. The second instruction of giving the answer as a single fraction was overlooked or done incorrectly by most candidates. A common error was to see $1-2\left(\frac{1}{x}\right)=1-\frac{2}{2x}$ or $1-\frac{2}{x}=\frac{-1}{x}$.

(c) The inverse function was generally very well done with candidates showing clear working. The most common error was to write $\sqrt[3]{x+1}$ rather than $\sqrt[3]{x-1}$. Others missed a stage and neglected to give their answer in terms of x by giving $\sqrt[3]{y-1}$.

(d) This part which involved matching given graphs with their equations produced a range of responses. A number of candidates did well. The common errors were to confuse graphs A and C and graphs D and E.

(e) This part proved challenging for most. A few candidates used the concise method of k(2) to solve the equation $k^{-1}(x) = 2$. The majority attempted the longer method of finding k^{-1} and then using this to solve the given equation. Many candidates made errors in finding the inverse, usually
$\sqrt[5]{x-3} = 2$ leading to an answer of 35.

Answers: **(a)(i)** $-\frac{1}{3}$ oe **(ii)** – 7 **(b)** $\frac{x-2}{x}$ **(c)** $\sqrt[3]{x-1}$ **(d)** *A, F, D* **(e)** 29

Question 10

(a) This was often correctly answered. Most set up an algebraic equation of $12x + 7(x + 1) = 31.7$ before solving correctly. The most common error was to either neglect the brackets on $7(x + 1)$ or incorrectly expand them to $7x + 1$.

(b) (i) This proved one of the more challenging aspects of the paper, although there were a number of Centres where candidates scored very highly in this part. For many, the fractions $\frac{36}{y}$ and $\frac{36}{y+1}$ were not considered within the proof and they incorrectly started with a rearrangement of the given equation.

(ii) There were a full range of responses to factorising the quadratic equation. There were many correct answers and also a large number where candidates had used their calculators to obtain the solutions and then fed them back into the factors incorrectly giving $(x + 1.8)(x – 0.8)$. Others did not recognise the form required for the factors and gave answers such as $25y (y + 1) – 36$.

(iii) This was very well answered by candidates even by those who did not score in the previous part as most used their calculators or used the quadratic formula in some cases to obtain the solutions.

(iv) This was very well answered and even those that did not score in the previous part were able to score a follow through mark using their positive root from **part (b)(iii)**.

Answers: **(a)** 1.3[0] **(b)(i)** correct proof **(ii)** $(5y + 9)(5y – 4)$ **(iii)** – 1.8, 0.8 **(iv)** 2.6[0]

Question 11

(a) The table was generally completed correctly by candidates. A few made errors in the second row with answers such as 14π and 19π, mistakenly thinking there was a linear sequence to be continued or in the third row where a similar error was made. Some omitted π from their answers.

(b) (i) This was a very well answered part. Equivalent expressions for the nth term such as $9 + 8(n –1)$ were acceptable. A few misunderstood the nth term and gave answers such as $n + 8$.

(ii) This was a very well answered part. The only common error was an answer 8777 from finding the 1097th term 8 x 1097 + 1.

(c) (i) Very well answered by candidates. A few omitted π from their answer in this part and also the next two parts and gave an answer of n^2.

(ii) The more able candidates answered well. A very common error was to omit important brackets and give $3n^2\pi$ as the answer instead of $(3n)^2\pi$.

(d) This proved to be the most challenging part of the question and a significant number were successful. Many other candidates gave an indication of some understanding by giving answers such as $n(n + 1)$ or $n^2\pi + n$ for example for which they scored 1 of the 2 marks.

Answers: **(a)** 33, 41 $16\pi, 25\pi$ $20\pi, 30\pi$ **(b)(i)** $8n + 1$ **(ii)** 137 **(c)(i)** $n^2\pi$ **(ii)** $9n^2\pi$ **(d)** $n(n+1)\pi$