MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key Messages

To succeed in this paper, candidates need to have completed the full Core syllabus, be able to remember and apply formulae and to give answers in the form required. Candidates are reminded of the need to read the question carefully, focussing on key words.

General Comments

Candidates must check their work for sense and accuracy as it was very noticeable that there were many answers in context that weren't realistic for the context. Candidates must show all working to enable method marks to be awarded. This is vital in two or multi-step problems, in particular with algebra, where each step should be shown separately to maximise the chance of gaining marks in, for example, **Questions 4**, **5**, **14** and **18**. This will also help candidates check their own work. It is also worth noting that candidates should use HB pencils for diagrams. Some candidates used pens, and then could not alter their diagrams.

The questions that presented least difficulty were **Questions 2(b)**, **3(b)**, **4**, **18** and **20(a)(i)**. Those that proved to be the most challenging were **Questions 12, 14**, **20(a)(ii)**, **21** and **22**. In general, the number of questions with no responses was similar to past series. It is likely that the blank responses were down to the syllabus area being tested rather than lack of time.

Comments on Specific Questions

Question 1

This was a straightforward start to ease candidates into the paper and many gave the correct answer. Workings were useful here for candidates to check they had the correct day and the most successful way was to make a mini calendar.

Answer: Sunday

Question 2

Sometimes this type of question asks for the difference between two temperatures so a negative answer is acceptable, but here, the question asks how many degrees colder it is in Berlin so –4 is not correct. This negative answer showed some understanding but could not gain the mark. Candidates were much more successful in part (**b**) although a common incorrect answer was 30.

Answers: **(a)** 4 **(b)** 16

Question 3

In part **(a)**, the majority of candidates were able to calculate 8% of 300kg, but went on to add this increase to 300kg. As this is a one mark question, this could not receive any credit. A large majority correctly answered part **(b)** but a few only gave 68% or truncated the answer to 67%, neither of which scored the mark.

Answers: **(a)** 24 **(b)** 67.5

Question 4

This question was answered correctly by many candidates. The method was to divide 1824 by 38 for the mass of one spoon then to multiply by 53 to calculate the mass of 53 spoons. However, a few candidates added 53 onto 1824 or multiplied 53 by 1824 or 38.

Answer: 2544

Question 5

Many candidates knew how to calculate the simple interest but good work was often spoiled by the principal being added at the final stage. A significant number of candidates attempted compound interest. Questions on interest have various aspects for candidates to consider; is what is asked for compound or simple interest and is the answer required just the interest earned or the interest and the principal? If candidates consider these two aspects they may be able to gain at least some marks. Candidates also need to check that their answer makes sense in context so a value that is larger than the original sum is not likely to be correct. There were no rounding issues in this question as the answer was an exact number of dollars.

Answer: 600

Question 6

This construction caused difficulties for some candidates maybe because the given line was vertical not horizontal. Many triangles did not have a correct pair of arcs so could only score one mark. A fairly common error was to assume that the triangle was right-angled, which left candidates unable to construct a triangle that had sides of the lengths given in the question.

Question 7

Candidates were more successful with part **(b)**, parallelogram, than with the circle in part **(a)**. Regular hexagon was the most common incorrect choice for part **(a)** probably due to candidates not appreciating that they were asked for the shape with more than 6 lines of symmetry rather than just 6 lines alone.

Answers: **(a)** Circle **(b)** Parallelogram

Question 8

Some candidates understood what was required and gave the correct form of the answers but made errors dealing with the directed numbers. Although some candidates tend to treat a vector as a fraction, including a horizontal line between components, this number was very small.

Answers: **(a)** $\begin{pmatrix} 9 \\ 15 \end{pmatrix}$ **(b)** $\begin{pmatrix} 11 \\ -2 \end{pmatrix}$

Question 9

There were many responses left blank for this question. For part **(a)**, most candidates who answered were correct and very few wrote 'negative'. Alternative answers that did not score included, direct proportion, linear, increasing, scattered, number of sales, symmetrical, and 5 : 2. This last was maybe an attempt to link the sales of each item and this idea fed through into some of the comments in part **(b)**. Candidates found it challenging to articulate the relationship between the sales of the two items. What is required is the trend that a line of best fit will show. Some candidates assumed that the trend was over time with the low plots at the start of the two weeks and higher at the end but any comment about time cannot be made from this diagram.

Answers: **(a)** Positive **(b)** The more ice creams sold, the more sun hats sold

Question 10

Most candidates answered this question well, gaining at least one mark. The most common incorrect answer was $24uw^3$. As two of the three components were correct, one mark was scored. Another fairly common error was that candidates did not understand that the indices must be added not multiplied and as this is a method error, did not score. Some candidates did not finish the multiplication of 6×4.

Answer: $24u^2w^3$

Question 11

Many candidates recognised the need for trigonometry and there were some very good answers that were supported by clear working. However, this question proved challenging for many as the correct method was seen then spoilt by inaccuracies, either from premature rounding leading to an inaccurate final answer, or from giving the final answer to only two significant figures. Those who wrote an implicit sine formula sometimes struggled to use it, with 37×sin11.2 being calculated in a significant number of cases. Incorrect trigonometric ratios were chosen in a number of cases, mostly cosine, but sometimes tangent.

Answer: 6.74

Question 12

Many candidates left this question blank and candidates continue to find this topic challenging. In part **(a)**, (3, 5) was the most common incorrect answer, presumably since these two numbers were in the question. As part **(b)** built on the understanding of the equation of a line, those who did not score in part **(a)** were generally not successful in this part. The common error was to change the gradient to $\frac{1}{3}$, –3 or another multiple of 3.

Answers: **(a)** (0, 5) **(b)** $y = 3x + k$, $k \neq 5$

Question 13

This was one of the more straightforward factorising questions as there was only one factor to consider. However some candidates wrote only the w or $3w - 2$ as their final answer. As this question was only one mark, the factorisation had to be completely correct to score. Candidates were more successful in part **(b)** and many were awarded at least one mark for multiplying out one of the brackets. A common error was to attempt to combine the x^2 and x terms.

Answers: **(a)** $w(3w - 2)$ **(b)** $2x^2 + 8x - 35$

Question 14

This question had no scaffolding so candidates were left to determine the approach which raises the difficulty level of the question. The consequence of this is that candidates struggled with this question and the answer space was left blank in many cases. The most common error was to ignore one of the given pieces of information – underlining each piece as it is used is a good technique here – with the most common piece to omit being the two spoons a day. Once the daily amount of medicine was found, candidates had to convert this into litres or the 2 litres into millilitres. This conversion stage was not performed well with many candidates assuming there is only 100ml in 1 litre. Finally, the amount of medicine had to be divided by the daily amount and rounded down.

Answer: 11

Question 15

This question involved a reverse volume calculation as instead of starting with the three dimensions and finding the volume, candidates had to divide the volume by the given dimensions to find the third. There were some very good answers to part **(a)** but the two stages had to be shown in order to earn the method mark. A number of candidates divided 288 by one of the given dimensions but then multiplied by the other. 60 was a common incorrect answer. In part **(b)**, there were many correct answers seen. However a wide variety of errors in method was also seen, for example, 64 (4^3), 72 (288 ÷ 4), 292 (288 + 4), 4608 ($4^2 \times 288$) and 95 551 488 ($288^3 \times 4$).

Answers: **(a)** 4.8 **(b)** 1152

Question 16

This question was answered well by many candidates, who showed complete and convincing working. The first step was for candidates to convert to an improper fraction and the majority of these went on to show a correct method for division. Some candidates made arithmetical errors. A few candidates arrived at a correct answer, but showed spurious or no working, suggesting that they had resorted to using their calculators to arrive at the solution and then worked backwards. Candidates should be clear that in questions of this type, a decimal fraction is not acceptable.

Answer: $\frac{21}{5}$ or $4\frac{1}{5}$

Question 17

Many candidates find standard form challenging and the main error in this question was having more than one digit before the decimal point. Many appeared to be counting zeroes, with the answer to part **(a)** given as 826×10^2. Candidates must remember not to round the given number to less figures unless told to do so. Part **(b)** was more complex than the previous part as the calculation had to be performed (using the correct order of operations) and the answer given in the form asked for. Many calculators give this answer as 199 which had to be converted to standard form.

Answers: **(a)** 8.26×10^4 **(b)** 1.99×10^2

Question 18

This question was correctly answered by many candidates including some who had problems with algebraic manipulation earlier in the paper. The weaknesses in algebra skills were exposed in this question as some candidates were unable to correctly multiply out the bracket or to divide both sides by 5. Almost all of the candidates who were able to perform this first step went on to produce the correct solution by the reverse operations. A few left their answer as $\frac{45}{15}$.

Answer: 3

Question 19

In general, this question was not answered well. There were two main types of error; not understanding what was required or a lack of accuracy in the drawing. However, some candidates did produce very neat, well executed diagrams but they were in the minority. Many only earned one mark for a correct line parallel to *AD* or for a correct arc around *C*.

Question 20

Some candidates left one or more of the last two parts blank of this question on sequences but for many, part **(a)(i)** was much more accessible. Candidates had difficulty in expressing the rule for continuing the sequence in part **(a)(ii)**. Some candidates explained how to find the difference, but not how to use it, others made reference to odd numbers but did not explain that the sequence involved adding the next odd number. Some candidates made erroneous or ambiguous statements, such as ‘add 2 each time’. Candidates were generally more successful in part **(b)** with many giving the first three terms correctly. Some started with $n = 0$ or $n = 2$ instead of $n = 1$. A few used the nth term as the first term in the sequence so gave $4n – 3$, $8n – 6$ and $24n – 18$. Other candidates gave 4, 1, –2 from misunderstanding $4n – 3$ as 'start with 4 and then keep subtracting 3'. There were other incorrect answers that had no workings to show how they had been calculated.

Answers: **(a)(i)** 27, 38 **(ii)** Add the next odd number **(b)** 1, 5, 9

Question 21

Candidates had difficulties writing 30 as a product of its prime factors as they included 1 or wrote the factors as a list rather than showing the multiplication. Some just gave two numbers that multiplied to 30. More candidates correctly answered part **(b)** or gave workings showing they were more familiar with multiples than factors. However, there were some that identified a common factor instead i.e. 3, 5 or 15.

Answers: **(a)** $2 \times 3 \times 5$ **(b)** 90

Question 22

For the large majority of candidates, this was the most challenging question on the paper. This was not a completely straightforward question on similar shapes as candidates had to scale down the triangle and the scale factor was not an integer. Some candidates assumed that the connection was 'subtract 2' so gave an answer of 8 for x and then y in the larger triangle became 11. If candidates calculated the scaling factor (in either direction) this was worth one mark in part **(a)**. If candidates had used their incorrect x and the 10 in a correct method to calculate y a follow through method mark was available. This did not score both marks as it is possible and preferable to calculate y without involving x.

Answers: **(a)** 7.5 **(b)** 12

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key Messages

Show clear working on all parts that have more than 1 mark. Answer precisely what the question is asking and where appropriate give answers that fit the context or diagram. Do not over approximate.

General Comments

The paper was felt to have a wide range of syllabus topics and good variation in standard of questions. While none of the questions were considered to be inaccessible to well prepared candidates, there were sufficient which allowed more able candidates to score well and those less able to feel they had made a positive attempt at the paper.

Time allowed appeared to present no significant difficulties and many candidates wrote clearly with working where appropriate. However, there were cases of unclear figures (0 or 6 and 4 or 9 were the main recognition problems), and instances of figures written over other figures. If candidates wish to change a figure it is strongly advised that the unwanted is clearly crossed out (preferably with one line) and the replacement clearly seen. Lack of working too meant that there were many cases of arithmetic errors producing incorrect answers but method could not be credited as it was absent or not clear. **Question 21d** was a particular case of where marks were often lost due to lack of working.

Answers are often being rounded too soon and often to just 2 significant figures.

Weakness with the four rules applied to directed numbers was apparent and with so many questions involving negative numbers this is an important topic.

Reading carefully just what the question is asking could improve the marks considerably. Giving interest when a total amount is required is just one example of unnecessarily losing a mark for this reason.

Comments on Specific Questions

Question 1

This question proved to be quite demanding. There were a considerable variety of incorrect responses with the most common being one hour longer or 14 hours 30 minutes from working in reverse. Simply adding the times to give 26 hours 50 minutes was rather unrealistic.

Answer: 9 h 30 min

Question 2

Most candidates had no difficulty writing this straightforward number in standard form but some lost the mark by rounding 5.34 to 5.3. There were quite a number who have not grasped that the first part has to be a value between 1 and 10 so 53.4 and 534 were seen.

Answer: 5.34×10^7

Question 3

The common way of expressing the gradient of the line appeared to be familiar to almost all candidates but many did not know that the coefficient of x was the gradient. A response of $3x$ or $-3x$ was common as also was 4.

Answer: -3

Question 4

It is rare for candidates to not recognise that a value raised to the power zero has value 1. However, many simply gave the answer 1 without thinking about the coefficient. While the majority of answers were correct, it was quite common to see $5x$.

Answer: 5

Question 5

This was a straightforward question on correlation and the diagram clearly indicated the trend. However, it is clear that some candidates were not familiar with the specific words to describe correlation. While the vast majority who knew the terms gave the correct response there were a number of 'positive' or 'zero' seen.

Answer: Negative

Question 6

Both parts of this question were very well answered showing a clear understanding of the relationships between fractions, decimals and percentages. In part **(a)** a few gave a fraction answer of $\frac{64}{100}$ and there were cases of that answer in part **(b)**, probably because the instruction to write the fraction in its simplest form was not read.

Answers: **(a)** 0.64 **(b)** $\frac{16}{25}$

Question 7

In this question it is vital to be clear about directed number operations and the expansion of the brackets was the major problem for many candidates. The most common error was to expand the second bracket to the expression $-3x - 15$. Whilst many gained one mark, usually from a correct expansion of the first bracket, much fewer gained the two marks.

Answer: $2x$

Question 8

Many candidates had success on this ordering question. Conversions to decimals were often seen, although some only gave 3^{-2} as 0.11, clearly not enough figures, or misread it as 3^2.

Answer: $\sqrt{0.011}$ 0.11 3^{-2} $\frac{2}{17}$

Question 9

Most candidates realised they had to add the probabilities and subtract from 1 but a significant number gave the answer 0.25, possibly due to there being four numbers on the dice or simply adding incorrectly. Although the addition and then subtraction from 1 was very basic, some candidates would have benefited from using their calculator or at least writing the sum down. Although working was not necessarily expected for this question, it was worth a mark if the full method was written down. After that was seen, of course, it was rare to see an error made.

Answer: 0.2

Question 10

This was quite a demanding factorisation question with two algebraic terms as common factors. Most candidates understood the method but there were some who attempted to take a numerical common factor. Double brackets were seen at times and there were many who took just one factor, most commonly x. However, fully correct answers were seen from the majority of candidates.

Answer: $xy(3x - 5z)$

Question 11

The question asked for two properties about the lines but many candidates thought that one of them was about angles. Perpendicular was often seen accompanying parallel, suggesting the two terms were not understood or a hope that one of them was certain to be correct. 'Same' on its own was not acceptable and neither were the terms for triangles, congruent and similar, which were often seen. Most scored at least one mark.

Answer: Parallel, Equal

Question 12

Most candidates realised that full working had to be shown to gain marks and no marks were given for just an answer. It is common to see the common denominator method instead of invert and multiply, and many achieved all the marks regardless of which method was employed. Both methods involved an improper fraction and at times this was incorrectly found, often $\frac{7}{3}$. Also a number of candidates inverted the first fraction instead of the second. Decimals were only rarely seen but some gave a final answer as a decimal, which again meant the full requirements of the question were not observed.

Answer: $\frac{3}{10}$

Question 13

Overall this question was not answered well with few candidates understanding how to resolve part **(b)**. Many answered part **(a)** correctly although it was common to see the length of the side, 7, or 3 from 7 – 4, given for x. The main problem in part **(b)** was an attempt to form an equation with side FG written as x. Although intended as an algebraic question, those who did get it correct usually arrived at it by simply working with numbers. There were quite a lot of instances of the perimeter being found to be 49, the area. Others produced a range of incorrect calculations, regarded the triangle as equilateral or even applied Pythagoras' theorem.

Answers: **(a)** 11 **(b)** 8

Question 14

Only quite a small number of candidates used simple interest when the question asks for compound and the majority used the formula for compound interest, not compulsory at Core level. The issue for some candidates, however, is that they know the formula but do not know how to apply it. Candidates who worked it in stages often lost accuracy but at least could gain 2 marks. This question showed a significant number not following what the question asked by giving the interest, even after arriving at the amount. While a range of answers were allowed from 3 significant figures to several decimal places, candidates should generally give the dollar money answers corrected to 2 decimal places.

Answer: \$548 or \$547.8 or \$547.75 to \$547.76

Question 15

The vast majority of candidates did not understand the term relative frequency. In part **(a)** the most common answer was 73, the number of families with 2 children. Although many more gained the marks for the estimated number of families in part **(b)** some misunderstood 'estimate' in this case and rounded their otherwise correct answer to 2 or 3 significant figures. 5400 ÷ 73 was often seen and quite a number of answers did not have a value greater than 1 and less than 5400, which showed a lack of understanding of the question.

Answers: **(a)** $\frac{73}{200}$ **(b)** 1971

Question 16

The question was answered well but components in part **(a)** were reversed by a number of candidates. Fraction lines were only occasionally seen. Although many gained the marks in part **(b)** quite a number treated *AC* as *OC* leading to (−5, 2) or (−5, −2) being plotted. Of those who did mark the correct point it was common to see the co-ordinates reversed, possibly since the point was on the *x*-axis.

Answers: **(a)** $\begin{pmatrix}3\\7\end{pmatrix}$ **(b)(i)** *C* marked at (−4, 0) **(ii)** (−4, 0)

Question 17

This geometry question was answered well, although many did not realise the alternate angle situation for angle *x*, often giving 53° as the answer for part **(a)**. Part **(b)** usually recovered a mark by follow through as nearly all applied the property of 180° in the triangle. Part **(c)** depended on understanding the relation between angles in an isosceles triangle and was not answered so well. Quite a number of candidates looked at the diagram or assumed *AD* and *BC* were parallel and gave 90 for the value of *z*.

Answers: **(a)** 37° **(b)** 53° **(c)** 74°

Question 18

Part **(a)** was very well answered. Although some candidates did find the correct expression in part **(b)** there were a lot of cases of +7*n* instead of −7*n* in the expression, since candidates did not relate the reducing terms to mean a negative coefficient of *n*. Many who did not understand how to give the expression wrote *n* – 7 or 80*n* – 7.

Answers: **(a)** 45, 38 **(b)** 80 – 7*n*

Question 19

The area of the front face of the barn was not very well answered with many candidates adding or multipling numbers with little method. Those who attempted trapezium calculations more often than not added 5 and 6, rather than 5 and 8. Splitting into rectangles and triangles was more successful, although errors were often made. Some did use the 12 by 8 rectangle but rarely knew how to subtract the triangle from it. Some attempted a solution involving π. Although many did gain the mark in part **(b)** by correctly multiplying their answer in part **(a)** by 15, many simply multiplied 3 numbers together such as 12, 5 and 8 or 12, 8 and 15. Also 15^3 was a common incorrect answer.

Answers: **(a)** 78 **(b)** 1170

Question 20

In part **(a)** the explanation had to relate to the diagram which showed 3 triangles. To gain the mark candidates needed to describe or write down as a calculation the connection between the numbers 3, 180 and 540 and not just quote the three numbers. It was answered quite well but just '3 angles of 180' or '5 × 108' or 'it has 5 sides' were often seen. Part **(b)** was not answered well with many candidates working out the angles from the ratio based on a total of 540° or 132° (from 79 + 53). Some realised that 132 had to be subtracted but took it from 180 or 360. Those who did manage to reach 408 almost always gained the full marks. This showed that ratio work is well known but working out the problem to reach that stage was only managed by more able candidates.

Answers: **(a)** 3 × 180 = 540 **(b)** 51, 153, 204

Question 21

This question was well answered with many candidates gaining full marks. Part **(a)** was usually correct but some gave the temperature, rather than the month. A common incorrect answer in part **(b)** was 7 from 8 – 1 again showing the importance of directed numbers for subtracting a negative value. Most candidates realised that the numbers had to be put in order to find the median in part **(c)** and usually they managed to cope with the negative temperatures. However, they often had only 11 numbers by missing one of the 8's. Many candidates didn't finish correctly as they could not average the two middle numbers. A few confused median and mean and found the mean in part **(c)**. Some calculated the mean for both parts **(c)** and **(d)**. While many gained all the marks in part **(d)**, many made errors in the addition (directed numbers again) and just gave an incorrect total divided by 12, which could not score the method mark. It is always important to show the method even if it means writing out an extra line or two. The final mark for rounding to 2 significant figures could have been awarded from an incorrect answer if an incorrect mean had been given to more than the 2 significant figures. This did happen at times but often either the incorrect answer was only given to 2 figures or the calculation worked out exactly to 2 figures. A missing 8 was often seen in otherwise correct working producing an answer of 8.333.... leading to 8.3.

Answers: **(a)** January **(b)** 9 **(c)** 9.5 **(d)** 8.8

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key Messages

To succeed in this paper, candidates need to have completed the full Core syllabus, be able to remember and apply formulae and to give answers in the form required. Candidates are reminded of the need to read the question carefully, focussing on key words.

General Comments

The standard of performance was generally good. The vast majority of candidates could tackle the majority of questions, but there were some topics which were not known by many candidates. Many candidates were able to use the correct form for answers, for example very few candidates had a fraction line in vectors. When solving a non-calculator question where the instruction to show each step of working is clearly stated, candidates should realise the need to show working.

Many candidates were unsure which way to divide numbers when converting currency, while others appeared not to understand what was meant by surface area. Candidates should be reminded to give answers to three significant figures; there were several questions where candidates lost marks for either truncating answers or premature rounding. On some questions where a different degree of rounding was required some candidates had not read the question carefully.

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

Comments on Specific Questions

Question 1

This question was generally well answered. The most common error was hundredths.

Answer: 700

Question 2

This question was generally well answered. The most common error was 124°.

Answer: 56

Question 3

This fractions question was also generally well answered. Common errors were $\frac{11}{25}$ and $\frac{88}{100}$.

Answer: $\frac{22}{25}$

Question 4

The majority of candidates understood how to do this basic ratio question, but some poor arithmetic was seen. Some gave answers which were not whole numbers.

Answer: 168

Question 5

Many correct answers were seen. Some candidates gave the answer as $3x(3x – 2x)$. A small number only used 3 or x as the factor.

Answer: $3x(3x – 2)$

Question 6

Fewer candidates were able to score both marks on this question. Several were able to give 1350 as the lower limit but often the upper limit was given as 1449. Other common errors were 1400/1500 and 1395/1405.

Answer: 1350 1450

Question 7

Many candidates were able to give the correct answer. Others used Pythagoras' theorem and rounded the third side to 4.6 which then led to an inaccurate answer for the angle. Some less able candidates did not understand trigonometry.

Answer: 66.4

Question 8

(a) Many correct answers were seen. The most common error was −2.

(b) Again the majority of candidates gave the correct answer, with the most common error being 6.

Answer: **(a)** 2 **(b)** −6

Question 9

(a) Only a small number of candidates were able to calculate the correct answer. Many gave the answer 37.84 from calculating $4.2 + 5.8^2$.

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

Answer: **(a)** 7.16 **(b)** 3.5

Question 10

(a) This part was well answered. Common incorrect answers were 27×10^4 or 2.7×10^4.

(b) Very few correct answers were seen, with not many candidates realising that they had to divide by 2 to calculate the mean. Some scored 1 mark for figures 457 or 9.14×10^8.

Answer: **(a)** 2.7×10^5 **(b)** 4.57×10^8

Question 11

Few candidates scored full marks as they were unable to deal with a mixed angle situation of a quadrilateral and an isosceles triangle. A lack of knowledge of angle properties was apparent. Several were able to work out 112° but could not go any further. Some thought angle x was 112.

Answer: 44

Question 12

(a) The majority of candidates were able to indicate both lines of symmetry. A very small number also added diagonal lines.

(b) This part was generally answered correctly, with a small number giving the answer 4.

Answer: **(b)** 2

Question 13

Only a few of the more able candidates answered this correctly and then rounding was often incorrect, as many hadn't rounded to two decimal places. $1.252 \div 2$ and 1.252×2 were often seen.

Answer: 1.60

Question 14

This fractions question was answered very well with nearly all candidates showing clear working. Decimals were only very occasionally seen as was inverting the wrong fraction. Many candidates were able to demonstrate an understanding of the common denominator method.

Answer: $\frac{27}{8}$

Question 15

This was a rather more challenging linear equation than is often seen. Many candidates expanded the brackets but then had problems re-arranging the algebraic terms. Often a correct $-5x = -14$ led to $x = -2.8$.

Answer 2.8

Question 16

The reduction of $17.50 was given by some candidates as the answer. Many did not know how to calculate a percentage reduction, some using 67.5 as the denominator. Some candidates were able to earn 1 mark for 79.4.

Answer: 20.6.

Question 17

(a) This part was generally correct. A small number of candidates reversed the co-ordinates.

(b) This part was the least well answered of this question. Common incorrect answers were $\begin{pmatrix} 5 \\ 2 \end{pmatrix}$ and $\begin{pmatrix} -2 \\ 5 \end{pmatrix}$.

(c) The majority of candidates gave the correct answer for this vector addition.

(d) The majority of candidates gave the correct answer. However in parts **(c)** and **(d)** candidates understood how to deal with vectors but made errors in the addition and multiplication of directed numbers.

Answer: **(a)** (1, 5) **(b)** $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ **(c)** $\begin{pmatrix} 6 \\ -1 \end{pmatrix}$ **(d)** $\begin{pmatrix} -18 \\ 42 \end{pmatrix}$

Question 18

(a) This was generally correctly answered but, as in previous questions, not rounding correctly let many candidates down. Many correctly found 0.85358 but then rounded to 0.9 rather than the two significant figures the question required. Some candidates didn't show any working and only wrote 0.9 which meant 2 marks were lost. Some less able candidates scored 1 mark for either a correct numerator or denominator.

(b) This was generally correctly answered, with the majority of those not scoring 2 marks being able to gain 1 for only 1 value in the wrong order.

Answer: **(a)** 0.85 **(b)** 0.507 0.5077 $\frac{5}{9}$ 57%

Question 19

(a) Although some candidates gave the correct answer of 67, some had missed the key word in the question "**the** prime number" and had written more than one number. A significant number appeared not to be familiar with the term prime as 63 and 65 were often seen.

(b) Those who understood how to do this question generally wrote the correct answer. Others made an attempt but often did not go far enough leaving the answer as $2 \times 3 \times 9$.

(c) Although some candidates were able to give the correct answer, many were confused between HCF and LCM. Some gave common factors such as 2, 3 or 9.

Answer: **(a)** 67 **(b)** 2×3^3 **(c)** 18

Question 20

(a) This was generally well answered, although many candidates did not use π, with $18 \times 12 = 216$ being a common incorrect answer. Others calculated the volume using $2\pi r^2 h$.

(b) (i) This part was not well answered with many candidates calculating the volume. A significant number had not realised that 4 faces were not the same and $2 \times 14 \times 8 + 4 \times 20 \times 14$ was common incorrect working.

(ii) Again few correct answers were seen. Multiplying by ten rather than a hundred was seen the most often. Other candidates divided or multiplied by various powers of ten.

Answer: **(a)** 2036 **(b)(i)** 1104 **(ii)** 110400

MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key Messages

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

General Comments

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

Candidates showed some good number work in **Questions 1**, **3**, **5** and **9**, a good understanding of expanding brackets and simplifying in **Question 4** and good functions knowledge in **Question 23**. Simultaneous equations in **Question 18** and matrices in **Question 22** were also dealt with well. Candidates struggled to find the *n*th term of a quadratic sequence in **Question 11b,** and also struggled with reasoning with vectors in **Question 14b** and the perhaps unfamiliar factorisation in **Question 20b.**

Candidates were generally good at showing workings; sometimes these were hard to follow and candidates should be encouraged to set these out in a logical manner which can be easily followed. This was especially prevalent in **Questions 13**, **18** and **21**.

Premature rounding part way through calculations caused some candidates to lose accuracy marks in **Questions 13**, **19** and **21**.

Comments on Specific Questions

Question 1

Almost all candidates obtained the correct answer to this question. Where an incorrect answer was given, it was usually 1.5 or –1.5.

Answer: 9.5

Question 2

The majority of candidates worked out this calculation correctly. There was a wide variety of incorrect answers, the most common being 47.49…from just the 10 being square rooted and 7.50...from the omission of brackets.

Answer: 7.37

Question 3

The majority of candidates were able to write the number in standard form. The most common incorrect answer was 27×10^4. A minority gave the answer of 2.7×10^{-5}.

Answer: 2.7×10^5

Question 4

Most candidates were able to successfully expand the brackets and collect like terms. If candidates did not gain 2 marks, they were often able to earn 1 mark for a correct expansion of one of the brackets, most often showing $5x - 35$. Following a correct expansion, most candidates could successfully simplify the terms. Following a completely correct simplification, there were a number of candidates who then went on to spoil their answer by halving all the terms, trying to re-factorise or equating to zero and attempting to solve for x.

Answer: $2x^2 + 8x - 35$

Question 5

Candidates were successful with this question and understood that they needed to show a comparison of the 2 values, usually showing 0.257 or 25.7%. Fractional comparisons were seen less often but were carried out well apart from the odd arithmetic error. Some candidates appeared to approximate $\frac{9}{35}$ to 0.25 or 25% with no supporting working.

Answer: Sammy with correct reasoning

Question 6

Most candidates scored 1 out of 2 marks in this question for showing one of the correct bounds 119.5 or 75.5. This was usually for 119.5 as both lower bounds were most commonly used, leading to an answer of 45. Candidates need to differentiate between the bounds of a measurement and the bounds in a calculation involving these measurements. A common incorrect method was 120 – 75 = 45 and then an answer of 44.5. A small minority of candidates were using 119.4, $119.4, 119.4\dot{9}$ and 119.05.

Answer: 44

Question 7

Most candidates demonstrated knowledge of simplifying indices by gaining 1 out of the 2 marks available; this was commonly for the answer of $24uw^3$. Candidates need to recognise that without an index number, it is equivalent to a power of 1. Other incorrect answers involved w^{-18} and some answers indicated that candidates did not recognise that index laws should be used or did not know the relevant laws.

Answer: $24u^2w^3$

Question 8

There were a reasonable number of fully correct answers to this question. A large number of candidates made a correct start by finding ±11 and ±8 as the difference in x and the difference in y and gained 1 mark for this. They then often went on to find the gradient and sometimes the equation of the line rather than the length. The expression $\sqrt{11^2 + -8^2} = \sqrt{121 - 64} = 7.55$ was not uncommon. Those who scored zero were commonly either adding the two x and the two y co-ordinates or subtracting the x and y values from one co-ordinate pair. Many made a sensible start by drawing a diagram and this may have helped those who were struggling to comprehend the situation.

Answer: 13.6

Question 9

This was a well attempted question with most candidates gaining 2 or 3 marks. Those who were most successful tended to use the method of inverting and multiplying $\frac{3}{7}$, often sensibly cancelling down before multiplying which avoided arithmetic errors later. Others found a common denominator, usually $\frac{63}{35} \div \frac{15}{35}$ which was also a successful method. Some got to this point and were then unsure how to continue. Even those candidates who did not know a suitable method for dividing a fraction often gained a mark for making a correct 1st step of changing the mixed number into $\frac{9}{5}$. A common misconception after this was to invert the 1st fraction rather than the second before multiplying. Some lost the final mark by leaving their fraction unsimplified, either as an improper fraction or $4\frac{3}{15}$ and a few converted to 4.2. Candidates should understand that when they are asked to demonstrate non-calculator skills they are required to show all steps of their working otherwise credit cannot be given.

Answer: $\frac{21}{5}$ or $4\frac{1}{5}$

Question 10

Most candidates understood that the area under the graph was required and gained at least 1 mark for the correct area of one of the sections, usually the central rectangle. Candidates regularly forgot to halve to get the area of the triangles and so 72 and 4320 were common incorrect answers. 42 was another common answer and this scored 2 marks; candidates just needed to be aware that the speed was given in metres per second and the time in minutes, so a conversion was necessary. Some candidates attempted to use the acceleration formula $s = ut + \frac{1}{2}at^2$ and a few candidates arrived at the correct answer from this. The majority who embarked upon this more inefficient method made errors, particularly in the final section where deceleration was involved.

Answer: 2520

Question 11

Many of the candidates found the linear nth term successfully in part **(a)**. The other common answers were 24 (the next term in the sequence) and $n + 4$. In part **(b)** by far the most common answer was 116, i.e. the next term in the sequence. Many candidates showed that there was a second difference of 6 in part **(b)** and some gained a mark for interpreting this by giving a quadratic expression as their answer. Few candidates were able to find the correct expression. Candidates need to be able to interpret the meaning of differences within a sequence and be equipped with methods to find nth term expressions, including quadratic.

Answer: **(a)** $4n$ **(b)** $3n^2 + 8$

Question 12

There were a good number of successful candidates in this question and they usually started off by showing $p = \frac{k}{(q+4)^2}$ to find $k = 72$. There were some careless arithmetic errors within a correct method, especially involving −2. Using the incorrect value of q, i.e. $2 = \frac{k}{(-2+4)^2}$ was not uncommon. Some attempted to define an incorrect relationship, often showing p varying directly with $q + 4$ or $(q + 4)^2$ and perhaps more who worked with p being inversely proportional to $q + 4$ or to $\sqrt{q+4}$.

Answer: 18

Question 13

A good proportion of candidates demonstrated a correct method to gain full marks for this question. The usual approach was to calculate $\frac{1.28}{64}$ = 0.02 and then 0.02 $\times$ 60 $\times$ 60. Many candidates gained 1 mark for showing the distance $\div$ speed, even if they did not take into account any conversions or went on to make errors in the conversions. $\frac{1280}{64}$ = 20 was a common starting point. The other slightly less common approach was to convert 64km/h into m/s and then divide 1280 by this speed. Some candidates lost the final accuracy mark when using this method as they rounded $17.\dot{7}$ m/s prematurely and so did not get a final exact answer of 72.

Answer: 72

Question 14

Many candidates were able to justify that $\overrightarrow{PS}$ = 2**b** in part **(a)** by showing a correct route from *P* to *S* or *S* to *P*. There were many who did not know how to attempt the question and so left it blank. The most common incorrect explanation involved candidates going round in a circle, taking the 2**b** as given and stating that, as *M* is the midpoint of *PS*, then *PM* = **b** and *MS* = **b** so **b** + **b** = 2**b**. Others made the assumption that *MR* = **a** without any justification and used this within a route. In part **(b)** few candidates identified the shape as a parallelogram; some of the common answers given were trapezium, rhombus and polygon. Candidates could have scored a mark for stating trapezium with the reason that *QR* is parallel to *PM* but most referred to *PS* and so were not using the given shape. Of those who did correctly identify the shape as a parallelogram, very few went on to gain the second mark as they only gave a partial answer, usually omitting to say that *QR* and *PM* are equal as well as parallel.

Answer: (a) **a** + 2**b** – **a** or **a** – (**a** – 2**b**) **(b)** Parallelogram with reasons

Question 15

Many candidates were able to score at least 1 mark on this question, commonly from identifying $y<8$ or for finding the correct equation(s) of the other 2 lines and leaving as an equation or for having an incorrect inequality sign. More candidates could give the equation of the line $y = x + 2$ than $y = 6 - x$. Successful candidates understood the meaning of broken and unbroken lines when describing the region. A large number of candidates did not understand what was being asked, with many writing down the co-ordinates of the 3 vertices of the triangle, referring to a shape, often triangle, or not attempting the question at all.

Answer: $y < 8$, $y \geqslant x + 2$, $y \geqslant 6 - x$

Question 16

Successful candidates in this question knew the compound interest formula and read the question carefully, realising that it was just the interest required and that it should be rounded to the nearest dollar. Many gained 2 marks for using the formula correctly to calculate 6597.39 and others went 1 step further to gain 3 marks for either taking 5000 away from this or rounding correctly. (Candidates should be aware that 1597.00 is not correctly rounded to the nearest dollar.) Candidates are expected to know the formula and so those who used the inefficient method of calculating year on year for 14 years were penalised unless they were extremely accurate with their rounding and reached the correct value. They could still gain 2 marks for subtracting the 5000 and rounding their answer correctly. A small number of candidates calculated simple interest. Candidates should also check that their answers are realistic in questions such as this.

Answer: 1597

Question 17

A large number of candidates scored both marks in part **(a)** or 1 mark for listing the prime factors or including 1 within their otherwise correct prime factorisation. Those who drew a factor tree / ladder usually went on to gain at least 1 mark for identifying the correct prime factors. The most common misconception was to list all factors of 30 or write out the factor pairs. Candidates tended to gain either 2 marks or zero in part **(b)** with very few giving a multiple which was not the lowest common multiple. The most common method seen was to list the multiples of both numbers rather than use prime factors which proved efficient in this case as the numbers were fairly small. About half of the candidates were confusing lowest common multiple with common factors and answers of 3, 5 and 15 were very common.

Answer: **(a)** $2 \times 3 \times 5$ **(b)** 90

Question 18

This was a well understood question with the most successful candidates employing the elimination method - multiplying the equations to equate one of the coefficients followed by an appropriate addition or subtraction. The 2nd method mark was sometimes lost through inconsistent adding or subtracting within the equations. A significant number of candidates were rearranging one of the equations and substituting into the other which usually gained them 2 marks for the correct method but they then went on to make far more algebraic and arithmetic errors than those using the elimination method and this prevented them from gaining the 2 answer marks. More candidates would have realised that they had incorrect values if they had checked them within both equations. Candidates should also be encouraged to make their working clearer within this type of question as multiple attempts at the question in the working space made it very difficult to award marks at times.

Answer: $x = 0.8$, $y = -3$

Question 19

Many candidates gave the correct answers in both parts **(a)** and **(b)**. Some lost accuracy marks by working in decimals rather than the straightforward fractional scale factors. The most common misconception was to simply look at the difference in the lengths and then take 2 away from 10 to give 8 as the answer in part **(a)** and add 2 to 9 to give 11 in part **(b)**. Some candidates were trying to find the missing lengths using Pythagoras' theorem.

Answer: **(a)** 7.5 **(b)** 12

Question 20

The factorisation in part **(a)** was well attempted with a good number gaining both marks. Candidates understood that they were looking for common factors and often managed to gain 1 mark with the partial factorisation of $y(p + t) + 2x(p + t)$ or $p(y + 2x) + t(y + 2x)$. The last mark was often lost with a final answer of $(p + t) + (y + 2x)$ or missing brackets such as $p + t(y + 2x)$. Part **(b)** proved to be a much more unfamiliar type of factorisation with only a few of the most successful candidates scoring any marks. The most common approach was to multiply out the brackets rather than look for the common factors within each term. Those who did identify $(h + k)$ or 7 as a factor often cancelled them from both terms leaving just $7(h + k) - 21$ or $(h + k)^2 - 3(h + k)$. Some thought that hk or $7hk$ were factors.

Answer: **(a)** $(p + t)(y + 2x)$ **(b)** $7(h + k)(h + k - 3)$

Question 21

The most successful working shown was for the volume of the cone and a large number of candidates gained 1 mark for this. Fewer candidates were able to calculate the value of the hemisphere, often forgetting to halve. Sufficient working was sometimes not shown and premature rounding or approximations to π caused these candidates to lose marks. Those who showed all their correct substitutions could gain 2 out of 4 marks even if they then went on to make errors in their calculations or rounding. The final mark in this question was awarded for rounding which many candidates did not spot or forgot about at the end of the question.

Answer: 285

Question 22

Candidates demonstrated some expertise in dealing with matrices and the majority scored at least 1 mark in part **(a)** where the most common errors were arithmetic when dealing with the negative values. Of those candidates scoring 0 marks, $\begin{pmatrix} -6 & 7 \\ -4 & 8 \end{pmatrix}$ was sometimes seen, resulting from multiplying the corresponding elements in each matrix. Part **(b)** was dealt with just as well, with the majority scoring at least 1 mark for finding the determinant or for having the correct values within the matrix.

Answer: **(a)** $\begin{pmatrix} 22 & 17 \\ 18 & 7 \end{pmatrix}$ **(b)** $\frac{1}{2}\begin{pmatrix} 4 & -3 \\ -6 & 5 \end{pmatrix}$

Question 23

Candidates demonstrated a good understanding of functions, especially in parts **(a)** and **(b)**. Most candidates knew that they had to substitute x for 6 in the function in part **(a)** and most reached the correct value. There were some arithmetic errors with positive 13 being a common incorrect answer. In part **(b)** most candidates demonstrated a correct starting point which gained credit even if this was simplified incorrectly. Some did spoil this correct starting point by turning it into an equation which they then solved. Many candidates also demonstrated a correct starting point in part **(c)** which earned a mark but then was often simplified incorrectly and so did not score the 2^{nd} mark. Common incorrect simplifications were $5 – 3(5 – 3x) = 2(5 – 3x) = 10 – 6x$ and $5 – 3(5 – 3x) = 5 – 15 – 9x = –10 – 9x$. Common incorrect starting points were $5 – 3x(5 – 3x)$ and $(5 – 3x)(5 – 3x)$. In part **(d)**, many candidates scored 1 mark for making a correct 1^{st} algebraic step or for interchanging x and y. There were many algebraic errors either in the 1^{st} step or subsequent steps, usually involving the $-3x$ where the negative sign was often lost. For example $y – 5 = 3x$ was commonly seen as a 1^{st} step and following a correct 1^{st} step of $y – 5 = –3x$, $\frac{y-5}{3}$ was often given.

Answer: **(a)** –13 **(b)** $-3x – 1$ or $5 – 3(x + 2)$ **(c)** $9x – 10$ **(d)** $\frac{5-x}{3}$

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key Messages

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

General Comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates showed evidence of good handling data work, fractions, standard form and indices work with particular success in **Questions 1**, **5**, **12**, **16(a)(i)** and **22(c)**. Candidates found **Questions 8**, **9**, **10**, **17(b)** and **21** particularly challenging. This included the topic of converting a recurring decimal into a fraction and some algebra topics that were a struggle for some, such as completing the square and finding the *n*th term of a quadratic sequence. Candidates are always advised to consider the plausibility of their answers in the given context; it was common for implausible answers to be seen in **Questions 2** and **13(a)**. Some candidates were not clear in forming numbers; there was difficulty in distinguishing between some digits, the problematic ones being 1, 7, 4 and 9. Candidates were very good at showing their working and more method marks were awarded as a consequence.

Comments on Specific Questions

Question 1

Most candidates showed an understanding of standard form and scored the mark. The most common incorrect answers were 534×10^5, 53.4×10^6, 5.3×10^7 and 5×10^7. Some candidates rounded the number to one or two significant figures. Writing the value in words was seen occasionally.

Answer: 5.34×10^7

Question 2

This question proved to be challenging for quite a few candidates. Many answers were correct, often with little evidence of a method. Of the incorrect answers the most common was 14 hours 30 minutes, where the candidate had subtracted 6.10 from 20.40 as if they were decimal numbers. Other common incorrect answers were 10 hrs 30 min, 10 hrs 50 min and 14 hrs 50 min. A significant minority had implausible answers for the number of hours the doctor worked, e.g. over 24 hours. Candidates are advised to check their answers to ensure they make sense for the given context.

Answer: 9 h 30 min

Question 3

Many candidates were successful with this question. Those who answered the question correctly often employed methods such as repeated powers of 3 until 81 was achieved and then converting the power of 4 obtained by this method to the power ¼. Many obtained the correct answer showing no working. There were very few embedded answers. A common incorrect answer of 4 often followed from the correct conclusion that $81 = 3^4$. Candidates who did not achieve a correct answer often appeared to know that $27^{1/3} = 3$ and the answer $27^{1/3}$ was sometimes seen. The most common incorrect answers were 4, as previously mentioned, and 27 arising from 81 ÷ 3.

Answer: $\frac{1}{4}$

Question 4

Whilst correct answers were seen for part **(a)** it proved to be challenging for many, with a common incorrect answer being 9. It was rare to see the given numbers listed in ascending order, which would have helped candidates to find the correct answer of 7. It was more rare to see 20 or 3 as answers, demonstrating that candidates appeared to understand the range better than the median. Some answers were given that were not numbers from the list. The majority of candidates that attempted part **(b)** were successful, with many giving 9 as their solution. A large number of candidates gave no answer to this question and some gave the mean as their answer.

Answer: **(a)** 7 **(b)** Any number except 3, 7 or 20

Question 5

This question was successfully answered by a large majority of the candidates. Very few scored 1 mark in this question due to candidates not writing down fully their workings. The most common error was to assume that the dice was fair giving the answer of 0.25. Occasionally answers greater than 1 were given.

Answer: 0.2

Question 6

This question was well attempted by most candidates and working was nearly always shown in full. The most successful candidates were those who, in the first instance, converted the terms given in standard form to a single integer value and subsequently expanded the brackets on the left hand side. Candidates who approached this question by first dividing both sides of the equation by 5 were also often successful in finding the solution of 8000. Algebraic style errors were most frequently seen in the initial work by those who chose first to multiply out the brackets on the left hand side, the most common error being the treatment of 4×10^3 as two separate terms so that in the expansion these candidates obtained $5w + 20 \times 5 \times 10^3$, and the final answer became –8000. Another common second step error was to follow the correct equation $5w + 20 \times 10^3 = 6 \times 10^4$ by division of 10^3.

Answer: 8000

Question 7

Most candidates gained at least 1 mark. Many seemed to understand the question but were not able to fully or clearly articulate the properties of the line segments. Common errors were saying they were ‘the same’, ‘similar’, ‘congruent’, ‘proportional’ or ‘equidistant’. A number of candidates appeared to have not understood “line segments” as they talked about ‘equal angles’, ‘have same angles’, ‘alternate’, ‘corresponding’, ‘opposite’, etc. Some thought the question was connected to transformation geometry as ‘rotation’, ’reflecting’, ’mirrored’ came up a few times.

Answer: Parallel and the same length

Question 8

A small proportion of completely correct answers were seen. Many candidates were able to construct a difference table and found a second difference of +4; few knew what to do at that point, with a common misconception being that this implied that $4n$ was part of the required expression. A few candidates were able to achieve a partial mark for recognition that the sequence was quadratic. The most successful candidates were able to find the coefficient 2 for n^2 using the 'half of the second difference' method and usually followed this with the required +3, usually intuitively as working was often not shown for this part. Those who attempted to use the method of finding a, b and c, for $an^2 + bn + c$, by substituting in values of $n = 1$, 2 and 3 and attempting to solve the resulting three simultaneous equations, often struggled to cope with how to eliminate one or more of the three unknowns. Amongst the less able candidates, a common incorrect response was to give the next term in the sequence, 75.

Answer: $2n^2 + 3$

Question 9

The most successful candidates used the method $100 \times 0.255\ldots - 10 \times 0.255\ldots$ to achieve $90x = 23$ and hence a correct answer of $\frac{23}{90}$. Some candidates were aware of the correct method but used $10 \times 0.255\ldots - 0.255\ldots$ or $100 \times 0.255\ldots - 0.255\ldots$ and so reaching $9x = 2.3$ or $99x = 25.3$. Candidates were obviously familiar with the method required and so often started correctly with $100x$ or $10x$ but then 'lost' the recurring part of the decimal and answers of $\frac{25}{99}$ and $\frac{25}{9}$ were given. A significant number of candidates gave the correct answer showing no working. A number of candidates used the incorrect decimal 0.25252525… A common incorrect answer was $\frac{1}{4}$, often with no supporting method or alongside $\frac{25}{100}$. Some rounded to 0.26 and gave incorrect answers of $\frac{26}{100}$ or $\frac{13}{50}$. A large number of candidates employed an incorrect method of terminating the decimal with a varying amount of 5s and then placed this as a numerator over varying powers of 10, then cancelled or multiplied by 2, 20, 200, etc. to end up with incorrect fractions such as $\frac{511}{2000}$, etc.

Answer: $\frac{23}{90}$

Question 10

Most candidates appreciated the principle that a calculation involving ± 0.5 was required as the measurements had been given correct to the nearest centimetre. Occasionally the incorrect value of 0.05 was used. It was quite rare for a fully correct solution involving finding the lower bound of 114 and the upper bound of 120 to be seen. A common error was for the upper bound of both heights to be found before they were subtracted and a more significant error was for 114 to be subtracted from 120 first and then 0.5 to be added to this difference. A few candidates incorrectly used 120.4 or 120.4999… as an upper bound for 120. 6, 6.5 and 120.5 were the most common incorrect answers.

Answer: 7

Question 11

Many candidates scored both marks with most gaining at least 1 mark for either the determinant correctly found or the adjugate of **M** correctly found. The most common errors were the incorrect manipulation of negative numbers when calculating the determinant or errors in writing the adjoint matrix. The determinant of –17 was common amongst the incorrect answers. Those who found the inverse by finding the adjugate of **M** and multiplying by the reciprocal of the determinant were more successful than the candidates who used a simultaneous equations approach, although this approach was rarely seen. It was also rare to see the incorrect method where the reciprocal of every element in **M** is found.

Answer: $\frac{1}{5}\begin{pmatrix} -2 & -1 \\ 11 & 3 \end{pmatrix}$

Question 12

Many candidates were able to successfully obtain the required solution of $\frac{3}{10}$ with full, clear and correct working. There was an improvement in the number showing working with significantly fewer candidates than in previous years simply writing down the answer alone. There were some who were unable to correctly convert the mixed number to an improper fraction, with $\frac{7}{3}$ or $\frac{4}{3}$ being the most common incorrect versions. These figures were generally from those candidates who had memorised a technique without fully understanding the process. Usually these candidates were still able to obtain the method mark for multiplying by the reciprocal of their fraction found. The most successful candidates were those who multiplied $\frac{4}{5}$ by the reciprocal of $\frac{8}{3}$. Some candidates inverted the wrong fraction or both fractions. Errors in the working were most frequently made by those candidates who chose to convert both fractions to obtain a common denominator, for example $\frac{12}{15} \div \frac{40}{15}$. At this point it was not unusual to see candidates falter, unsure how to proceed, with a common incorrect follow on being $\frac{12 \div 40}{15}$ rather than $\frac{12}{40}$. The decimal answer 0.3 in the final solution was relatively rare, as candidates usually paid attention to the required form given in the question.

Answer: $\frac{3}{10}$

Question 13

In part **(a)** most candidates were able to equate the sides of the square to obtain the correct answer, although a significant number used trial and improvement. Common incorrect answers included $x = 7 – 4 = 3$; $x = 11 – 4 = 7$ and $7x = 28$ so $x = 4$. Part **(b)** was not answered as well. Some did not connect parts **(a)** and **(b)** to form an equation to solve for *FG*. Many also did this part of the question without algebra, preferring to use a trial and improvement approach. One misconception was to give the unknown *FG* a label of x arriving at $x + (x - 1) + (x - 1) = 28$, with the incorrect answer of 10 being extremely common. Another common error was using 11 as the length of the square side, consequently finding a perimeter of 44, or using $x = 7$ even if the correct answer of 11 was seen in part **(a)**. Taking the triangle to be equilateral or right-angled (using Pythagoras' theorem) was seen. Where working was shown it was generally well set out and easy to follow. With questions such as this, candidates should be encouraged to critically reflect on the plausibility of their answers; a number of candidates had negative values for their answer which is not possible for a length.

Answers: **(a)** 11 **(b)** 8

Question 14

Many candidates were able to reach the correct answer of 684 m^3. Of those who did not get the right answer many were able to obtain a method mark for a partially correct starting point. A large proportion correctly started by converting 3 hours into 180 minutes and quite a few went on to multiply this by 4 to reach 720 then omitted the final step of multiplying by the cross-sectional area, with 720 being almost as common an answer as the correct answer. Others started by correctly multiplying 0.95 by 4 to find the volume per minute, 3.8, but then either stopped or went wrong, usually dividing 180 by 3.8 and consequently 47.4 was a common incorrect answer. The confusion for many was the area given in the question with quite a few attempting to find the square root of 0.95 at some point in the calculation or writing work such as $0.95\text{m}^2 \times 100 = 95\text{m}^3$. Another cause of confusion, particularly for the less able candidates, was the use of exponents in the units m^3 and it was not uncommon for the final answer to be cubed. A large number of candidates divided 720 by 0.95. Candidates are advised to show their working in more detail; many attempted to do this in the minimum number of steps, often in one single calculation, and consequently a possible correct starting point was mixed up with incorrect working and therefore method marks could not be awarded.

Answer: 684

Question 15

This question was well understood and most candidates successfully formed a common denominator of $(x + 2)(2x – 5)$ and a numerator of $3(2x – 5) – 4(x + 2)$. Many then went on to correctly expand the brackets to achieve a numerator of $2x – 23$. The most common error was in the multiplication of 2 by –4; this was frequently given as 8 instead of –8 and consequently the incorrect numerator of $2x – 7$ was often seen. Some candidates needlessly expanded the denominator, often correctly; however, some candidates did lose the final mark because their expansion was incorrect. The final mark was usually lost due to a lack of care in following through workings and also through incorrect 'simplification' of a fully correct answer, such as dividing any even terms by 2 or crossing out an x from each term containing one, especially after multiplying out the denominator. It was only the less able candidates who started this question incorrectly to score no marks.

Answer: $\frac{2x-23}{(x+2)(2x-5)}$

Question 16

Part **(a)(i)** was a well answered question with nearly all candidates giving the correct answer. The vast majority of candidates gave the correct solution of 4 for part **(a)(ii)**. A few candidates gave $\frac{1}{4}$ as their solution, treating the minus sign as if it were part of the power, and a further few gave 21.3 as their solution, finding $\frac{1}{3}$ of 64 rather than $64^{1/3}$. The most common error seen was for the minus sign to be taken outside the brackets and an answer of –4 to be given. Part **(b)** was well answered with many candidates scoring the mark. The most common incorrect answer was 2.38, which resulted from candidates including the denominator of 3 inside the square root. A small number of candidates rounded their answer to 1.4 without showing a more accurate solution. Candidates are reminded that, unless indicated otherwise, answers should be given to a suitable degree of accuracy as stated on the front of the exam paper, in this case that is three significant figures. Some candidates appeared to be confused by the part of the question asking for the "decimal value of", presenting 1.374… in the working area then giving an answer of 0.374, i.e. just the numbers after the decimal point.

Answers: **(a)(i)** 0.5 **(ii)** 4 **(b)** 1.37

Question 17

Part **(a)** was well answered by the majority of candidates. Of the candidates who did not score full marks, a high proportion went on to score 1 or 2 marks. The most common errors included mixing the *x* and *y* co-ordinates and finding the reciprocal of the correct gradient. Some candidates were unsure how to express their final answer with some finding *m* and *c* correctly then putting a substituted value for *x* as their final answer, e.g. $y = 2(0) + 3$. A small number of candidates had the correct equation, e.g. $y - 11 = 2(x - 4)$ then did not attempt to, or were not able to, successfully make *y* the subject. Fewer candidates completed part **(b)** successfully. Some candidates who did not score full marks in part **(a)** often did have the correct gradient and were able to successfully obtain the correct answer. Of the candidates who did not answer part **(a)** correctly, only a very small number scored the follow through mark. Common errors included taking only the reciprocal or the negative of the gradient in part **(a)** and not both or to give the gradient of a parallel line instead of a perpendicular line. Some candidates gave their answer embedded, i.e. $-\frac{1}{2}x$ alone or gave the answer as an equation of a possible perpendicular line.

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

Question 18

The solutions to both parts **(a)** and **(b)** of this question were confidently found by many of the candidates. The most common approach to part **(a)** was to find the area of the rectangle 5×12 and then to add on the area of the triangle $\frac{1}{2} \times 12 \times 3$. Occasionally candidates forgot to halve the 12×3 or used 2 instead of 3. An equal number of candidates split the shape into two trapeziums instead of a rectangle and triangle, finding the area of the trapezium forming one side of the barn $\frac{1}{2}(5+8) \times 6$ and doubling this. A significant number of candidates who attempted to find the area of a trapezium used the wrong combination of numbers, for example $0.5 \times (5 + 6) \times 8$ or $0.5 \times (5 + 12) \times 8$ were very common. A common incorrect answer was 96 arising from 12×8. There were a significant minority of candidates who did not take a straightforward approach. For example some candidates drew diagonals from the top vertex to the bottom two, creating triangles that were very difficult to solve. Some candidates thought that trigonometry was needed or used Pythagoras' theorem to find lengths or just tried combining the given dimensions in various ways. Some candidates introduced π into the solution. Many candidates had the correct answer in part **(b)** or recognised the relevance of the answer to part **(a)** and obtained the follow through mark. Many did not use their answer to part **(a)** and started again with the most common incorrect answers being 1440 and 900 from $8 \times 12 \times 15$ and $5 \times 12 \times 15$ respectively. A large number of candidates did not answer this question, even if they had achieved a correct answer in part **(a)**.

Answers: **(a)** 78 **(b)** 1170

Question 19

There were a large number of fully correct responses. Candidates are advised that they need to use a sharp pencil in diagrams as some images were inaccurate due to blunt pencils. The most common error in part **(a)** was not drawing a complete circle. There were not many full circles of completely wrong radius although inaccurate circles were sometimes seen. Some candidates also drew superfluous circles, centred at *A* and *B* or a 4 cm line with centre *C*. Most candidates completed part **(b)** correctly demonstrating a good understanding of loci. Correct answers were almost always supported by the construction arcs. Some candidates lost a mark because they only had one pair of arcs as they used a ruler to find the midpoint of *AB* for the second point required to draw the line. Others had the correctly constructed two pairs of intersecting arcs but no line was drawn. If part **(a)** and part **(b)** were completed correctly, many were able to gain the mark for part **(c)** although there were still a large number shading incorrectly or not at all. The most common errors were usually because candidates did not have a complete circle or their line did not extend to meet the top edge of the circle causing the boundary of the region to be incomplete. Many had drawn in triangle *ABC* and felt the shading should lie within that too. Some used one of their bisector arcs as a boundary.

Question 20

A large number of candidates made good use of the Venn diagram to show their working and they appeared to find it helpful in formulating their responses to the parts of the question. Most got the diagram right although a small number confused odd and even numbers or missed out one or two elements from one of the sets. Part **(a)(i)** was answered reasonably well. Quite a few, having correctly identified the elements of set N, did not realise the meaning of the terminology n(N) and gave a list of the elements instead of the number of elements in the set. Another common incorrect answer was 2, often because the elements in the intersection were not included or only these elements were included; this was demonstrated further by 6 and 12 or 3 and 9 being common incorrect answers as well as 3, 6, 9 and 12 already mentioned. Part **(a)(ii)** was more challenging for many candidates. The most common errors were the inclusion of 1 in the intersection or only giving one of the two elements required. Only a very small number confused the intersection with the union of the two sets. The most common error in part **(a)(iii)** was to not appreciate the difference between $\subset$ and $\subseteq$, with quite a few candidates giving all six numbers 1, 3, 5, 7, 9 and 11, which is a subset but not a proper subset. A few described the set in words, similar to how sets were described in the question. Often these descriptions did not give sufficient detail to score the mark. For example answers such as "the set of prime numbers under 12", "odd numbers under 12", "multiples of 7" were usually incorrect as they often included even numbers, all of the elements of M or numbers outside of the universal set. A small number gave the empty set, $\varnothing$, as a correct proper subset. Many candidates were successful in part **(b)**. Some candidates were unclear in their shading, with some areas being shaded darker than the rest. If this occurs all the shaded area is marked, unless the candidate makes it clear what part of the shading is their answer, so candidates should be encouraged to think carefully before they start shading to ensure that their answer is not ambiguous. Incorrect answers were varied; common errors were to include the intersection of the three sets in the shading; to shade $A \cup C$; or to include the outer region.

Answers: **(a)(i)** 4 **(ii)** {3, 9} **(iii)** fewer than 6 numbers from {1, 3, 5, 7, 9, 11} or $\varnothing$

Question 21

The most successful candidates in part **(a)** were aware of the completing the square method, writing $(x + 2)^2 - 6 - 2^2$ in the working and were then able to give the correct answers of 2 and –10. Many candidates correctly stated that $x^2 + 2mx + m^2 + n = x^2 + 4x - 6$; most with this starting point did not understand that the next step is to equate coefficients and did not progress after spending a lot of time on various attempts at algebraic manipulation. The correct value of 2 for m was seen far more often than the correct value of –10 for n, indicating that they had some understanding of the method involved. The value –6 was often given for n, either with the correct value of m or with a value of 4 for m. In part **(b)** candidates who were fully conversant with the completing the square method for solving equations answered this question well. Even when they had the correct values in part **(a)**, many candidates opted to use the quadratic formula straight away or resorted to it after realising they were not sure how to solve from their completion of the square. These candidates were still able to gain a mark for finding the positive solution although some did not read the question and gave the negative solution or both.

Answers: **(a)** $m = 2$, $n = -10$ **(b)** 1.16

Question 22

Throughout this question candidates are encouraged to draw lines on the cumulative frequency graph to demonstrate their method; many did do this although occasionally there were inaccuracies due to these lines not being ruled. Many candidates were successful in part **(a)**, although a few candidates simply found 80% of 60 and quoted 48 as their final answer. Some others attempted to use the graph to find the 48th value but misread the scale and gave 42 km rather than 44 km as their answer. Another commonly seen incorrect answer was 58 coming from reading the cumulative frequency for a distance of 80 km. Part **(b)** was answered well by many candidates. A few candidates found only the lower or upper quartile successfully. The most common error, which was seen quite often, was for candidates to subtract 15 from 45 rather than the 15th value from the 45th value. Some of these candidates then gave 30 as their final answer, whilst others read off the 30th value from the graph, giving an answer of 29. Candidates answered part **(c)** of the question well with the majority scoring full marks. Those that did not score both the marks often obtained 1 mark for an answer of 55, the number of people who travelled less than 60 km. There was a significant minority of candidates that left the entire question blank.

Answers: **(a)** 44 **(b)** 24 **(c)** 5

Question 23

Many candidates were able to successfully answer part **(a)**. A large number of candidates gave their answer as a negative ignoring the fact that the question asked for the deceleration. Of the candidates who did not score the mark, 0.9 was a common misconception from $\frac{18}{20}$. The vast majority of candidates scored at least 1 mark in part **(b)**. Most candidates understood that they needed to find an area; however, a significant number of candidates found the area above rather than below the lines and did not go on to subtract this from 2400. Of those who found the area above, most still obtained a mark for a correct area, often for $\frac{1}{2} \times 8 \times 20$. A common misconception was the assumption that the shape above the line was a trapezium. Some candidates, when finding the area of the trapezium between $y = 18$ and $y = 10$ approximated rather than found the width of 114. The majority of candidates showed clear working here and the best candidates indicated clearly on the graph which areas they were finding by splitting the graph up and labelling it, e.g. A_1, A_2, A_3. A significant number of candidates did not show where their values came from. Some candidates did not correctly use the scales on the axes. When finding the area of triangles a common error for a small number of candidates was to forget to halve their answers. Most candidates understood how to correctly answer part **(c)**. Quite a number successfully scored the follow through marks here even when their answer was incorrect in part **(b)**. Some candidates did not adhere to the instruction on the front of the exam paper with regards to accuracy and rounded or truncated their decimals too soon rather than giving an answer to three significant figures.

Answers: **(a)** 0.4 **(b)** 1430 **(c)** 11.9

Question 24

In part **(a)** most candidates recognised that $g(3x) = (3x)^2$, but this was then frequently left incomplete and unfinished or expanded to give a final answer of $3x^2$, rather than the correct answer of $9x^2$. Candidates are advised to practise applying techniques, such as those involving indices, in a variety of different contexts such as in functions questions. Other common incorrect answers were 9, $9x$ and $9x^3$. Part **(b)** was generally well answered with a large proportion of the candidates scoring both marks or at least 1 mark. Most candidates accurately identified the appropriate algebraic steps, as well as writing the final answer in the required form in terms of x. The most successful candidates began with the step $x = 3y + 5$, going on to rearrange to make y the subject. Those who chose not to interchange the x and y at the start often forgot to do so later on in their work and $\frac{y-5}{3}$ was a common incorrect answer. The most common incorrect first line of working was $y + 5 = 3x$. A common incorrect answer, often from no working shown or from using a flow chart (which was rarely successful) was $\frac{x}{3} - 5$. In part **(c)** some candidates did not recognise this as a composite function and proceeded to find $f(x) \times f(x)$, i.e. $(3x + 5)(3x + 5)$. The correct solution of $9x + 20$ was identified by many candidates, although this was then occasionally spoiled when some proceeded to equate the expression to zero and 'solve' the equation obtained. There were a large number of incorrect expansions of $3(3x + 5) + 5$, e.g. $6x + 15 + 5$, $9x + 5 + 5$ and $9x + 15 + 15$ all of which were seen several times.

Answers: **(a)** $9x^2$ **(b)** $\frac{x-5}{3}$ **(c)** $9x + 20$

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key Messages

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

General Comments

In the working many candidates are truncating lengths and angles to one or two figures. The effect is that the final answer is only accurate to at most one figure. Candidates are advised to keep at least four figures in their working or to use their calculator to store the answer from the previous calculation and use that number in the next calculation. Answers should always be given to three significant figures unless the question requests otherwise.
The work on algebra and geometry was particularly good. In the two questions on two- and three-dimensional geometry some solutions were spoilt by taking too little accuracy in the working and many candidates gave their answer to two significant figures. In trigonometry it is not usually necessary to find the third side of the triangle as only two are required to find any angle in a right-angled triangle.

Comments on Specific Questions

Question 1

The common method was to divide 240 by 10 and then to multiply by 7. The few errors were those who tried to divide 240 by 7. There were a lot of correct answers without any working shown.

Answer: 168

Question 2

Many candidates found the common factor of both terms, $3x$. However, a common error was to write $3x(x – 2)$, leaving the first term in the bracket as x and not $3x$.

Answer: $3x(3x – 2)$

Question 3

The best attempts made use of the cosine ratio at the start. However, many candidates used Pythagoras's theorem to find the vertical side and then used the sine ratio, or the sine rule, to find the angle. In this method early truncation of numbers led to an inaccurate result.

Answer: 66.4

Question 4

In this question it was necessary to find the bounds for 6.2 which were 6.15 and 6.25 and multiply them by 3. Some multiplied by 3 first and then found the bounds of 18.6, which were 18.55 and 18.65.

Answer: 18.45   18.75

Question 5

This question was answered well. The other common answer was $(2x - 3)(x - 1)$ which gave the first two terms correct or $(2x - 3)(x + 1)$ which gave the first and last terms correct. There were a few attempts to solve an equation by equating the roots of this expression to zero.

Answer: $(2x + 1)(x - 3)$

Question 6

A common error was to write the two columns the wrong way round or writing the 1s as either both negative or both positive.

Answer: $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

Question 7

Many candidates wrote the answer to one decimal place or rounded down when they should have rounded up. The common error in the method was to divide 1.252 by 2.

Answer: 1.60

Question 8

The first step was to change the mixed number into an improper fraction and this was done successfully by most candidates. Some wrote the improper fraction with a numerator of 9 or a denominator of 7.

Answer: $\frac{27}{8}$ or $3\frac{3}{8}$

Question 9

Many candidates successfully answered this question. The main error was in combining the number terms as $12 - 2 = 10$ by using the incorrect operation on the -2. A few did not apply the correct method when expanding brackets and wrote $3x + 4 = 8x - 1$, by omitting to multiply the second term inside the bracket by the number outside.

Answer: 2.8

Question 10

The working seen in this question was sporadic. There was a lot of reliance on the formula $85(1 - x) = 67.5$ and many could not get the answer as a percentage from this. The most successful approach was to find the reduction, 17.5[0], and to divide this by 85 and then convert to a percentage by multiplying by 100.

Answer: 20.6

Question 11

Many candidates tried to use the sine ratio even though this is not a right-angled triangle and there were a few attempts with the cosine rule. Most gave the answer to an appropriate degree of accuracy.

Answers: 12.2

Question 12

In part **(a)** the most common error was to try to use one of the three speed, distance and time formulae, which were not appropriate for this context. The two main correct approaches were to work out the area of the trapezium or to work out the area of the rectangle and the triangle separately, this final method being the most successful. In part **(b)** most used the correct method. Some multiplied their answer to part **(a)** by 10 instead.

Answers: **(a)** 5 **(b)** 2

Question 13

In part **(a)** the most common error was to divide the powers, so $4x^4$ was a common answer. In part **(b)** the main problem was calculating the eighth power of 256 and a common answer seen was $32y^{32}$.

Answer: **(a)** $4x^9$ **(b)** $2y^{32}$

Question 14

A few candidates did not know the quadratic formula but most wrote it down and substituted correctly into it. A few did not make it clear where the fraction line went, in particular whether the $-b$ was included in the fraction or not. Many answers were given to three decimal places, e.g. 0.781, despite the request in the question.

Answers: –1.28 0.78

Question 15

The method was usually correct in part **(a)** but the accuracy was sometimes too little and many used an insufficiently accurate approximation for π. In part **(b)** some did not realise that this was from the same circle in part **(a)** and so they calculated the radius often getting double or half the correct answer. Some did not halve the area of the full circle for this semi-circle and some used the formula for circumference instead.

Answers: **(a)** 4.77 **(b)** 35.7

Question 16

In part **(a)(i)** many candidates did not have a method for finding the intersection. The most common method used was 25 + 18 + 1 – 30. Many did not include the 1 student not studying either language, so 13 was a common incorrect answer. Part **(a)(ii)** was well answered but in part **(a)(iii)** it was usual to see 30 again as the denominator. Many converted the answer to a decimal or percentage but this is unnecessary. In part **(b)** some candidates included the intersections with P and/or Q as well.

Answers: **(a)(i)** 14 **(ii)** $\frac{11}{30}$ **(iii)** $\frac{11}{12}$

Question 17

Part **(a)** was answered very well. In part **(b)** some candidates knew that they needed the 50th and 150th cumulative frequency but instead of looking up the values from the graph they simply subtracted 50 from 150 to give 100. There were a few who looked up the values incorrectly. In part **(c)** some looked up 4.2 and therefore gave the answer as 175.

Answers: **(a)** 6 **(b)** 2 **(c)** 180

Question 18

The most common method was not the most efficient. Candidates calculated *AC* first and then halved to work out *AM* and then *AP* from the right-angled triangle. Some thought that triangle *ABP* was right-angled so used *AP* and *AB* to find the area of the triangle. Others used the sine or cosine rule or the trigonometric ratios to find lengths. The most efficient method was to find the length of *P* to the mid-point of *AB* and then use that to find the area of one of the triangular faces.

Answer: 912

Question 19

Part **(a)** was answered well except for part **(a)(ii)** in which many candidates gave the answer of $\frac{1}{2}\mathbf{a}$ using *B* as the origin. In part **(b)** the intention was that candidates use the position vector of *M* found in part **(a)(ii)** and either *OX* or *XM* to establish that *OXM* is a straight line using the parallel property of vectors which are a multiple of each other. Some tried to show similar triangles. This is more challenging and required the justification of equal angles such as angle PBX = angle OAX due to alternate angles.

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

Question 20

One method was to find the perpendicular height of the triangle, 7.7 cm, from 38.5 ÷ (0.5 × 10). Some using this method omitted the 0.5, a common error. Two applications of Pythagoras's theorem are then required followed by a simple subtraction. However, the common approach was to use the sine formula for the area, to find angle *RPQ* and then to use the cosine rule to find the required side. This has less stages but is more complicated. The other problems were a lack of working and working that was difficult to follow with the usual early truncation of numbers leading to an inaccurate answer.

Answers: 9.37

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key Messages

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

General Comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time, and most of the candidates were able to make an attempt at all questions. The standard of presentation was generally good and there was evidence that most candidates were using the correct equipment to answer the construction question. Candidates continue to improve in showing their workings and gaining method marks. However many candidates were unable to gain marks in the questions which asked for a reason for their answer as they did not use the correct mathematical terms. Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to fully process calculations and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set.

Comments on Specific Questions

Question 1

This question gave all candidates an opportunity to show their understanding of number.

(a) (i) The vast majority of candidates were able to identify two factors of twelve correctly. The most common pairs of factors were 2 and 6 or 3 and 4, with very few candidates giving all six possible factors. Very few candidates confused multiples for factors.

(ii) Candidates were successful in identifying the correct prime number of 23. The most common incorrect answer was 21.

(iii) Many candidates knew or calculated correctly the cube root of 64. Some candidates confused square root for cube root and gave the incorrect answer of 8, with very few cubing 64 instead of cube rooting.

(iv) Candidates found writing the number in figures challenging. A large proportion of candidates did not include enough, or too many, zeros in their answers. The most common incorrect answers were 20 507, 200 507 or not putting the digits in the correct place value, hence writing 2 507 000 or 2 500 007.

(v) A large proportion of candidates attempted to give factors instead of multiples. Successful answers were commonly 75 and 150 or 150 and 225.

(vi) This question caused some candidates difficulties in two ways. Firstly a number of candidates did not know π beyond 3 decimal places and did not use their calculators to find π beyond this accuracy. Those candidates who used their calculators confused significant figures for decimal places and often gave their answer to 5 decimal places, i.e.3.14159. Some significant errors in rounding were evident by less able candidates, with the answer of 3.1426 often seen.

(b) (i) Virtually all candidates gave answers containing the figures 163. However common errors were to divide by 100 to give the answer of 0.0163% or multiply by 10 to give an answer of 16.3%.

(ii) Candidates were more successful at converting fractions to percentages with the correct answer given by the majority of candidates. A common error was to divide by 100 after dividing the numerator by the denominator.

(c) (i) Most candidates showed their ability to round to 1 decimal place correctly. Very few answers gave answers to more decimal places. However a common error was to truncate and the answer of 63 521.7 was often seen.

(ii) Candidates found rounding to the nearest hundred a more challenging question with only the most able candidates giving the correct answer. Often candidates misread the question and rounded to the nearest hundredth or retained the 3 decimal places and gave the answer of 63 500.000. Some candidates confused place values and rounded the last 3 digits and gave a common incorrect answer of 63 521.800.

(d) (i) The best answers showed an understanding of conversion between mm and m, showing knowledge that there are 1000 mm in a metre. The most common errors were to assume 100 mm in a metre or to misread the question and convert 234 cm into metres. This led to the most common incorrect answer of 2.34 m.

(ii) Converting square metres to square centimetres proved to be one of the most challenging questions on the whole paper. The most common error was again to misread the question and convert metres to centimetres or to use 100 cm² = 1 m². This led to the most common incorrect answer of 87 600 cm². Many less able candidates did not attempt this question.

Answers: **(a)(i)** At least two of 1, 2, 3, 4, 6, 12 **(a)(ii)** 23 **(a)(iii)** 4 **(a)(iv)** 2 000 507 **(a)(v)** e.g. 75, 150,… **(a)(vi)** 3.1416 **(b)(i)** 163 **(b)(ii)** 7.5 **(c)(i)** 63 521.8 **(c)(ii)** 63 500 **(d)(i)** [0].234 **(d)(ii)** 8 760 000

Question 2

Candidates described the single transformations in part **(a)** well, with very few describing two transformations instead of one.

(a) (i) Good answers contained all three parts to describe a rotation, including angle, direction and centre of rotation. The most common error was to omit the centre of rotation. Less able candidates were able to correctly identify the transformation as rotation and often included 90° but did not include the direction or centre.

(ii) Candidates found describing a reflection easier with the majority of candidates gaining full marks. The equation of the mirror line was given as the *y*-axis or $x = 0$ in equal measures. However a large number of candidates gave the incorrect answer of $y = 0$ for the *y*-axis.

(iii) Less able candidates often attempted a description rather than the vector. However many did not give enough description, often giving an unacceptable answer of ‘eight *across* and five down’. Candidates need to be reminded to give directions fully if they are not writing the vector.

(b) Drawing the enlargement proved to be the most challenging part of this question. Some candidates drew the correct enlarged shape but often in the wrong place. Some candidates chose not to attempt this question.

Answers: **(a)(i)** rotation, 90° clockwise, [centre] (0,0) **(a)(ii)** reflection, *y*-axis or $x = 0$
(a)(iii) translation, $\begin{pmatrix} -8 \\ -5 \end{pmatrix}$

Question 3

Most of the question was well answered giving candidates the opportunity to show their understanding of money, ratio and solving simultaneous equations.

(a) (i) Nearly all candidates were able to gain full marks. Not all candidates chose to show working for this question.

(ii) Candidates who showed working often gained 1 of the 2 marks despite not getting the correct final answer of 0.21. A large number of candidates gave the incorrect answers of 0.2, 0.20 or 0.22 with no working seen. These candidates hadn't used the correctly rounded value of 5.79 and by not showing how they got their answer, missed out on a potential method mark. Candidates should be reminded and encouraged to show all their working out.

(b) (i) The majority of candidates showed good understanding of ratios and correctly identified the numbers of marbles. However this was again often given without any working seen. A very common misconception was to divide the total number of marbles by the values in the ratio.

(ii) Good answers showed the addition of the 11 red, 9 blue and 20 green to their values in part **(i)**. However this ratio was often not given in its simplest form. The most common error was to not read the question carefully enough and not add the 11 red, 9 blue and 20 green to their previous answer. Candidates should be reminded to reread the question once they have answered it to check they have answered it correctly.

(c) (i) This part proved to be the one most often incorrect. Candidates did not read the whole question carefully enough and did not spot that they had to complete the equation in cents rather than dollars. The correct answer of 570 was rarely seen.

(ii) Candidates who continued to give their answers in dollars rather than cents were not penalised in this part therefore the majority of candidates gained full marks for their second equation, despite using $2.40 instead of 240 cents. The vast majority of candidates correctly gave the algebraic part of the equation.

(iii) Simultaneous equations proved to be a challenging question for many candidates. Those who had given the previous two answers in dollars were not penalised again for giving their answers in dollars in part **(iii)**. Very few candidates did not show any working out. Less able candidates who were unable to solve the pair of equations often gained 1 mark for giving two values which correctly satisfied one of their equations. However this was often lost if they did not give their answers in the same units as their original equations, dollars or cents.

(d) Candidates who gained full marks had to demonstrate a number of conversions. The most common correct method was converting 3.4 metres to 340 cm, dividing by 20, multiplying by 99 cents and finally converting to dollars. However often one (or more) of these conversions was not completed correctly.

Answers: **(a)(i)** 6 **(a)(ii)** 0.21 **(b)(i)** 5, 15, 20 **(b)(ii)** 2 :3 : 5 **(c)(i)** 570 **(c)(ii)** $b + 2t = 240$ **(c)(iii)** 90, 75 **(d)** 16.83

Question 4

Candidates demonstrated a good understanding of probability and averages in this question. The question tested a range of mathematical skills including bearings, scales, speed, probability, averages, exchange rates and upper and lower bounds.

(a) (i) Bearings continue to cause difficulties for some candidates. The most common error was to measure the line *KH* and give the answer of 9.5 cm.

(ii) Candidates who had measured the length of *KH* in part **(i)** correctly converted this to km and gained full marks. Very few candidates could not use the scale correctly. The most common error was not measuring the length of the line accurately and therefore their converted answer was not within the range of accepted answers. Some candidates who did not know how to convert using the scale usually gained 1 of the 2 marks for correctly measuring the length of *KH* within tolerance.

(iii) Most candidates showed that they understood how speed is calculated. However this question tested the candidate's ability to convert a speed from km/h to m/s. This required the candidates to know that 1000 m = 1 km and 3600 seconds = 1 hour. Most candidates showed one of these conversions but very few knew both. The best solutions gave full working by converting to metres and then dividing by 3600 seconds (often given as two division sums, e.g. divide by 60 then divide by 60 again). Less able candidates often missed this question out or most common was to divide by 60 only, reaching an answer of 7.5 m/s.

(b) (i) The majority of candidates showed understanding that the probability of an event not happening is '1 – the probability of it happening'. Very few candidates showed this sum and the most common incorrect answer was 0.75, where candidates had performed the subtraction incorrectly.

(ii) Many candidates had not read the question carefully enough. A large proportion of candidates used their previous answer, which was the number of flights not on time. Candidates should be encouraged to reread the question once they have given their answer to check it has actually answered the question given.

(c) (i) Most candidates showed understanding of range. Many candidates just gave the correct value of 6, however some gave the solution as 21 – 15, or 15 to 21, which did not gain the mark.

(ii) This was the best answered part of this question with the vast majority of candidates correctly identifying 16 as the mode. Very few candidates did not attempt this question with only a small number of candidates calculating the median or mean instead.

(iii) The majority of candidates showed understanding of median. However a large number of candidates missed out on the mark as they did not calculate the value between 16 and 18 and gave their solution as '16,18'

(iv) Candidates showed good understanding of mean, with the best solutions showing full working out, including an addition sum and division by 6. The most common errors were to not divide by 6, or to do the whole sum on the calculator as $15 + 16 + 16 + 18 + 19 + 21 \div 6 = 87.5$. Candidates should be encouraged to calculate the total first then divide by the number of values.

(v) Candidates continue to improve in giving probabilities as fractions, percentages or decimals, with very few ratios or worded descriptions seen. Many candidates simplified their fraction, although this was not essential to gain full marks, and candidates who gave their probability as a percentage or decimal generally gave it to the desired level of accuracy (at least 3 significant figures). The most common error was to misread the question and give the probability of choosing a suitcase with 18 items ($\frac{1}{6}$) or choosing a suitcase with 18 or more items ($\frac{3}{6}$).

(d) (i) Candidates often gained full marks in this question. However some candidates multiplied the values given and a number of candidates gave an answer of 2.6 with no working. Candidates must be encouraged to show all workings out and to round to an appropriate degree of accuracy.

(ii) Many candidates were successful in this question, giving the two correct values. Many candidates were able to gain 1 of the 2 marks for 245 but often missed the second mark giving the value of 254 as the upper bound. Some candidates chose not to attempt this question or simply wrote the values given in the question.

Answers: **(a)(i)** 292 **(a)(ii)** 380 **(a)(iii)** 125 **(b)(i)** 0.85 **(b)(ii)** 36 **(c)(i)** 6 **(c)(ii)** 16 **(c)(iii)** 17 **(c)(iv)** 17.5 **(c)(v)** $\frac{2}{6}$ **(d)(i)** 2.62 **(d)(ii)** 245, 255

Question 5

This question provided candidates with the opportunity to show their understanding of pie charts.

(a) The vast majority of candidates correctly identified green as the least favourite colour, with only a very small number finding the most favourite colour as yellow.

(b) Calculating the total number of children in the school proved to be very challenging to many candidates. Of those candidates who used a correct method, most commonly they divided 135° by 27 to find the number of degrees for each child (5°) and then divided 360° by 5°. The other method seen was to divide 360° by 135° and then multiply by 27. Candidates who showed all working generally gained full marks. Candidates who were not as accurate with their measuring of the yellow sector often gained full marks as they completed the calculation correctly and then rounded to 71 or 73 children. Candidates who gave their answers as decimals gained 2 of the 3 marks. The most common error was not to measure the yellow sector and to assume that it was a third of the circle.

(c) Calculating the percentage of children who chose red proved very challenging for the majority of candidates. A large proportion of candidates did not measure the red sector and assumed it was 90° and therefore gave the answer as 25%. Candidates who tried to use their previous solution generally went wrong, often calculating the number of children who chose each colour from their incorrect total number of children in part **(b).** Some candidates were able to gain a mark for correctly following through their previous incorrect answer.

Answers: **(a)** green **(b)** 72 **(c)** 22.2

Question 6

This construction and angles question offered candidates the opportunity to show they could bisect an angle and to use symmetry and parallel lines to answer angle problems.

(a) (i) Many candidates were able to identify the correct order of rotational symmetry. The most common incorrect answer was 4, or to not give the order in a number form but to use letters to describe a rotation, e.g. *A-B-C-D*.

(ii) The number of lines of symmetry proved to be more challenging for the majority of candidates with 2 being the most common incorrect answer (with 1 and 4 also seen often).

(iii) The angle sum of a quadrilateral was the most successful part of this question with the majority of candidates correctly identifying 360°. Common incorrect answers were 4 or 180°.

(b) (i) Those who drew a correct bisector within the tolerances generally scored 2 marks as candidates left in clear construction arcs. The arcs on the lines *AB* and *AD* were sometimes not left clearly enough. A number just drew a line from *A* to *C*. Candidates had clearly read the question fully as the majority of correctly drawn bisectors were extended to reach *DC* and the letter *E* marked on the diagram.

(ii) To gain the mark for this explanation question candidates had to clearly identify that the two angles were alternate angles, or 'Z' angles. Candidates often gave lengthy descriptions why they were the same size but did not include the correct mathematical terms.

(iii) Candidates who had correctly bisected the angle in part **(i)** generally were able to identify that the triangle *ADE* was isosceles. The reason why was not answered well. Candidates had to identify which two angles or sides were the same size. Nearly all candidates simply wrote that two angles or two sides were the same, without saying which ones.

(iv) Candidates found identifying the mathematical name of the quadrilateral *ABCE* difficult, with the most common answer being parallelogram.

Answers: **(a)(i)** 2 **(a)(ii)** 0 **(a)(iii)** 360 **(b)(ii)** alternate [angles] **(b)(iii)** isosceles, [angle] *DAE* = [angle] *DEA* **(b)(iv)** trapezium

Question 7

Understanding of speed, time and travel graphs were essential skills tested in this question.

(a) (i) The majority of candidates were able to correctly identify between which two towns the train travelled fastest but their reason was often not accurate enough. Often answers only mentioned details of one part of the journey without a comparison with the previous part.

(ii) This question required candidates to take values from the travel graph, and candidates often read the distance travelled between Brookland and Cawley as 35 km instead of 25 km. Some candidates divided by 0.15 or 15 mins instead of the correct value of 0.25.

(b) (i) Candidates showed that they understood that a horizontal line on a travel graph represents when the train had stopped. As a result most candidates were able to gain 1 of the 2 marks for correctly drawing a horizontal line two squares long. The return journey proved more challenging, which often finished at 10 30 or 11 00.

(ii) Candidates who had attempted the return journey on the travel graph generally were able to gain a follow through mark. Very few candidates misread the scale, with the most common error reading one square as 10 mins instead of 5 mins.

(c) A variety of methods were used to solve this time question. Successful solutions often included writing the departure times of each train although some candidates lost a mark for not giving the final time in the correct form; 2:00 or 02 00 was often seen when the required answer was 14 00 or 2 pm. Some candidates used 1 hour = 100 minutes and gave the common incorrect answer of 1300. A very common error was to count too many or too few trains, giving the answers of 12 20 or 15 40.

Answers: **(a)** Brookland to Cawley and [gradient is] steeper **(a)(ii)** 100 **(b)(ii)** 10 20 **(c)** 1400

Question 8

This shape question tested candidates' understanding of circle theorems, area of circles and triangles and Pythagoras' theorem.

(a) Candidates were generally successful in reaching 153° or in calculating 27° for angle *BCA*. Giving reasons proved to be more challenging. Many candidates wrote the calculations down that they had performed as sums or as worded descriptions without reasons why these sums were correct. Candidates often left out key words or descriptions. Candidates need to be reminded that they must use exact phrases to describe their reasons. In particular when describing the angle sum of a triangle, many candidates simply wrote 'a triangle adds up to 180°'. To gain the mark candidates must use the word 'angles' in this reason. Similar comments apply for angles on a straight line. Most candidates clearly identified angle *ABC* as 90° but very few correct reasons were seen. Candidates often confused 'radius and tangent meet at 90°' with 'an angle in a semi-circle is 90°'.

(b) Most candidates were able to gain at least 1 mark for the area of the square. A variety of methods were then used to calculate the shaded area. The most common method was to calculate the area of the square and circle, then find $\frac{3}{4}$ of the circle and take that away from the square. Candidates who followed this method generally got full marks, although some did lose a mark for incorrect or premature rounding of their area of the circle. A large number of candidates attempted part of this method but found $\frac{1}{4}$ of the circle and added or subtracted it from the area of the square. Depending on the amount of working seen this method gained a variety of marks. Candidates need to be reminded that on a large mark question it is essential to show all working out to be able to gain the part marks if their final solution is incorrect or inaccurate. Candidates generally used the correct value for π with very few using 3.14 or $\frac{22}{7}$.

(c) (i) The majority of candidates correctly identified that they had to use Pythagoras' theorem with many excellently presented answers seen. The most common error was to add the squares of each side. Candidates should be reminded to check the validity of their answers in relation to the triangle as it is clear from the diagram that *FG* is the longest side and that *GH* should be shorter than 45 cm.

(ii) Candidates who attempted part **(i)** generally gained a follow through mark in part **(ii)** for correctly adding the other 2 sides to their previous answer.

(iii) Candidates who had attempted part **(i)** generally gained a 2 mark follow through in part **(iii)** for correctly calculating the area of the triangle. This was often given with no working out shown, and in some cases this led to no marks being awarded when the candidate had rounded their answer to less than three significant figures.

Answers: **(a)(i)** 153° and two correct geometrical reasons **(b)** 14.8 **(c)(i)** 36 **(c)(ii)** 108 **(c)(iii)** 486

Question 9

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

(a) (i) The majority of candidates successfully completed the table. A common error was to calculate $-x^2$ as x^2 which caused problems in part **(ii)** when plotting the graph.

(ii) Points were generally plotted correctly and curves were drawn accurately with smooth curves and few instances of "sketching". The most common error was to join the points (2,6) and (3,6) with a straight line giving the curve a flat top.

(b) Candidates showed understanding of what was required in this question but were unable to gain the mark if they had not drawn the curve accurately enough in part **(a)(ii).** The most common error followed a flat top of their curve and (2,6) and (3,6) were very common incorrect answers. It was essential that candidates recognised the symmetry of the curve to give the *x* co-ordinate as 2.5.

(c) Many candidates used the intersection of the *x*-axis and their curve rather than drawing the line $y = –3$. Some candidates misread the scale.

(d) (i) Candidates who had plotted the graph correctly generally drew the line of symmetry correctly. A large proportion of candidates did not attempt this question, either because they had not plotted their graph in part **(a)(ii)** or their graph had no line of symmetry following errors in part **(a).**

(ii) The more able candidates could correctly write the equation of their line of symmetry. A large number of candidates omitted the $x =$ or started their equation with $y =$.

(iii) The most common error in this part was to assume the symmetry was around the *y*-axis and to give the answer as 10. Very few correct answers of 15 were seen.

Answers: **(a)(i)** 0, 6, 6, –6 **(b)** (2.5, k) where $6 < k \leqslant 6.5$ **(c)** 5.4 to 5.7 and –0.4 to –0.7 **(d)(ii)** $x = 2.5$ **(d)(iii)** 15

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key Messages

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

General Comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper, making an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. Candidates should also be reminded that in “show that” questions full method needs to be shown.

Comments on Specific Questions

Question 1

All candidates were able to attempt all or part of this question as it offered a wide range of questions on various areas of mathematics and numeracy involving definitions, factors, multiples and roots.

(a) (i) This part required knowledge of the term factor and was generally answered well although a significant number of candidates lost marks by only giving one example from the given list and not stating all the possible factors. A common error was to include 0 as a factor.

(ii) This part involved prime factors and again was answered generally well although common errors were 4 and 7.

(iii) This part involved finding the highest common factor and again was answered generally well although common errors were 1 and an attempt at the lowest common multiple.

(iv) This part involved finding the square root of 49 and again was answered generally well although common errors were 7^2 and 2401 (from 49^2).

(v) This part involved finding the cube root of 27 and again was answered generally well although common errors were 3^3, 9, and 19683 (from 27^3).

(b) (i) This part was generally answered well although a variety of incorrect 4-digit numbers and non 4-digit numbers were seen. Common errors included 9,7,5,4, 9999, 1260 (from $9 \times 7 \times 5 \times 4$) and 9754320.

(ii) The vast majority of candidates were able to write their answer to part **(b)(i)** in words.

(c) (i) The vast majority of candidates were able to find the required common multiple although a small number had to write down all the multiples of 5 and 8 up to 150 rather than use the lowest common multiple of 40. Common errors were 40, 80 and 300.

(ii) This part on finding a square number was less successful with common errors of 19, 19^2, 360 and 380.

Answers: **(a)(i)** 2, 3, 4 **(ii)** 2 or 3 **(iii)** 7 **(iv)** 7 **(v)** 3 **(b)(i)** 9754 **(ii)** nine thousand seven hundred and fifty four **(c)(i)** 120 **(ii)** 361

Question 2

This question tested the candidate's ability in algebra with a number of concepts covered.

(a) This simplification by collecting like terms was generally well done although it was often spoilt by sign errors usually in the "*f*" term with $11e - 4f$ a common error.

(b) This substitution of values into a given expression was generally well done although again sign errors were made often leading to the common error of 40 – 27 = 13. Other common errors included $40g - 27h$ and 85 + 93 = 178.

(c) The correct solution to the equation was generally found although the common error of $x = 5.5$ coming from an incorrect first line of working of $4x = 29 - 7$ was seen.

(d) The majority of candidates were able to apply the correct law of indices to obtain k^{-7} or the equally valid $\frac{1}{k^7}$. However common errors of k^{44}, k^{15}, and k^7 were seen.

(e) (i) Most candidates knew how to complete the equation but a very common error was to use 2.20 due to a misunderstanding of the units. The question clearly stated that the equation represented the cost in cents and so the answer should have been 220. However consistent use of dollars in part **(e)** was only penalised by the loss of 1 mark. Other common errors in this part included 0.22, 2200, 22 and $8pw$.

(ii) Again most candidates knew how to complete the equation but a very common error was to use 3.50 with 0.35, 35, 3500 and $14pw$ also seen.

(iii) The solving of the two simultaneous equations proved a good discriminator with a number of fully correct methods and solutions seen. The method of elimination was the most successful method used. However a significant number were unable to progress further than the equating of coefficients stage. Less able candidates were often unable to apply a valid method but were sometimes able to give a solution that fitted one of the equations.

Answers: **(a)** $11e - 6f$ **(b)** 67 **(c)** 9 **(d)** k^{-7} **(e)(i)** 220 **(ii)** $4p + 10w = 350$ **(iii)** $p = 45$, $w = 17$

Question 3

This question tested geometrical properties requiring knowledge of circles, triangles, formulae for circumference and area, and also involved the application of Pythagoras' theorem and trigonometry. A small but significant number of candidates continue to use 3.14 or $\frac{22}{7}$ for the value of π despite the instructions on the front of the question paper.

(a) (i) The majority of candidates used the correct formula to find the circumference of the circle although a significant number lost the accuracy mark due to premature or incorrect rounding, using an unacceptable value for π, or not giving their answer correct to three significant figures. Other common errors included π x 10.5, $2 \times \pi \times 21$, $\pi \times 21^2$.

(ii) Again the majority of candidates used the correct formula to find the area of the circle although once again a significant number lost the accuracy mark. Other common errors included $\pi \times 10.5$, $\pi \times 21$, $\pi \times 21^2$ and 21×16.

(b) (i) This part was generally well answered with the majority of candidates recognising the angle in a semi-circle property. A small number attempted to calculate angle *ADB* or angle *BAD* with the other common errors being answers of 180, 360 and 45.

(ii) There were a number of excellent and clear answers seen. As this was a “show that” question, 21^2, 9^2, subtraction, square root and the accurate value of 18.97 all needed to be seen in the working to gain full marks. Whilst many candidates recognised the need for Pythagoras' theorem not all of these requirements were seen. Other common errors included $21^2 + 9^2$, the use of the given value of 19 in a circular argument, or invalid reasons such as $40 - 21 = 19$.

(c) (i) This part on finding the area of a triangle was generally well answered although the common errors of 9×19, $\frac{1}{2} \times 9 \times 21$ were seen.

(ii) Not all candidates recognised the connection between this part and previous parts of the question and did not realise that the required follow through calculation of $\frac{1}{2}$ part **(a)(ii)** – part **(c)(i)**, i.e. area of semi-circle – area of triangle, was needed. Those candidates who started again were less successful. A common error was using *AB* and *BD* incorrectly as diameters with the shaded regions being treated as semi-circles.

(d) (i) Tangent was correctly identified by a number of candidates although a full variety of mathematical names were seen with the most common errors being straight line, horizontal, 180˚, chord and diameter.

(ii) Radius was more successfully identified although again a full variety of mathematical names were seen with the most common errors being straight line, vertical, 90°, right angle and diameter.

(iii) Some good trigonometrical calculations were seen with the tangent ratio being most commonly used although a number of longer methods were seen. Less able candidates often attempted to use Pythagoras' theorem or simply stated 90˚ or 45°. Other common errors included $\tan^{-1}(\frac{21}{16})$, $\tan^{-1}(\frac{16}{10.5})$, $\tan(\frac{10.5}{16})$ and incorrect use of the sine and cosine ratios. Premature approximation was again a problem here with a number losing the accuracy mark.

Answers: **(a)(i)** 66.0 **(ii)** 346 **(b)(i)** 90 **(c)(i)** 85.5 **(ii)** 87.5 **(d)(i)** tangent **(ii)** radius **(iii)** 33.3

Question 4

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

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

(ii) The graph was generally plotted well. The majority of candidates were able to draw a correct smooth curve although a significant number made the error of joining points with straight lines particularly the two points at (1,10) and (2,10).

(iii) This part proved challenging. The common error was stating (1,10) and/or (2,10).

(b) (i) The table was generally completed well.

(ii) The graph was generally plotted well. The majority were able to draw a correct smooth curve although a significant number again made the error of joining points with straight lines particularly the two points at (2, 6) and (1, 12), or included the point (1, 10) in their curve.

(c) The majority of candidates appreciated that the *x* co-ordinates from the intersections of the two graphs were the required values. However a common error was to misread the horizontal scale and thus give inaccurate values. A small but significant number of candidates continue to attempt to solve the given equation but as this was a cubic none were successful.

Answers: **(a)(i)** 10, –2 **(iii)** (1.4 to 1.6, 10.1 to 10.4) **(b)(i)** 6, 3 **(c)** 1.1 to 1.3, 4.1 to 4.3

Question 5

This question on quadrilaterals and transformations was generally well answered although a significant number of candidates were unaware of the correct mathematical terms to be used in describing the given transformations. It was a common error in all parts to give extra transformations and/or worded descriptions such as “slide down and flip” and “move across and shrink”.

(a) (i) The majority of candidates were able to correctly identify the kite although a full range of other names and shapes were seen.

(ii) The majority of candidates understood the concept of lines of symmetry although 2 was a common error.

(b) This part on finding the area of the given shaded kite was generally answered well with a variety of methods demonstrated although common errors of 24, 6, 10, 11 and 18 were seen.

(c) (i) The majority of candidates were able to correctly identify the transformation as a translation but the full description with a correct vector was less common.

(ii) The majority of candidates were able to correctly identify the transformation as a reflection but the full description with a correctly identified line of reflection was less common. Those candidates who identified the equally valid transformation of rotation often omitted or gave an incorrect centre of rotation.

(iii) The majority of candidates were able to identify the transformation as an enlargement but the full description with a correct scale factor and centre of enlargement was rarely achieved. The fractional scale factor caused problems for some candidates and a number of unacceptable alternatives to the correct term of enlargement were seen.

(d) Many correct answers were seen but often candidates only scored 1 mark for a rotation with the correct size and orientation but in an incorrect position suggesting difficulties with the given centre of rotation.

Answers: **(a)(i)** kite **(ii)** 1 **(b)** 12 **(c)(i)** translation $\begin{pmatrix} 7 \\ -9 \end{pmatrix}$ **(ii)** reflection $y = -1$ or rotation 180° centre (–2,–1)

(iii) enlargement scale factor $\frac{1}{2}$ centre (–6, 0)

Question 6

All candidates were able to attempt all or part of this question as it offered a wide range of questions on various areas of mathematics and numeracy involving time, percentages, fractions and ratio.

(a) (i) As this was a “show that” question full working of $3\frac{1}{4} \times 60$ or $\frac{13}{4} \times 60$ or 3.25×60 or $3 \times 60 + \frac{1}{4} \times 60$ was required. This was not always seen with 180 + 15 being common.

(ii) Some good solutions were seen with full marks awarded but a significant number were unable to add the three given times to 16 15 without making at least one error in the process. The conversion of time to the correct decimal equivalents caused a number of problems. Common errors included omitting the $3\frac{1}{4}$ hours and/or the 45 minutes, use of 2.30 and/or 0.45 and

1615 + 195 + 150 + 45 = 2005.

(iii) The use of a common unit in the ratio was not always appreciated with 3.25 : 2.5 : 45 being a common error. The conversion to the correct decimal equivalents again caused a number of problems. The more successful candidates started with 195 : 150 : 45 though this was not always converted to the correct simplest form.

(b) This part was generally well answered.

(c) The calculation of the percentage decrease caused more problems although a good number of candidates were able to score full marks with the most successful method of $\frac{1.8}{22.5} \times 100$ being used. Common errors included the use of $\frac{22.5}{20.7}$, $\frac{1.8}{20.7}$ and the use of 200.

Answers: **(a)(ii)** 22 45 **(iii)** 13 : 10 : 3 **(b)(i)** 78 **(ii)** 30 **(iii)** 87 **(c)** 8

Question 7

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

(a) (i) This part was generally answered well although a small number did not appreciate that they needed to use the given total of 100 to work out the required missing value.

(ii) This part on writing down the modal length was generally answered well although common errors of 35 (highest frequency) and 68 (largest number in the table) were seen.

(iii) Whilst the majority of candidates demonstrated that they understood the meaning of the term range few correct answers were seen. It was not generally appreciated that as the lengths of 62 and 68 had zero frequency the required calculation was 67 – 63. Common errors were 68 – 62 = 6 and 35 – 0 = 35.

(iv) Whilst a number of good solutions with correct working leading to the correct answer were seen, the use and meaning of the given frequency table was often not appreciated or understood. A very common error was (62 + 63 + 64 + 65 + 66 + 67 + 68) ÷ 7 = 65. Other common errors included (62 + 63 + 64 + 65 + 66 + 67 + 68) ÷ 100, (63 + 64 + 65 + 66 + 67) ÷ 5, (0 + 12 + 30 + 35 + 15 + 8 + 0) ÷ 7, 62 × 0 = 62, 68 × 0 = 68, and 65 (possibly coming from the median).

(v) The pie chart was well drawn by the majority of candidates although there was a lack of working shown which may well have resulted in the loss of possible method marks in the case of inaccurately drawn angles in the pie chart.

(b) This question on bounds was generally well answered. However common errors included 64.95 and 65.05, 60 and 70, and 65.4 or 65 as the upper bound.

Answers: **(a)(i)** 15 **(ii)** 65 **(iii)** 4 **(iv)** 64.77 or 64.8 **(b)** 64.5, 65.5

Question 8

This construction question proved challenging for a number of candidates.

(a) (i) This part was generally correct. A small number did not show their working and may have lost the method mark available for accurately measuring the line in centimetres first.

(ii) The majority of candidates were able to correctly measure the bearing. Some candidates however clearly measured the bearing anti-clockwise from North or read the wrong scale on their protractor.

(b) Some very good constructions were seen, usually with accurately measured arcs. However a small number found the correct position for the point *C* without showing the arcs used or just by using a ruler which was awarded just 1 of the 2 available marks.

(c) The majority of candidates were able to correctly draw the position of the point *D*. The common error was to use an incorrect bearing with the same errors as mentioned in part **(a)(ii)**.

(d) Many candidates who had drawn a completely correct diagram were able to calculate the correct value for the perimeter. Those who had drawn in the lines to show the field *ABCD* tended to be more successful. A small number of candidates did not appreciate that three of the required distances were given in the question and that *CD* was the only line that needed to be measured. Other common errors included using 240 m for the missing length, omission of the line *CD*, inclusion of the line *AC* and omission of working. As a follow through was allowed, a number of candidates may have lost possible method marks by this omission of working.

Answers: **(a)(i)** 116 **(ii)** 065° **(d)** 630 to 646

Question 9

This question on a variety of mathematical concepts with a common theme proved a good discriminator and the full range of marks was seen.

(a) The majority of candidates gained full marks on this part by correctly calculating the three required values. A common error was to divide the given numbers giving 162.5 for sandwiches and 25 for magazines in which case the follow through mark for correct addition was usually gained.

(b) This part on money conversion using the given exchange rate was generally well answered with an acceptable value stated. Common errors included 546.5, 10000×18.3 and $\frac{18.3}{10000}$.

(c) Many candidates demonstrated that they understood the process to find the average speed but full marks were not always achieved. As this was a "show that" question both a valid method of $1937 \div 2.83$, $1937 \div 170 \times 60$, or $1937 \div 2\frac{50}{60}$ and a more accurate answer between 683.6 and 684.4 was essential. Other common errors included division by 2.5 and reverse methods using the given value of 684.

(c) This part proved to be the most challenging with many candidates not appreciating the time difference between the local times in Mumbai and Dubai. Method marks were available but not always awarded because of a lack of clear working. Common errors included adding the 1.5 hours time difference leading to the answer of 1735, omission of the 2 hrs 50 min flight time leading to the answer of 1445 and giving a 12-hour clock time.

Answers: **(a)** 650, 225, 875 **(b)** 546 **(d)** 14 35

MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key Messages

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

General Comments

The paper gave the opportunity for candidates to demonstrate their knowledge and application of mathematics. The majority of candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates attempted all of the questions with the occasional part question being omitted by individuals. The standard of presentation was generally good. A substantial number of candidates did show all necessary working. However, some candidates just provided answers or did not carry out calculations to sufficient accuracy and consequently lost marks. There was an increase in the number of candidates who, for the graph question, either only plotted points or used straight lines to join the plotted points.

Centres should continue to encourage candidates to show all working clearly in the answer space provided. The formulae being used, substitutions and calculations performed are of particular value if an incorrect answer is given.

In “show that” questions, candidates need to understand that a rhetorical solution is not acceptable; a result cannot be used to show that result.

Centres should encourage candidates to read the front cover of the examination paper carefully and to use the correct value for π.

Candidates should take the time to read the questions carefully to understand what is actually required in each part, for example, not giving an answer to 1 decimal place when required by the question.

Comments on Specific Questions

Question 1

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

(a) (i) Candidates were able to provide very accurate frequency tables with only a few slips. The tally column was sometimes used instead of the frequency column for the answer.

(ii) Many candidates gave the correct answer for the modal value.

(iii) Candidates should be encouraged to understand the difference between mean and median.

(iv) Candidates generally gave the correct answer. The common error was to not use the 24–hour clock as stated in the question but to write down 11 50 pm. A few candidates misread the hours and minutes hands.

(b) (i) Many candidates gave the correct answer.

(ii) Many candidates gave the correct answer but some gave an incomplete answer stating 10 – 16.

(iii) Candidates found this part challenging. Many simply described the shape of the bar chart. Very few gave a comparison involving either the mode or mean or range or total number of trains.

Answers: **(a)(i)** 2, 1, 3, 5, 4 ,3, 2 **(ii)** 13 **(iii)** 13.25 **(iv)** 23 50 **(b)(i)** 16 **(ii)** 6

Question 2

Most candidates showed some knowledge of trigonometry. However, their answers would be improved by showing their working more clearly.

(a) The majority of candidates gave the correct answers although their spelling could be improved. Some candidates mixed up isosceles and equilateral.

(b) (i) Many candidates gave the correct answer. The most common error was to just add up the four lengths given and not include the lengths which needed to be found.

(ii) Those candidates who gave the correct answer for part **(b)(i)** tended to give the correct answer here as well. Most candidates used a sensible method of dividing up the area but arithmetic errors were sometimes seen when working was shown. Some candidates did not fully read the question and omitted the units.

(c) (i) Very few candidates gave the correct answer. The common error was to write it is a right-angled triangle or to write about tangents, chords and diameters.

(ii) Many candidates recognised that they needed to use Pythagoras' theorem but some used it incorrectly by assuming *AC* was the hypotenuse. Some candidates assumed the triangle was isosceles.

(iii) Some candidates gave the full correct answer showing all their working. Some candidates did not show any working and gave an answer which was not accurate so lost all the marks. The other common error was to not halve the area of the circle.

Answers: **(a)** equilateral, isoceles, right-angled or scalene **(b)(i)** 40 **(ii)** 86 cm^2 **(c)(i)** angle in a semi-circle **(ii)** 14.8 **(iii)** 56.0

Question 3

Candidates showed an extremely good understanding of pie charts. They could improve their responses by doing further work on how pie charts can link to probability.

(a) (i) Nearly all candidates gave the correct answers.

(ii) Although the vast majority of candidates drew the correct line quite a few did not draw it accurately.

(b) Many candidates gave the correct answer. However, some did not fully read the question and gave an answer which was not in its simplest form.

(c) Some candidates found this part challenging. Many understood that they needed to use 64° but linked it with 90° rather than 360°.

Answers: **(a)(i)** 76, 124 **(b)** $\frac{4}{15}$ **(c)** 72

Question 4

Candidates demonstrated a good understanding of constructions. However, they could improve by understanding that bearings are measured from the North in a clockwise direction.

(a) Many candidates completed the construction carefully and accurately. The common error was to not show arcs.

(b) Fewer candidates completed this part correctly. There were a considerable number of candidates who drew a line bisector rather than an angle bisector.

(c) When a point *D* had been identified nearly all candidates could measure the length of *BD* accurately.

(d) Many candidates gave the wrong angle. The most common incorrect answers were to look at the bearing of *A* from *C* or to measure the bearing in the anti-clockwise direction.

Answers: **(c)** 5.9 to 6.3 **(d)** 119 to 123

Question 5

Many candidates demonstrated a good understanding of ratios. Care needs to be taken in money and time questions. Candidates would improve their responses if they had more practice on how to estimate.

(a) Many candidates gave the correct answer but even more only gave the interest rather than the total amount as asked for in the question. Few candidates attempted to use compound interest.

(b) Although nearly all candidates understood they needed to multiply 28 by 15.85 a considerable number didn't recognise that this was money and an exact answer and gave answers to 3 significant figures.

(c) The vast majority of candidates understood how to work out the total to pay and gave the correct answer. In general the main errors were caused by inaccurate multiplication or addition.

(d) Nearly all candidates gave the correct answer with little or no working evident in the working space.

(e) Some candidates gave the correct answer. Working was often poorly presented and hard to follow. A few candidates assumed there were 100 minutes in an hour.

(f) Some candidates gave the correct answer. The most common error was to perform the multiplication in full and then round that answer to 1 significant figure. The other common error was to estimate 7.95 as 8 but leave 21 unrounded.

Answers: **(a)** 47 200 **(b)** 443.8[0] **(c)** 142 **(d)** 45, 30, 105 **(e)** 52.5 **(f)** 8 x 20 = 160

Question 6

Many candidates showed a good understanding of travel graphs. Candidates could improve by ensuring the starting point and end point are correctly placed on the *y*-axis.

(a) The vast majority of candidates gave the correct answer. The two most common errors were to misread the starting point as being at the origin (09 00) or to misread the horizontal scale as 09 10.

(b) Most candidates understood where *B* was on the travel graph and gave the correct answer.

(c) Most candidates gave the correct answer.

(d) This part proved challenging for many candidates. Many split the travel into two sections when the train was in motion and averaged those two answers and ignored the time when the train was stopped. Some candidates incorrectly changed the time travelled into minutes or used 2.30.

(e) (i) A small majority of candidates drew the correct travel graph. Many other candidates started the second train from *A* instead of *C*.

(ii) Many candidates could read off the time when the trains crossed. However, there was evidence that some candidates misread the scale.

(f) Most candidates correctly multiplied the two numbers together. However, many did not give the exact answer.

Answers: **(a)** 09 20 **(b)** 10 00 **(c)** 20 **(d)** 50 **(e)(ii)** 1040 to 10 50 **(f)** 56.28

Question 7

Candidates generally could complete a table and plot points. However, there was a large number of candidates who did not join the points to create a curve or drew straight lines between their plotted points.

(a) A few candidates gave the correct answer. Many forgot the minus sign or misread the scale for the intercept.

(b) (i) The majority of candidates completed the table correctly. The common error was calculating the value when $x = -3$ with the negative sign being mishandled.

(ii) Many candidates plotted the points correctly although a large number misread the vertical scale. Drawing the curve was good although many candidates did not join the points to create a curve or drew straight lines between their plotted points.

(iii) Candidates understood how to find the intersection but many of them misread the scale or forgot the minus sign for one of the answers.

Answers: **(a)** –1 **(b)(i)** 16, –2, –2, 16 **(iii)** Strict follow through their intersections

Question 8

Candidates generally demonstrated how to simplify expressions and solve equations of one variable. They could improve their answers by having more practice on solving simultaneous equations.

(a) (i) Candidates clearly demonstrated how to insert a value into a formula although some showed no working and lost marks when they gave an incorrect answer. The common incorrect answer was to not give an answer to 1 decimal place as asked for in the question.

(ii) Candidates could generally simplify the *a* terms but had problems when simplifying the *b* terms due to the negative signs.

(iii) Nearly all candidates gave the correct answer. The common error was to divide instead of multiply giving an incorrect answer of 2.

(iv) Nearly all candidates gave the correct answer. The common error was to subtract instead of add giving an incorrect answer of 7.

(b) Candidates found this part challenging. Although some gave the correct answer, a few of these did not show any working as stated in the question. Some candidates who did show working did not lay it out neatly and logically. Many candidates made errors in adding and subtracting.

Answers: **(a)(i)** 394.1 **(ii)** $7a - 4b$ **(iii)** 18 **(iv)** 11 **(b)** [x]= 5, [y=] –2

Question 9

Candidates showed that they understood what a sequence is and how to deal with the first few terms. They could improve their answers by having further practice on questions involving *n*th terms and how to write down rules and give explanations.

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

(ii) Many candidates gave the correct answer. Some candidates gave the rule for finding the general term rather than the next term.

(iii) Some candidates gave the correct answer. The common error was to write $n+3$ as the answer.

(iv) Very few candidates gave the correct answer. The common error was to say that 300 is a large number so would not be in the sequence.

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

(ii) Very few candidates gave the correct answer. Good attempts were seen which did not quite give the correct answer. For example, stating adding one to previous number rather than adding one to the previous difference.

Answers: **(a)(i)** 17 **(ii)** add 3 **(iii)** $3n+2$ **(iv)** 300 is in the 3 times table **(b)(i)** 22, 29 **(ii)** the difference increases by one each time

Question 10

Many candidates demonstrated a good knowledge of lines of best fit. There was some evidence of candidates just joining up the points.

(a) Nearly all candidates plotted the points accurately.

(b) Many candidates made a good attempt at drawing the line of best fit. The most common errors were to just join up the points with straight lines or to join up the corners of the graph.

(c) The majority of candidates gave the correct answer. Most of the remaining candidates gave an answer of positive even though they had drawn a line with a negative gradient.

(d) Many candidates showed a good ability to read values from their line of best fit.

(e) Many candidates showed a good ability to read values from their line of best fit.

Answers: **(c)** negative **(d)** 2.25 to 2.30 **(e)** 460 to 560

Question 11

Candidates demonstrated a reasonable understanding of transformations. They could improve their answers by having further practice at describing single transformations and understanding all the elements required to fully describe a single transformation.

(a) Some candidates gave the correct answer. The common error was to reflect the triangle in a different line from the given one.

(b) Many candidates gave the correct answer. The common error was to assume the translation vector was the co-ordinates of one of the points of the new shape.

(c) (i) Many candidates only partially described the single transformation. Others described it as two transformations – usually a rotation plus a translation.

(ii) Many candidates only partially described the single transformation. Others described it as two transformations – usually an enlargement plus a translation.

Answers: **(c)(i)** Rotation, [centre] (0, 0), 90° (anti-clockwise) **(ii)** Enlargement, [centre] (4, 1), [sf] 2

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key Messages

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

General Comments

Most candidates seemed well prepared for the paper and demonstrated a clear knowledge of the wide range of topics tested. Candidates used their time efficiently and attempted all of the questions. The standard of presentation was generally good; however, there were occasions when candidates did not score as they did not show clear working. For less able candidates, working tended to be more haphazard and difficult to follow making it difficult to award method marks when the answer was incorrect. All candidates need to be aware of the need to retain sufficient figures in their workings so that their final answer is accurate; a number of marks were lost due to premature approximation of values. Centres should continue to encourage candidates to show the formulas they use and the calculations performed.

Comments on Specific Questions

Question 1

(a) (i) The vast majority of candidates gained the mark but it was quite common to see the reverse method.

(ii) Almost all responses were correct. There were just a few candidates, with a variety of responses, who did not understand what was required. Some who had a poor response to part **(a)(i)** also couldn't answer this part correctly.

(b) Most candidates showed the individual totals for the different vehicles and indicated the correct addition. Just a few did not show any indication of addition of the 3 amounts. One rare error seen was addition of the charges and then multiplication of $8 by 12 000.

(c) Candidates struggled with this reverse percentages question. Addition or subtraction of 8% was very common but just as common was finding 92%, resulting in an answer of $31 740. Candidates should decide whether the answer is to be a smaller or larger amount, which at least would eliminate some of the possible incorrect responses.

(d) Most candidates obtained the correct answer with just a few candidates earning 1 mark for a correct fraction but not in its simplest form.

(e) Although many correct answers were seen there were a significant minority who obtained one of a variety of incorrect responses. Common incorrect answers were 89 995, 85 000, 87 500 and 85 500.

Answers: **(a)(ii)** 4000 **(c)** 37 500 **(d)** $\frac{11}{26}$ **(e)** 89 500

Question 2

(a) A small majority of candidates completed the table correctly. Errors often occurred with the negative values of *x*, suggesting misuse of the calculator. A few candidates had calculated the –0.75 and 0.5 correctly but then seemed to assume symmetry rather than working out the other two values, leading to answers such as 0.75, –0.5 for the negative values of *x*. More than a few times the value of 0 was seen for either $x = 0.5$ or $x = 1$ as candidates spotted the change from negative to positive.

(b) Most candidates were able to plot their values correctly, although the four points at $x = \pm 0.25$ and at $x = \pm 0.2$ were sometimes plotted incorrectly as a result of misinterpreting the scale. The quality of curves was good with only a few joining the two sections or joining the points with ruled lines.

(c) Many candidates had drawn the line $y = 2$ but a lack of accuracy in reading from their graph sometimes resulted in loss of marks.

(d) Candidates struggled with this part of the question and many made no attempt. Those attempting the question sometimes gave a single value for *k* rather than a range of values.

(e) Most candidates attempted this part but only a few earned all 3 marks. Loss of marks often resulted from inaccurate tangents, in some cases running along the curves or from good attempts with a gap between them and the curve. Another common cause for the loss of marks resulted from misreading the horizontal scale.

Answers: **(a)** 1.5, 1.25, –0.75, 0.5 **(c)** –1.35 to –1.25, –0.27 to –0.251, 1.51 to 1.55 **(d)** $k < 1.2$
(e) –1.7 to –1.3

Question 3

(a) (i) Most candidates were able to draw the correct image with a few earning 1 mark for a translation with either the correct horizontal displacement or correct vertical displacement.

(ii) Candidates were less successful with the rotation but a majority earned both marks. Of the rest, some picked up a mark for a rotation of 180° with the image in the wrong position.

(iii) About half of the candidates were able to draw the correct image for the matrix transformation. Some showed clear matrix calculations and some were able to draw the image by recognising the matrix. Matrix calculations were usually correct but errors in reading the co-ordinates led to many errors for the rest. A significant number made no attempt at all.

(b) The negative enlargement proved a challenge for most. Candidates sometimes attempted to deal with this by combining a positive enlargement with a rotation, reflection or translation. Only a few fully correct responses were seen. Enlargement of 3 with centre (1,0) was the most common answer. The use of negative enlargement with factor 3 did not earn the mark for the scale factor.

(c) Only a minority of candidates were able to give the correct matrix and earn full marks. Some earned 1 mark for a correct column or row. Some recognised the transformation and were able to give the correct matrix without the need for any method. Others attempted this by using simultaneous equations from a matrix with four unknowns but only a few were successful. Others had quoted the correct columns but reversed them in the matrix.

Answers: **(b)** enlargement, (1, 0), factor –3 **(ii)** $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$

Question 4

(a) The vast majority of candidates obtained the correct answer. The most common error involved the omission of 2 in their calculations leading to an answer of 7.

(b) A small majority of candidates correctly used set notation to describe the shaded region, although some of these used rather long descriptions. For many others there was confusion between union and intersection and the notation was often interchanged. Some included + in their descriptions.

(c) Those who experienced no difficulties in the previous part usually earned the mark in this part.

(d) (i) A small majority of candidates found the correct probability. Most errors resulted either from the candidates ignoring the two students who did not own any of the three items or the use of the complement notation.

(ii) Almost all candidates obtained the correct probability.

(e) This proved to be a challenging part of the question with only a small minority finding the correct probability. Many didn't appreciate that the question was only concerned with those students who had a computer and it was common to see probabilities with denominators of 30 and 29. Others treated it as if it was a replacement question and so seeing two probabilities with a denominator of 17 was also common.

Answers: **(a)** 5 **(b)** $C \cap M$ **(c)** 3 **(d)(i)** $\frac{8}{30}$ **(ii)** $\frac{14}{30}$ **(e)** $\frac{30}{272}$

Question 5

(a) (i) With no diagram given, this question proved quite demanding. While most realised right-angled triangles were involved, many did not appreciate that 'angle of elevation' was from the horizontal. Consequently, although the tangent ratio was used, it was often the wrong angle identified. Many candidates felt they had to find the hypotenuse first and then use sine (or occasionally cosine) which often led to errors or lack of accuracy.

(ii) Those who used the wrong angle in part **(a)(i)** generally made little progress in this part. Many did progress to finding the new distance from the tower but only a minority of these progressed to the value of x. Those who identified the side as $294 - x$ often found the tangent ratio involving an algebraic expression beyond their capabilities. Many who were able to give a correct implicit form for the tangent expression could not rearrange it correctly and often ended up with $55 \tan 24.8$.

(b) (i) Most of the more able candidates appreciated what was required, finding half the diagonal first. Some did not halve the diagonal. Quite a number of candidates went straight to using 3 and 4 as the sides for working Pythagoras' theorem. Accuracy was lost at times by over-approximating half the diagonal. Some candidates seemed confused by the diagram, unsure of when to use the various lengths given on the diagram.

(ii) The majority of candidates were able to use correct trigonometry to find this angle. Occasionally the angle between the sloping side, rather than edge, was used.

Answers: **(a)(i)** 10.6 **(ii)** 175 **(b)(i)** 4.9 **(ii)** 54.7

Question 6

(a) (i) Almost all candidates gave the correct modal time interval.

(ii) This standard question of mean from a frequency table was generally well answered, with marks lost occasionally due to arithmetic errors or not taking the mid-values. Some candidates had a partial understanding and multiplying the frequencies by the class widths or the bounds of the interval were reasonably common errors. However, there were some who clearly had no idea of the method and simply added the frequencies or class widths before division by 6.

(b) (i) A large majority of candidates were able to complete the table correctly with only occasional slips in addition producing an error. Less able candidates appeared not to understand cumulative frequency so gave confusing values or omitted this part completely.

(ii) The graph was frequently drawn correctly with most candidates scoring at least 2 marks. Poor accuracy with plotting points prevented quite a number gaining full marks. Common errors usually involved plotting the points at mid-values or misreading the scale.

(c)(i) Throughout part **(c)** the accuracy of the graph was most important in getting an answer in the required range. Most candidates gained the mark for the median, or at least were close to a value in the required range.

(ii) Inter-quartile range was probably the least well answered of the four parts. In cases where the answer was incorrect it was more likely that the lower quartile of 24 was identified than the upper quartile of 36 to 38.

(iii) It was common to award a mark for identifying the correct cumulative frequency of 60 as the 15th percentile. The lack of accuracy of the graph and/or the poor reading of the scale prevented some candidates gaining the second mark. A common error involved interpreting the 15th percentile as a cumulative frequency of 15 on the vertical scale instead of 60.

(iv) Candidates were more successful in this part of the question. As long as the graph was reasonable, most earned the 2 marks. Some earned 1 mark for giving the number of people who took less than 50 minutes.

Answers: **(a)(i)** $24 < t \leqslant 30$ **(ii)** 30.875 **(b)(i)** 235, 320, 390 **(c)(i)** 27.5 to 29 **(ii)** 12 to 14 **(iii)** 18 to 20 **(iv)** 30 to 45

Question 7

(a) (i) Most candidates were able to start the cosine rule correctly. Some candidates misquoted the rule, some were missing the 2, + instead of – and the use of sine instead of cosine. When the formula was correct there were two common errors. Some gave their final answer as 8.3 and did not show a more accurate value and some gave an incorrect value of PQ^2 after prematurely approximating the value of cos 62 to too few figures. Some of the less able candidates used right-angled trigonometry (dividing 7.6 by 2), the sine rule or Pythagoras' theorem.

(ii) The area of the triangle was usually correctly calculated. A few candidates decided to calculate the perpendicular height first. Some introduced errors by unnecessarily working with inaccurate or incorrect values calculated in part **(i)**.

(b) A lot of candidates struggled to find the angles they needed to solve the problem. Some attempted to put parallel north lines through the diagram but were unable to find the one angle they needed from this. A very common error was treating angle *HGJ* as 126°. Where candidates were able to find the necessary angles most realised they needed to use the sine rule and quoted it correctly with their angles. Having quoted a correct version of the sine rule some struggled to rearrange it correctly to find *GJ*.

Answers: **(a)(i)** 8.27 **(ii)** 28.2 **(b)** 55.8

Question 8

(a) There were two common errors which resulted in an incorrect equation from the start. One of these involved misinterpreting “12 more than” as being ‘12 times more’. The other involved Luther having three times as many badges as Jamil rather than Kiera. More able candidates coped well, derived the equation and solved it correctly. Almost always, a correct equation led to a correct solution. Many less able candidates attempted trial and improvement – a correct answer from this method did not score full marks.

(b) Only the more able candidates were able to solve the inequalities. Some made a good attempt but ‘integer values of *t*’ was missed or ignored by many. A common incorrect approach involved attempts to solve both inequalities together. Relatively few candidates tried to solve the question by substitution of numbers into the inequalities. Correct answers were seen but the values of 5.29 and 8 were more common.

(c) (i) This was an equation that many were able to solve. Less able candidates struggled with the rearrangement and $4x + 3$ was often seen as a result of eliminating the fraction. Following $5x = 9$ a few gave the answer as $\frac{5}{9}$.

(ii) Many candidates earned full marks but for some, poor presentation was an issue. Candidates need to ensure the division line is completely drawn under the numerator and that the root sign encloses all of ‘$b^2 - 4ac$’. Others substituted 5 rather than –5. Some were able to recover but many lost marks needlessly. Some of those obtaining the correct solutions then wrote their answers to the wrong degree of accuracy. A few less able candidates misquoted the quadratic formula. Attempts to complete the square were rarely seen.

Answers: **(a)** 15 **(b)** 6, 7 **(c)(i)** 1.8 **(ii)** –2.91 and 0.57

Question 9

(a) (i) Most candidates knew that the angle between the diameter and the tangent is 90º. This resulted in 42° appearing correctly on the diagram and, usually, in the answer space. However, not all candidates were familiar with angles in the same segment and so a variety of incorrect answers were seen. A common incorrect answer was 27° from assuming *AB* was parallel to *DC*.

(ii) This part was very well attempted and many candidates earned both marks. Others earned 1 mark for correctly identifying angles of 111°, 69° or 27° on the diagram.

(b) (i) The given shape proved challenging for many of the candidates and only the most able candidates scored well. Many were aware of the formula for the circumference of a circle but some forgot to divide their answers by 2 while others substituted the radius for the diameter or vice versa. Some were able to calculate the three correct values but then subtracted the smaller arc from the sum of the larger two. Even when the method was applied correctly, premature approximation of the calculations sometimes led to a final answer outside of the acceptable range.

(ii) Very similar issues arose in this part of the question; incorrect formula for area, incorrect use of the formula and premature approximation of the various areas. Added to that was the issue of inconsistent units. Many multiplied their area in cm^2 by the thickness in millimetres. Some did attempt to change the units – those that changed the radii to millimetres were more successful than those attempting to convert their areas to mm^2. Only the more able candidates scored full marks.

Answers: **(a)(i)** 42 **(ii)** 111 **(b)(i)** 37.7 **(ii)** 12100

Question 10

(a) Although there were many correct answers seen, some candidates lost marks needlessly by not recording their measurement of *BC* before giving an incorrect answer in metres.

(b) Most candidates produced a perpendicular bisector, though not always by drawing two pairs of intersecting arcs. It was evident that some candidates measured the line to find the midpoint and used a protractor to obtain the bisector. This sort of approach did not gain 2 marks.

(c) Most candidates understood the first bullet point and realised that an arc, centred at *B*, was required. Most arcs were drawn with a correct radius. Fewer candidates understood the second bullet point, probably because it was given as a locus rather than explicitly asking for an angle bisector. Those that did understand usually produced a correct bisector, although not always with the appropriate arcs. If the arc and bisector were correct the region was almost always identified correctly.

Answers: **(a)** 475

Question 11

(a) Candidates found this part challenging although most candidates could gain 1 mark, usually for a correct first step. Common errors involved not multiplying both terms by *t* and not isolating the *x* terms. After some progress, few used factorisation as they simply tried to eliminate *r* by division while ignoring the *x* or *xt* term. Presentation of the solution tended to be haphazard, sometimes with more than one attempt in the working space. A significant number of candidates attempted to indicate each step of the process by combining each line of their solution with the method required to reach the next line. This tended to produce incorrect lines of algebra such as $t \times A - x = \frac{xr}{t} \times t$.
Some were able to recover but in many cases the working became confused and difficult to follow as each new line was embellished with more method.

(b) Very few candidates gained full marks on this question with the majority not able to make an appropriate start. Many gained a mark from correctly multiplying out the right hand side of the identity but all too often the $2xb$ term was missing or incorrect. Attempts at completing the square were rare. However, the question was a good discriminator and a significant number of very able candidates found the correct values.

(c) Many candidates made a worthwhile start to the question and a majority of them went on to obtain the correct answer. The numerator was often seen as $6(3x - 2) - 5(x - 4)$ and similarly the denominator as $(x - 4)(3x - 2)$. Most errors resulted from incorrect expansion of the brackets and with the collection of the resulting terms, usually the constant terms. Some candidates spoiled their correct answers by attempting inappropriate cancelling of algebraic terms.

Answers: **(a)** $\frac{At}{t+r}$ **(b)** $a = 64$, $b = -8$ **(c)** $\frac{13x+8}{(x-4)(3x-2)}$

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key Messages

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

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

Candidates need to be aware that in drawing graphs, linear functions should be ruled and curves should be drawn freehand with a sharp pencil.

When comparing distributions in statistical questions the comparisons should be of a general nature and will usually involve averages, ranges or spread.

General Comments

The overall performance of the candidates was good in quite a challenging paper. Most were able to attempt almost all of the questions, and solutions were usually well-structured with clear methods shown in the space provided on the question paper.

There were very many excellent scripts with a large number of candidates demonstrating an expertise with the content and showing excellent skills in application to problem solving questions.

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

The standard of graph drawing was very good and many excellent graphs were seen in **Question 5**. Candidates' recall of formulae, particularly the cosine rule and quadratic formula, contained few errors. Most candidates followed the rubric instructions with respect to the values for π although a few still used $\frac{22}{7}$ or 3.14, giving final answers outside the range required. There continue to be a significant number of candidates losing unnecessary accuracy marks by either approximating values in the middle of a calculation or by not giving their answers correct to at least three significant figures.

The topics that proved to be most accessible were percentages, angles in a circle, graph drawing and tangents, cosine and sine rules, calculation of a mean from grouped continuous data, drawing a histogram, writing inequalities from given information and factorising.

The more challenging topics included ratio, obtaining an equation from given information, similar triangles, surface area of a frustum, variation, interpreting graphs, comparing data, linear programming, algebraic expansions, indices, showing a result algebraically, vectors and probability.

Comments on Specific Questions

Question 1

The ratio parts of this question proved to be a challenging start to this paper. The percentage parts were generally well answered.

(a) The majority of candidates gained full marks on this part of the question either by multiplying by 1.12 or by finding 12% and then adding this on to \$1650. Occasionally candidates stopped after finding the increase only. Some candidates lost the accuracy mark by rounding \$1848 to \$1850. In calculations which give rise to an exact answer, candidates are expected to give this exact value. Some candidates gave the answer \$1980 from misreading 12% as 20% and a few calculated 1650 ÷ 1.12 or 1650 – 198.

(b) (i) Only a few candidates understood that one part of the total prize money could be found by dividing 500 by 4 and hence an efficient solution would be (500 ÷ 4) × 14. Instead division by 9, 5 or 14 was frequently seen with attempts to form complex equations which were rarely successfully completed. A common incorrect answer was \$277.78 from the calculation $\frac{5}{9} \times 500$, or \$777.78 by then adding the \$500. Similarly $\frac{9}{14} \times 500$ and $\frac{5}{14} \times 500$ were incorrect methods seen.

(ii) This question part was successfully completed by many, converting the fraction $\frac{9}{14}$ to a decimal, multiplying by 100 and rounding to at least 3 significant figures. On occasions the mark was lost due to rounding to 2 significant figures or truncating the answer to 64.2. Incorrect answers were seen from candidates who used their incorrect answer from part **(b)(i)** in their fraction equivalent to $\frac{1125}{1750}$.

(c) (i) Many candidates did not appreciate the necessity of having a common number of children in the two ratios and so a very frequent incorrect answer was 11:10. Some candidates got as far as $\frac{11}{2}$ or $\frac{10}{3}$ and then stopped. Many fully correct answers were seen but accuracy was also lost by some who approximated $\frac{10}{3}$ to 3.3 and a few reversed the correct ratio.

(ii) Many fully correct solutions were seen here. Some candidates correctly found the number of men and the number of women and then omitted to add on the 24 children. Others added the 24 children to both the men and the women thus including them twice. Another common error in approach was to divide 24 by (2 + 3), then multiply by 11 for the men and 10 for the women. Similarly 26 ÷ 5 (from 11 + 2 + 10 + 3) was also seen. Non-integer answers that resulted were then simply rounded.

(d) Many candidates were successful in this part. Of these candidates some immediately calculated 20.40 ÷ 120 then multiplied by 100 and others chose to use the formula for percentage profit: $20 = ((20.40 - x) \div x) \times 100$ and solved to find x. The common error of finding 20% of \$20.40 and either adding to or subtracting from \$20.40 was also seen from a significant number of candidates.

Answers: **(a)** 1848 **(b)(i)** 1750, **(ii)** 64.3 **(c)(i)** 33 : 20 **(ii)** 236 **(d)** 17

Question 2

The majority of this question on circle theorems and triangle properties was well answered.

(a) (i) This part was well answered by the vast majority of candidates. Candidates used the fact that triangle *ABD* was isosceles and were able to accurately use the angle sum of a triangle. Less able candidates gave the answer 48°, presumably from observing that the angles looked equal.

(ii) Almost all candidates recognised that a tangent meets a radius at 90° and successfully subtracted their answer to part **(a)(i)** from 90°.

(iii) This was again answered correctly by many candidates, who recognised the isosceles triangle *BOD* to find angle *BOD* and then correctly halved their answer, applying a correct circle theorem. Less able candidates observed that angle *BCD* looked the same as angle *BAD* and gave the answer 48°. Others appeared to believe that opposite angles in all quadrilaterals add to 180° and so gave the answer 132°.

(iv) Many correct answers were seen here as well as correct follow through answers from 180 – their answer to part **(a)(iii)**, suggesting that candidates recognised that opposite angles in a cyclic quadrilateral add to 180°. The incorrect answers 132° and 48° were seen, probably from the misconceptions that the opposite angles in *BODE* should either be equal or add to 180°.

(b) Many fully correct answers were seen and many correct methods from candidates correctly applying the area formula ½*ab*sin*C* to the triangle *BOD*, using their angle *BOD*. Some candidates used trigonometry in a right-angled triangle with the angle 24° to find the height of triangle *BOD* and the length of half of *BD*, so that they could apply the formula area = ½ base × perpendicular height. Some correct answers were seen from this method but in many cases candidates forgot to double their area or base length when necessary. A lack of working shown or answers rounded prematurely prevented some candidates from gaining marks. Less able candidates tried to use formulae similar to area of a sector or area of the circle.

(c) The better answers referring to opposite angles adding up to 180° were given by a number of candidates. Many candidates gave statements that explained why *BCDE* was a cyclic quadrilateral or referred to the circle already drawn, for example, 'all four corners are on the circumference of the circle', '*AD* and *AB* are tangents' or '*OD* and *OB* are radii'. Some candidates incorrectly stated 'opposite sides add to 180°'.

Answers: **(a) (i)** 66 **(ii)** 24 **(iii)** 66 **(iv)** 114 **(b)** 83.6

Questions 3

This question proved to be a challenge for many and part **(a)(ii)** in particular was a discriminator.

(a) (i) Many correct algebraic expressions were seen but there was also a very mixed response. Some candidates appeared confused by the use of litres per 100 km and others tried to combine the two journeys of x km and x + 20 km. Incorrect answers seen included $\frac{6}{x}$, $\frac{606}{x}$, $\frac{600}{x(x+20)}$, $\frac{1200}{x+20}$.
Less able candidates often gave a numerical answer, not understanding 'an expression in terms of x'.

(ii) A significant number of candidates were unable to interpret this question to obtain a correct starting equation by linking the expression $\frac{600}{x}$ and their expression from part **(a)(i)**. Of the candidates that did subtract their two expressions and equate to 1.5, some reversed the correct subtraction. Those who were able to create an equation tackled the common denominator and expansion of brackets well, although many candidates were trying to do too many stages in one step without writing down and using brackets. This led to sign errors. In a 'show that' question such as for this equation, candidates should ensure that each line of working is clear, precise and a complete equation. If alterations are made to original working, for example by changing signs, these changes should be consistent throughout all the working.

(b) This part of the question was well answered. The vast majority of candidates successfully obtained the correct solutions to the equation. The most common method was to use the quadratic formula. When using this method some candidates made sign errors, using 20 instead of –20 for –*b*. Others shortened the division line so that only the $\sqrt{32400}$ was divided by 2. Candidates who factorised to find the solutions were usually correct but the numerical error $40 \times 20 = 8000$ did lead incorrectly to $(x + 40)(x - 20)$ for a few. The sign error in the factors $(x - 100)(x + 80)$ was also sometimes seen.

(c) The majority of candidates did not understand how to use the positive value found for x to find the rate of fuel used for the complete journey. It was expected that candidates would use x to calculate (total litres used ÷ total distance travelled), $\frac{12}{180}$, and then multiply by 100. Some candidates found the average of $\frac{600}{80}$ and $\frac{600}{100}$. Many candidates did appreciate that the context of the question required the positive value for x to be used and so gained a mark for substituting this into an algebraic expression.

Answers: **(a)(i)** $\frac{600}{x+20}$ **(b)** –100, 80 **(c)** 6.67

Question 4

(a) (i) This part was answered quite well. Most candidates substituted correctly into the formula for the arc length of the sector. Many then gave the answer as a multiple of π as asked for in the question but others gave the answer as a decimal. There were some who calculated the area of the sector.

(ii)(a) Those candidates that understood that the circumference of the base is the same as the arc length in part **a(i)** generally answered this part well. Candidates who had given the answer to the previous part in terms of π and those who had given it as a decimal often scored full marks in this part. Quite a large number did not appreciate the correct connection between the two parts and incorrectly assumed that the semi-vertical angle in the cone is $135^\circ \div 2 = 67.5^\circ$ and calculated r using trigonometry. Others gave the radius as $12 \div 2 = 6$.

(ii)(b) This was answered quite well with most using Pythagoras' theorem correctly although some did not give the answer to a sufficient degree of accuracy. Full follow through marks were allowed from the previous answer where appropriate.

(b) (i) Candidates found this part challenging. Some who attempted to use a combination of Pythagoras' theorem and trigonometry were almost always unsuccessful. Most appreciated that the most efficient method is to use similar triangles but a very common error was to give $l = \frac{15}{8} \times 35$ leading to an answer of 65.625. Those students giving a correct equation for l such as $\frac{l-35}{l} = \frac{8}{15}$ nearly always solved this correctly. Similarly those giving a correct equation for the slant height of the smaller cone solved it to give 40 cm.

(ii) Most candidates substituted their answer to part **b(i)** into the formula for the curved surface area of a cone to give the area of the larger cone and many went on to also calculate the curved surface area of the smaller cone and subtract these. Some did not use the correct radius and others did not subtract 35 to give the correct slant height of the smaller cone. Many did not attempt to calculate the area of the base of the plant pot whilst others calculated the base and the top of the plant pot.

(c) (i) This part was answered well with those candidates who wrote down $M = kr^3$ usually finding k correctly and scoring full marks. Some assumed that $M \propto r$ or $M \propto r^2$ and so were not able to form a correct equation.

(ii) There were many correct answers to this part. Quite a number of candidates gave 2 : 3 and some 4 : 9.

Answers: **(a)(i)** 9π **(ii)(a)** 4.5 **(ii)(b)** 11.1 **(b)(i)** 75 **(ii)** 2730 **(c)(i)** $16r^3$ **(ii)** 8 : 27

Question 5

This question involved graphing a function, drawing a tangent at a point to estimate the gradient of the function at that point followed by using the graph to answer questions involving equations.

(a) The two values for the table were usually correctly evaluated. A common error was to give the value at $x = -2$ as -6 rather than 2.

(b) For the graph, point plotting was generally very accurate. Some candidates made a small error in plotting 1 or 2 of the 10 points and a small number of candidates mis-plotted the points at $x = -0.5$ and $x = 0.5$. Curves were often very well drawn with the curves passing through the plotted points. Very few did not recognise the nature of the function and so it was rare to see the two branches of the curve linked. Very few candidates had ruled straight line sections in their graph.

(c) Tangents were generally well drawn and usually at the correct point to the curve at $x = 1$. Most used a correct method to calculate the gradient of the tangent and any errors were usually as a result of the tangent not being drawn quite accurately enough. A few gave the answer as a positive value rather than a negative value.

(d) (i) Most did not appreciate that the right hand branch will have values greater than $x = 4$ and that this will affect the number of solutions to the equation. However in this case it was considered acceptable to allow values of k in the range $11 < k \leqslant 21$ for the domain provided in the question as well as in the range 5 to 6 to score the mark.

(ii) Most of those that gave an acceptable value for k in the previous part were able to read off their two values to give the solutions and score full marks.

(e) Candidates found this part challenging and it was rare to see all three values given correctly. Many drew the line $y = 3x + 1$ and read off some values and those that did equate $f(x)$ to $3x + 1$ were rarely able to rearrange the equation into a suitable form to give the required values.

Answers: **(a)** 2, 7 **(c)** –13 to –8 **(d) (i)** 5 to 6 **(ii)** –2.55 to –2.35 and 2 to 2.35 **(e)** –5, –1, 12

Question 6

This question on using general trigonometry was answered well by many candidates who were well prepared for the use of the cosine rule and sine rule.

(a) Almost all candidates quoted the appropriate version of the cosine rule needed to find the distance AB directly, made the necessary substitutions and carried out the calculations accurately. Not all candidates showed an intermediate step and it was advisable to show at least an accurate value of AB^2 , for example 19054. Some candidates, following the substitutions, only then gave a final answer of 138, given in the question. To earn full marks in this type of question it is essential to give an answer that is more accurate than that given in the question. So in this case an answer such as 138.0 or 138 .04 was sufficient.

(b) This was also answered very well with candidates applying the sine rule correctly to find angle BAC. As in the previous part it was advisable to write down the answer to this to at least three significant figures before going on to find the bearing. Most candidates calculated the bearing correctly with just a few making an error such as adding the answer for angle BAC to 146°. Some worked out angle ABC instead of angle BAC but most realised which angle it was so were able to complete a longer correct calculation to find the bearing. Some only reached 36.2° and others subtracted from 180° instead of 146°.

(c) Candidates found this part challenging. Very few drew a line from L perpendicular to the direction in which the ship is sailing in order to give the right-angled triangle needed. One error was to draw a line from L to the end of the line giving the direction the ship is sailing and others used a triangle with an angle of 45°. Those that were able to identify the appropriate triangle sometimes calculated the distance from L rather than the distance that the ship had sailed.

Answers: **(b)** 110 **(c)** 18.8

Question 7

This statistics question was generally answered well.

(a) (i) This part was answered very well with many candidates scoring full marks. There were a few who used the correct method but made an arithmetic error or an error with one of the mid-values and a small number gave the correct mid-values, added these together and divided the answer by 5. There were also some who calculated the interval widths and multiplied each of these by the respective number of students

(ii) This was also answered well with many calculating the correct frequency densities and then producing a good quality histogram. Some drew the first block correctly but then made errors with the second and third blocks usually by assuming that the interval was 100, rather than 50 in each case. A few calculated a frequency density for the interval $200 < M \leqslant 400$ and so gave a single block.

(b) This part proved to be challenging for many candidates with very few giving general statements that compared spread and average for the two distributions. One mark was given for indicating that the mean estimate for the mass of the sweets for adults is higher than that of the students. Another mark was given for a correct comparison of the ranges of the estimates. Most candidates gave either one or two answers that compared the frequency densities for a specific class such as 300 to 350. However many made a statement that indicated that none of the adults had estimates below 200 grams but that some students did (it was not necessary for candidates to give the number of students who did give an estimate below 200 grams as 5). As such a statement does imply that the range for the adults is less than that for the students this was awarded 1 mark and many candidates scored this mark. Some of the comments implied a degree of misinterpretation of the data e.g. 'sweets eaten', 'jars of sweets'. It is important for candidates to be clear and concise and make general observations when comparing distributions.

Answers: **(a)(i)** 316

Question 8

This question on inequalities and simple linear programming proved accessible to most candidates.

(a) (i) The inequality was almost always correctly stated. Only a few candidates gave a strict inequality and very few gave the inequality the wrong way round.

(ii) The inequality was almost always correctly stated. Only a few candidates gave a strict inequality and very few gave the inequality the wrong way round.

(iii) The inequality was almost always correctly stated. Only a few candidates gave a strict inequality and very few gave the inequality the wrong way round.

(iv) This inequality proved to be a little more challenging usually as a result of not putting both sides in the same units. A few candidates used an equality sign, probably being distracted by the 40 and 80 or the 0.4 and 0.8 complicating the situation. It is important in 'show that' questions that no errors are shown in arriving at the required answer.

(b) The four lines and a correct region were frequently seen. Candidates do need to be careful in not mixing up x and y as this would make three of the lines incorrect. Candidates also need to shade carefully, especially when a small region, such as in this question, could look unshaded when the intention was for it to be shaded. A few candidates drew some of the lines freehand when they should be ruled. Good knowledge of straight line graphs is vital in these questions as many marks depend on this.

(c) Interpreting results is always more challenging and this question was no exception. A number of candidates omitted this part and others found a point in their region but did not work out $0.4x + 0.8y$, but instead calculated $x + 2y$.

Answers: **(a)(i)** $x \geqslant 100$ **(ii)** $y \geqslant 120$ (iii) $x + y \leqslant 300$ **(c)** 200

Question 9

Parts of this question on algebraic manipulation and reasoning were well-answered.

(a) This question demonstrated a need for more careful expansions of brackets. There was a large number of sign errors and the occasional x missing from $2x \times -5$.

(b) (i) This factorising by grouping was usually well done. Candidates do need to be aware of the need to take the largest factor out of each pair of brackets and that the partially factorised mark is only earned when the contents of the two pairs of brackets are exactly the same.

(ii) This factorising using the difference of two squares was also usually correctly done. A few candidates gave perfect squares as their answers and a few appeared to need more practice with this special factorising situation.

(c) This indices question proved to be more challenging and many candidates demonstrated the need for more experience with a negative fractional index, as many answers and working were very confused and lacked a systematic approach to the problem.

(d) (i) This explanation question was quite well answered, with many candidates realising the need to include both the multiplication by 2 and the subtraction of 1 in their explanation. The notion of even and odd was generally well understood. Substitution into the expression, demonstrating some values, was not accepted as a general explanation. A number of candidates gave answers without reference to the 2 and/or the minus 1 and these did not earn the mark.

(ii) The odd number after $2n - 1$ was found to be more challenging. Unsimplified answers, such as $2n - 1 + 2$ or $2(n + 1) - 1$, were given the mark. The common incorrect answers were $2n - 3$ and $4n - 1$ and these were frequently seen.

(iii) Many candidates appeared to lack experience in using algebra to show a general result, even though $2n - 1$ was in part **(i)**. A large number chose to only demonstrate the result with numerical examples and one pair of consecutive odd numbers was not considered to be adequate, whilst two or more pairs were awarded 1 mark. Many candidates omitted this question, which turned out to be a good discriminator.

Answers: **(a)** $4x - 3x^2$ **(b)(i)** $(2 + y)(3w - 2x)$ **(ii)** $(2x + 5y)(2x - 5y)$ **(c)** $\frac{27x^6}{64}$ **(d)(ii)** $2n + 1$

Question 10

This vectors question was found challenging by many.

(a) (i) Many candidates did not appear to recognise the notation and errors included dividing, multiplying, adding and subtracting 5 and –8. A significant number of candidates were aware of the method for finding the magnitude of a vector, and many were able to at least get as far as the square root of 89. However some candidates then wrote the solution to only 2 significant figures. A small number also struggled to square (–8) correctly when using Pythagoras' theorem.

(ii) Many candidates were able to find the co-ordinates of P. A common error was to give (7, 11) or (3, –5).

(b) (i)(a) A large proportion of candidates found this question challenging and were able to make little progress. However, there were also some candidates who had a clear understanding of routes and vectors and were able to score well. Good use was made of the given diagram in tracing routes and translating them into vectors. The most able candidates were able to write $\overrightarrow{AM}$ as ½(**b** – **a**) as the starting point before arriving at the solution. A common error was to find $\overrightarrow{AM}$ or $\overrightarrow{MB}$ but then to use **b** + $\overrightarrow{MB}$ instead of **b** – $\overrightarrow{MB}$.

(i)(b) Candidates who were successful in part **(b)(i)(a)** were usually correct here and a follow through was allowed for an answer that was ½ of the answer to part **(b)(i)(a)**.

(i)(c) Many candidates were able to give a correct route but fewer were able to give a correct simplified answer in terms of **a** and **b**, often as a result of an error made in one of the previous parts.

(ii) There were a number of correct answers and also a number of candidates who appeared to be guessing at the ratio from the diagram. Many candidates were able to score a mark by writing $\overrightarrow{AN}$ correctly in terms of **a** and **b**.

(c) (i) This was answered well by many candidates and those with incorrect drawings were able to gain partial credit for evidence of successful matrix multiplication with the vertices of the given triangle. There were a few instances where the matrix was interpreted as an enlargement, scale factor –1.5 and a triangle of correct orientation and size but incorrect position was drawn.

(ii) This was well answered by many. Some candidates were often able to define the transformation in words but had forgotten the corresponding matrix. There were some attempts to use matrix multiplication either numerically or to form simultaneous equations which were usually unsuccessful.

Answers: **(a)(i)** 9.43 **(ii)** (–3, 5) **(b)(i)(a)** ½**a** + ½**b** **(i)(b)** ¼**a** + ¼**b** **(i)(c)** ¼**b** – ¾**a** **(ii)** 3 : 4
(c)(ii) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

Question 11

This probability question proved to be challenging. There was no given tree diagram and there were 3 possible outcomes. Some candidates did draw their own tree diagram and this proved to be extremely helpful.

(a) The more able candidates gave very good solutions, demonstrating the ability to understand the context and choose an appropriate method. Many candidates found some correct products but did not double their answers as the particular selections could happen in two ways, so three products instead of six were often seen. The other very common misunderstanding was to treat the situation as a replacement one when the context of choosing two sweets should have been without replacement.

(b) This part proved to be even more challenging with many candidates finding the understanding of the description of the context difficult. “None of the three sweets is lemon flavoured” was frequently interpreted as “not all the three sweets are lemon flavoured”. Candidates who tried to use all the combinations of 3 sweets consisting of only orange and strawberry often missed some combinations. The efficient method of probability of (not lemon and not lemon and not lemon) = $\frac{5}{8} \times \frac{4}{7} \times \frac{3}{6}$ was only seen from the very able candidates.

Answers: **(a)** $\frac{38}{56}$ **(b)** $\frac{60}{336}$

MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key Messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus.

The accurate statement and application of formulae in varying situations is always required.

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

Candidates need to be aware that in geometrical constructions all arcs should be clearly visible so examiners can give credit when appropriate.

Straight lines in graphs should be accurately ruled with the correct intercepts on the axes.

General Comments

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

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

Graphs were often well drawn and the readings taken from them were to the required accuracy. Some candidates still confuse the equations of horizontal and vertical lines. Many candidates drew an accurate tangent to the curve in **Question 3(e)** but lost marks when finding the gradient by counting squares rather than using the differing scales on the axes.

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

Comments on Specific Questions

Question 1

(a) (i) The correct reflection was often drawn. The errors seen were reflection in the line $y = -1$, the y-axis or the incorrect vertical line.

(ii) In this question the usual error was to rotate the given shape about the wrong centre, often one of the vertices of the triangle.

(b) (i) Most candidates recognised the translation but a significant number did not use the correct mathematical term. Move and translocation were popular alternatives that were not credited.

(ii) Many candidates stated only two of the three requirements for the complete description of this enlargement. Occasionally the scale factor was given as a ratio but the most common error was in finding the centre of the enlargement. It was rare to see lines joining the corresponding points on the grid.

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

Question 2

Throughout this question many candidates used the year on year approach even though the compound interest formula is now included in the syllabus.

(a) (i) Candidates who used the correct formula often lost a mark because they did not give the answer to the calculation to at least 4 significant figures to show it rounded to \$721. Of those who used the year on year approach, many were not rigorous enough and did not show all the steps in their calculations (both multiplications and/or additions) to gain full marks. A list of the values at the end of each year is insufficient when asked to show that the final value is \$721.

(ii) Those candidates who used trial and improvement in this question were usually unsuccessful as their answer of 3% was not accurate. Many who did use the formula lost the accuracy mark by approximating the fourth root of 721 ÷ 640 as 1.03 which gave them the inaccurate answer of 3%.

(b) This question was often correctly answered with only a few not using the reduction. Many candidates rounded their answer to \$875. This was an exact answer and should not have been rounded.

Answers: **(a)(ii)** 3.02 **(b)** 874.80

Question 3

(a) There were many correct values calculated. The value when $x = -2$ often was stated as –3.

(b) Graphs were accurately plotted with the occasional missed points and it was rare to see the plots joined by straight lines. The use of sharper pencils would have given more accurate readings from the graphs in some cases. Few candidates joined the branches.

(c) The value stated was usually within the acceptable range. Some candidates tried to calculate the solution rather than reading it from the graph whilst others omitted the negative sign.

(d) The vast majority of candidates drew the correct line. Incorrect solutions were from misreading the scales rather than lack of knowledge about where the solution was positioned.

(e) Most candidates drew the correct tangent but many were unsuccessful in obtaining its gradient. Errors were usually caused by misreading the scales which most assumed were the same on each axis.

Answers:**(a)** 1, 3, 2.5 **(c)** –2.6 to –2.4 **(d)** –1.6 to –1.4 **(e)** $0.9 \leqslant$ gradient $\leqslant 1.5$

Question 4

(a) Most candidates used the correct method but there were occasional errors with the mid-value of 70–75 and/or 75–90. A few used the upper ends of the intervals or merely added the mid-values and divided by 4.

(b) When errors with the widths of the blocks occurred it was usually with the first and/or the last as these were extended to the edge of the grid. The heights were less problematical but the tops of the first and second blocks often were along horizontal lines of the grid.

Answer: **(a)** 72.5

Question 5

(a) The three probabilities were usually correctly given in this part.

(b) (i) There were many correct solutions seen. A few candidates added the relevant fractions and a significant number used replacement of the cards.

(ii) Only the more able candidates were successful in this question. Frequently only three of the six possible combinations, AB, AC and BC, but not the reverse, were considered. Those who used 1 – the probability of both the same were more successful.

(c) Those who used the efficient method of Not C × Not C × Not C always had the correct answer. Others tried to use AAA + AAB + ABB but most did not take into account the 3 permutations of AAB and similarly for ABB or forgot to include AAA. A few candidates were successful with the method of considering C in each of the three positions, added these probabilities and then subtracted from 1. Again some used replacement of the cards.

Answers: **(a)(i)** $\frac{4}{7}$ **(ii)** $\frac{6}{7}$ **(iii)** $\frac{5}{7}$ **(b)(i)** $\frac{12}{42}$ **(ii)** $\frac{28}{42}$ **(c)** $\frac{120}{210}$

Question 6

(a) There was a wide variety of approaches to this question with many candidates drawing extra parallel lines, extending edges, drawing perpendicular lines both inside and outside the hexagon and some of these led to a very efficient calculation. The use of angles in parallel lines and angles in polygons were correctly used by most but a significant number of candidates made false assumptions. The most common of these was angle *EDA* = angle *FAD* = 70° or angle *BCD* = 120° or angle *AFE* = angle *BCD*. However many candidates proved that angle *EDA* + angle *FAD* = 140° or angle *FAC* + angle *DCA* = 180° to give them the correct solution from quadrilateral *AFED* or pentagon *AFEDC*.

(b) (i) There were many correct solutions to this question but again false assumptions, usually of angles bisected, were made by some candidates.

(ii) Most candidates gained full marks as their answer was correct or correct on a follow through basis.

(iii) A large number of candidates did not know these triangles were similar. Responses included congruent but also parallel, same segment and butterfly.

(c) Of those who correctly found the area scale factor as 1.21, a significant number divided 23 by this instead of multiplying. By far the most common error was to multiply by the linear scale factor.

(d) (i) Many candidates made errors in solving $\frac{n}{10} = \frac{360}{n}$. The answer $n = 6$ was the common incorrect value. Some candidates subtracted an expression for the interior angle from 360° rather than 180°.

(ii) This question proved to be quite challenging as candidates often did not recognise the relationship to the previous part. Many interpreted their answer to part **(i)** as the exterior angle and merely subtracted it from 180°.

Answers: **(a)** 100 **(b)(i)** 50 **(ii)** 41 **(iii)** Similar **(c)** 27.8 **(d)(i)** 60 **(ii)** 174

Question 7

(a) (i) This was well answered but out of range answers were due to using $\pi = 3.14$ rather than 3.142 or the calculator value.

(ii) Both versions of the correct formula were often seen. A significant number of candidates went on to incorrectly cancel πr after a correct rearrangement was reached.

(b) (i) Some candidates lost an accuracy mark by rounding to 4.4 without showing the more accurate value. There were few candidates who found the average of the speeds rather than the average speed.

(ii) Many excellent solutions were seen with impressive algebraic and representational skills demonstrated. Those who made errors were usually the ones who merely used distance or time = 7.

(c) (i) This was well answered but the common errors were to evaluate 20% of 19.80 and deduct this from 19.80 or add it to 19.80.

(ii) This was one of the more challenging questions in the paper. Many candidates did not appreciate that they needed to express *y*% in fractional form whilst others did not fully simplify their correct expression with a fraction in the denominator.

Answers: **(a)(i)** 331 **(ii)** $\frac{A-\pi r^2}{\pi r}$ **(b)(i)** 4.39 **(ii)** 12 **(c)(i)** 16.50 **(ii)** $\frac{100x}{100+y}$

Question 8

(a) This was generally answered well. The errors came from using incorrect formulae for the cylinder volume such as $2\pi rh$ or $\frac{1}{3}\pi r^2$.

(b) (i) Those who split the shape into a rectangle and triangles were less successful than those who used the formula for the area of the trapezium. Some candidates misinterpreted the diagram and used 40 as the slant height and others calculated the surface area instead of the volume.

(ii) Most candidates correctly converted their answer to part **(i)** into litres. The common error was to divide by 100.

(c) There were many correct solutions seen but a significant number of candidates who reached 3.33 hours gave the answer as 3h 33mins. Most success was gained by those candidates who took two steps to change 12000 seconds into minutes and then into hours.

(d) (i) Often the triangles with hypotenuses *AF*, *AD* and sometimes *DF* were compared to give a correct relationship between corresponding lengths which was correctly transformed into the required one. Occasionally *DA* and *CB* were extended to form a different pair of similar triangles which were used correctly. A significant number of candidates tried to use the area of the trapezium instead of following the instruction to use similar shapes.

(ii) Most candidates wrote a correct expression which included the required brackets.

(iii) The common error was to omit 150 in the equation for equal volumes.

(iv) Of those who gave an answer to part **(iii)**, most gained the follow through mark here.

Answers: **(a)** 28.3 **(b)(i)** 360 000 **(ii)** 360 **(c)** 3 h 20 min **(d)(ii)** $\frac{1}{2}(x+50)2(x-50)$ **(iii)** 60.8 **(iv)** 21.7

Question 9

(a) This question was often answered correctly. Occasional arithmetic errors led to one incorrect element.

(b) The majority of candidates correctly interchanged the elements on the leading diagonal and changed the sign of the others. Errors occurred when calculating the determinant which sometimes became 1 or 5 instead of 3. A very small minority of candidates took the reciprocal of each element.

(c) Some candidates did not distinguish clearly between their *u* and *v* and misread them when comparing the products of the matrices. Others made errors when multiplying by 0 or with simplifying their expressions in the matrices.

(d) Many candidates answered this question correctly. A significant number of candidates started with the incorrect statement $\frac{1}{2w-24}$ = 0.

Answers: **(a)** $\begin{pmatrix} 2 & 13 \\ 1 & 14 \end{pmatrix}$ **(b)** $\frac{1}{3}\begin{pmatrix} 3 & -2 \\ 0 & 1 \end{pmatrix}$ **(c)** u =3, v = 2 **(d)** 12

Question 10

(a) Most success was gained by those candidates who evaluated f(3) first and then f(5). Some correctly found the expression for ff(x) as $2(2x - 1) - 1$ but then made slips after substituting $x = 3$. A small minority of candidates confused ff(x) with f(x) × f(x).

(b) There were many correct solutions seen but sometimes these were spoiled by incorrect factorising to $2x(x - 1)$. Many candidates lost marks by not substituting f(x) correctly into g(x) and started with $(2x - 1)^2 + x$. Others incorrectly expanded $(2x - 1)^2$ as $2x^2 - 4x + 1$ or $4x^2 \pm 1$.

(c) This question was often answered correctly. The only errors seen were forgetting to interchange y and x after reaching $\frac{y+1}{2}$ and the initial step as $y - 1 = 2x$.

(d) Many candidates answered this question correctly. A few went on to incorrectly cancel and others expanded $2(x + 2)$ as $2x + 2$ in their working.

Answers: **(a)** 9 **(b)** $4x^2 - 2x$ **(c)** $\frac{x+1}{2}$ **(d)** $\frac{4x+4}{x(x+2)}$

Question 11

(a) This question was extremely well answered by the vast majority of candidates. Very few made errors with the 5th terms but a very small minority wrote the 6th terms in the last column. The nth term of sequence D proved to be more problematical than the others.

(b) This question confused some candidates as they thought that the numerator and denominator must always differ by 2. Hence answers of 'not possible' were sometimes seen. Others gave the answer as 36 after comparing just the numerators. Of those who wrote the correct equation $\frac{n}{n+2} = \frac{36}{37}$ only some went on to solve this accurately.

(c) There were many correct solutions to this question even by those who did not find the nth term of sequence D. Some continued sequence D until they reached 725 whilst the more able candidates solved the equation $n^2 - 4 = 725$.

Answers: **(a)** $\frac{5}{7}$, 7, 3, 21, $\frac{n}{n+2}$, $n + 2$, $n - 2$, $n^2 - 4$ **(b)** 72 **(c)** 27