MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key Messages

To succeed in this paper, candidates need to have completed the full 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 paper was accessible to most candidates, with the majority attempting all questions. Candidates must check their work for sense and accuracy as it was very noticeable that there were many answers to questions in context that made no sense. Candidates must show all working to enable method marks to be awarded. This is vital in 2 or multi-step problems, in particular with algebra, where each step should be shown separately to maximise the chance of gaining marks. This will also help candidates check their own work. In other questions, intermediate values were sometimes rounded prematurely.

The questions that presented least difficulty were **Questions 4**, **8**, **13(a)** and **(b), 19, 20(a)** and **22(a)**. Those that proved to be the most challenging were **Questions 12, 13(c)**, **16(b)**, **18** and **20(b)(ii)**.

Comments on specific questions

Question 1

While there were many completely correct answers, a significant proportion of candidates were unable to order the given numbers correctly. The majority of errors involved the incorrect positioning of 5.0204 and more often than not, placing it as the largest number.

Answer: 0.542, 5.0204, 5.024, 5.204

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 for the rise, so –17 is not correct. Some candidates did not deal with the directed numbers correctly, subtracting 8 from 9, leading to a final answer of 1.

Answer: 17

Question 3

Some candidates showed they were not confident in working with indices, giving answers such as r^3 or $\frac{r^3}{r}$.

There were a few answers of 4, with workings that did show some understanding of indices but these could not gain the mark.

Answer: r^4

Question 4

Many candidates were able to answer part **(a)** correctly. One example of misunderstanding what was required was from candidates who evaluated 168 ÷ (5 ÷ 12), giving 403.2 as the answer. However, in part **(b)**, after the correct value was seen, many candidates went on to give answers that had been rounded or truncated to one or two decimal places, and these inaccurate answers could not gain the mark.

Answers: **(a)** 70 **(b)** 0.375

Question 5

In part **(a)**, rounding or truncation of the correct exact value was sometimes seen. Other candidates didn't use the correct order to perform the calculation. For part **(b)**, the most common incorrect answer was 0.74... from $\sqrt{2.54} - 0.85$. Candidates need to understand that the square root sign groups the calculation in the same way that brackets do.

Answers: **(a)** 18.88 **(b)** 1.3

Question 6

Many candidates were able to access a mark for evaluating 3**p** or for writing one of the two entries in the final vector correctly. Some tried to cube **p** instead of multiplying by 3. A few candidates gave a single value in the vector brackets showing a lack of understanding of the topic. The frequency of candidates putting a 'fraction line' between the 2 entries was slightly higher than in the recent past.

Answer: $\begin{pmatrix} 13 \\ -9 \end{pmatrix}$

Question 7

The most common incorrect translation used the vector $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$. However, also commonly seen was a triangle with the bottom right point at (2, –3).

Question 8

Candidates performed well on this question. The most common error was to divide $785 by 4, Pip's share, instead of 5, the total number of parts.

Answer: 628

Question 9

This question on statistics is more complex than simply finding the mean of a list of data as it needs a deeper understanding of the mean. It caused significant difficulty for many candidates but a large majority made at least an attempt to answer. Many found it difficult to use inverse operations to arrive at the answer in an efficient manner. Incorrect attempts often involved the division of 53 (the total of the given numbers) by either 7.5 or 8. Other candidates appeared to be treating 7.5 as the median. Some candidates made arithmetical errors. Often workings were not laid out logically, making it difficult for candidates to reach the next stage or check their own work for errors.

Answer: 7

Question 10

A large number of candidates didn't comprehend what was expected of them and worked out the exact answer and then sometimes rounded these at some stage. Those who realised the need to round the given values were usually able to round at least 3 out of the 4 correctly, with 29.3 proving the most challenging (this was often incorrectly rounded to either 29 or 3). Another common error was to place the whole of the numerator inside a square root symbol.

Answer: 10

Question 11

This question was answered well by many candidates, who showed complete and convincing working. Some candidates made arithmetical errors, which should have been picked up when checking. A small number inverted the first or both fractions. Some candidates showed no calculations at all, simply marking in diagonal lines. Presumably these lines were intended to indicate some form of cross-multiplication, but this could not be given credit unless the candidate also showed calculations to make their method clear. Sometimes questions ask for the answer in its simplest form but that was not necessary here. A few candidates arrived at a correct answer, but showed spurious or no working, suggesting that they had used their calculators to arrive at the solution and then worked backwards. Candidates should be clear that in fraction questions a decimal answer is not acceptable.

Answer: $\frac{8}{15}$

Question 12

There were some very clear, totally correct answers but this was a complex problem as candidates had to determine the method to use. The first stage was to calculate the area of the path. The most common attempts at an area counted the square in the corner twice. Others calculated the perimeter or multiplied all the dimensions together. The second stage was to determine the number of bags and many divided their area correctly by 0.5. However, some multiplied or even subtracted 0.5. The last stage was an appreciation of the context, that only whole bags can be bought and the need to round up. Many candidates missed out this stage completely.

Answer: 14

Question 13

There were many correct answers to parts **(a)** and **(b)**. There were some errors in calculations. A few candidates seemed to be judging the angles by looking at the relative sizes in the diagram, even though it was labelled as not to scale. Many of these candidates seemed to assume that triangle *AEB* was isosceles and a number of these thought that angle *EBD* was 90°. Part **(c)** was found more challenging with a very wide variety of answers seen. The most common incorrect answer was corresponding. Other common incorrect answers were interior, internal, complementary, alternating and alternative.

Answers: **(a)** 84 **(b)** 28 **(c)** alternate

Question 14

This question had no scaffolding, so candidates were left to determine the approach, which raises the difficulty level of the question. Many were confused about whether to divide 360° or 180° by 15 to find the exterior angle. Others attempted to use the alternative method, but did not know that (15 – 2) × 180° was required, with some calculating 15 – 1, or multiplying by 360°, or subtracting from 180° or 360° before multiplying. Many candidates did not get beyond finding the exterior angle of the polygon. Those that did go on to calculate the interior angle occasionally spoilt the method by dividing by 2.

Answer: 156°

Question 15

Part **(a)** was usually correctly answered. Part **(b)** was found more challenging. Some candidates arrived at 0.37, but wrote it over a denominator formed from some of the other values in the table. Others assumed that every flavour had a probability of $\frac{1}{5}$ or gave the answer as 'lime' (the flavour that had the highest probability of the two).

Answers: **(a)** 0.21 **(b)** 0.37

Question 16

Many candidates struggled to identify this as a right-angled triangle. A number of candidates thought that the right angle was at the centre of the circle; this suggests that candidates were not completely familiar with angle properties of circles and tangents. As the question in part **(a)** asks for the size of the angle, an answer of 'right angle' or the symbol drawn on the diagram did not score the mark. A few candidates attempted to find a missing length in this part. In part **(b)**, many candidates recognised the need for trigonometry and there were some very good answers that were supported by clear working. Incorrect trigonometric ratios were chosen in a number of cases, mostly cosine, but some used sine. Of those that did not realise that this was a trigonometry problem, some attempted to use formulae relating to circles including dividing 11 by 2 as if it was a diameter. A significant proportion of the candidates who used a correct method (or even an incorrect method) gave inaccurate answers that had been truncated or given to less than 3 significant figures. This part was the one on the paper that was omitted the most by candidates.

Answers: **(a)** 90 **(b)** 8.29

Question 17

In part **(a)**, the majority of candidates knew the scatter graph showed negative correlation but positive, moderate, weak and decrease were seen as answers. Some tried to describe the connection between the age and price of the cars. In part **(b)**, the line of best fit was ruled in the majority of cases, but did not always follow a suitable line. In many cases, the line joined the leftmost to the rightmost points rather than being a best fit for the set of points. Other candidates showed a ruled line going only through the 4 central points which, by chance, lay almost exactly in a line. A few candidates drew a line of positive gradient starting at the origin. A few candidates offered a set of line segments that went from 'dot to dot'. In part **(c)**, there were many correct answers seen, although a significant number of candidates had difficulty reading the scale correctly.

Answers: **(a)** negative **(c)** 4000 to 5100

Question 18

There were very few completely correct answers seen. Most creditworthy responses involved an attempt to find the circumference of a whole circle or the arc length of the given semi-circle. Very few candidates recognised the need to add on the length of the straight edge. Attempts that involved the area formula were very common. Some candidates only gave the length of the straight edge. Candidates should follow the rubric indicating which values of π are acceptable and should not use 3.14 or $\frac{22}{7}$.

Answer: 31.4

Question 19

This question was very well answered, with virtually all candidates gaining some marks. The values in part **(a)** were often substituted correctly into the equation even if the signs of the directed numbers were then ignored. In part **(b)**, the most common error was the mishandling of the 7, subtracting it from 10 instead of adding. Some candidates got as far as $\frac{17}{5}$ but then went on to simplify this incorrectly.

Answers: **(a)** 9.2 **(b)** 3.4

Question 20

In part **(a)**, a few candidates made numerical errors working out the time. There were also a few more candidates who subtracted 11 50 from 12 17 as if the times were numbers, to give an answer of 67. In part **(b)(i)**, 3 was the common incorrect answer as this is the distance from Maria's home rather than from the mall. Often in **part (b)(ii)**, candidates drew a line from the correct point down to (16 00, 0) without using Maria's speed to calculate the time it took her. Of those candidates who showed some correct calculations, the most common error was to misinterpret 0.75 as 1 hour 15 minutes rather than as 45 minutes.

Answers: **(a)** 27 **(b)(i)** 2

Question 21

In part **(a)**, there were many correct answers seen. The most common error involved rounding exact values to give an inexact and therefore incorrect final answer. Many candidates added in additional steps, for example, reaching the correct weekly wage and then multiplying by 7. For part **(b)**, questions on interest have various aspects for candidates to consider. Here, the calculation involved compound interest and the total of principle and interest generated. Candidates need to check that their answer makes sense in the context. Some candidates substituted into the compound interest formula, which is not on this syllabus, but then did not know what to do.

Answers: **(a)** 348.60 **(b)** 805.31

Question 22

Part **(a)(i)** was very well answered with candidates recognising the sequence and continuing it correctly. However, in part **(a)(ii)**, many candidates simply added another 12 to the last term to give 36. Some tried to explain these sequences giving +4 and ×2 as their answers. Part **(b)** was more challenging. Most candidates realised that the pattern was to add 5, but going on from this to find the *n*th term proved difficult for many. $n + 5$ was a very common answer. A number of candidates seemed to be finding either the next, the ninth or the tenth term rather than the *n*th term.

Answers: **(a)(i)** 21 **(ii)** 48 **(b)** $5n - 3$

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key Messages

To succeed on this paper, candidates need to have fully studied all topics in the syllabus. They should read questions carefully and answer precisely what is asked.

General Comments

There were many candidates who showed understanding of most topics. However, some questions were poorly answered by many candidates or not even attempted.

It is expected that candidates will be familiar with terms in the syllabus. For example, 'interest' should be understood as distinct from 'amount', which was a common error on this paper. Also, 'bearing' continues to be a term unknown by many candidates.

There were some questions on this paper that tested the required skills in a different way to that commonly seen in past papers but well-prepared candidates should be able to apply their understanding to solving the problems in these cases. Questions that were slightly different and consequently not well answered were **Questions 2**, **4**, **17** and **21**, while **Questions 4**, **12(b)**, **21** and **24(c)** had a large percentage of nil reponses.

Work was generally presented well and shown where necessary, although marks were still lost at times due to lack of working. Accuracy remains a problem for some candidates who rounded to less than 3 significant figures. Some candidates' responses seemed to show a lack of the essential equipment of ruler and compasses.

Comments on Specific Questions

Question 1

This question was answered well and most candidates gained the mark. The main errors were to give answers of 1 or −1, which showed a lack of understanding of a directed number scale.

Answer: 17

Question 2

This was a slightly different way of testing symmetry, which caused a problem for a significant number of candidates. Quite a large number gave two answers, one for each of the bullet points. Careful reading of the question should have made it clear that the question was asking for one shape with both symmetry properties.

Answer: Parallelogram

Question 3

Most candidates did not understand the meaning of the term 'irrational' resulting in a very poor response. All options were seen, although 1.2×10^{-3} and −36.2 were the most common incorrect answers.

Answer: $\sqrt{3}$

Question 4

Most candidates found this unfamiliar style of question difficult and did not realise that the two values needed to be put in the same form. Many did not even attempt it and few gave any reasoned explanation or clearly thought they were equal. Although 0.3 = $\frac{3}{10}$ was often seen, there was rarely an attempt to indicate that $\frac{1}{3}=\frac{3}{9}$. Many changed $\frac{1}{3}$ into a decimal but often the decimal form was isolated and not clearly related to the fraction $\frac{1}{3}$. Other methods, such as multiplying both by 10 or 100, occasionally led to a convincing solution.

Answer: Examples are $\frac{1}{3}$ = 0.33[3...] or 0.3 = $\frac{3}{10}$ and $\frac{1}{3}$ = $\frac{3}{9}$

Question 5

This question was a straightforward case of rounding, unrelated to the more usual calculator question. Rounding to 2 decimal places was well done but many did not get the mark as they did not round up when the third decimal place was a 7. Others just moved the decimal point to two places from the end. Significant figures presented more problems. The main issue was that after realising that the digits needed were 14, many did not add the two zeros to give the correct place value. Others added more zeros after the decimal point or included other non-zero digits after 14.

Answers: **(a)** 1426.31 **(b)** 1400

Question 6

This simple interest question was quite well answered but some candidates attempted compound interest. A common error was to add the 2600 to the correct answer, which indicated that they did not read the question carefully or they did not understand what interest meant. Although most applied the formula correctly, some wrote $(2600 \times 4\% \times 5) \div 100 = 5.2$ and others ignored the 5 years. Candidates should look at their answers to see if they are consistent with what is asked in the question.

Answer: 520

Question 7

With a question on changing currencies, candidates need to apply some thought as to whether they should be multiplying or dividing by the exchange rate. In this case, they should have realised that the answer should be less than 950 and hence division was required. Unfortunately, many multiplied by the exchange rate. Some even calculated 1.368 ÷ 950, which produced an unrealistic answer.

Answer: 694

Question 8

Proportion questions normally cause difficulties for candidates and this was no exception. Few seem able to apply the transformation enlargement when the question concerns physical objects rather than shapes on a grid. The main error was that many felt they had to add 10, the difference between the heights, to 7.2. Others added 5 to 7.2 or multiplied it by 2. Those who did make progress, and often reached a correct answer, started with a proportion relationship of, or equivalent to, $\frac{x}{7}=\frac{25}{15}$.

Answer: 12

Question 9

Few responses to the *n*th term contained the letter *n*. Sequence questions often start by asking for the next term and many candidates felt they simply had to write down the next term, 15. Of those who did write an algebraic expression, $n + 4$ was the most common error. Some did get as far as $4n$ but added an incorrect number, often 1.

Answer: $4n - 5$

Question 10

Candidates need to realise that 'Use trigonometry' means that one of the ratios, sine, cosine or tangent, is required and not Pythagoras' theorem. Of those who did apply trigonometry, many chose the incorrect ratio, cosine, probably assuming the angle required was at *B*, the more usual one between the hypotenuse and base. Some responses were spoilt by rounding sine *x* to 0.75 or even giving 0.75 as the answer.

Answer: 48.7

Question 11

(a) There were many correct answers but quite a number of candidates just divided by 3 and did not find the square root. Some subtracted 3 or calculated $\frac{\sqrt{108}}{3}$.

(b) Again the index question was quite well answered but some wrote the answer as w^{12}. Another error was to give 3 for the answer obtained by dividing the indices.

Answers: **(a)** 6 **(b)** 12

Question 12

(a) There were many incorrect answers to this part even though this was a very straightforward question on vectors. There were numerous combinations of ±6 and ±3 for the components, many of which were incorrect.

(b) There were also many incorrect answers to this part and many candidates did not attempt it. The main error was swapping the vectors round. Possibly many were confused by this part having no connection with the previous one or related to the diagram. Very few fraction lines were seen in the vectors.

Answers: **(a)** $\begin{pmatrix} 6 \\ -3 \end{pmatrix}$ **(b)** $\begin{pmatrix} -5 \\ 7 \end{pmatrix}$

Question 13

There were many correct answers to this change of subject question but it was common to see adding or subtracting used when these operations did not appear in the formula. Otherwise, errors came from swapping *R* and *y* or making an error after the stage $4R = ty$.

Answer: $\frac{4R}{t}$

Question 14

(a) This was very well answered with the vast majority of candidates making the correct choice. Those who wrote the incorrect answer should have at least used their calculator to change $\frac{5}{8}$ to a decimal.

(b) Again this was well answered but some candidates wrote the decimal point in the wrong place, usually after 13. A few rounded to 130.4, so candidates should realise that exact values must be given in full unless instructed otherwise.

Answers: **(a)** 62.5 **(b)** 130.35

Question 15

Although a specific instruction about using a ruler and compasses was not given, the term 'construct' makes it clear that an accurate triangle is required. This can only be done with arcs drawn. Many candidates did not show arcs and consequently could only earn 1 mark if both lines were within the accuracy limits. Another error seen was making a triangle with a line perpendicular to the given line. There were many nil responses, which could indicate that some candidates did not have the necessary equipment. Some did not even form a triangle.

Question 16

While there were many correct solutions to this question, a significant number of candidates either changed the $1.27 to $1.25 or 3.5 to 4. Otherwise some did not add the two parts to form a total cost, while others misunderstood completely by multiplying 3.5 by 4 or performing other inappropriate calculations.

Answer: 10.96

Question 17

This was a challenging question for candidates. The step of subtracting $\frac{11}{15}$ from 1 to use $\frac{4}{15}$ was only understood by a small minority, some of whom progressed to a correct answer. The majority simply multiplied $\frac{11}{15}$ by 14.40 and left that as the answer or added it to 14.40.

Answer: 54

Question 18

The mean from a frequency table is a standard requirement of the syllabus and this was a straightforward question. However, although many did find the total for the number of pets, a considerable number divided by 6 or performed their own addition of the frequencies incorrectly, even though this total was given in the question. Otherwise, there was a variety of incorrect additions and divisions, most of which did not give a value for the mean as a representative measure for an average number of pets. Some found the correct answer but gave the answer 4, presumably believing that the mean had to be a whole number.

Answer: 3.5

Question 19

This question ideally required the use of Pythagoras' theorem but a number of candidates chose to follow a long trigonometry method, usually incorrectly or losing accuracy. Most made an attempt at Pythagoras' theorem. However, many squared the given lengths, added and found the square root. This gave a value of x greater than the hypoteneuse, 8, which should have indicated the error. However, many did make progress but some then lost the final mark by giving a two significant figure answer.

Answer: 6.24

Question 20

This subtraction of fractions question was answered well, with working more evident than for previous papers, even if at times it was incorrect working. Some made an error when changing the mixed number to an improper fraction, which was the method used by the vast majority. $\frac{7}{4}$ instead of $\frac{9}{4}$ was seen quite often. A variety of multiples of 12 were seen for the denominator but most managed to cancel their correct fractions to the right answer. Those who left the mixed number in that form often became confused as negative values arose.

Answer: $1\frac{1}{3}$ or $\frac{4}{3}$

Question 21

This was an unfamiliar way to test the knowledge of these statistical measures and candidates found it challenging. Many did gain the mark for the mode by having at least two items of 3 and some gained the mark for either the median or the range, but few gained all three marks. Little working was seen to show evidence of a thought out solution and most seemed to have little system to their answer. Clearly some thought that putting 6 in the middle space was sufficient for the median regardless of their other values. The set 1,2,3,4,5 was often seen as well as other sets that did not even include a 6. Quite a lot of candidates did not attempt the question or did not write down a full set of five numbers.

Answer: 3, 3, 6, 7, 8

Question 22

(a) This question was challenging for candidates with two main errors. Firstly, many candidates measured the radius instead of the diameter and secondly many did not observe that the question asked for an answer in millimetres. The large number of nil responses suggests that many did not have a ruler. Some gave an angle for the answer or calculated an area.

(b) This part was answered far better than part **(a)** but a significant number did not know the correct formula for the area of a circle. $2\pi r$, $2\pi r^2$, $\pi^2 r$ were often seen as well as formulas not involving π. Some of those who did use the correct formula lost a mark by using an incorrect value for π. While 3.14 and $\frac{22}{7}$ are valid for the method mark, they will very likely give an answer outside the accepted range.

Answers: **(a)** 44 to 48 **(b)** 507

Question 23

(a) Although there were quite a lot of correct responses, the negative before the value outside the brackets caused many to make errors. The most common response was $-8w - 20$, while some went on to do a form of simplification to reach 12 or $12w$.

(b) A common answer to this part was $x(6x - x)$, although many did reach the correct answer. Again combining unlike terms was evident from quite a number of candidates leading to responses of $5x^2$ or $5x$. The response $x(6x)$ probably resulted from an inability to cope with the fact that $-x = -1x$.

(c) Substituting the numbers into the expression was not a problem for most candidates but many could not then correctly work out the value of their expression. Examples of this were $2 \times 7 + 2 \times 5$ or $2 \times 7 \times 2 \times 5$ for $2pq$. Adding instead of multiplying, or incorrect multiplication, were very evident as well as taking -2 as $+2$, resulting in the often seen response of 112.

Answers: **(a)** $-8w + 20$ **(b)** $x(6x - 1)$ **(c)** 28

Question 24

(a) Inaccurate use of the protractor or rounding down a measured angle produced the often seen response of 110°. Reading the wrong scale on the protractor and measuring the bearing of *F* from *P* were also quite common. Many did not realise that a bearing is an angle and the length of *FP* was seen many times.

(b) In many cases there was enough evidence of measuring the length of *FP* but a considerable number of candidates did not multiply by the scale. Inaccurate measurement of the line was also evident.

(c) Many candidates did not attempt this part. Very few knew they had to subtract 180° and an answer of 124°, from 360° – 236°, was the most common error. There were a few answers of 55° or 57° which presumably came from an attempt to draw and measure the angle, though no evidence of this was seen.

Answers: **(a)** 111° to 115° **(b)** 304 to 320 **(c)** [0]56°

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key Messages

To succeed on this paper, candidates need to have fully studied all topics in the syllabus. They should read questions carefully and answer precisely what is asked.

General comments

The standard of performance was generally quite high.

The question on proportion was the least well answered. Many candidates do not appear to understand bearings. The majority of candidates showed working out, although on the fractions question several candidates did not show all the steps of their working as requested in the question. Some candidates appeared not to have access to rulers and compasses.

Careful checking of the wording of the questions would help to reduce errors. For example, when a question asks for the answer as a fraction, credit is not given for answers given as decimals or percentages.

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

Comments on specific questions

Question 1

This question was well answered. The most common error was to omit the zero or to include it twice.

Answer: 6054

Question 2

The majority of candidates were able to give an answer within the acceptable range. Several appeared not to have a ruler, while others did not measure in centimetres.

Answer: 6.7

Question 3

Many candidates appeared not to understand the term ‘rotation symmetry’. Some added to the diagram while others gave the answer 1, 2, triangle or hexagon. A significant number of candidates did not answer this question.

Answer: 3

Question 4

Many candidates were able to round correctly. Common errors were 170.0, 17 and 169. Other responses included more than two non-zero figures.

Answer: 170

Question 5

Many candidates were able to calculate the correct answer. The most common error was to not give an answer to at least 3 significant figures, so 0.10 was seen often. Candidates should be aware of the rubric about rounding on the front of the question paper.

Answer: 0.101

Question 6

The majority of candidates gave the correct answer. Of those who did not, many knew the answer was 6, but wrote it as $\frac{6}{30}$.

Answer: 6

Question 7

(a) Almost all candidates were able to give the correct answer. A small number only gave one factor.

(b) The majority of candidates gave the correct answers, with a small number losing a mark for listing only one number or for including one extra.

Answer: **(a)** 12,15 **(b)** 11,13.

Question 8

(a) Almost all candidates were able to give the correct answer.

(b) This was less well answered with confusion between the rule and the expression. Some candidates wrote $-4n + 25$, while others wrote $n - 4$.

Answer: **(a)** 5 **(b)** subtract 4

Question 9

This question was not well answered. Several candidates had problems with the negative terms, the most common error being $5 - 3u$.

Answer: $5 - u$.

Question 10

(a) This part was generally well answered.

(b) This part was also correctly worked out by most candidates.

Answer: **(a)** 2 **(b)** –9

Question 11

Some candidates did not seem familiar with trigonometry. Pythagoras' theorem was attempted by some as well as attempts to measure the angle. Candidates should understand not to measure diagrams that are "not to scale". Some candidates who knew to use trigonometry selected the incorrect ratio. Those who selected the correct ratio usually went on to give the correct answer.

Answer: 23.6

Question 12

Many candidates were able to give the correct answer. Many found the correct factors but then listed them without including the multiplication symbols or included addition symbols. Many candidates used factor trees, but not always down to just primes. Some just wrote a pair of factors.

Answer: $2^3 \times 3^2$

Question 13

The majority of candidates understood they needed to use Pythagoras' theorem. Some however, used trigonometry. Common errors were to subtract 18^2 from 26^2, and not finding the square root.

Answer: 31.6

Question 14

Although many candidates scored both marks, many constructed triangles without arcs. There were some inaccurate triangles and several candidates did not attempt this question. Some candidates appeared to have no access to rulers and compasses.

Question 15

The majority of candidates understood how to calculate the volume of a cuboid, although a small number attempted to find the surface area. The majority gave the correct units.

Answer: 562.5 cm^3

Question 16

The majority of candidates were able to give the correct answer and did show all steps of working. Some had broken the question down into two parts, but unfortunately not all showed the working for the first part. Twelve was often used as the common denominator, although 24 and 72 were also seen. Several less able candidates showed no understanding of common denominators and just added or subtracted the numerators and denominators.

Answer: $\frac{7}{12}$

Question 17

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

(b) The majority of candidates gave the correct factorisation, with others scoring 1 mark for partial factorising almost always for $x\,(2 - 4x)$. Only a small number gave answers unrelated to factorising.

Answer: **(a)** $3x + 21$ **(b)** $2x\,(1 - 2x)$

Question 18

(a) Many candidates did not demonstrate a good understanding of bearings. Common incorrect answers were 130° and 140°. A small number gave the distance rather than the bearing.

(b) Many candidates did not attempt this part of the question. Several candidates scored 1 mark, usually for the distance.

Answer: **(a)** 230

Question 19

(a) This part was often correct, with a small number of candidates using a positive index and giving the answer as 17000. There were some errors with the number of zeros after the decimal point. A small number of candidates gave the answer as a fraction.

(b) This was generally well answered with only a small number of candidates unable to give the correct figures from the calculation. Some errors were made with the index.

Answer: **(a)** 0.00017 **(b)** 1.026×10^{-3}

Question 20

(a) Many candidates clearly know angle facts and were able to give the correct answer. Many others scored 1 mark for 84°, the fourth angle in the quadrilateral. The most common error was 112 using alternate angles. A small number did not know that the internal angles of a quadrilateral add to 360°.

(b) Only a small number of candidates were able to give the correct answer. Common incorrect answers were 360 and 14.4.

Answer: **(a)** 96 **(b)** 4140

Question 21

(a) This question was not well answered. Many candidates tried to find a solution using Pythagoras' theorem. Those who knew proportion often gave the correct answer. Some simply added or subtracted 3.75 (the difference of the given sides).

(b) Generally only the candidates who scored in part **(a)** scored the marks in this part.

Answer: **(a)** 12 **(b)** 3.75

Question 22

There was a good response to this question, with many candidates scoring full marks. Others made some progress but manipulating negative numbers was usually the major problem. Some candidates knew they had to equate the coefficients but often forgot to multiply one or more of the terms.

Answer: $x = 4$, $y = -6$

Question 23

(a) (i) Many candidates were able to answer this part correctly. A common error was 120° from incorrect use of a protractor.

(ii) This part was mainly correct. Of those not scoring the mark, it was often because candidates had given the answer as 25% and not a fraction.

(iii) Almost all candidates got the correct answer, with a small number not attempting this part.

(b) Many candidates were able to calculate the correct answer. Common errors were adding the frequencies and dividing by 6, or finding the median.

Answer: **(a)** **(i)** 60 **(ii)** $\frac{90}{360}$ **(iii)** 46 **(b)** 2.4

MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key Messages

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

General Comments

Some topics are well understood by most candidates, including algebra, functions, proportionality and percentages. There are some topics that are not well understood, including compound interest, probability, averages and trigonometry.

There were many responses to questions that did not show any working at all. Methods also need to be clear and set out in a logical order otherwise the working is difficult to follow. Candidates should read a question very carefully. There was evidence in this paper that some candidates were not giving the required information.

The accuracy of the numbers in the working should be greater than three figures if the final answer is going to be correct to three figures. This happens especially in questions involving π. $\frac{22}{7}$ should not be used because this fraction leads to inaccurate results. The rubric on the front of the question paper should be adhered to. Partial answers were often rounded to two or three figures, leading to the final answer being inaccurate.

Comments on Specific Questions

Question 1

A few candidates added rather than subtracted, resulting in an answer of 1. Another common incorrect answer was –17 achieved by subtracting in the wrong direction.

Answer: 17

Question 2

Many candidates struggled with this question. The most common error was shading the region B', i.e. not including the intersection.

Question 3

Most answers were fully correct. Some triangles were in an incorrect position, out by 1 square in one or both directions, possibly because the candidate forgot which corner they started from. Occasionally a reflection, usually in the *x*-axis, or an enlargement, were seen.

Question 4

This ratio question was usually answered correctly by dividing by 5 to find a single share, and then multiplying by 4. Incorrect responses tended to include division by 4.

Answer: 628

Question 5

The majority of candidates gained credit for finding the total was 60. The most common error was summing the 8 values to $53y$, then dividing 60 by 53 to finish with 1.13, rather than equating $53 + y$ to 60. Another method seen was $53 \div 7.5 = 7.066...$ rounding to 7. Some candidates attempted $53 \div 8$. Candidates need to reflect on their answer and ask if it is sensible or reasonable.

Answer: 7

Question 6

Some candidates did not round the figures and gave an answer by putting the calculation directly into their calculator. Other candidates rounded the figures, but incorrectly, to 1 decimal place. For those who did round, as asked, most got the correct figures, but many slipped up with the 30 and gave 29 instead. Another common error was to extend the square root to the 30/29. Occasionally, 3 was written instead of 30.

Answer: 10

Question 7

This question was answered well. The most common errors were finding 180 as the LCM, or correctly finding prime factors but not selecting the correct ones to multiply, usually just 3^2. Many started by listing factors but didn't give all factors, therefore giving a common factor of the two but not the highest one.

Answer: 18

Question 8

In part **(a)** most candidates gave the correct answer, although some gave the answer 53°. Part **(b)** was also relatively well answered. Many candidates used the tangent ratio to gain the correct answer, but the sine rule was also used frequently, and quite well done although sometimes the angle 90° was used instead of 53°. Using the tangent ratio, some candidates gave their answer to tan 37 as 0.75. It should be stressed to candidates that there is a need to write down at least 4 significant figures from their calculator before attempting any rounding. A significant number of candidates selected an incorrect trigonometric route, of which the most common was $OP \div 11 = \sin 37°$, leading to an answer of 6.62. A few used Pythagoras' theorem and then the sine or cosine ratios but generally errors were made in the method and few achieved the correct answer using this method.

Answers: **(a)** 90 **(b)** 8.29

Question 9

In part **(a)** there was a tendency to stop at a partial factorisation, usually $a(x + y) + 3c(x + y)$. In part **(b)** candidates often gave $3(a^2 - 4b^2)$ and were often unable to factorise the expression within this bracket.

Answers: **(a)** $(a + 3c)(x + y)$ **(b)** $3(a - 2b)(a + 2b)$

Question 10

Many answers of $\frac{15}{100}$ or $\frac{3}{20}$ were given, usually with no working. Many candidates also used the decimal 0.1515… rather than 0.1555… .Some tried to multiply by a power of 10 and then subtract, but many got lost in the subtraction and didn't eliminate the recurring 5s. Many correct answers were given with no working shown.

Answer: $\frac{14}{90}$

Question 11

It was common to see the semi-circumference calculated correctly and then the addition of the diameter omitted. Some candidates continue to use $\frac{22}{7}$ for π.

Answer: 31.4

Question 12

This question was very well attempted and most candidates knew how to approach it. However, the major downfall was incorrect reading of the question. Instead of cubed, candidates used no power, squared, square rooted or cube rooted. The method that followed was correct and showed understanding of proportionality, so it is essential that candidates read the questions very carefully before starting to answer.

Answer: 81

Question 13

Those candidates who left finding the square root until the last step were usually successful, although some only took the root of the numerator and not the entire fraction. Some found the square root at an earlier stage and they were always unsuccessful. Candidates should be encouraged to perform just one step at a time and show the result of that single step.

Answer: $[\pm]\sqrt{\frac{y-b}{a}}$

Question 14

The working of candidates in this question was often difficult to follow. Working could be very haphazard and not very thorough. An attempt to find speed in m/s was commonly seen. For those who used the correct method, many stopped at 19.3 and did not round their answer correctly. Candidates generally found the conversion of units very challenging.

Answer: 19

Question 15

Most candidates realised they needed to factorise, although some less able candidates attempted to cancel the x^2 from the numerator and denominator before factorising the expressions. Errors in the signs in the brackets were sometimes seen. Of those that attempted to factorise, most correctly factorised the numerator but many couldn't correctly factorise the denominator.

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

Question 16

This question was attempted reasonably well. Only a few candidates chose the simple interest route. Many candidates forgot to subtract the 1800 and many did not round correctly, or did not round at all. Candidates should be encouraged to look back for the accuracy requirements of a question once they have completed their calculations. Some candidates did attempt a year-on-year method, but they were not very successful and did not produce an answer within the range. Some candidates made an error with their bracketed term, for example $\frac{1+1.5}{100}$ or 15% was used.

Answer: 198

Question 17

In part **(a)** almost all the candidates recognised this transformation as an enlargement, but fewer gave the correct centre or scale factor. Many candidates gave 2 as the scale factor, for mapping *T* onto *S*, and (4, 2) or (2, 1) were common incorrect centres of enlargement. The word reduction was used regularly for enlargement; candidates must use the correct terminology. In part **(b)** the diagonal form was understood by many candidates but some wrote 1 in place of $\frac{1}{2}$ or 1 in the first cell and $\frac{1}{2}$ in the fourth cell. Some attempted to set up a matrix equation and solve it but they usually made errors. The most successful method was to learn the structure of the matrix and substitute in the required values.

Answers: **(a)** enlargement [centre] (0,0) [scale factor] 0.5 **(b)** $\begin{pmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{pmatrix}$

Question 18

Part **(a)** was usually answered well with some candidates making small numerical errors but the method was usually correct. In part **(b)** most used the correct method but, for the determinant, numerical errors led to –10 or 2 and in the matrix some were confused which pair of numbers were swopped and which pair of numbers had their signs changed. In part **(c)** most responses identified the different number of columns. However, some were confused with multiplication and gave their reason linked to that.

Answers: **(a)** $\begin{pmatrix} -9 & -5 \\ -7 & -5 \end{pmatrix}$ **(b)** $\frac{1}{10}\begin{pmatrix} 4 & 2 \\ -3 & 1 \end{pmatrix}$ **(c)** not the same order

Question 19

A few candidates worked with the top and bottom faces as triangles rather than sectors. Most candidates gained credit for one or both of the rectangles, with a smaller number finding the area of the sector(s) correctly. Finding the curved surface area proved to be the most challenging part, with many candidates finding a volume instead. There were some correct solutions which found the area of all five faces correctly, but made rounding errors in their accuracy.

Answer: 281

Question 20

In part **(a)** there were many candidates who used a correct method. Some, however, assumed that there were only ten people and used this number without replacement. The other error here was the answer of 0.8, which came from candidates just finding 0.4 + 0.4. Part **(b)** was found to be more challenging than part **(a)**. However, some candidates used a correct method but only found the probability of three of the six outcomes. Those who found the probability of both having the same colour and then subtracted from 1, usually gave the correct answer.

Answers: **(a)** 0.16 **(b)** 0.58

Question 21

Most candidates attempted this question very well. In part **(a)** the most common error was to add the powers rather than multiply. In part **(b)** a few multiplied the two functions. Some used the correct method, but made errors in expanding the brackets and simplifying. Some went on to solve an equation. In part **(c)** some candidates left the expression in terms of *y* rather than *x*.

Answers: **(a)** 512 **(b)** $6x - 2$ **(c)** $\frac{1}{2}(x - 1)$

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key Messages

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

General Comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates showed evidence of good number work, with particular success in **Questions 1, 3** and **12**. Candidates found some of the mathematical terminology difficult and **Questions 4** and **6(a)** were particularly challenging. It was rare to find candidates showing no working and more method marks were awarded this year as a consequence.

Comments on Specific Questions

Question 1

Nearly all candidates attempted this question, with the majority answering correctly. Common incorrect answers were –1, 16 and 18, the former of these from adding instead of subtracting to find the difference. Quite a few candidates gave the answer of –17.

Answer: 17

Question 2

The correct answer was often seen, with the most common incorrect answer being trapezium. It was rare to see the answer rhombus and occasionally the answer line was left blank or a choice of answers were given. Some candidates thought that two answers were required, one for each condition.

Answer: Parallelogram

Question 3

This question was well attempted, with the majority of candidates scoring 2 marks. The most common errors included: 950 × 1.368; incorrect rounding with no more accurate answer e.g. €694.40; and a small number of candidates lost the accuracy mark due to misreading 1.368.

Answer: 694

Question 4

Many candidates demonstrated a lack of understanding of the terminology with some thinking it was connected to finding the determinant of a matrix rather than the magnitude of a vector, writing *ad−bc* as their starting point and then unable to proceed. A few presented their answers as a vector involving 3 and 5 with negative signs in various positions. Of those candidates that realised that this was about finding the length of the vector there were a variety of issues, the most common being $\sqrt{-3^2 + 5^2} = 4$, $\sqrt{5^2 - (-3)^2} = 4$ and $\sqrt{(-3)^2 + 5^2} = 28$, where the candidate had clearly calculated $\sqrt{(-3)^2} + 5^2$.

Answer: 5.83

Question 5

This was a well attempted question with a large proportion of candidates scoring full marks or the special case mark. The SC1 mark was very common as candidates did not all read or understand the hemisphere part of the question. A small number of candidates squared *r* rather than cubed. Other candidates lost marks for being slightly out of tolerance on their answer, usually due to using 3.14 or $\frac{22}{7}$ for π rather than following the instructions on the front of the exam paper to use 3.142 or the π key on their calculator.

Answer: 262

Question 6

Part **(a)** was a good discriminator, with the correct answer seen sometimes. Many candidates demonstrated a lack of understanding of the terminology. The most common errors were to list the numbers in the regions or to give the answer 5 (the number of regions/numbers). 1 was also seen as an answer quite regularly. Part **(b)** proved a little less challenging, with the correct answer seen more often, although it was quite common to see the region of candidates who only study Spanish shaded.

Answer: **(a)** 18

Question 7

Almost all candidates demonstrated an ability to multiply matrices, although this was sometimes spoilt by arithmetic errors or confusion about signs, and a few candidates transposed the –8 and –6. Only a small minority showed no understanding of a matrix product. Some of these multiplied the corresponding elements of the two matrices, leading to an answer of $\begin{pmatrix} 15 & 0 \\ -2 & 8 \end{pmatrix}$.

Answer: $\begin{pmatrix} 11 & -8 \\ -6 & 8 \end{pmatrix}$

Question 8

Many candidates were successful in this question, with the best solutions arising from those who had learned a formula, i.e. $8000 \times (1 \quad 0.1)^7$. Many used a year-on-year approach with varying degrees of success and often these included arithmetic slips somewhere along the way. The most common errors were to calculate 8000 × 0.1 × 7 or 8000 – (8000 × 0.1 × 7), with 5600 and 2400 being the most common incorrect answers. Also seen quite regularly was $8000 \times (1 + 0.1)^7$ followed by the answer $15 589.74, with no appreciation that this was higher than the original value of the car and clearly not a decrease.

Answer: 3826

Question 9

This question was a good discriminator proving challenging for many. Almost all candidates had a good attempt at this question, with many realising they needed to square the 50 000 but then were unable to deal with the conversion from square centimetres to square kilometres. The most common incorrect answers included the figures 6 or 36 from using 50 000 rather than $50\,000^2$, or 1.2^2 instead of 1.2. Some highly implausible answers existed, for example fields larger than many countries. Some candidates were unable to, or forgot to, consider the common sense of their answers.

Answer: 0.3

Question 10

There were a significant number of correct answers. The incorrect answer 19.64 was almost as common as the correct answer, from those thinking that $\frac{11}{15}$ of the money was left rather than spent. There were a few issues of lost accuracy marks due to premature rounding, i.e. from those dividing 14.4 by 0.27 instead of $\frac{4}{15}$. The most common error in the working was $x-\frac{11}{15}=14.4$ rather than $x-\frac{11x}{15}=14.4$. Consequently 15.13 was a common incorrect answer.

Answer: 54

Question 11

This question was generally well answered and the majority of candidates were able to successfully use Pythagoras' theorem to find the correct length. The most common error was not taking note that the hypotenuse was given. Consequently, candidates added 8^2 and 5^2 rather than subtracting, leading to the common incorrect answer of 9.43. A few candidates used longer trigonometric methods, sometimes but not always, successfully. A significant number of candidates chose to round their answer to 2 significant figures or rounded inaccurately. It was common to see the answer 6.25.

Answer: 6.24

Question 12

This was a well answered question with a significant number of candidates scoring all three marks. The most successful candidates used the lowest common denominator, 12, with the working $\frac{27}{12}-\frac{11}{12}=\frac{16}{12}$ leading to the correct answer. Some chose to use a less efficient method, often with a common denominator of 48. Those candidates were not as successful at cancelling their final answer to its lowest terms. It was also common to see $2\frac{1}{4}$ interpreted as $2\times\frac{1}{4}$.

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

Question 13

The vast majority of candidates understood that the sine rule was needed to answer this question. A large proportion of candidates achieved the correct answer but there were some issues with the manipulation of the sine rule and inaccurate answers due to premature rounding part way through their solution. A significant number of candidates had conceptual problems and incorrectly rearranged and used $\sin^{-1}$. A few candidates used ratios involving the actual angles and the sides rather than the sines of the angles and the sides. A significant number of candidates lost the final accuracy mark because they did not successfully round their answer to 3 significant figures. Common answers were 8.1 and 8.11. An answer of 7.77 was sometimes seen, where the candidates did not have their calculator in the correct mode for working with angles measured in degrees.

Answer: 8.12

Question 14

The correct answer was often seen from correct working. However, if it came from wrong working, which happened quite frequently, it did not score any marks. Common incorrect working included the equivalent of $\frac{101}{100} \times 2475 = 2499.75$ or $2475 \times 0.99 = 2450.25$ both of which round to 2500. Many candidates were able to obtain the first method mark for associating 2475 with 99%, even if they were unsure how to proceed from here.

Answer: 2500

Question 15

Part **(a)** was correct approximately half of the time, with many candidates not spotting that the question was about the difference of two squares. Common errors included the answers $(3w - 10)^2$, $(3w)(3w) - (10)(10)$, $(3w - 100)(3w + 100)$ and $(9w - 10)(w + 10)$ or attempting to take out a variety of common factors, sometimes leaving decimals inside the brackets. Part **(b)** was much more successful with incorrect answers less common. Errors tended to be as a result of a careless omission of a letter or brackets rather than a lack of understanding. Sometimes partial factorisation occurred, e.g. $p(m + n) - 3q(2m + 2n)$ and then candidates stopped at this point. Quite often there was confusion with the signs and a common error was $p(m + n) - 6q(m - n)$.

Answer: **(a)** $(3w + 10)(3w - 10)$ **(b)** $(m + n)(p - 6q)$

Question 16

Many candidates were able to successfully answer this question. The two most common errors were to work out the area of the sector or to forget to add 30 to the arc length, with 6.81 being seen as an answer almost as frequently as the correct answer.

Answer: 36.8

Question 17

This was a very well attempted question, with the majority of candidates earning at least 2 marks. The most successful candidates had the starting point $y = k(x - 1)^2$ and correctly obtained $k = 7$. Usually this was followed by the correct answer. However a significant number then substituted $x = 6$ into $y = 7(x - 1)$ or even just worked out 7×6 instead of using $y = 7(x - 1)^2$. Other common errors were arithmetic slips or a conceptual misunderstanding when substituting $x = 4$ into $(x - 1)^2$ with $x^2 - 1^2$ often used instead. The two most common incorrect starting points were to ignore the square on the $(x - 1)$ or to use inverse proportion. Consequently, 105 and 22.7 were the most common incorrect answers.

Answer: 175

Question 18

Many candidates were able to correctly answer this question, with a large majority obtaining at least 1 or 2 marks. The most common errors were to work out the area instead of the perimeter or to find the perimeter not using bounds and then to add and subtract 0.5 from 16.4. It was common to see 0.5 added and subtracted from 5.8 and 2.4 instead of 0.05, to find the bounds for the lengths.

Answer: 16.2, 16.6

Question 19

Most candidates showed appropriate working and knew the correct form of the quadratic formula. Arithmetic errors and particularly sign errors were quite common, with the majority of the confusion connected with the $(-6)^2$ in the discriminant. It was very common to see -6^2, which was not recovered; also –6 was often seen instead of –(–6). Some candidates took insufficient care in rounding or missed the accuracy requirement, or do not understand rounding rules. –0.380 was very common, suggesting candidates were probably applying the standard 3 significant figure rounding rather than the 2 decimal places asked for in the question. A very small number of candidates completed the square, usually successfully. There were a small minority who only partially remembered the quadratic formula or did not have any correct starting point.

Answer: −0.38, 1.58

Question 20

This was a well answered question by the majority of candidates, with the most common errors in part **(a)** being to draw a line from (0, 0) to (10, 8) instead of a horizontal line. Occasionally the diagonal line stopped at (52.5, 0) instead of (55, 0) where there was a misinterpretation of the scale. The majority of candidates understood that the area under their graph in part **(a)** was required for part **(b)**, with the majority scoring 3 marks or at least 1 mark for an attempt at an area. The most common incorrect working was 8 × 55 or to have some problems with correct substitution into the trapezium area formula.

Answer: **(b)** 260

Question 21

Many candidates completed part **(a)** well, although there were a significant number of misreads, usually 7.5 for 7.2. A few candidates used squares or square roots of the scale factor. Premature rounding was a problem for some candidates; $\frac{25}{15}$ was regularly approximated to 1.67 giving a final answer greater than 12. A small minority added 10 to 7.2 as 25 was 10 greater than 15. Many candidates also went on to answer part **(b)** well too, more than usual for this type of question, possibly because the existence of part **(a)** made them think about what was different in the second part. However there were a large number of candidates giving the answer 8.19, arising from using the linear scale factor or cubing everything e.g. $\left(\frac{16}{y}\right)^3 = \left(\frac{375}{192}\right)^3$.

Other common errors were to cube instead of cube rooting the $\frac{192}{375}$ or to use square root instead.

Answer: **(a)** 12 **(b)** 12.8

Question 22

Many candidates were able to successfully reach the answer of 3.5 in part **(a)** with the most common errors being 1 × 0 = 1 leading to $\frac{85}{24}$ = 3.54 and 21 ÷ 7 = 3. Other common errors were 84 ÷ 7 = 12 and 24 ÷ 7 = 3.43. Some candidates decided that you can not have half a pet and so rounded their answer to 4; usually the correct more accurate answer appeared earlier in their working. If so, those candidates still obtained the accuracy mark but for some candidates this was not the case. A significant number of candidates demonstrated confusion by inventing mid-points to non-existent classes and using these mid-points in their calculation of the sum of f*x*. Part **(b)** proved to be a little more challenging, although there were still many correct answers or correct methods following through from an error in part **(a)**. Two common incorrect starting points were $\frac{84+x}{24} = 3.44$ and $\frac{84x}{25} = 3.44$, instead of $\frac{84+x}{25} = 3.44$.

Answer: **(a)** 3.5 **(b)** 2

Question 23

The majority of candidates had completely correct tree diagrams in part **(a)** or scored at least 1 mark for $\frac{8}{14}$ and $\frac{5}{13}$ positioned correctly. Candidates were generally successful in consistently using denominators of 13, probably because one was already given but this was not always the case as denominators of 12 and 14 were also seen in the second tier of branches. The most common errors were to reverse the $\frac{6}{13}$ and $\frac{7}{13}$ or to repeat the $\frac{5}{13}$ and $\frac{8}{13}$ in the second set of branches. Part **(b)(i)** was also often correct with most able to find the two correct values to multiply. A fairly common error was to add the two fractions rather than to multiply them. There was a follow through mark for those who had the incorrect values in the diagram but as most had the $\frac{5}{13}$ correct this was not often needed. Part **(b)(ii)** was less well answered. The most successful candidates used the most efficient method of $1-\frac{8}{14}\times\frac{7}{13}$. The most common mark was the method mark for using just two of the three correct routes through the tree diagram. In the majority of these cases, this was for finding the probability of *exactly* one red pencil rather than *at least* one red pencil. The follow through marks were awarded quite often to those who had errors on their tree diagram. A significant minority of candidates presented answers greater than 1 for a probability answer in part **(b)**.

Answer: **(a)** $\frac{8}{14}$, $\frac{5}{13}$, $\frac{6}{13}$ and $\frac{7}{13}$ **(b) (i)** $\frac{30}{182}$ **(ii)** $\frac{126}{182}$

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key Messages

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

General Comments

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

Candidates showed some good number work in **Questions 3**, **5**, **10** and **15**; a good understanding of simplifying and factorising algebraic expressions in **Questions 6** and **7**; and a sound understanding of trigonometry in right-angled triangles in **Question 9**.

Candidates struggled with set notation in **Question 12**; volume scale factors in **Question 14**; bounds in **Question 20**; and using vectors in **Question 23**.

Candidates were generally good at showing working although the algebraic manipulation was sometimes difficult to follow in **Questions 16** and **22**.

Comments on Specific Questions

Question 1

The majority of candidates gave the correct value of 170. Common incorrect answers were 170.0, 17, 169 and 160.

Answer: 170

Question 2

This was well attempted by the majority of candidates. An efficient use of the calculator was demonstrated as many did not write down any part calculations and arrived at the correct answer. Those who did write down workings often left their answer as $\frac{0.18}{1.79}$. Many candidates rounded prematurely or truncated to 0.1, 0.10 or 0.100.

Answer: 0.101

Question 3

The vast majority of candidates were able to write down the correct value. The most common error was to omit a zero, giving 0.0017. There were occasions when more than 1 decimal point was in the answer as a result of counting decimal places and so candidates should make their answer very clear. Candidates should also be aware that giving a fractional answer is not acceptable when converting from standard form.

Answer: 0.00017

Question 4

Almost all candidates answered this correctly. Sometimes an answer of $\frac{6}{30}$ was incorrectly given.

Answer: 6

Question 5

Almost all candidates answered both parts of the question correctly. Occasionally, only 1 of the 2 numbers was given or an extra number was given, most commonly 15 in part **(b)**.

Answers: **(a)** 12, 15 **(b)** 11, 13

Question 6

The majority of candidates simplified the expression correctly. Errors were made by those who did not look at the signs carefully, the majority of errors being made when dealing with $-2u + u$, which often resulted in $\pm 3u$ or $+u$. Similarly, ± 3 was often seen in place of 5.

Answer: $5 - u$

Question 7

The factorisation was carried out correctly by the majority of candidates. Others gained 1 mark for a partial factorisation, although a common error when taking just the 2 outside the brackets was to give $2(x - 2x)$. Some candidates could not deal with the factor of $2x$ to give 1 inside the bracket, leading to an answer of $2x(-2x)$.

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

Question 8

The majority of candidates used the most efficient method of $(25 - 2) \times 180$ to arrive at the correct answer. The most common error was to then spoil this answer by dividing by 25 to give the value of an interior angle of a regular 25-sided polygon. Another common misunderstanding was to try to use proportion from other shapes that they knew, for example 540° from a pentagon multiplied by 5 to give 2700°.

Answer: 4140

Question 9

The vast majority of candidates identified the correct trigonometric ratio to calculate the angle correctly. There were some who used Pythagoras' theorem to find the missing side and then chose to use a different ratio; this inefficient method often caused some accuracy errors.

Answer: 23.6

Question 10

Almost all candidates gained both marks in this question. There were relatively few who showed any working and so efficient calculator skills were being demonstrated here. In part **(b)** there was the occasional incorrect answer of $\frac{1}{9}$, where the negative index had not been dealt with.

Answers: **(a)** 625 **(b)** 9

Question 11

Part **(a)** was well attempted by the majority of candidates. There was a large variety of incorrect answers given, the most common being $\frac{2x}{2}, x\frac{x}{2}, \frac{x^2}{2}, 3x, 3x^2$ and $\frac{3x^2}{2}$. Part **(b)** caused more difficulties for candidates, although the majority did arrive at the correct answer. Again there were many different incorrect answers given, including $\frac{2+x}{x}, \frac{2x^2}{x}, \frac{2x}{x}$ (often cancelling to 2), $x\frac{2}{x}$, x^2 + 2 and $\frac{x+2}{2x}$.

Answers: **(a)** $\frac{3x}{2}$ **(b)** $\frac{x^2+2}{x}$

Question 12

Candidates were more successful at interpreting the notation in part **(a)** than using the correct notation to describe a region in part **(b)**. The majority did give the correct answer in part **(a)** although any combination of the four values was seen, most commonly 5, 15 and 19. There were many correct answers given in part **(b)**, the most common correct form seen was $P \cup Q'$ although there were a number of correct equivalents given. $P \cap Q'$ was a common incorrect response. Candidates must ensure that they use the notation specified in the syllabus; some were using + and – in their responses. Others gave numerical answers and many left the answer space blank.

Answers: **(a)** 10 **(b)** $P \cup Q'$

Question 13

The most able candidates were able to interpret the information given in order to set up the equation 21 – 2u = 1 and solve it. There were some who then made an error in rearranging the equation leading to answers of –10, 10.5, 11 or –11. Where candidates did not gain 2 marks, they were often able to gain 1 mark for 7 × 3 – 2 × u either on its own or as part of an attempt to find an inverse matrix. Those gaining no marks were usually making errors in finding the determinant, where 21 + 2u and 2u – 21 were commonly seen, along with calculations involving addition of all elements in the matrix. There were a significant number of candidates who did not make a response to this question.

Answer: 10

Question 14

This proved to be one of the most challenging questions on the paper with only the most able candidates gaining any marks. Most candidates assumed a linear relationship between the ratio of volumes and the ratio of lengths leading to an answer of 10.7. Of those candidates who did understand the correct relationship, there was the occasional loss of the answer mark for prematurely rounding $\frac{4}{3}$ to 1.33, leading to an answer of 5.99.

Answer: 6

Question 15

Candidates were adept at dealing with the addition and subtraction of fractions and the majority clearly showed their working to gain full marks. The most efficient denominator of 12 was seen most often but other denominators were also correctly used. Many added the first two fractions to get $\frac{5}{6}$ or $\frac{15}{18}$ and then utilised a common denominator of 24 or 72 in the second step of their working. Marks were occasionally lost through arithmetic errors or by not cancelling the fraction down for the final answer but the insistence of clear working meant that at least 1 mark was usually scored in this case. A very small number of candidates did not score due to showing no working or incorrect working.

Answer: $\frac{7}{12}$

Question 16

The most successful candidates showed clear succinct working to gain all 3 marks in this rearrangement. Most gained at least 1 mark for demonstrating a correct step even if wasn't displayed in a simplified form. Many isolated the term in *a* correctly for 1 mark but struggled to deal with multiplying by 2 and/or dividing by t^2. When dealing with the $\frac{1}{2}$, many did not multiply every term by 2 and many left their answer as a fraction within a fraction, i.e. $\frac{s-ut}{\frac{1}{2}t^2}$ which gained 2 marks. The main misconception was to treat at^2 as $(at)^2$, hence square rooting and then dividing by *t* at a later stage. Candidates should be aware that they need to show each line of working clearly as it is possible to gain marks even following incorrect work. Many have a tendency to show multiple steps within one line of working or combine what they intend to do in their next step on the current line; these interim steps cannot gain credit if a correct line of working is not seen.

Answer: $\frac{2(s-ut)}{t^2}$

Question 17

There was a good spread of candidates across the whole range of marks in this question. The powers were generally dealt with well and it was the 16 that caused the most problems, commonly resulting in $\frac{x^{16}}{4y^4}$. In some instances, candidates had some of the correct terms in a fraction but then went on to incorrectly cancel the power of *x* with the power of *y*.

Answer: $\frac{x^{16}}{2y^4}$

Question 18

The vast majority of candidates understood the tree diagram and knew to multiply the probabilities, with many reaching the correct answer. The most common error here was omitting the route of finishing both runs, resulting in an answer of 0.32. However, most candidates showed sufficient working and so gained 1 mark for this. There was a minority who clearly did not understand the tree diagram and were adding probabilities, often giving an answer greater than 1, or adding the 3 routes and dividing by 3 to gain an 'average'.

Answer: 0.96

Question 19

The majority of candidates understood the relationship that was presented to them and there were many fully correct answers. Candidates should be aware that they may be asked to give an equation as a final answer as in this question rather than a value of *y*, which they may be more familiar with. Many gained 1 mark for starting with a correct equation and obtaining $k = 18$ but then reverted to a final answer of $\frac{k}{(x+2)^2}$. There were also those who found the correct equation and then substituted $x = 1$ back in to give a final answer of $y = 2$. Where candidates did not score any marks, the most common approaches were to work with *y* directly proportional to $(x + 2)^2$, or inversely proportional to $(x + 2)$.

Answer: $\frac{18}{(x+2)^2}$

Question 20

Few candidates demonstrated a full understanding of this bounds question. Many gained 1 mark for demonstrating the use of bounds for each measurement but the vast majority of these did not appreciate the need to use the minimum volume divided by the maximum area. The most common incorrect method was to use lower bounds for all 3 values, leading to an answer of 24.5. Others did not consider the bound of the volume and used 878 in the calculation. Candidates should be aware that recurring 9s are not acceptable as a bound. There were many who did not consider bounds at all or deducted 0.5 from their answer of 20.9 to give a final answer of 20.4.

Answer: 18

Question 21

Candidates were expected to solve a quadratic equation that could not be factorised and show the steps in their working. Some candidates successfully demonstrated completing the square but the majority chose to use the quadratic formula, usually with some degree of success. Of those who showed all correct working, 3 marks were awarded as frequently as 4 marks, due to answers being given to 3 significant figures rather than the required 2 decimal places. There were many candidates who could not recall or only partially recall the formula but 1 mark was often awarded for a correct required part. Care should be taken with the fraction line and square root sign to demonstrate that the formula is being used correctly. A small minority wrote down the correct answers with no working or had incorrect working along with the correct answers from their calculator; these candidates should be aware that they will not gain full marks where working is required.

Answer: –2.12 and 0.79

Question 22

This simplification proved challenging for most candidates. The most common correct method seen was to divide the top and bottom of the fraction by 2 to give $\frac{2+5w}{4-25w^2}$ and then factorise the denominator to $(2 + 5w)(2 – 5w)$. Many gained 2 marks for reaching the first stage of this method and leaving this as the final answer, or going on to do incorrect steps from here. 3 marks were sometimes earned by those who either left a common factor of 2 in the top and bottom of the fraction, or who divided by $2 + 5w$ but forgot that this would result in a numerator of 1, giving an answer of $2 – 5w$. Less frequent, but equally correct, was the use of $(4 + 10w)(2 – 5w)$ or $(4 – 10w)(2 + 5w)$ in the denominator, the second of which often resulted in the candidate leaving a common factor of 2 in the answer. A large number of candidates did not score any marks on this question as they were incorrectly cancelling common factors from individual terms, such as dividing the 4 and the 8 by 4 and the $10w$ and $50w^2$ by 10 and *w*.

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

Question 23

In part **(a)**, if candidates understood the concept, it was usually carried out correctly. The most common misconception appeared to be taking $\overrightarrow{AB}$ as $\pm\mathbf{b}$ resulting in, e.g. $-\mathbf{a}+\mathbf{b}-\frac{2}{3}\mathbf{b}$. Many answers were not actually vectors as they included terms such as **ab**, $\mathbf{a}^2$ or $\mathbf{b}^2$ or the addition of a numerical value, usually 1, 2, $\frac{1}{3}$ or $\frac{2}{3}$. In part **(b)** many candidates gained marks for a correct follow through, either simplified or by demonstrating the need to add **a** to their answer in part **(a)**. Part **(b)** had the highest proportion of no responses on the paper, perhaps demonstrating that candidates did not understand the terminology here. Candidates should be advised that clearly setting out a route would be a good starting point in this type of question.

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

Question 24

Candidates demonstrated a good understanding of cumulative frequency. Part **(a)** was answered correctly by the vast majority of candidates. The most common error was to read off 50 rather than 50% for the median, which resulted in an answer of 6.5. Part **(b)** was the least successful part of the question and although most did understand that they were reading from the cumulative frequency at 24, a significant number simply read from the graph at 30 resulting in an answer of 5.9 or 6. Part **(c)** was carried out correctly by almost all candidates.

Answers: **(a)** 6.2 **(b)** 5.8 **(c)** 70

Question 25

The full range of possible marks were awarded for this question with a large number gaining the full 5 marks, or 4 marks where a complete correct method was shown but premature rounding caused the answer to be inaccurate. The majority of candidates utilised the method from the mark scheme although there were a reasonable number who reflected the diagram in the line *OA* and then found the area of the 60° sector and the area of the triangle using $\frac{1}{2}ab\sin C$. Of those who did not show a complete method, many were able to make some headway into the problem and calculate either the area of the sector, the length of *OC* or *BC* and/or the area of the triangle. Where candidates did not gain any marks, it was common to observe them making the incorrect assumption that *OC* was 8 cm.

Answer: 2.9[0]

Question 26

Many candidates did not link the 3 parts of this question, starting again on each part rather than making the connection with what they had just answered. Part **(a)** was answered correctly by the majority of candidates with common errors being to divide by just 60 rather than 60^2, multiplying 45 by powers of 10 other than 1000, to multiply and divide the wrong way round or to multiply everything together so answers containing figures 75, 125 and 162 were often seen. Some candidates gained the follow through mark for dividing their part **(a)** by 10 but a large proportion started with 45 again and divided this by 10. Similarly in part **(c)**, a large proportion of candidates used 45 but demonstrated that they were finding the area under the graph and so an answer of 1125 gained 2 marks. The majority of candidates gained at least 1 mark for finding an appropriate area under the graph, usually 20 × 45, even if they were then performing an incorrect conversion afterwards.

Answers: **(a)** 12.5 **(b)** 1.25 **(c)** 312.5

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. Few candidates omitted part or whole questions. The standard of presentation was generally good and there was evidence that most candidates were using the correct equipment to answer the construction question. Candidates generally showed their workings and gained method marks. However, many candidates were unable to gain marks in the show/explain questions if they used the value they had to show from the beginning. Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed. Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to fully process calculations and to read questions again once they have reached a solution, so that they provide the answer in the format being asked for and answer the question set.

Many candidates used a method for calculating a missing value that is not accepted as clear working and, in many cases, they lost the method marks available. This method involves the following:
Question: Calculate the percentage of the 26 272 seats that are empty.

Method used: 26 272 – 100 $x = 9.2$
2418 – x

The method used does not show that the candidate has divided 2418 by 26 272 and then multiplied by 100. Candidates who gave the correct answer of 9.2 were able to gain full marks but many who did not, lost the opportunity of a method mark as this working does not show the method used. Centres should encourage candidates to clearly show their working, explicitly showing which values they are multiplying or dividing together.

Comments on Specific Questions

Question 1

(a) (i) Candidates completed the table wel,l with the vast majority of candidates gaining full marks. Very few candidates did not attempt this question.

(ii) To gain full marks, candidates had to first identify the correct values to form a fraction and then simplify. The most common error was due to misreading the question. Many candidates used the value for the total number of girls (55) rather than girls aged 16 (44). Another common error was to use the total number of girls rather than the total number of children and therefore using the fraction $\frac{44}{70}$ instead of $\frac{44}{120}$. Most candidates showed good simplification.

(iii) The majority of candidates gained one mark for correctly identifying the values from the table, 26 : 39. Simplification of this ratio proved more challenging as it needed to be divided by 13. Many candidates gave non-integer values in their solution, which was not acceptable as a simplest form.

(b) (i) Few candidates found the mean instead of the median. However, the nature of the figures (all to 2 decimal places) caused less able candidates more difficulty when having to find the value between two given values. Many candidates gained one mark for correctly ordering the values. However fewer candidates were able to correctly find the middle value. The most common error was not ordering the values and finding the value between 7.15 and 7.72.

(ii) The range was correctly found by the majority of candidates. Some candidates left their answer as a range or a subtraction sum (9.86 – 6.21), which did not gain the mark. Very few candidates did not attempt this question.

(iii) Finding the two possible distances was one of the most challenging questions on the paper. Very few candidates showed understanding that the 20 cm had to be converted to metres and then subtracted from the lowest value and added to the largest value. A wide range of incorrect answers were seen, with the most common including not converting 20 cm to 0.2 m; 6.41 m, from adding to 6.21 instead of subtracting; and adding or subtracting from incorrect values. Less able candidates often did not attempt this question. Very few full marks were awarded for this question. However, some more able candidates were able to gain one mark, often for 10.06 correctly found.

Answers: **(a)(i)** 26, 39, 11, 55, 50 **(ii)** $\frac{11}{30}$ **(iii)** 2 : 3 **(b)(i)** 7.53 **(ii)** 3.65 **(ii)** 10.06 6.01

Question 2

(a) (i) The vast majority of candidates were able to give a multiple of 6. The most common error was due to not reading the question carefully and giving a value outside of the range 20 to 30. This common error was repeated by some candidates in all parts of part **(a)**.

(ii) Candidates correctly identified square numbers, with the majority of candidates giving the correct answer of 25. A few candidates gave 4 or 16. Some candidates gave the answer of 5^2, which was not accepted as a correct answer.

(iii) Candidates found identifying a cube number more difficult, although many correct answers were seen. 8 was seen from a few candidates and 3^3 was not an acceptable answer.

(iv) Candidates were more successful at identifying a prime number between 20 and 30, with many candidates giving both possible values. 21 was a common incorrect answer along with prime numbers outside of the range of 20 to 30.

(b) (i) This question was well answered by more able candidates, who correctly used their calculator to find the cube root of 4913. The most common error was misreading the cube root symbol as 3 times the square root of 4913, which led to the incorrect answer of 210.278…

(ii) Nearly all candidates were able to correctly use their calculators to find the value of 3^5. Very few incorrect answers were seen, the most common being 15 from 3×5.

(iii) Many correct answers were seen. The most common incorrect answer given was 0.

(iv) Many correct answers were seen. The majority of candidates gained full marks for an answer of 0.0625, with fewer candidates giving their answer as a fraction. The most common incorrect answers were –8 and –16.

(c) (i) Part **(c)** was the most challenging of the question. In this part, most candidates showed some understanding by using a factor tree or table to attempt to find the product of prime factors. However, many correct tables or trees were followed by incorrect answers. Common errors included not dividing by prime numbers, so answers of $4 \times 3 \times 7$ and $2 \times 2 \times 21$ were often seen. Few candidates wrote their prime factors as a list, with many candidates able to give their solution in index form.

(ii) The majority of candidates gained one of the two possible marks by correctly identifying a common factor of 84 and 126. Most candidates repeated the use of a table or tree for 126 but many were unable to use this information to find the HCF, often giving the LCM instead.

Answers: **(a)(i)** 24 or 30 **(ii)** 25 **(iii)** 27 **(iv)** 23 or 29 **(b)(i)** 17 **(ii)** 243 **(iii)** 1 **(iv)** 0.0625
(c)(i) $2^2 \times 3 \times 7$ **(ii)** 42

Question 3

(a) (i) Most candidates were successful. The most common errors were finding 5% and not taking it off; rounding the answer to 3 significant figures when an exact answer was required; or using the method described in the General Comments section of this report, without showing explicitly what values were being multiplied or divided to calculate the 5%. This method gained no marks if the correct answer was not seen.

(ii) Candidates answered this part well, with candidates who had made errors in part **(a)(i)** being able to gain full marks by correctly following through their previous incorrect answer. Many candidates gave the answer as 608 without subtracting their answer from part **(a)(i)**. Other candidates subtracted 595 from 608. Another common incorrect answer was 30.4, being 5% of 608.

(b) More able candidates were able to gain full marks. Many candidates who attempted finding the percentage of full seats first subsequently made errors when attempting to find the percentage of empty seats, through rounding errors. An incorrect answer of 9.21 was seen often from poor rounding of the percentage of occupied seats (90.79%) and then subtracted from 100%. Many candidates found 90.8% but did not subtract from 100%. The method outlined in the General Comments section was frequently used, which did not show the calculation being attempted and often led candidates to gain no marks. 24.18, from $\frac{(26272-23854)}{100}$ was seen frequently. 91% and hence sometimes 9% were seen, with no working, which showed poor or premature rounding. Candidates should round the final answer only, and then to 3 significant figures.

(c) This question proved to be very challenging for all except the most able candidates. A common incorrect answer was 506×10^3. Many candidates were able to gain one of the two available marks for a partially correct standard form, giving 10^5 or 507.

(d) (i) The vast majority of candidates gained full marks on this question, correctly giving the two required angles. Where incorrect answers were given, often one was correct and candidates were able to gain two of the three marks available.

(ii) Candidates answered this part very well, showing good use of a protractor. Very few incorrectly drawn pie charts were seen following correct answers to part **(d)(i)**, and many gained follow through marks if errors were made in the first part and their angles added to 200°.

(e) Candidates demonstrated a better attempt at standard form in this part because no rounding was required. Many gained one of the two marks for correctly identifying ‘384’. However, only the more able candidates gained full marks for an answer in the correct standard form.

Answers: **(a)(i)** 565.25 **(ii)** 42.75 **(b)** 9.2[0…] **(c)** 5.07×10^5 **(d)(i)** 120°, 80° **(e)** 3.84×10^6

Question 4

(a) (i) The correct answer was given by the majority of candidates. Units were often seen within the algebra, though these still gained the mark. There were misunderstandings about “5 more” meaning “adding 5”. Frequently seen were $m = m + 5$; ($m + 5 =$) $5m$; $5 > m$; and m^5.

(ii) Candidates found this part easier than part **(a)(i)**. Common incorrect answers were m^2; $2(m + 5)$; and $m + 10$. The symbols =, < and > were also used within answers, showing some candidates’ misunderstanding of the word ‘expression’.

(iii) Forming an equation proved to be the most challenging part of this question. The most common error was to omit m for Ahmed’s suitcase. Many candidates did not write ‘= 47’ to complete the equation. Those who remembered both of these, generally gained marks for their equation often with follow through from their answers to parts **(i)** and **(ii)**.

(iv) Candidates who had formed an equation in part **(iii)** were generally able to solve their equation correctly in part **(iv)**. Many less able candidates who did not form an equation in part **(iii)** often did not give a response to this part. A common incorrect equation was $3m + 5 = 47$ to give $m = 14$.

(b) (i) This question asked candidates to ‘Explain your answer’. This proved challenging for candidates, who often did not give a mathematical reason for a correct ‘yes’ response. Many less able candidates did not include any quantities, which were required to gain any marks in this part. Many candidates added the values given in the table but did not give units or incorrectly converted mm to cm. Good solutions showed a correct addition, a conversion to cm and a comparison with the upper limit of 115 cm.

(ii) The correct answer was given by most candidates. However, the concept of upper bound proved challenging for less able candidates. The most common incorrect answers were usually 5.4 or 5.49 but also 6 or 10. There were also several ranges that showed understanding but did not answer the question, e.g. $4.5 < m < 5.5$.

(c) (i) The vast majority of candidates correctly converted from dollars to euros. The most common error however, was to confuse when to multiply or divide. Candidates should be encouraged to work out a simple estimate first to see if their answer should be greater or less than the original value.

(ii) This part was the most successfully answered question of the whole paper. Candidates correctly recognised that they had to divide by the exchange rate to convert from euros to dollars. Candidates who had incorrectly divided in part **(i)** often made the same error in part **(ii)** by multiplying.

Answers: **(a)(i)** $m + 5$ **(ii)** $2m$ **(iii)** $m + m + 5 + 2m = 47$ **(iv)** 10.5, 15.5, 21 **(b)(i)** Yes, 114.5 **(ii)** 5.5 **(c)(i)** 102 **(ii)** 37.5[0]

Question 5

(a) (i) Most candidates were able to give a value within the acceptable range. Of those who did not score full marks, many scored one for 9.4 to 9.8 written in the working or on the diagram. Many then incorrectly multiplied by 2 rather than divided. Few candidates measured the length inaccurately. Others had clearly multiplied by 2 instead of divided by 2 but scored no marks because they had not written down their measurement. Candidates should be reminded to show all their working.

(ii) Measuring a bearing proved to be one of the most challenging questions on the paper. The most common incorrect answers were 43° from reading the wrong value from the protractor; and 317° from measuring the bearing of A from B. There were a large number of candidates who did not attempt this question, indicating that they did not understand the term ‘bearing’ and/or did not have a protractor.

(b) The majority of candidates were able to gain one of the two marks available for a correct length of 6.4 cm drawn for AC. Few candidates gained full marks due to the difficulty in drawing a bearing of 310°. Bearings of many other angles were seen but only the most able candidates were able to draw the correct bearing.

(c) The vast majority of candidates gained full marks, showing clear arcs in their constructions. There were very few blank responses. Some candidates drew only one set of arcs and just drew the bisector as far as the line *AB*. These candidates gained no marks as a bisector must cross the line *AB*. A few candidates misread the question and bisected the angle at *A* or *B*.

(d) This part proved very challenging for the majority of candidates. Very few candidates scored full marks. A few did not attempt it at all. Most made an attempt but did not show that they understood that an arc, centre *B*, with radius 6 cm was required. Many arcs with centre *B* were drawn but often not of the correct radius or of the required length. Marks lost for shading the correct region were mainly due to shading only on one side of the line *AB*.

(e) The best answers showed the formula, substituted correctly and then converted from hours to minutes correctly. Many candidates gained one mark for 0.8 and those who reached 48 usually went on to the correct time. A common error was to divide 15 by 12 and add the resulting 1.25 hrs to 10 15. Some of these achieved one mark for correctly converting 1.25 (hrs) to 1 h 15 m to get 11 30. It was common to see 10 23 (10 15 + 8 mins) and 13 15 ($15 \times 12 = 180 = 3$ hrs).

Answers: **(a)(i)** 4.8 **(ii)** 137 **(e)** 11 03

Question 6

(a) The majority of candidates gained full marks for correctly identifying the shape. A number of poor spellings were seen, although accepted.

(b) Candidates found identifying the description of a cube or cuboid more difficult. Most candidates did not give a 3D shape as an answer, highlighting the importance of reading the question carefully. The most common answers were octagon and dodecahedron, because both 8 and 12 were mentioned in the question.

(c) (i) This 'show that' question was well answered. Most of the responses were clear and detailed. The most common error was to omit to write down 5.19….. A small number of candidates attempted a trigonometry approach and some were successful. A number of candidates added 6^2 to 3^2. A small minority used 5.2 from the start and therefore gained no marks, although this was rarely seen.

(ii) The majority of candidates gained both marks here. The most common error was to forget to divide by 2 for a triangle. Some candidates incorrectly used 6 in their calculation. Candidates who had made errors in part **(i)** often used their incorrect value for *BC* instead of the value 5.2 cm, which was given in the question. Another common error was $\frac{1}{2} \times 3 \times 5.2 \times 6$.

(iii) Despite giving the correct area of the triangle in part **(ii),** most candidates chose to restart the question in part **(iii)**. These approaches rarely scored full marks. Many candidates used $8 \times 5.2 \times 3$ or $8 \times 8 \times 8$ or $8 \times 6 \times 3$ for the volume.

(d) (i) The best solutions for calculating the area of the trapezium included the correct formula, substitution of the correct values and full working out. Many candidates used the wrong formula. It was common to see $\frac{1}{2} \times 4 \times 8$. A very common incorrect answer was 32, from 4×8. Those who used the formula were generally successful, as were those who split the shape into a rectangle and a triangle. In the latter case, a frequent error was with the calculation of the area of the triangle, in which candidates often forgot to halve. $8 \times 6 \times 4 = 192$ was also often seen.

(ii) Similar to part **(c)(iii)**, many candidates who had correctly calculated the area of the trapezium restarted the question in part **(d)(ii)**. Candidates who did use their answer to part **(i)** generally gained full marks by dividing 336 by their area. The most common incorrect answer was 10.5 from $\frac{336}{(8 \times 4)}$.

Answers: **(a)** cylinder **(b)** cube or cuboid **(c)(ii)** 7.79 to 7.8 **(iii)** 62.4 **(d)(i)** 28 **(ii)** 12

Question 7

(a) (i) Candidates showed good understanding of the equation $y = \frac{6}{x}$ and used it well to find the missing values in the table. Very few incorrect answers were given, with very few candidates not attempting the question.

(ii) Many candidates correctly joined their points with an accurate, smooth curve. Very few straight lines or thick lines were seen. Some less able candidates however, lost a mark for joining the points (–1,–6) and (1, 6).

(iii) The vast majority of candidates correctly drew the line $y = 4$. Common errors were drawing $x = 4$ or a diagonal line through the point (0, 4). Some candidates lost the mark for not drawing with a ruler, not drawing a continuous line (i.e. dashed or dotted line drawn) or not drawing a long enough line.

(iv) Candidates showed a good understanding of the scale on the x-axis and the vast majority who had correctly drawn their curve and $y = 4$, gave the correct co-ordinate.

(b) (i) Candidates showed good understanding of plotting co-ordinates. The most common error was plotting (–3,–1) instead of (–1,–3).

(ii) Only the most able candidates successfully drew a line with gradient 2 through their point A. Very few correct lines were seen, with the majority of candidates drawing a line with gradient 1 that passed through –2 on the y-axis, or a line with gradient 5, passing through 2 on the y-axis. A number of vertical and horizontal lines were given but the vast majority of less able candidates did not attempt this part of the question.

(iii) Due to the difficulty met by candidates in part **(ii)**, few candidates gained full marks in this part. Many candidates, however, gained part marks by either using the gradient of 2 from the question and giving an answer of $y = 2x + c$, or using their y-intersect correctly and gaining a follow through mark for $y = mx$ + 'their y-intersect'.

Answers: **(a)(i)** –2, –3, –6, 3 **(iv)** (1.4 to 1.6, 4) **(b)(iii)** $2x – 1$

Question 8

(a) (i) The vast majority of candidates correctly identified the order of rotational symmetry. Common incorrect answers were order 1 or describing the rotation using angles, e.g. 180°.

(ii) Most candidates gained full marks by correctly drawing 2 lines of symmetry only. These were generally well presented with the use of a ruler and pencil. The most common error was drawing 4 lines of symmetry, including two diagonal lines.

(b) (i) Candidates found the transformation of the triangle challenging, with many less able candidates choosing not to attempt any of part **(b)**. The triangle was often reflected in an incorrect mirror line, most commonly the y-axis.

(ii) Only the most able candidates correctly enlarged the triangle. The majority of candidates used the ray method which led to many inaccurate, but close, answers due to the distance required from P for two of the points. A large number of candidates gained one of the two marks for drawing a correct enlargement of scale factor 3 but from the wrong centre, typically starting their shape from P. A very large proportion of candidates did not attempt this transformation.

(iii) The description of the rotation was attempted by most candidates, with the majority gaining one mark for correctly identifying the transformation as a rotation. Few candidates gained all three marks as most left out one of the two required parts to describe a rotation. This was often the description of direction, with 90˚ seen often without the clockwise direction.

Answers: **(a)(i)** 2 **(b)(iii)** rotation, 90° clockwise, (0,0)

Question 9

(a) Most candidates showed some ability at expanding brackets and were able to gain one of the two marks for correctly expanding the first bracket. However, the second bracket proved much more difficult due to the need to multiply by a negative value. The most common incorrect answer seen was $2x + 8$, from incorrectly multiplying –4 and +1. Most candidates showed their expansion before giving the final solution, so many were able to gain a method mark.

(b) The majority of candidates were able to gain one or two marks by either fully factorising or partially factorising the expression given. Very few candidates did not attempt this question.

(c) Most candidates found rearranging the formula very challenging, with few candidates scoring full marks. Candidates showed working but many made an error with their first step by attempting to multiply by 4 but forgetting to also multiply the 5. Therefore $4a = b - 5$ was a common incorrect first step leading to a very common incorrect answer of $4a + 5$. A large proportion of candidates divided by 4 instead of multiplying, or subtracted the 5 instead of adding.

(d) Candidates responded to the instruction to show all working well with very few candidates giving answers only. However, few candidates gained all three marks due to the difficulty met when trying to eliminate one of the variables. Most candidates correctly multiplied the equations to get either x or y with common coefficients. However, a large proportion of candidates were inconsistent with their addition or subtraction, adding some parts and subtracting others. A large number of candidates attempted this question using the substitution or equating methods. This was equally well attempted, with a large proportion making errors in rearranging or multiplying once a correct substitution had taken place.

Answers: **(a)** $2x$ **(b)** $3y(y - 2)$ **(c)** $4a + 20$ **(d)** [x=] 5, [y=] –2

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key Messages

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

General Comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper, making an attempt at most questions. The standard of presentation and amount of working shown 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.

Comments on Specific Questions

Question 1

(a) This part required knowledge of place value and involved the conversion of twenty one million into figures. It was generally answered well, although common errors included the use of 20 and/or the addition or omission of zeroes.

(b) This part was generally answered well, although common errors included 1, 3, 7 only, or the factor pairs of 1×21 and 3×7.

(c) This part was again generally answered well, although common errors included 0.21, 21% and $\frac{21}{10}$.

(d) This part was again generally answered well, although common errors included a single bracket round the middle pair of values. A small yet significant number of candidates were unable to answer this part.

(e) This part was again generally answered well, although not all candidates were aware of the definition of a prime number and gave non-prime values. Other common errors included 3 and 7.

(f) This part was not as well answered, with many candidates not appreciating that it was a question on equivalent fractions. Common errors seen were 21, 210, and 10, with a significant number of nil responses.

(g) This part was generally answered well.

(h) This part was generally answered well.

(i) This part was generally answered well, although the common errors of 0 and 21 were seen.

(j) This part was generally answered well, although the common errors of 2.1×10^{3} and 21×10^{-4} were seen.

(k) Not all candidates appeared to understand the term 'lowest common multiple', although the majority were able to score the method mark by listing the multiples of both 21 and 15. Common errors included 3, 5, 7; $3 \times 5 \times 7$; 3; $3 \times 3 \times 5 \times 7$; or 315.

Answers: **(a)** 21 000 000 **(b)** 1, 3, 7, 21 **(c)** $\frac{21}{100}$ **(d)** (210 + 21) ÷ (2.1 + 21) = 10 **(e)** 23 and 29 **(f)** 2100 **(g)** 436 **(h)** 21 **(i)** 1 **(j)** 2.1×10^{-3} **(k)** 105

Question 2

(a) The majority of candidates were able to use the pattern of the four given diagrams to successfully draw diagram 5. However, a number of slips were made, usually in the number and position of the 'X's, and occasionally in the size of the required 5 by 5 shape.

(b) The required table was generally completed well, either by use of a correct diagram in part **(a)** or by using the pattern in the given table.

(c) This part was not generally answered as well with few correct expressions seen. Few candidates appeared to recognise that the table in part **(b)** could be used and that the values of 1, 4, 9, 16, 25 were square numbers and thus the required expression was n^2.

(d) This part, particularly with a follow through from an algebraic expression in part **(c)**, was generally more successful.

(e) Candidates found it difficult to appreciate what this part was actually asking them to do and gave a variety of answers. A common error was to simply give a rule to find the next number, rather than a rule for continuing the sequence. A significant number of candidates found it difficult to express their thoughts in words and give a full mathematical explanation.

Answers: **(b)** 10, 6, 16 and 15, 10, 25 **(c)** n^2 **(d)** 529 **(e)** add on 2 then 3 then 4, etc.

Question 3

(a)(i) A small but significant number of candidates were unable to answer this part, suggesting that they were unfamiliar with the terms used in the question. A very common error was to draw the net for an open box rather than for a cuboid.

(ii) The term 'surface area' was not universally understood and common errors included finding the perimeter; total length of the edges; the volume; and the area of just the base of the cuboid. Few candidates appeared to appreciate that their net drawn in part **(a)(i)** could have been used.

(iii) This part was answered slightly better, although a full variety of incorrect formulae were used. A small number of candidates omitted the units, resulting in the loss of one of the available marks.

(b) This part was also challenging for a number of candidates with many not appreciating that the three values had to have a product of 60. Common errors included 1, 6, 10 and 2, 3, 10, which did not fit all the given conditions but could be awarded the method mark. Other responses seen were 20, 20, 20; 1, 8, 10; 4, 4, 5; and many other sets of values that did not fit the given conditions. A significant number of candidates were unable to attempt this part.

Answers: **(a)(ii)** 132 **(iii)** 80 cm^3 **(b)** 3 by 4 by 5

Question 4

(a) This part was generally answered well, although the common error was 48˚.

(b) This part was not generally answered as well, with a number of candidates not appreciating that the other internal angle of the given quadrilateral had to be calculated first. Common errors included 149 (from 360° – 120° – 91°) and 56 (from 120° + 91° – 155°).

(c) (i) This part was generally answered well, albeit with a number of interesting spellings. Common errors included equilateral, rectangular triangle and quadrilateral.

(ii) This part was generally answered well, although a very common incorrect answer was 44°.

(iii) This part was generally answered well, particularly with a follow through from part **(c)(ii)** being applied.

(d) (i) This part was generally answered well, although a significant number of candidates did not appear to recognise that angle *BAC* was 90° as triangle *ABC* was in a semi-circle. The common incorrect answers were 68° and 56°.

(ii) This part was not generally answered well, with few candidates able to correctly name the given line as a chord. Common incorrect answers included radius, diameter, straight line, circumference and semi-circle.

Answers: **(a)(i)** 132 **(b)** 124 **(c)(i)** isosceles **(ii)** 68 **(iii)** 127 **(d)(i)** 28 **(ii)** chord

Question 5

(a) (i) This part, on the interpretation of the given pie chart, was generally answered well with a number of candidates gaining full marks. The fourth statement caused a few problems as a number of candidates did not appreciate that two of the given sports were required.

(ii) This part proved to be less successful and few candidates appeared to appreciate that the given information led to the fact that 20° represented 5 children and thus 120° represents 30 children.

(b) (i) This part was generally answered well, although a significant number of candidates did not appreciate that, as a probability was asked for, all that was required was to identify the 7 out of the 10 boys who took longer than 300 seconds.

(ii) This part was generally answered well, with the majority of candidates able to correctly and accurately plot the 4 points.

(iii) This part relied on the interpretation of the scatter diagram and proved difficult for many candidates who did not appreciate the relevance of the diagram having zero correlation. Common errors included "yes" and attempting to give a numerical answer, mention of a line of best fit, and comments about the scale or size of the other given values.

Answers: **(a)(i)** 55 , tennis, hockey, gymnastics and hockey **(ii)** 30 **(b)(i)** $\frac{7}{10}$

(iii) no, because no/zero correlation

Question 6

(a) (i) This part on ratio was generally answered well, with many candidates able to score full marks. Common errors included 36, 90 and 22.5 (from $180 \div 5, 180 \div 2, 180 \div 8$); 900, 360, 1440 (from $180 \times 5, 180 \times 2, 180 \times 8$); and 300, 120, 480 (from $\frac{5}{3} \times 180$, $\frac{2}{3} \times 180$, $\frac{8}{3} \times 180$).

(ii) This part was reasonably well answered, although many candidates did not appreciate that the statement was completed by the use of bounds. A variety of answers were seen, with common incorrect answers of 70, 80; and 74, 76.

(b) (i) This part was generally answered well although the common incorrect answers were 0.65; $\frac{13}{20}$; and 374.4 (from $156 \times 240 \div 100$).

(ii) This part proved challenging for many candidates as they appeared not to appreciate that their answer to part **(i)** could be used. The two valid methods of 0.65×1200 or $\frac{156}{240} \times 1200$ were rarely seen. Other common incorrect answers included 1200; 288 (from 1.2×240); and 1846 (from $\frac{240}{156} \times 1200$). Incorrect conversions of 1.2 kg into grams were also seen.

(iii) This part was reasonably well answered, although many candidates did not appreciate that the mass was increased. The most common method was to use $240 + 0.35 \times 240$, with the alternative method of 1.35×240 rarely seen. Common errors included 84 (from 240×0.35), and 156 (from $240 - 84$).

(c) There was a great variation in answers in this part, suggesting that the use of fractions within a practical situation was challenging for many candidates. The two required operations of $1 - \frac{3}{10}$ followed by $\frac{7}{10} \div 4$ were rarely seen or calculated correctly. Common incorrect methods included $\frac{3}{10} \times 4$, $\frac{3}{10} \div 4$, $\frac{7}{10} \times 4$, $\frac{10}{7} \times 4$ and $\frac{7}{3} \div 4$.

(d) (i) The correct answer of 470 was rarely seen, with the majority of candidates giving their answer in dollars not cents. This error was only penalised once on its first occurrence within part **(d)**. Other common incorrect answers included $8mt$, 8 and 37.6.

(ii) This part was generally answered better, with many candidates able to score full marks with either $4m + 3t = 3.7$, or more rarely, 370. Common incorrect answers included $7mt$, 7 and 25.9.

(iii) Some very good solutions to the simultaneous equations were seen, although less able candidates were often unable to attempt this part. The majority of candidates used the elimination method to solve their equations. The setting out was generally very clear with very few errors or slips being made and only the rare candidate choosing the wrong operation for the elimination. On the rare occasion when candidates chose to use the substitution method, most were able to rearrange one of the equations and correctly substitute into the other. However, this method did cause more candidates to lose accuracy marks with numerical and algebraic errors leading to incorrect final values for m and t.

Answers: **(a)(i)** 60, 24, 96 **(ii)** 74.5, 75.5 **(b)(i)** 65 **(ii)** 780 **(iii)** 324 **(c)** $\frac{7}{40}$ **(d)(i)** 470
(ii) $4m + 3t = 370$ **(iii)** $m = 40$, $t = 70$

Question 7

(a) (i) This part was generally answered well, although the common incorrect answers of 0.8, 2, 16 and 9 08 were seen.

(ii) Many candidates attempted to use a correct formula to find the required speed, with many gaining the method mark for the first stage of $\frac{16}{20}$ or equivalent. However, many then found it difficult to convert from minutes to hours with $\frac{16}{20} \times 60$ rarely seen, and frequently an inaccurate truncation of $\frac{1}{3}$ to 0.33 or 0.3 was used. Other common errors included the use of 18 rather than 20; candidates should be made aware that any stopping time should be included when calculating the average speed of a journey. Possibly the easiest method, of realising that 16 km in 20 minutes is equivalent to 48 km in 60 minutes, was rarely seen.

(b) (i) This part proved more challenging, with many candidates not appreciating that the time for the return journey had to be calculated. Many candidates wrongly assumed that the graph should be simply joined to the time of 09 40 at the bottom right hand of the graph.

(ii) This part proved challenging for many candidates and few fully correct answers were seen. Few candidates appreciated that the two operations of multiplying by 1000 and dividing by 60 × 60 were both needed to make the required conversion from km/h to m/s. A full range of incorrect methods involving 80, 1000, and 60 or 3600 were seen.

(c) This part also proved to be challenging and few correct answers and/or indication of a correct method were seen. The conversion of 75 minutes into 1 hour 15 minutes followed by a list of the departure times of 09 00, 10 15, 11 30 and 12 45 was rarely seen. There are a number of equally valid methods, but it was often difficult to see exactly what a candidate was trying to achieve. One common approach was to add 75 minutes and then subtract 60 to convert into hours but this rarely led to correct values. Other common incorrect answers included 10 15 (from just one time period); 14 00 (from 4 time periods); and a variety of times earlier than 09 00.

Answers: **(a)(i)** 10 **(ii)** 48 **(b)(ii)** 22.2 **(c)** 12 45

Question 8

(a) (i) The majority of candidates were able to correctly identify this transformation as an enlargement. The scale factor was generally correctly stated, although common errors of 2, $\frac{1}{3}$ and −3 were seen. The centre of enlargement proved more difficult and was often not given.

(ii) The majority of candidates were able to correctly identify this transformation as a rotation, although reflection was a common error. The angle of rotation was generally correctly stated, although common errors of 90° and 270° were seen. The centre of rotation proved more difficult and was often not given.

(iii) The majority of candidates were able to correctly identify this transformation as a translation, although reflection and transformation were common errors. The translation vector proved more difficult and was often not given, with other common errors of inverted vectors or sign errors seen.

(b) This part, which required the drawing of a reflection, was not well answered and was often left blank. Those who did attempt the drawing either scored full marks or, more commonly, one mark for a reflection in $x = k$, usually $x = 4.5$.

Answers: **(a)(i)** enlargement, centre (1, 8), scale factor 3 **(ii)** rotation, centre (0,0), 180°
(iii) translation $\begin{pmatrix} -5 \\ -2 \end{pmatrix}$

Question 9

(a) This part, which required the writing down of the equation of a given line, proved to be very challenging for a large number of candidates, many of whom appeared not to recognise the use of the standard form $y = mx + c$. A variety of incorrect answers were seen, often simply using the two intercepts of 4 and –2. This part was also often not attempted. However, a number of candidates were able to score two of the available marks by using the formula correctly with either the correct gradient or the correct intercept. Many attempts to use rise/run appeared confused and often used incorrect co-ordinates, with the obvious triangle formed by the origin and both intercepts usually overlooked.

(b) The table was generally completed very well with the majority of candidates giving eight correct values for full marks.

(c) The graph was generally plotted very well with two distinct branches. The majority of candidates were able to draw correct smooth curves with very few making the error of joining points with straight lines. However, a significant number of candidates lost accuracy marks for inaccurate plotting of the points, often at $x = \pm 0.5$ and $y = \pm 0.25$. A small number of candidates did not attempt this part, often despite having a fully correct table in part **(b)**.

Answers: **(a)(i)** $y = 2x + 4$ **(b)** −0.5, –1, –2, –8, 8, 2, 1, 0.5

Question 10

(a) (i) This was the most successfully attempted part of the question, with a good number of correct and accurate constructions seen. Common errors included the omission of the pair of arcs outside the shape, and not continuing the constructed line past *AB.*

(ii) A number of candidates did not appreciate that the required locus was equivalent to drawing the bisector of angle *AFE*. A number of the attempted constructions of the required locus contained accuracy errors, insufficient construction arcs, incorrect use of points *A* and *E*, and bisecting the lines *FA* and *FE*.

(b) (i) This part of the question caused the most challenges for candidates, with many not realising that they needed to draw two arcs in order to identify the required region. Common errors included the use of straight lines from *D* and *C* often to form triangles; incorrect arcs, often of length 6 cm from *D* and 3 cm from *C*; and attempts to use lines from part **(a)**. A small number of candidates drew two correct arcs but were unable to correctly shade the required region.

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

This 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 only the occasional part question being omitted. The standard of presentation was generally good. Many candidates showed all necessary working. However, some candidates just provided answers or did not carry out calculations to sufficient accuracy and consequently lost marks.

Centres should continue to encourage candidates to show all working clearly in the answer space provided. The formulae used, substitutions and calculations performed, are of particular value if an incorrect answer is given. Premature approximation remains an issue, for example, rounding to one decimal place in the working when an answer to two decimal places is required.

Centres should encourage candidates to read the front cover of the question 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.

Comments on Specific Questions

Question 1

(a) Many candidates gave the correct answer. Some candidates made errors with counting on and subtracting, often losing or gaining one hour. Candidates could be encouraged to draw a careful time line to show whether to add or subtract.

(b)(i) Most candidates gave the correct answer. A small number of candidates made arithmetic errors.

(ii) Many candidates gave the correct answer. Some candidates gave an answer of 85% with no working. Since the general rubric requires three significant figures, these candidates lost marks.

(iii) A substantial number of candidates gave the correct answer. A few candidates gave an answer of 96.28 .

(c) A few candidates gave the correct answer. The most common error was to assume that ‘correct to the nearest metre’ meant the answer was ±1 of the given number, rather than ±0.5.

(d) (i) Most candidates gave the correct answers in the correct spaces.

(ii) Generally all candidates drew the bar chart and completed the scale on the frequency axis very carefully. Some candidates did not choose the most appropriate scale to enable accurate bars to be drawn. Candidates need to be encouraged to look at the largest frequency and work out how high this could sensibly go up the *y*-axis. Most candidates were careful in ensuring the bars had equal gaps or widths.

Answers: **(a)** 9 hours 5 minutes **(b)(i)** 12 034 **(ii)** 84.9 **(iii)** 9628 **(c)** 100.5, 101.5 **(d)(i)** 3, 5, 10, 4, 8

Question 2

(a) The majority of candidates gave the correct answer, with or without working. Candidates should be aware that there is no ability to gain part marks when no working is shown. The common method errors were to divide 21 600 by 2 then 3 then 4, or to just divide 21 600 into 3 equal parts.

(b) (i) Many candidates gave the correct answer. The main error seen was copying 14 000 inaccurately as 1400. Candidates should be encouraged to look at their answers in general to check for inaccurate copying.

(ii) Most candidates gave the correct answer. The common error was to not simplify the fraction to its lowest form as required.

(iii) Some candidates gave the correct answer. Many candidates did not take off all of the parts, 4200, 8000 and 600.

(c) A large number of candidates gave the correct answer. The common errors were only calculating $\frac{17280}{21600} \times 100 = 80\%$ or dividing by 17 280 to reach 25%.

(d) Although there were a few correct answers given, a number of candidates did not answer this part. Those candidates that did attempt this part generally used compound interest. The most common errors were to either round too soon, losing accuracy, or to give 5922.89 as the answer. Some candidates accurately found the interest each year but omitted the final step of adding them together.

Answers: **(a)** 4800, 7200, 9600 **(b)(i)** 4200 **(ii)** $\frac{4}{7}$ **(iii)** 1200 **(c)** 20 **(d)** 422.9[0]

Question 3

(a) (i) For those candidates who tried to plot the points, most plotted all 4 points accurately, with the rest plotting 3 accurately. Some candidates did not plot the extra four points.

(ii) Most candidates attempted this part, even those who had not plotted the points in part **(a)(i)**. Candidates would benefit from having further practice at drawing lines of best fit. Care should be taken that a balance of points occurs on each side of the line. Some candidates joined all the points. It should be emphasised that the line does not need to go through the end points of the data.

(iii) Many candidates gave 'negative' correctly as their answer. Some candidates embellished this further with terms such as 'weak' or 'strong'.

(b) (i) Most candidates picked out the correct point but some gave the *x*-value instead of the *y*-value.

(ii) Many candidates, with or without a correct line of best fit, were able to come up with a sensible answer.

Answers: **(a)(iii)** negative **(b)(i)** 73 **(ii)** 50 to 56

Question 4

(a) (i) Candidates generally gave the correct answer. The common error was to incorrectly change the signs of terms when moving from one side of an equation to another. The most common incorrect answers were 47 and –11.

(ii) Candidates generally gave the correct answer. The common errors included $8y + 24 = 164$, $8y + 28 = 656$ and $2y + 7 = 164 - 4$.

(b) Most candidates gave the correct answer. The most common errors were $48x^4$, or trying to factorise.

(c) (i) The majority of candidates gave the correct answer.

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

(iii) The majority of candidates gave the correct answer. The common incorrect answers were 8 and 0.

(d) (i) Many candidates gave the correct answer. A few gave answers of 6700 or 7000 or 680.

(ii) Nearly every candidate gave the correct answer. A few candidates gave a percentage instead of a fraction. It is essential that candidates read the question carefully to see how the answer should be displayed.

(iii) Nearly every candidate gave the correct answer. The most common errors included 60, 0.06%, $\frac{6}{100}$.

(iv) Most candidates gave the correct answer. The common error was 687×10^6.

Answers: **(a)(i)** 11 **(ii)** 17 **(b)** $48x^5$ **(c)(i)** 9 **(ii)** 343 **(iii)** 1 **(d)(i)** 6800 **(ii)** $\frac{1}{4}$ **(iii)** 6 **(iv)** 6.87×10^8

Question 5

(a)(i) Many of the candidates gave the correct answer, although 'radio' and 'ratio' were seen commonly.

(ii) Very few candidates answered this correctly. Incorrect words included 'diameter', 'segment', 'tangent' and 'rope'.

(b) (i) Candidates struggled with the reasons in this part. Of those who knew the reasons, it was more common to show a calculation than give the reason in words. A number of candidates measured the angles. Few used the word 'semi-circle'.

(ii) Many candidates omitted the word 'angles'.

(iii) Follow through marks were awarded a number of times. The reason was very rarely correct.

(iv) Follow through marks were awarded a number of times. The reason was given correctly a few times.

Answers: **(a)(i)** radius **(ii)** chord **(b)(i)** 90° angle [in a] semi-circle **(ii)** 25° angles [in a] triangle [add to] 180° **(iii)** 65° angle [between] radius and tangent is 90° **(iv)** 65° alternate angles

Question 6

(a) (i) Many candidates gave the correct colour.

(ii) Nearly all candidates wrote the correct probability. However, a few candidates spoilt their answers by writing 2 to 16, 2 out of 16, 2:16 or $\frac{16}{2}$.

(b) (i) Many candidates knew how to find an area. However, the most common error was to round too soon in the working, causing a loss of marks, especially if no working was shown.

(ii) The common error in this part was to use an incorrect radius, 0.9 instead of 1.5. There was evidence of premature approximation in the working. A substantial number of candidates did not give an answer.

(iii) Many candidates gave the correct answer. Some candidates forgot to find the change, only working out the amount spent.

Answers: **(a)(i)** blue **(ii)** $\frac{2}{16}$ **(b)(i)** 4.52 **(ii)** 9.42 **(iii)** 2.6[0]

Question 7

(a) (i) A substantial number of candidates gave the correct answer. There were few arithmetic errors and no clear apparent common error.

(ii) Some candidates obtained the correct answer following an incorrect answer in the previous part, suggesting that candidates may have started again.

(b) (i) A large majority of candidates measured the length accurately and converted it using the given scale.

(ii) Most candidates produced clear accurate diagrams. A common error was to shade the wrong area. A few candidates did not answer this part.

(iii) The majority of candidates gave the correct answer. Some candidates did not convert properly, for example, 0.00065.

Answers: **(a)(i)** 8 **(ii)** 6 **(b)(i)** 30 **(iii)** 6500

Question 8

(a) A few candidates gave the correct answer. Most candidates were unable to find the gradient and others misunderstood the different scales on the two axes.

(b) (i) The majority of candidates gave the correct answer. However, many candidates calculated the values involving negative signs incorrectly.

(ii) The majority of candidates carefully plotted and drew the curve smoothly. There was little evidence of joining the points with straight lines.

(iii) Some good responses were seen, with scales read accurately. However, a common error was to read the scale backwards from '–1', so instead of –0.4, –1.6 or similar was seen. A few candidates used the quadratic formula and tried to answer this algebraically. They often gave roots that were very accurate but commonly both positive, or the signs the wrong way round.

Answers: **(a)** $5x + 3$ **(b)(i)** 10, 3, −5 **(iii)** −0.5 to – 0.4 and 4.4. to 4.5

Question 9

(a)(i) Many candidates gave a correctly rotated triangle. Some, however, used the wrong centre.

(ii) Some candidates drew the correct reflection. However, a few candidates reflected the triangle in x = k or y = –1.

(iii) Candidates found this part particularly challenging. Only a few gained full marks. The centre of enlargement was often inaccurately stated due to drawing lines from shapes and writing (7.5, 3.5) or (4,7). The scale factor was often stated as 'half the size'.

(b) (i) Candidates generally gave the correct answer but sometimes gave answers such as (5, 2) or (–5, –2).

(ii) Although some candidates gave the correct answer, many had problems with the signs in the vector. Some candidates wrote the previous answer as a column vector.

(iii) Many candidates found this challenging. *Z* was seen marked in a variety of places but commonly at (–5, 1).

Answers: **(a)(iii)** enlargement, [scale factor] 0.5, [centre] (7, 4) **(b)(i)** (5, −2) **(ii)** $\begin{pmatrix} -3 \\ -5 \end{pmatrix}$

Question 10

(a) Nearly all candidates gave the correct answer.

(b) (i) Although many candidates gave the correct answer, a few gave a numerical answer rather than an expression in terms of n. The most common error was n + 5.

(ii) Those candidates who wrote 5n for part **(b)(i)** generally got this right. Very few candidates who got part **(b)(i)** incorrect realised that they needed to add 1 to the previous answer.

(c) A large majority of candidates gave the correct answer.

Answers: **(a)(i)** 15, 20 and 16, 21 **(b)(i)** 5n **(ii)** 5n + 1 **(c)** 100, 101

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key Messages

To succeed in this paper, candidates need to be familiar with all aspects of the 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.

General Comments

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

There were 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 due to lack of familiarity with the topic or difficulty with the question rather than lack of time.

The standard of graph drawing was good and many excellent graphs were seen in **Question 2**. Candidates' recall of formulae, particularly the cosine rule and quadratic formula, was also good.

Most candidates followed the rubric instructions but there were a significant number of candidates losing unnecessary accuracy marks by either approximating values in the middle of a calculation, or by not giving answers correct to at least three significant figures.

The questions on the topics of exponentials, linear programming and statistics were very well answered by candidates.

Weaker areas were unit conversions in problems; angles in circles and reasoning; vectors; and finding a general formula for a cubic relationship.

Comments on Specific Questions

Question 1

(a) Virtually all candidates arrived at 5.25 following the correct calculation. The majority of candidates, however, ignored the context of the question and did not round 5.25 to 6, the actual number of tins needed.

(b) The best solutions showed a clear step of working to add 25% to $17.16. A significant proportion of candidates regarded $17.16 as 25% of the total quantity and multiplied by 4. Some candidates arrived at the correct answer and then rounded to $21.5, which is inappropriate as the answer was exact.

(c) The best solutions made an initial statement that $17.16 represented 104% of the previous cost. This then led to the correct method of division by 1.04. An alternative method of finding 1% was fairly common. The main errors were to subtract 4% or to regard $17.16 as 96%.

(d) This part was very well answered but there was still some confusion between the currencies. A few candidates started, incorrectly, with a mixed currency calculation, 17.16 –13.32. Some worked in euros and then had rounding errors when converting back to dollars.

(e) (i) Very few candidates seemed familiar with the fact that 1 litre is the same as 1000 cm^3 and only a few gave the correct answer.

(ii) This was well answered and candidates could score marks using their incorrect answers from the previous part. Many candidates lost a mark by ignoring the request for answers to be rounded to 1 decimal place. A significant proportion of candidates did not use the correct volume formula.

(iii) Those candidates that realised that a scale factor of 8 was involved were successful. Some candidates used the longer method of $\pi r^2 h$ but many did not realise that the radius had to be doubled with the height. Many simply worked out the volume multiplied by 2.

(f) The majority of candidates could not see that 10 times the upper bound of one tin would give the answer. Many tried to find the upper bound of 8900 and gave answers such as 8905. Many candidates left their answers as 895 or 900, overlooking that there were 10 tins.

(g) This was often correctly answered. A few candidates did not understand how to calculate an expected value.

(h) This part rarely received full marks. The main problem was converting 2 m^2 to 2 000 000 cm^2 and the related problem of how many cm^3 in one litre.

Answers: **(a)** 6 **(b)** 21.45 **(c)** 16.50 **(d)** 1.34 **(e)(i)** 750 **(ii)** 4.7 **(iii)** 6 **(f)** 8950 **(g)** 210 **(h)** 160 000

Question 2

(a) Calculators were used to obtain the answer here but many candidates missed the mark by giving an inaccurate answer of 1.6 or 1.63.

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

(ii) This part was very well answered.

(iii) This part was less well answered. A large number of candidates did not convert 4 to 2^2 and used $9 - x = 4$ instead of $9 - x = 2$.

(iv) Many candidates knew that the cube root was the same as a power of $\frac{1}{3}$. The mark was frequently lost by giving the answer 0.33. In any decimal answer, 3 significant figures are required if it is inexact and a specific degree of accuracy is not requested. Answers of $0.\dot{3}$ and 0.333 were acceptable.

(c) (i) The table was almost always correct; 2^0 was occasionally written as 0.

(ii) The drawing of the graph was generally excellent. The only issue for a few candidates was to use ruled line segments or to miss a point when plotting.

(iii) This was almost always correct. The only error was misusing the x-scale when reading 2.3 as 2.6, for example.

(iv) There were many excellent concise answers to finding the equation of a straight line. A number of candidates made arithmetic errors when calculating the gradient using the correct method. Some who reached the correct result then gave their answer as an expression $3x - 1$, rather than an equation.

(v) Very few candidates showed in their working that the line $y = x + 2$ was needed and even fewer correctly drew this line. Consequently, this was the weakest part of the question for many candidates.

Answers: **(a)** 1.62 **(b)(i)** 7 **(ii)** 4 **(iii)** 7 **(iv)** $\frac{1}{3}$ **(c)(i)** 0.25 and 1 **(iii)** 2.3 **(iv)** $y = 3x - 1$
(v) –1.7 to –1.5 and 2

Question 3

(a)(i) The more able candidates coped well with this problem, using Pythagoras' theorem to find *TB* then using tan *TCB* to find the angle of elevation. Some candidates used much longer methods, for example, finding *TB* (by trigonometry) and then *TG* by Pythagoras' theorem and then further trigonometry to find angle *TCB*. For some, the first major error was to misuse Pythagoras' theorem by writing $TB^2 = 50^2 + 70^2$. The next major error was to incorrectly identify angle *BTC* as the angle of elevation. Some candidates had difficulty with the 3D aspect of the problem and involved angle *BCA* and even reflex angle *TCA*. As in any multi–stage method, candidates are advised to keep full decimal values on their calculator throughout to avoid inaccuracy in the final answer. Many candidates did this but many did not and lost an accuracy mark.

(ii) This involved a straightforward use of the cosine rule and it was generally well answered. Less able candidates often could not recall the correct formula or, having earned the method marks for correct substitution into the cosine rule, did not then progress to the solution correctly. A few candidates used right-angled trigonometry with angle *ABC* as 90°.

(iii) Most candidates recalled and applied $\frac{1}{2}bc\sin A$ correctly when finding the area. Some used $\frac{1}{2}bh$ and errors usually occurred, for example, the misconception that the height bisects 130° or the base length.

(b) Some candidates knew how to find the diagonal in one step. Many used Pythagoras' theorem twice and were usually successful apart from those that did not keep full decimal (or surd) values throughout the calculation. A few used longer methods involving trigonometry, which was legitimate but less efficient.

Answers: **(a)(i)** 25.4 **(ii)** 109 **(iii)** 1340 **(b)** 51.5

Question 4

(a)(i) This part was generally well attempted, with most candidates interpreting the statements correctly and avoiding the use of strict inequalities in the first three inequalities. The most common error was reversing the 'less than' and 'more than' inequalities with *x* and *y* in the first three statements.

(ii) This was well attempted but not as many candidates gained full marks here. The errors seen included $y = x + 1$ drawn instead of $y = x$; $x = 8$ and $y = 5$ drawn; lines drawn too short or not properly ruled; and the line $y = x$ often omitted. Even with all four lines correct, the region R was sometimes not identified correctly or clearly by those using shading.

(b) Those candidates who managed to indicate a region in part **(a)(ii)** usually realised that they must select an integer point in this region. Consequently, part marks were often awarded, even where the correct answer of $78 was missing. Some candidates managed to obtain the correct result by calculation or trial and improvement but many couldn't reach the correct answer using these methods. Another common error was the use of non-integer values for *x* and/or *y*, which were invalid in this context. A few candidates simply wrote down a final answer with no supporting working.

Answers: **(a)(i)** $x \geqslant 5$, $y \leqslant 8$, $x + y \leqslant 15$, $y > x$ **(b)** 78

Question 5

(a) Most candidates gave the correct answer. Some gave the reason as 'angles on the same chord', which is ambiguous, rather than 'angles in the same segment' or 'angles on the same arc'.

(b) Many candidates gave angle *BOD* as 74° and often appeared to know the correct reason but did not state it using the correct geometric language. For example, some referred to the angle at the centre or the angle at the origin but not the angle at the circumference. Correct reasons should refer to both the angle at the centre and the angle at the circumference.

(c) This part was the least well answered, with many candidates giving an answer of 106° from an incorrect assumption that *OBCD* is a cyclic quadrilateral**.** Some gave an angle of 148°, thinking that angle *BCD* is twice angle *BOD*. For the reason, the term 'cyclic quadrilateral' was essential.

Answers: **(a)** 37, angle in same segment **(b)** 74, angle at centre is twice the angle at the circumference
(c) 143, opposite angle of a cyclic quadrilateral are supplementary

Question 6

(a) The estimated mean was usually correctly calculated and the method understood by most candidates. Common errors were the use of the upper or lower class boundary, or even the class widths, instead of the mid-interval; dividing by 6; and errors in arithmetical calculation.

(b) (i) The vast majority of candidates gained full marks, showing their understanding of cumulative frequency. The most common error seen resulted in figures 42, 27, 44, 25, found by multiplying the upper limit by the frequency. A few made arithmetic errors when adding the frequencies.

(ii) The graph was very well drawn, with most candidates plotting the points accurately and joining these with a curve or polygon, although some of the curves were a little untidy and not smooth. A few candidates drew blocks and there were some who plotted the points at mid-intervals instead of the upper bound given in the cumulative frequency table.

(iii) There was a mixture of answers in all of the parts of this question. Some candidates incorrectly gave answers by reading off values from the vertical scale (cumulative frequency), rather than the horizontal (time) scale. Part **(a)** was generally understood and read off the graph accurately. In part **(b)**, the inter-quartile range was not as well understood as the median. An error that appeared a number of times was to subtract the cumulative frequency 30 from the cumulative frequency 90, obtain the answer 60 and then to read the 60th value, so repeating the median. Part **(c)** was answered well where candidates understood that the 35th percentile was found at cumulative frequency 42. The most common error was reading off a value at cumulative frequency 35. A few were able to calculate the 42 but did not proceed further.

(c) (i) Most candidates were able to give correct values from the table in part **(a)**, although 102 and 120 were often seen from some confusion with cumulative frequencies. The incorrect answers nearly always indicated a lack of understanding of what was required, rather than miscalculation.

(ii) It was rare to see both answers correct in this part, indicating a general lack of understanding of histograms and how scaling factors can be used along with the frequency densities. Many candidates divided the frequencies by 20, fewer divided by 2 and by 3 respectively, and very few divided by 40 and by 60.

Answers: **(a)** 1.35 **(b)(i)** 93, 102, 113, 118 **(iii)(a)** 0.6 to 0.85 **(b)** 1.3 to 1.7 **(c)** 0.3 to 0.6
(c)(i) 30 and 18 **(ii)** 0.75 and 0.3

Question 7

(a) Although this was usually answered correctly, there were candidates who did not measure the line sufficiently accurately.

(b) This bearing question was not as well answered. There was a wide variety of incorrect answers, with many candidates not appearing to realise that the answer must lie between 270° and 360°. A common error was to give an answer of 110°.

(c) Very few candidates understood what was required in this part in terms of converting the cm/km scale given to a common unit and only the more able candidates managed to write the correct answer. Most candidates' answers involved other powers of 10 and some just wrote 1:10*n*.

(d) There were many fully correct solutions to this locus problem. Many other candidates were able to gain part marks for constructing either the perpendicular bisector of *BC*; the angle bisector of angle *ACB*; or the line parallel to *BC*. Constructions, where attempted, were done well with compasses, pencil and ruler. The perpendicular bisector of *BC* was nearly always correctly drawn and arcs were often seen, although the radius of these was sometimes too small to permit a very accurate line. The bisector of angle *ACB* was less successful, although in many cases correct arcs were seen. The line parallel to *CB* proved to be the most difficult, although when a parallel line was drawn it was generally the correct distance from *CB*. However, many candidates constructed the perpendicular bisector of *AC* here, or drew a line from *B* to some point on *AC*. Where all lines were drawn correctly, the correct region was frequently indicated.

(e) In this part, it was not widely understood that the scale must be squared when considering area and not many correct answers resulted. Often, an incorrect answer of 4 or 16 was seen.

Answers: **(a)** 123 to 127 **(b)** 288 to 292 **(c)** 1 000 000 **(e)** 40

Question 8

(a) This was almost always answered correctly with just a small number of candidates making sign errors and giving, for example, $(x + 5)(x + 2)$. A few candidates gave $x(x - 3) - 10$.

(b) (i) In order to earn full marks in this part, candidates are required to write down each step correctly with no omissions. In particular all the brackets must be shown. Most candidates combined the two fractions and gave the numerator as $x(x + 2) + 3(x + 1)$ but a few omitted essential brackets in their method.

(ii) Almost all candidates used the standard quadratic formula to solve the equation, with only a very small number quoting the formula incorrectly. Of those that used the formula correctly, a common error was to round the solutions to two decimal places rather than three decimal places. At the substitution stage, an error seen quite frequently when carrying out the substitution was to write $-b$ as -2, rather than $- -2$ or 2. Another was to write -2^2 for b^2 followed by -4, rather than $(-2)^2$, although some did correct -2^2 to 4, which was accepted. There were some candidates that rounded the square root before the division by 4, and so accuracy was lost before the final answer. There were a few candidates obtaining correct answers without showing the correct substitution in their working. In those cases, only partial credit was given.

(c) Most candidates wrote down the numerator correctly but some did not include a denominator. By far the most common error was to give the second part of the numerator, $-x(x + 2)$, as $-x^2 + 2x$ when expanding the brackets. Brackets were often omitted but in many cases the correct multiplication was given on the next line and so a recovery of the method was allowed. Some candidates obtained the correct answer but then used incorrect cancelling to give an answer of 1.5, for example, and so did not score the final mark.

Answers: **(a)** $(x - 5)(x + 2)$ **(b)(ii)** –0.823 and 1.823 **(c)** $\dfrac{x^2+3x+3}{x^2+3x+2}$.

Question 9

(a) (i) This part was almost always answered correctly.

(ii) Candidates generally gave the correct answer. A few gave an unsimplified expression for n^2.

(b) (i) Most candidates giving a response to this part extended the table and those using the second differences of 9 and 13 usually wrote down the next one as 17 and added this to 26 to give the correct answer. Candidates who did not show any working sometimes gave the correct answer but incorrect answers, such as 42, were seen. A few were able to find the quadratic expression for the number of lines in terms of the diagram number and substitute 4 into this to give the answer.

(ii) This part was sometimes omitted. Those who continued to extend the table were often able to reach 118 and so give the correct answer. Some candidates who did not extend the table had some idea of which diagram is needed for 118 lines and gave the correct answer but it was quite common to see an answer of 6.

(c) The majority of candidates found this part challenging and it was quite common for nil responses to be seen, or to see responses in which no attempt was made to substitute a value for n in the given expression. Those that did make a substitution did not always equate their expression to the appropriate number of lines for the value of n used. The most common example of this was to substitute $n = 2$ and then use 13 rather than 17. Some candidates had difficulty in simplifying their equations correctly. Those that were able to obtain two simultaneous equations in a and b often earned a method mark by correctly using either the elimination or substitution method.

Answers: **(a)(i)** 16 **(ii)** n^2 **(b)(i)** 43 **(ii)** 7 **(c)** $\frac{5}{2}$ and $\frac{5}{6}$

Question 10

(a) Most candidates answered this part correctly, with $\mathbf{a} - \mathbf{b}$ being the most common incorrect response.

(b) When answering a vector question of this type, a good first step is to write down a route using the capital letter notation. By looking at the routes, it is often possible to select the simplest route in order to make the solution as straightforward as possible. In this case $\overrightarrow{XM} = \overrightarrow{XB} + \overrightarrow{BM}$ is simpler than $\overrightarrow{XM} = \overrightarrow{XA} + \overrightarrow{AC} + \overrightarrow{CM}$ and, in general, those candidates using the simpler route were more successful in reaching the correct answer. Many candidates used the ratio of 1 : 4 incorrectly, giving $\overrightarrow{XB} = \frac{3}{4}(\mathbf{b} - \mathbf{a})$ for example, but were able to earn 2 marks if the rest of the work was done correctly. Those using the route involving $\overrightarrow{XA}$ often made a sign error so it was common to see $\overrightarrow{XA} = \frac{1}{5}(\mathbf{b} - \mathbf{a})$.

Answers: **(a)** $\mathbf{b} - \mathbf{a}$ **(b)** $\frac{4}{5}\mathbf{b} - \frac{3}{10}\mathbf{a}$

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key Messages

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

General Comments

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

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

Graphs were often well drawn and the readings taken from them were to the required accuracy.

Some candidates lost accuracy marks by rounding values in the working to 2 or 3 significant figures and using these in later work.

Comments on Specific Questions

Question 1

(a) (i) This question was often very well answered. The common error was to not show the division by 32, i.e. 32 parts = 512, 1 part = 16, then 16 × 14 = 224. Candidates need to be aware that every step must be shown in a 'show that' question in order to show they have not worked backwards.

(ii) This question was very well answered by the majority of candidates.

(b) Candidates knew to calculate 224 × 45 and correctly arrived at 10 080 to score the method mark. Errors arose in rounding to the nearest \$100. The common incorrect final answer was \$101.

(c) An incorrect final answer of 18 was seen very frequently. Candidates knew to calculate 224 ÷ 12 but then truncated their solution instead of rounding up to 19 groups. Some candidates also went on to calculate the remainder of candidates left over from 18 groups and gave 8 as their final answer.

(d) (i) Most candidates answered this correctly but a variety of incorrect answers were seen, the most common one being 493 000.

(ii) Most candidates gave a response in standard form notation. However, they often rounded their answer to part **d(i)** to 2 or 3 significant figures and hence lost this mark. Follow through marks were often awarded here from an incorrect response in part **d(i)**.

(e) This question was not well answered. The vast majority of candidates found a percentage of the selling price instead of the cost price. Of those who found a percentage of 2.75, many omitted to find the increase or did not multiply by 100 and reached answers of 298% or 1.98%. Some candidates who reached 198% then went on to subtract 100 and gave the final answer as 98%.

Answers: **(a)(ii)** 112 **(b)** 10 100 **(c)** 19 **(d)(i)** 4 093 000 **(ii)** 4.093×10^6 **(e)** 198

Question 2

(a) A few candidates rounded the final answers to 1 or 2 significant figures.

(b) Graphs were usually accurate and well drawn. The point (–0.5, 3.375) was often incorrectly plotted. Many graphs ran along or crossed the line $x = 2$ and/or $x = -2$. It was rare to see points joined by straight lines.

(c) Many candidates correctly ruled the line $y = x + 1$ but some of these lost marks for short lines and/or incorrect reading of the required x values. Some candidates who did not draw a line tried to calculate values by trial and improvement.

(d) This question was very well answered by the vast majority of candidates, as points of contact of the tangents were usually within the required accuracy. Some candidates drew the tangent at $x = 1.5$. The calculations of the gradient were often accurate but m = (difference in x) ÷ (difference in y) and/or incorrect signs in the final value were seen.

Answers: **(a)** 0, 4, 0.625, 0.875 **(c)** 0.2 to 0.3 and 1.8 to 1.95 **(d)** 2.2 to 5

Question 3

(a) Accurate cumulative frequency curves or polygons were often drawn. Occasionally, several points were inaccurately plotted but candidates were able to score marks for either correct vertical or horizontal positions of their points and an increasing diagram. A significant number of candidates drew a block diagram.

(b)(i) Readings from the cumulative frequency diagram were usually accurate.

(ii) This question was well answered by many candidates with only a few using inequalities. A few read the correct cumulative frequency value but then subtracted this from 200 instead of 120.

(c) This question was very well answered.

(d) This question was often well answered. The usual error of using the interval widths instead of the mid-values was seen on several occasions. Very few candidates used 120 ÷ 6 = 20 as the solution.

(e) This question was often well answered. The common error was to divide all three frequencies by 10.

Answers: **(b)(i)** 32 to 34 **(ii)** 120 – reading at $r = 50$ **(c)** 8, 18, 27 **(d)** 35.2 **(e)** 1.6, 1.35, 0.3

Question 4

(a) This question was generally well answered, usually by using the sine rule in triangle *ABC* rather than a right-angled triangle using the mid-point of *BC*. Errors occurred in the misinterpretation of the information that triangle *ABC* was isosceles. Candidates were seen to use angle *BAC* as 68° instead of angle *BCA*, or alternatively to mistakenly treat angles *BAC* and *BCA* as the equal angles. Candidates who wrote the sine rule in its implicit form were adept at rearranging to the explicit form. A minority treated *ACB* as a right-angled triangle and used $\tan 68 = \frac{AC}{1.2}$.

(b) Candidates showed good recall of the cosine rule and many correct solutions, with the required accuracy, were seen. Candidates who quoted the formula for cos*ABC* in its implicit form were not always successful in rearranging to the explicit form required. Sign errors were commonly seen and occasionally the mistreatment of the rule as $a^2 = (b^2 + c^2 - 2ab)\cos A$. Some candidates rounded values prematurely and lost accuracy marks. Others found angle *ACD* instead of angle *ADC*. A minority of candidates treated *ACD* as a right-angled triangle throughout.

(c) This part of the question proved to be the most challenging. Candidates who approached the solution by using the mid-point of *BC* in triangle *BCD* to create a right-angled triangle and calculate the height, often applied Pythagoras' theorem correctly. Errors seen included using 1.2 instead of 0.6 as the base and using the height as the hypotenuse, leading incorrectly to $(\text{height})^2 = 2.3^2 + 0.6^2$. Candidates invariably went on to use their height correctly in the area formula for the required triangle. Many candidates who approached the question using trigonometry methods in triangle *BDC* were also successful and went on to use the area formula 0.5 $ab\sin C$ correctly. A significant minority of candidates made incorrect assumptions about angle *BDC*, working in the wrong plane or a combination of planes. Some used the value for angle *ADC* or halved this value, misinterpreting the given diagram. Accuracy was sometimes lost in otherwise good solutions. Candidates must work with at least 4 significant figures throughout to reach a final answer accurate to 3 significant figures. A minority of candidates thought the area was 0.5 × 1.2 × 2.3.

(d) Candidates who were able to visualise the correct triangle by dropping a perpendicular from *A* to the floor, often went on to give a fully correct solution using trigonometry in a right-angled triangle. Others found the angle at *A* instead of the angle at *D*. Candidates who could not visualise the required right-angled triangle often used 2.3 in their calculations or involved angle *ADC*.

Answers: **(a)** 1.60 **(b)** 43.5 or 43.6 **(c)** 1.33 **(d)** 41.1

Question 5

(a) (i) Candidates almost always understood that it was necessary to write an expression for the area of the shape by splitting it into rectangles and equating to 24. Those who chose to split the shape with a horizontal line usually produced a complete, efficient solution from $4x(x + 13) + 2x(3x - 9) = 24$. Those who approached the problem by using a vertical line, or by considering a large rectangle and subtracting a smaller one, were less successful. When expressing the side *DC* in terms of *x*, they invariably omitted brackets and wrote $4x - 3x - 9$, leading incorrectly to $x - 9$. In all methods seen, the most common source of errors was omission of brackets or incorrect expansion of brackets. To achieve full marks in a 'show that' question, candidates must demonstrate a rigorous approach using correct notation throughout. A few candidates attempted to use perimeter as a starting point or tried to solve the given equation.

(ii) Many fully correct factorisations were seen to give the correct solutions. A few candidates made sign errors in their factorising, or did not use integer values. A significant number of candidates ignored the instruction in the question to use factorisation to solve the equation and instead used the quadratic formula. The correct solutions were often obtained but did not earn the full 3 marks available. When a method is specified in the question, candidates are required to demonstrate skill in using that method.

(b) Many candidates demonstrated a good understanding of how to solve simultaneous equations, either by elimination or by substitution methods, and executed the whole process very well. When errors were seen, they almost always originated from a sign error while attempting to eliminate one of the variables. Candidates usually still went on to correctly substitute their value for *x* or *y* into one of the original equations to find the other variable.

(c) Many candidates demonstrated good skills in dealing with algebraic fractions and completed multiple steps clearly to lead to the correct solution. A majority of candidates obtained the common denominator $t(t + 3)$ and correctly reached $2(t + 3)(t + 3) - t^2$ as the numerator of the left-hand side of the equation. Once again, a common source of errors from here was a lack of care when expanding brackets. $2(t + 3)$ was seen as $2t + 3$ and candidates who wrote $2(t + 3)\ t + 3$ or $2t + 6(t + 3)$ rarely corrected themselves on the next line to $2t^2 + 6t + 6t + 18$. Some candidates reached the correct fraction $\frac{t^2 + 12t + 18}{t^2 + 3t}$ but then incorrectly simplified the equation, often by cancelling the t^2 terms. A few candidates dealt with both numerators correctly at the start but lost the denominator completely, forgetting to multiply the right-hand side of the equation by $t(t + 3)$.

Answers: **(a)(ii)** $\frac{3}{5}$, – 4 **(b)** $x = 3$, $y = -7$ **(c)** – 2

Question 6

(a) (i) This question was usually answered correctly. The only incorrect solutions seen were 47 and 137.

(ii) The majority of candidates correctly used all angle rules and theorems necessary to give the correct angle of 62°. Few candidates were able to articulate the reasons for their answer. It was often stated that two angles were equal but no reason was given. Mention of using an isosceles triangle was rarely seen. Key words such as 'centre' and 'circumference' were usually missing from the attempts to explain the use of 'angle at the centre is twice the angle at the circumference'. Many candidates tried to give reasons numerically, for example, stating 'angle *YOZ* = 124° and so *w* is half of 124°'.

(iii) Again, many candidates were able to state the correct answer of 30°. Articulating the reason proved difficult. The key words 'cyclic quadrilateral' were often missing or spoilt by incorrect statements such as 'opposite sides add to 180°'. The succinct, correct statement that 'opposite angles in a cyclic quadrilateral sum to 180°' needs to be recalled and used by candidates. A few candidates incorrectly assumed that the angles at *H* and *F* were also *p* and used 'angles in a quadrilateral add to 360°'. Others assumed that *EHGF* was a trapezium.

(b) (i) Many correct answers of 1 : 2 or equivalent were seen. The most common errors were answers of 1 : 1 and *RN* : *RQ*.

(ii) A minority of candidates were able to complete all statements correctly. Common errors included using *P* and/or *R* as part of their answers even though these points were not vertices of the two triangles being considered. Many candidates used *OM* = *ON* for the second statement and then incorrectly used *MQ* = *NQ* for the third. When attempting to describe the common side, *OQ*, a number of candidates stated a single point, or gave three letters indicating an angle or a triangle. In the final statement, 'equal chords are equidistant from *Q*' was a common error.

Answers: **(a)(i)** 43 **(ii)** 62 with reasons **(iii)** 30 with reason **(b)(i)** 1: 2 **(ii)** *OQ*, *MQ* = *NQ*, *OM* = *ON*, centre

Question 7

(a) (i) This question was generally well answered, especially the rotation and the angle. The centre was more difficult with (0, 0) being the common incorrect answer. A significant number of candidates gave two transformations as the answer.

(ii) Most candidates recognised this as a reflection and often with the correct line of reflection. The equation $x = 1$ was stated a significant number of times.

(iii) This was a more challenging transformation to describe and there was a little uncertainty about the word 'enlargement' because the image was smaller than the object. The centre of enlargement was usually correct but the scale factor of $-\frac{1}{2}$ was often seen as –2 or $\frac{1}{2}$. As in part **(i)**, some candidates gave a combination of transformations.

(b) Many candidates gave the correct follow through matrix and a few gave the correct enlargement matrix after an incorrect scale factor in part **(a)(iii)**. There were a significant number of nil responses in this question.

(c) This question was usually answered correctly.

(d) The description of the transformation represented by the given matrix was met with mixed responses. Reflection was quite often stated but with an axis as the mirror line. Many candidates gave rotation as the answer and again there were a significant number of nil responses.

Answers: **(a)(i)** rotation of 90° anticlockwise with centre (0, 2) **(ii)** reflection in $y = 1$ **(iii)** enlargement, scale factor $-\frac{1}{2}$ and centre the origin **(b)** $\begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} \end{pmatrix}$ **(d)** reflection in $y = x$

Question 8

(a) This question was usually answered correctly.

(b) Many candidates found the length correctly. Errors involved adding co-ordinates instead of subtracting, not squaring the differences, and subtracting the squares. A significant number of candidates found the gradient of the line.

(c) This more challenging question was often correctly answered. Most candidates found the correct gradient and many substituted a correct set of co-ordinates into the straight line equation. There were numerical errors seen in this substitution but these usually earned 2 out of the 3 marks. Almost all candidates remembered to write the equation as 'y = …'.

(d) This question proved to be quite discriminating. Many candidates did not realise that $c = 0$ in this case. So, after finding the correct perpendicular gradient, solutions then were seen from the substitution of co-ordinates of one of the points in earlier parts. Another error frequently seen was the substitution of $x = 6$ into the answer to part **(c)**.

Answers: **(a)** (4, 6) **(b)** 4.47 **(c)** $y = 2x – 2$ **(d)** –3

Question 9

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

(ii) This question was usually answered correctly. Candidates who found g(3) first rarely made errors in the next stage, thus proving this method to be the most efficient. Those who found gg(x) first gave themselves more work and ran the risk of giving gg(x) = 2^{2x} instead of 2^{2^x} .

(b) This was a straightforward inverse function question and was generally well answered. Almost all candidates gained the first mark for the first step, although a few did think that the inverse is the reciprocal of the function. The second mark was occasionally lost as a result of sign errors or leaving the answer in terms of y.

(c) This was a straightforward algebraic compound function and there were many correct answers. Most candidates attempted to find fh(x) and only a few chose hf(x). There were errors in removing the brackets with $2(7 – 3x) + 5$ becoming $9 – 6x$.

(d) This was the most challenging part of the question. Candidates found the inequality quite difficult to deal with as well as overlooking the requirement to give integers for the final answer. Many candidates scored 2 out of 3 marks by simplifying the inequality correctly but not giving integer answers, or by omitting one of the integer answers (usually 0 or 2), or even including – 2 in the final list of integers.

Answers: **(a)(i)** 11 **(ii)** 256 **(b)** $\frac{x-5}{2}$ **(c)** $19 – 6x$ **(d)** – 1, 0, 1, 2

Question 10

(a) This question was usually answered correctly.

(b) This question was usually answered correctly.

(c) (i) The common incorrect answer was n^2.

(ii) Those candidates who answered part **(i)** correctly were also successful here. There were a number of candidates who gave 8281 as the answer.

(d) (i) Candidates found this question to be quite difficult, as they did not see the connection between this and the two sequences above and consequently chose to look at this sequence in isolation, rarely with any success.

(ii) Most candidates answered this question correctly, as they were able to continue the sequence when their answer to part **(i)** was incorrect.

(e) This question was often answered correctly. Sign errors were the most common loss of marks.

Answers: **(a)** 8, 25, 17 **(b)** $n + 2$ **(c)(i)** $(n - 1)^2$ **(ii)** 92 **(d)(i)** $n^2 - 3n - 1$ **(ii)** 39 **(e)** 1 and $-\frac{1}{2}$, $\frac{1}{4}$, $-\frac{1}{8}$

MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key Messages

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

General Comments

The paper gave the opportunity for candidates to demonstrate their knowledge and application of a wide variety of topics. 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 with many candidates showing all necessary working. However, some candidates provided answers with little or no working or didn't carry out calculations to sufficient accuracy and consequently lost marks. Centres should continue to encourage candidates to show all working clearly in the answer space provided. When incorrect answers are given, method marks are usually awarded for the correct use of formulae, correct steps in algebraic questions and for calculations performed. The poor use or omission of brackets in algebra questions often resulted in the loss of marks. Candidates should take the time to read the questions carefully to understand what is actually required in each part, for example, giving an answer correct to the nearest dollar, when asked to do so.

Comments on Specific Questions

Question 1

(a) (i) The vast majority of candidates obtained the correct answer. A common error involved division of \$2.60 by 5, falsely assuming that \$2.60 was equivalent to the total cost of the biscuits and water. A few divided by 3.

(ii) Many candidates obtained $\frac{13}{18}$ with a significant minority leaving their answer as $\frac{6.5}{9}$, whilst some wrote their answer as a percentage. An error in part **(i)** was often followed through in this part. Some less able candidates, realising a fraction was required, sometimes wrote down $\frac{2.6}{9}$ as these were the amounts given in the question.

(iii) A small majority of candidates linked \$9 with 37.5% and went on to obtain the correct answer. Two common incorrect methods were seen, namely linking \$9 with 62.5% and increasing \$9 by 62.5%.

(b) The majority of the most able candidates opted to use the repeat percentage formula and almost always obtained \$109. For the significant number who opted to do the calculation year on year, unclear method and arithmetic errors were frequently made, resulting in a loss of marks. Many of the errors resulted from a calculation for 9 years, and occasionally 11 years, rather than 10. A sizeable minority lost the final mark by not giving their answer to the nearest dollar. Other common errors involved division by 1.08^{10} or a total depreciation of 80%, leading to an answer of \$50.

Answers: **(a)(i)** 3.90 **(ii)** $\frac{13}{18}$ **(iii)** 24 **(b)** 109

Question 2

(a) (i) Most candidates understood translation and earned full marks. Many of the others earned one mark for a correct translation in either the horizontal or vertical direction.

(ii) Candidates were slightly less successful with the reflection. Errors usually involved reflection in the line $x = -1$ or in a horizontal line other than $y = -1$, usually $y = 1$ or the x-axis.

(b) The inclusion of more than one transformation was rarely seen and many candidates earned full marks, usually for the rotation rather than the alternative enlargement. The use of vector notation, reverse co-ordinates or giving an equation of a line, resulted in the loss of a mark for the centre of rotation. The most common incorrect transformation was reflection.

(c) (i) Although this was not as well answered as the previous part, a majority were able to score full marks. Many of the others were able to correctly identify reflection as the transformation but could not match it to the correct line of reflection. Common errors usually involved $y = x$ as the line of reflection or no line being given.

(ii) Only a minority were able to give the correct matrix. Some earned one 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. Some successfully used the images of (1, 0) and (0, 1) as reference points. Attempts to use simultaneous equations from a matrix with 4 unknowns were rarely successful. Others had quoted the correct columns but reversed them in the matrix. A significant number made no attempt.

Answers: **(b)** Rotation, 180º, (–1, 0) **(c)(i)** Reflection, $y = -x$ **(ii)** $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$

Question 3

(a) Many candidates were successful in calculating the volume. Some calculated the area of the cross-section using the formula for the area of a trapezium, while others attempted the area of a rectangle and triangle(s), which sometimes led to errors. Others calculated volumes of cuboids and triangular prisms, which also led to some errors. A few candidates appeared to return to the question after answering part **(b)**. They crossed out the correct answer replacing it with 39 600, falsely believing that if the depth of water was half the height of the trough then the volume of water would be half the volume of the trough.

(b) (i) Success in this part depended on a correct method being used to find the width of the surface of the water. Many recognised that it would be the average of 25 and 35 but a significant number of candidates used methods such as similar triangles and trigonometry. Some earned no marks by using a circular method, using the given volume to find the 30 cm and then using this to confirm the volume.

(ii) Most candidates were able to earn this mark by calculating the correct percentage or following through from a previous incorrect answer. A few lost the mark for not giving their answer to a sufficient degree of accuracy.

(c) Most candidates understood what was required and went on to earn full marks. For some, the conversion from cubic centimetres to litres proved problematic with factors of 10 and 100 being common errors. Most candidates calculated the time in hours and then converted to minutes. Many candidates who made errors were able to obtain a mark by successfully converting their time in hours to a time in hours and minutes.

(d) Fewer fully correct answers were seen in this part. Quite a number of less able candidates didn't work with the correct formula for the volume of a cylinder. Some of those starting with the correct equation struggled to deal with the algebra and many simply square rooted to eliminate the square term. Even when candidates obtained r^3, some went on to square root.

(e) Although many correct answers were seen, the conversion between grams and kilograms proved difficult for some.

Answers: **(a)** 43 200 **(b)(i)** $0.5 \times (25 + 30) \times 6 \times 120$ **(ii)** 45.8 **(c)** 1 h 39 min **(d)** 12.8 **(e)** 21

Question 4

(a) The vast majority of candidates were able to complete the table of values correctly. Two errors were very common: evaluating $-1 - \dfrac{1}{2\times-1^2}$ as $-1 + \dfrac{1}{2\times1^2}$ leading to –0.5; and treating $2x^2$ as $(2x)^2$ leading to values of –1.25 and 0.75.

(b) A small majority of candidates were able to plot their points accurately and draw a smooth curve through their points. A significant number were unable to plot (–0.3, –5.9) and (0.3, –5.3) accurately; they seemed to struggle with both *x* and *y* co-ordinates. In general, the curves were good with few straight line segments seen and with few candidates joining together the separate parts of the curve.

(c) Many candidates began by clearly drawing the line $y = 1$ before reading the scale correctly for the *x*-value. Marks were usually lost as a result of incorrect plotting of co-ordinates.

(d) Many candidates didn't understand what was required in this part. Many of the incorrect answers involved numbers such as –0.5, –1.5, or positive integers such as 1, 2 and 3.

(e) (i) The method required to find the straight line equation was not known or understood by the vast majority of candidates and many made no attempt at all. Of those that attempted this part, $y = 2x - 2$ and $y = c$ (for random values of *c*) were common incorrect answers along with a lot of confused working.

(ii) It was extremely rare to award full marks but some candidates earned marks for correctly plotting the graph of their straight line equation.

Answers: **(a)** –1.5, 0.5 **(c)** 1.25 to 1.35 **(d)** –1 **(e)(i)** $2 - x$ **(ii)** 1.15 to 1.25

Question 5

(a) The cosine rule was understood by the majority of candidates and many of these gained full marks. Loss of marks usually resulted from treating the rule as $(b^2 + c^2 - 2bc)\cos A$, forgetting to square root after obtaining a^2, and simple slips from one line of working to the next. Less able candidates were unable to use the correct formula or treated triangle *KDC* as right-angled.

(b) Candidates were more successful with the sine rule and many correct answers were seen. Others lost the final mark due to premature approximation in the working. Having quoted a correct version of the sine rule some struggled to rearrange it correctly to find sin *KMC*. Another common error was to separate sine from its angle or include terms such as sin 2380.

(c) The bearing of *M* from *C* proved challenging for many candidates, with only a minority earning full marks. Some were able to find the bearing of *C* from *M* but were unsure of the required step to find the reverse bearing. Some subtracted the bearing from 180° or 360° instead of adding 180°. Many of the less able candidates gave angle *KCM* as their bearing.

(d) (i) Most candidates obtained the correct time.

(ii) Candidates were generally successful in calculating the speed and many earned both marks. Writing 2 hours 24 minutes as 2.24 hours was a common error.

Answers: **(a)** 2180 **(b)** 78.7 **(c)** 309 **(d)(i)** 23 39 **(ii)** 650

Question 6

(a) Calculating the mean from a grouped frequency table was well answered, with many candidates earning full marks. Some had a partial understanding and multiplying the frequencies by the class widths or the bounds of the interval were common errors. However, very few candidates simply added the frequencies or class widths before division by 4.

(b) Despite a lack of working, many correct histograms were seen. Candidates scoring two marks usually made an error with the width of the first bar, often drawn over the interval 20 to 80 and sometimes from 0 to 80.

(c) Most candidates obtained the correct probability, usually as a fraction.

(d) (i) Although candidates were slightly less successful in this part, many correct answers were seen. Errors usually stemmed from candidates ignoring the phrase 'without replacement' and a denominator of 160 for the second probability was a common error. Adding the two probabilities, with or without replacement, was another common error.

(ii) This proved to be more of a challenge for many of the candidates and fully correct answers were far less frequent. As in the previous part, some candidates ignored 'without replacement', some only considered one of the products and some added the individual probabilities or multiplied the products. Some candidates used a tree diagram to help but they were not necessarily more successful than those who managed without a diagram.

Answers: **(a)** 101.5625 **(c)** $\frac{40}{160}$ **(d)(i)** $\frac{1560}{25440}$ **(ii)** $\frac{4000}{25440}$

Question 7

(a) Success in this part relied on candidates working with consistent units throughout. Many candidates opted to set up an equation but often the costs of the cakes and loaves were in cents and the total cost in dollars. This usually led to an answer of 4.03 and seemingly not raising any concerns for candidates. Those that worked with consistent units were almost always successful.

(b) Many candidates used correct expressions for the areas of the rectangle and triangle and were able to form and solve a correct equation to gain full marks. Expressions with errors involving brackets were common, e.g. $y \times y + 3$, $2y + 1(y + 1)$ and $0.5 \times 2y^2 + 3y + 1$. Answers were usually given as fractions with decimals less common. A few gave decimal answers to only 2 significant figures.

(c) Again, success in this part relied on candidates working with consistent units throughout. Most candidates understood the need to set up at least one equation. This was achieved in a number of ways: equating expressions for the number of bottles of milk and the number of bottles of water; equating expressions for w in terms of the number of bottles; setting up simultaneous equations for the total cost of the milk and of the water. Those that worked with consistent units in part **(a)** did so again and were generally successful. Those working with inconsistent units gained only part marks. Less able candidates made little progress, often setting up equations based on costs and ignoring the number of bottles.

(d) (i) Many candidates correctly equated an expression for the area of the triangle with 2.5 and rearranged it into the correct form. Most used '$\frac{1}{2} \times$ base $\times$ height' and a few used '$\frac{1}{2}ab\sin C$' and were also successful. Some started with $u(3u - 2) = 5$, others with $3u^2 - 2u = 5$, both of which were unacceptable for a question requiring candidates to show a particular result. As in part **(b)**, a few candidates had an error with brackets, e.g. $\frac{1}{2} \times 3u^2 - 2u = 2.5$. Some misinterpreted the requirements and instead solved the equation, usually using the formula.

(ii) Many successful attempts at factorisation were seen. Common errors usually involved reversed signs within otherwise correct brackets or $u(3u - 2) - 5$. A small number of candidates attempted to use fractional values, rather than integers, within the brackets.

(iii) Those candidates who substituted $\frac{5}{3}$ often gained full marks. Some rounded their decimal values to 1.66 or 1.67 before the use of trigonometry, resulting in a loss of accuracy in the final answer. Others gained marks for correct substitution of their positive value, while less able candidates simply stated tan = $\frac{u}{3u-2}$ and could go no further. A few used Pythagoras' theorem to calculate the hypotenuse of the triangle and then used the sine ratio to reach a final answer.

Answers: **(a)** 83 **(b)** $\frac{1}{3}$ **(c)** 25 **(d)(ii)** (3*u* – 5)(*u* + 1) **(iii)** 29.1

Question 8

(a) (i) This proved challenging for many candidates. Those candidates who stated that angle *A* was common and that as angle *ADB* = angle *ABC* then angle *ABD* = angle *ABC*, usually didn't state a reason. Those who gave angles summing to 180° in both triangles were more successful. They were able to pair up the equal angles in their equations and correctly reach angle *ABD* = angle *ACB*. Others used properties such as exterior angles = sum of interior opposite angles to help set up sums where equal angles could be matched up. Some simply stated the reason was similar triangles without any proof.

(ii) This was answered correctly by the majority of candidates. There was a range of incorrect answers including isosceles, scalene, congruent and equal.

(iii) Few correct answers were seen. As the required triangles were not drawn in the same orientation, candidates had difficulty matching up the corresponding sides. A common error was $\frac{12}{16} \times 12 = 9$. Other methods used included trigonometry, Pythagoras' theorem and the sine and cosine rules.

(b) (i) As reasons were not required in part **(b)** it is difficult to draw conclusions as to where candidates went wrong. Many correct answers were seen.

(ii) Fewer correct answers were seen in this part. Successful candidates often showed angle *DBC* = 38º on the diagram, showing an appreciation of the isosceles triangle *DBC*.

(iii) There were slightly fewer correct answers here than in part **(ii)**, with a wide variety of incorrect answers. A few candidates thought that opposite angles of a cyclic quadrilateral were equal.

(iv) Only a minority of candidates obtained the correct answer. Some seemed to be using the angle sum of triangle *ABC* and an incorrect answer seemed to stem from errors with angle *w* and/or angle *DBC*.

(c) This proved to be the most challenging question for most candidates. Very few fully correct answers were seen. A number of candidates gained some marks by showing a variety of correct angles, in terms of *m*, on the diagram but often a link could not be deduced from these. Some believed the two given angles added to 180°, leading to an answer of 60°. Others formed an equation from the angles in a quadrilateral, which simplified to 0 = 0. Many candidates incorrectly thought that the obtuse angle *POR* was twice angle *PQR*. A few introduced extra lines, the most successful being the radius *OQ*, giving two isosceles triangles, which led some to obtain a correct equation in *m*.

Answers: **(a)(ii)** Similar **(iii)** 8.25 **(b)(i)** 38 **(ii)** 38 **(iii)** 78 **(iv)** 26 **(c)** 36

Question 9

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

(b) Again, many correct answers were seen with the majority finding the value of g(0.5) = 2 and using this in the function f. Very few attempted to find the function fg(*x*), in terms of *x*, as their first step.

(c) A majority of candidates obtained the correct inverse function. Common errors included an incorrect rearrangement following a correct first step, leading to $\frac{x-1}{2}$, and leaving the answer as $\frac{y+1}{2}$. Only the less able candidates didn't earn any marks.

(d) Many correct answers were seen. Some candidates earned 1 mark only, making a sign error when simplifying $4x - 2 - 1$ as $4x - 1$. The most common error was to square f(x).

(e) A majority of answers were correct but errors in squaring $(2x - 1)$ resulted in a loss of marks. Omission of the *x* terms and errors with the signs were the common errors. A significant number of candidates attempted to square $(2x + 1)$.

(f) This proved challenging for most candidates and it was rare to award the mark. A common incorrect answer involved 2 to the power 2^x.

(g) The majority of answers were correct but there was a good number of answers indicating f and h. There were several candidates who made no attempt and a few who stated that none of the statements were true.

(h) Few correct answers were seen. Incorrect answers usually involved a combination of two or three of the functions f, h and their inverses. Several candidates made no attempt to answer the question.

Answers: **(a)** 8 **(b)** 3 **(c)** $\frac{x+1}{2}$ **(d)** $4x - 3$ **(e)** $4x^2 - 4x + 7$ **(f)** x **(g)** $g^{-1}(x) = g(x)$ **(h)** fh(*x*)

Question 10

Completing the table for the 5th and 6th terms proved straightforward for the majority of candidates. Errors usually involved the power series or slips with the arithmetic. The *n*th term of the linear sequence, usually in its simplest form, was found correctly by a large majority of the candidates. Candidates were slightly less successful with the sequence of fractions and the sequence based on the square numbers. For the former, some didn't pick up on the fact that the numerators and denominators could be treated as two separate linear sequences. Sequence D, based on powers of 3, proved the most challenging and only the most able candidates obtained the correct answer. Incorrect answers were often based on n^3 but in many cases no answer was offered at all.

Answers: **A** –13, –20 $22 - 7n$ **B** $\frac{9}{22}$, $\frac{10}{23}$ $\frac{n+4}{n+17}$ **C** 26, 37 $n^2 + 1$ **D** 162, 486 $2 \times 3^{n-1}$