MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/11
Paper 11 (Core)

Key messages

Candidates who were most successful were those that had knowledge of the full syllabus, used their calculator throughout to avoid arithmetic errors and read the questions carefully. Not rounding values prematurely was a key part of maintaining accuracy throughout, as well as ensuring that answers were given in the format asked for in the question.

General comments

This paper proved accessible to many candidates. There were a considerable number of questions that were standard processes, and these questions proved to be well understood, and, in many cases, there did not seem to be much confusion about what was being asked. Many candidates showed some working with the stronger candidates setting their work out logically with all numbers clearly formed. A significant number used arrows or lines to show connections between numbers rather than forming proper equations which were not awarded marks.

Comments on specific questions

Question 1

Candidates who converted 15 months to 1 year 3 months and then subtracted were most likely to be successful. A wide variety of calculation errors were seen in this question. Those who converted Jacob's age into months, before subtracting 15 and then converting the answer to years and months frequently made errors. The most common error was 9 years and 3 months from using 10 months in a year.

Question 2

There were many correct answers given for this question. A significant number did not know the correct conversion factor or, if they did, divided instead of multiplying. A common error was to state that there were 100 m in a km.

Question 3

(a) Most candidates measured the angle to the required degree of accuracy. Only a few appeared to be using the wrong scale on their protractor, as shown by an answer of 97°. A few assumed the angle was 90°. There were some highly inaccurate answers, suggesting that these candidates either did not have access to a protractor or did not know how to use it.

(b) Most candidates identified the angle as being acute and the most common wrong answer was obtuse, with right angle and reflex also seen.

Question 4

Most candidates reached the correct answer. Some spoiled their answer by giving it in an incorrect format, for example 1032 rather than 1032 pm, by giving it as a time interval, for example 22 hrs 32 mins, or as 22°32'.

Question 5

There were some good answers here and most candidates got at least two symbols correct. A common error was to give > for the first line. Very few candidates showed any working to help them decide.

Question 6

Most candidates interpreted the stem-and-leaf diagram correctly and gave the correct answers. A small number looked only at the values for the 'leaves' in one or both parts of the question leading to the error 8 – 0 = 8 for the range in **part (a)** or the incorrect answer 2 for the mode in **part (b)**. 30, the median, was seen as answers in both parts.

(a) As well as the above error, some gave 54 (the maximum number of cars), –44 (subtraction in the wrong order), 22 (44 found then divided by 2) or gave an incorrect range because of arithmetic errors. A few showed 54 – 17, choosing the value at the wrong end of the first row.

(b) Some gave the answer 7, suggesting they had identified the correct entry in the table and were then unable to interpret the result.

Question 7

Few candidates answered this question correctly. Candidates were most successful when they chose to convert the mixed number first. Errors were seen in later conversion attempts or purely inverting the fraction leading to answers of $\frac{4}{1}$ or $1\frac{4}{1}$. The most common wrong answer was $\frac{1}{1\frac{1}{4}}$.

Question 8

Few candidates gained full marks for this question. Successful candidates took the approach of finding the internal angle 222°, then using the fact that angles in a quadrilateral sum to 360°. Some recognised that 138° was an external angle and correctly subtracted 49° and 28° from 138°. Many candidates did not realise that 138° was an external angle and used it as an internal angle, leading to the common error of subtracting all 3 angles from 360°. Some subtracted 49° and 28° from 180°, leading to a final answer of 103°, which did not gain any marks.

A significant number of candidates made incorrect assumptions about angles in the diagram. For example, some divided the given shape into two triangles and assumed this resulted in the given angles being bisected, or that one of the resulting triangles was right-angled.

Question 9

A good number of candidates answered this correctly with clear working. Arithmetic errors were common. Others used 2.6 per cent in their method instead of 0.26 or $\frac{2.6}{100}$. Some candidates did not read the question carefully as many gave the total amount of money, rather than just the interest earned or used compound interest instead of simple.

Question 10

(a) This question was done well, with most candidates reaching the correct answer. A few wrote '+6' or found the *n*th term, rather than the next term.

(b) There were some excellent answers here, with many candidates using inverse operations. Others showed a correct trial using 23, however some gave the answer 68 instead of the 23. Some candidates who used inverse operations to arrive at the answer 23, did not realise this was the final answer and went on to use this in further calculations, usually by subtracting 1 from 23.

Question 11

This question proved to be challenging for most candidates. Whilst some candidates scored full marks, many others scored two marks for finding the diameter in centimetres. Common errors included using an incorrect formula for the diameter such as multiplying the circumference by π, dividing the circumference by 2π, dividing by 2 or using the formula for the area of a circle. Some found the radius rather than the diameter and could only be awarded one mark if a conversion was correct.

Question 12

Many candidates found completing the diagram with the correct symmetry to be difficult, which may have been because the given line of symmetry is diagonal. Some drew a shape that had a vertical line of symmetry, rather than the sloping line indicated in the question.

Question 13

(a) This was done well, with the majority reaching the correct answer. Many gained one mark for a partly correct method. The most common error was to deal with the negative value incorrectly.

(b) This was tackled less well than the previous part. Candidates were more successful if they chose to keep the values positive whilst rearranging. Dealing with negatives proved problematic for candidates with an equation such as $-5x = 4$ or $17x = 12$ given. The last stage, of dividing by 5, was often handled incorrectly as an answer of 1.25 was frequently seen.

Question 14

Most candidates reached the correct answer of 42.5 although, a few gave the answer 43, which was not sufficiently accurate. The most common error was to multiply 34 and 80 and then divide by 100, leading to 27.2 per cent.

Question 15

Many candidates realised the need to multiply the number of people in each category by the frequency and then find the total of their products. Quite a few made an error and stated that $0 \times 1 = 1$ leading to a total of 62. As long as all the multiplications and additions were seen, this was awarded the method mark. However, if no method was given and only the 62 was seen, this gained no marks.

Some had found the correct total number of people, but did not divide this by 25 (the number of stops). Some candidates divided by 15 (from $0 + 1 + 2 + 3 + 4 + 5$), others divided by 6 (the number of categories) or by 5. A few did not realise that 25 had been given in the question and added the frequencies, making arithmetic errors.

Question 16

This question proved challenging to candidates. There were a few excellent responses, with clear working, leading to the correct answer. A reasonable number of candidates substituted the given values into the correct formula but were then unable to deal with the value $\frac{1}{2}$. A large number cancelled the 2 in the denominator with the 12 inside the bracket, but did not realise that w also needed to be divided by 2. Many attempted to multiply out the brackets and made errors. Some omitted one or more brackets, leading to errors as they tried to solve their equation. A few wrote $\frac{1}{2}(12 + w)8$ but did not equate this to 78. Many were unable to form a correct equation, and others did not use the correct formula.

Question 17

This was a standard process that was not recognised or well-remembered by many candidates. A few candidates obtained the correct values but reversed them in the answer space. Many responses were to one decimal place, rather than two.

Question 18

(a) Most candidates gave the correct answer, however some reversed the coordinates or gave an answer that was not written in a correct form, for example ($x = 0$, $y = 5$) which could not be accepted.

(b) There were very few correct answers for this question. Most gave the answer (7, 8), the coordinates of P before the enlargement had taken place. Those who did attempt to find the coordinates of the image of P rarely got both values correct. A common error was to double both 7 and 8, leading to the answer (14, 16). Another common error was to give the answer (12, 11) from adding the width and height of the rectangle to the original coordinates. Both of these examples were awarded one mark for one coordinate correct.

(c) This question was found to be challenging by many candidates. Most found the area of the original rectangle and gave the answer 15 whilst some went on to double this value. Some candidates also used incorrect formulas for the area of a rectangle.

Question 19

(a) A common error was to put 39 in the region for $A' \cap B$, either with the correct value, 12, in the intersection, or with the intersection left blank. There were many responses where candidates put two or more numbers in a single region of the Venn diagram, sometimes leaving other regions blank.

(b) This question caused some difficulty for candidates. Some candidates did not realise that they could use their diagram from the previous answer and so they started again. These candidates often reached an incorrect answer by adding the three given values and not taking account of the fact that people who owned both cars and motorbikes were counted twice.

(c) Some candidates demonstrated their knowledge of this notation by either giving the correct answer of 12 or following through their diagram. The common errors were to give the answer of 0 or 1, presumably because there was no number or one number in their intersection.

Question 20

Many candidates did well here. A few spoiled their final answers by rounding to 33. Some reached the stage of finding 67.5, the percentage remaining, finishing before taking the final step. A significant number found that the loss was \$2535 and then divided this by 100 rather than by the original amount.

Question 21

(a) There were many good answers here, however some candidates gave their answer as $4x - 5$, with the factor of 7 discarded.

(b) This question caused real difficulty, with many unable to perform the first step correctly. Some tried to multiply by 4, but did not multiply every term, leading to the common error, $4T = \frac{r}{4} - p$. Some reached $T + p = \frac{r}{4}$, and then spoiled their final answer by omitting brackets, giving answers such as $4 \times T + p = r$.

Question 22

Some candidates were able to answer this question well. Most candidates attempted the elimination method, with the majority able to rewrite the given equations so that they had common coefficients. A significant number then performed the incorrect calculation, adding the equations when they needed to subtract or vice versa. Some added one side of their equations and subtracted the other. A large number of candidates made sign errors, often omitting a negative sign in one of the equations. Some candidates omitted the variable when using the elimination method, for example writing $28 = 112$ not $28y = 112$.

Question 23

There were some excellent answers here, with most candidates showing their full working. A small number of candidates gave a correct answer with no working; this did not score any marks. A few showed full working, but did not give their final answer in the form specified in the question.

The majority opted to write both mixed numbers as vulgar fractions and then find a common denominator, which worked well. A significant number were unable to convert mixed numbers to vulgar fractions.

Question 24

Very few candidates produced good responses here. Most of those who reached the stage of writing a correct starting equation went on to find that $x = 24$, which some gave as the final answer. A significant number did not see that they needed to use angles on a straight line equal 180 and so were unable to form the initial equation. Some started incorrectly by stating that $x + 132 = 180$, or $x + 132 + x = 360$. A large number opted to use the formula for the total of the interior angles as their next step and were unable to resolve this to reach a solution. Those who recognised that x was an exterior angle and used the method of $360 \div 24$ were often successful.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/12
Paper 12 (Core)

Key messages

Often questions were not attempted of more demanding topics, however, within these, were simpler questions that candidates could have attempted, given the knowledge demonstrated earlier in the paper.

Reading through a question after answering it to check the answer fits the demand of the question and is possible for the diagram or situation, is a key skill required by candidates.

General comments

There were a considerable number of well-expressed, correct solutions giving many high and very high total marks. However, those with lower total marks usually did not gain marks due to carelessness or not answering what was asked. Solutions from some were rather confused with scattered parts and unclear deleted sections. Not attempting a demanding two stage question often meant no marks were awarded for it but in most cases the starting point of the question was straightforward and could gain at least 1 mark, if attempted.

Presentation and clarity of working was generally quite good, but candidates always need to be aware of the way their responses appear to the Examiner, particularly with those needing several lines of working.

Comments on specific questions

Question 1

Most candidates gave the correct answer for half a million but some had 1 500 000 or added an extra zero.

Question 2

The last line of the question asked for the scale to be completed. Some candidates ignored this and did not gain this mark. The scale of one square per car was used by the vast majority. Vertical line graphs were seen from a few and a small number did not keep even gaps, or had unequal gaps, between the bars. Some gave a non-linear scale or wrote their numbers in the gaps on the scale instead of on the lines. Other linear scales were considered but most of these, apart from two squares per car, did not give accurate heights for 9 and 11.

Question 3

(a) Most candidates knew they had to divide 14 by 5 but a significant number subtracted 5 from 14 or multiplied by 5.

(b) There were only a few errors made on this part but those who only got **part (b)** correct might have realised that their **part (a)** was extremely unlikely to be the same answer as **part (b)**.

Question 4

(a) Most identified the specific name for the polygon shown but hexagon was often seen and occasionally, other polygons. Quite a number of candidates did not seem to know the specific names of the polygons.

(b) The question asked for all the lines of symmetry, but the most common response was just one vertical line. Those who realised there were more than one line generally got all the lines, but some missed one or two out.

(c) Many candidates were confused between rotational symmetry and line symmetry since they simply gave the number of lines drawn in **part (b)**. That meant that nearly all correct answers in this part were from those who got **part (b)** correct.

Question 5

(a) Around half the candidates did not manage to round the number correctly. Most errors were from adding zeros after a decimal point, while 53683.6 was often seen. Truncating to 53 600 occurred and confusion between thousands and hundreds meant 54 000 was seen. Some ignored the figures 53 to give answers such as 600 or 700, but many other inexplicable responses were also seen.

(b) Rounding to a decimal place was done better compared to **part (a)** but even so, there were still a variety of incorrect responses seen. Again, further zeros after the first decimal was the most common error made.

Question 6

Many candidates were well prepared and practised in constructions, resulting in many accurate results. A significant number of candidates either did not have compasses or did not use them, which meant a maximum of 1 mark for a close enough triangle. A small number of attempts had totally incorrect lengths or lines which did not meet at a single point or not at all.

Question 7

(a) The vast majority of candidates could work out where to put the brackets, but some ignored the instruction to give just one pair of brackets. Some did not make an attempt to answer the question.

(b) The possibility of bracketing 3 items seemed not to occur for quite a number of candidates. Those who realised this possibility usually got the correct answer.

Question 8

While there were many fully correct answers, a significant number of responses gained just 1 mark, nearly always from the c coefficient. Combining a negative and a positive term caused numerous difficulties, although only a few gave an answer that did not contain two distinct terms. The main example of a single term was $7cd$, often after the correct answer was seen.

Question 9

A large majority clearly knew that the base angles of the isosceles triangle were equal and applied the total of 180° for the triangle correctly to gain the value of x. Some subtracted 43 from 180 but seemed to realise that 137 was not correct, so halved that for their answer. Another error seen in some cases was subtracting the 43 from 90.

Question 10

Most candidates gained at least one mark for this question, usually for identifying the natural number correctly. 3.142 was often incorrectly identified as irrational, due to being recognised as an accepted value for π. Many realised the reciprocal of 4 was $\frac{1}{4}$, however some incorrectly chose $-\frac{1}{4}$ instead of the decimal value that was listed in the table.

Question 11

(a) The difference between a negative and a positive temperature was done well. Errors were often for −24 and from subtracting 8 from 16.

(b) Again, this was answered well, although −4 and adding 12 to the answer for **part (a)** instead of to town *A* were seen occasionally.

Question 12

(a) Candidates who were able to identify the correct angle to measure, usually measured the bearing within the range, although 140 was seen at times, which was outside of the accepted range. Some candidates measured the reverse angle of *A* from *B*. Many candidates gave a distance, 6.5 cm in most cases, for the bearing. Others simply worked out the distance according to the scale and gave that for **part (a)**.

(b) Finding the distance from measuring and converting the scale was far better done than **part (a)**. Some candidates measured the distance of 6.5 cm correctly but were unable to convert correctly or at all by the scale.

Question 13

(a) Some candidates added all 8 values of number of people, an example being 423, but most did identify the correct point. There were errors on reading the scale and 78 was often seen as well as reading the wrong scale giving the number of rooms, likely 46, for 67 people.

(b) Plotting a specific point was well done, with most candidates showing a point close enough for between 32 and 34 rooms.

(c) (i) Many candidates did not know what a line of best fit was, which meant that there were a significant number of no responses and zigzag lines joining the points on the grid. Most who did know what to do gave a line which was reasonable enough for the mark to be awarded but some drew a line from the origin to the last point or to the extremity of the grid.

(ii) Since the question did not insist on using the line of best fit, those who did not score the mark in **part (c)(i)** could still gain this mark, if they gave an answer in the range 27 to 33. Misreading the chart was common and some of those with a mark for their line from **part (c)(i)** did not use it to answer this part. However, there were a reasonable number of correct responses either from their line or judging a sensible value for number of rooms from 46 people.

(d) Most candidates understood the type of correlation, but some gave the answer negative or zero. There were a number of no responses, suggesting candidates either did not understand what is meant by the word correlation or were unable to use words to describe it.

Question 14

This reverse question of finding one of the parallel sides of a trapezium from a given area and other dimensions was the worst answered question on the paper. Almost all correct answers were from candidates who gained high marks on the whole paper. Some realised the area formula for a trapezium was needed but did not cope with, or omitted, the brackets. There were attempts to split the trapezium into a rectangle and a triangle or two triangles, but only a few of these were successful. Some were determined that Pythagoras had to be used, which did not help and a significant number did not know how to start.

Question 15

While there were a significant number of correct expressions for the total number of points, many gave an equation, rather than an expression. Some misinterpreted the wording and thought the 2 points applied to both draw and bonus points, resulting in 2*b* in their expressions. A significant number of candidates did not attempt it.

Question 16

There was a good response to the compound interest question from those who knew the difference between compound and simple interest and were familiar with the formula. However, a few candidates thought they had to then subtract 3600 which would give the interest instead of the value of the investment, which was being asked, while some added 3600 which had no meaning at all. A few did not gain the last mark due to incorrect rounding, usually with 4337.9, not correct for 1 decimal place.

Question 17

This question needed candidates to realise that the two expressions added to 180° and to show skills of forming and solving a linear equation. Only the higher scoring candidates gained marks with not many gaining all 4 marks available. Some did reach the correct value for *x* but then were often not sure about the final step. There were a significant number of no responses as well as various attempts to put the two angles equal to each other in order to find the value of *x.* Some correct attempts at finding a value of *x*, from an incorrect equation, gained 1 mark but no more was forthcoming after that.

Question 18

Most candidates knew how to tackle this powers question and went on to a correct answer. However, many divided the powers of *x*, rather than subtracting them, with a few subtracting 3 from 18 instead of dividing. The answer needed to be a single expression and not as a fraction with a denominator of 1.

Question 19

While there were candidates who clearly worked back from *B* to find the correct point, others did find points close to *A*. Had they then checked by applying the given vector from *their A*, more correct points may have been seen. The major error was to apply the vector to point *B*, to give point *A* at (7, 0) or other points to the right of point *B*.

Question 20

This was another 2-stage question which many of the higher scoring candidates did work through to a correct result. Many did not attempt the question or had little idea what was needed. Those who made progress did first attempt to find the radius from the area of the circle. With formulas not given, some mixed up those for area and circumference, but did at times gain a mark for using their radius correctly in finding the area of the triangle. A common error, after finding a value for the radius, was using Pythagoras to calculate the hypotenuse and thinking that was one of the two perpendicular sides. Over-rounding the value of the radius worked out correctly, but rounded to 6.2, often spoiled what would have been a correct solution.

Question 21

The vast majority of candidates changed the mixed numbers to improper fractions, most often correctly. Many continued to a fully correct answer, but some did not change the resulting improper fraction back to a mixed number, as the question stated. A small number did not show all their working by leaving out the resulting improper fraction from the multiplications of numerators and denominators. Decimals were also seen in responses, with some giving the answer 4.125, which is not a mixed number. Candidates need to be clear about which fraction questions require a common denominator since, in this case, those who used one generally only then multiplied the numerators.

Question 22

Candidates who had performed poorly on the paper managed good, usually correct, solutions to the simultaneous equations. While a few used the rearrange and substitute method, the vast majority followed elimination of one of the variables. Most did this correctly and only a few added the resulting equations instead of subtracting them. Those making errors on the arithmetic had the chance of a special case mark for 2 incorrect answers fitting one of the equations.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/13
Paper 13 (Core)

Key messages

Questions should be read carefully, such as in **Question 17** which states 'write down an equation'. In this case, candidates should ensure that an equation is written, rather than an expression. Showing all stages of working and checking that answers are reasonable are also essential.

General comments

Most candidates attempted all the questions, with many setting out their working in a clear and logical way. Others did not write their working, even when questions asked for working to be shown. Candidates generally did well on number questions, although some confused compound and simple interest.
The use of inefficient methods e.g. using a year-on-year approach rather than using the formula for compound interest, meant that accuracy was lost in the calculation.
Other topics which candidates found challenging were finding the interior angle of a polygon and finding the total amount when a fraction of the amount was given.
Candidates appeared to have used a calculator when needed and there was sufficient time to complete the paper.

Comments on specific questions

Question 1

Many correct answers were seen, the most common error was 6470.

Question 2

Most candidates gave the correct answer.

Question 3

Almost all candidates gave the correct answer. A small number of candidates used 65 rather than 65.1.

Question 4

Most candidates gave the correct answer, with only a small number giving the mean rather than the mode.

Question 5

All parts of this question were generally well answered; however, some candidates gave their answers as fractions rather than as letters, as asked for in the question.

Question 6

(a) (i) Most candidates gave the correct answer.

(ii) This part was generally well attempted by all candidates; however, some candidates wrote 7 rather than plus 7.

(b) This part of the question was not well answered. Some candidates wrote the next term or the term-to-term rule. Common incorrect answers included $n + 3$, $–4n + 3$ and $2n – 1$.

Question 7

This question was generally answered correctly, with the most common incorrect answer being $2p + 3t$.

Question 8

Both parts of this question were answered well.

Question 9

(a) Many candidates gave the correct answer, with others scoring 1 mark for correctly measuring the distance.

(b) Several candidates gave an incorrect answer of 245, the bearing of K from L, as they were unable to identify which angle was being asked for in the question.

(c) Many candidates gained 1 mark, usually for the length. Few candidates were able to plot *M* on the correct bearing.

Question 10

It was rare for a fully correct answered to be offered. Many candidates gained 1 mark for dividing by 6, but were unable to progress further, others then divided by 2. Some candidates instead found the square root of 121.5.

Question 11

The majority of candidates gave the correct answer to both parts of the question.

Question 12

Few correct answers were seen. Many candidates did not recognise that 2 was the gradient of the given line with 3x and -2x being the most common errors.

Question 13

(a) Some candidates were able to find the median with 1 being a common error.

(b) A common incorrect answer was 2.85 from adding the frequencies and dividing by 7. A few candidates worked out the total number of coins correctly but then divided by 7, rather than 20.

Question 14

Many candidates gave the correct answer however, a small number wrote $4x – 3$.

Question 15

Few candidates were able to give a completely correct answer to this question. It was very common to see the answer 24 from $360 \div 15$ or 2340 from 13×180.

Question 16

It was essential that candidates read the question carefully. Those that were able to do this, often gained full marks, others had not and instead found $\frac{7}{9}$ of 63.

Question 17

Although the question told candidates to write an equation, many did not do this and, as a result, 4 marks were rarely awarded. Several scored 1 mark for a correct expression of $3n$ or $3n - 2$, but then did not use their expressions in subsequent working. Others equated just $3n$ or $3n - 2$ to 54 and did not include n. There were several answers of 8 with either no working or just evidence that 8 + 24 + 22 = 54.

Question 18

This question was generally well answered, the most successful method was changing the given fractions into improper fractions first. Some candidates gave the answer as $\frac{4}{12}$; not cancelling their fraction to the simplest form prevented the final mark being awarded.

Question 19

(a) Several candidates were able to correctly complete the Venn diagram, however some wrote 32 in the section for only tea alongside the 6 that was already given. Some did not take account of the 8 outside the circles, they correctly wrote 26 in the middle but then wrote 15 in just coffee. A few candidates did not attempt this question.

(b) It was essential that candidates understood set notation for this question with 39 being the most common incorrect answer as they had used $n(C \cup T)$.

(c) Various fractions with a denominator of 47 were seen for this question, the most common incorrect answer seen was $\frac{40}{47}$ from those who do not *just* drink coffee and ignoring those who drink both.

Question 20

Candidates found this question challenging with few gaining full marks. Common errors were 463.8 and 464 or 462.9 and 464.9.

Question 21

Most candidates were able to correctly use their calculator to gain this mark.

Question 22

Many candidates did not use the formula for compound interest. Some did compound interest using year-on-year calculations and lost accuracy in their answer. Many candidates did simple interest instead.

Question 23

Many candidates were able to gain full marks for this question. Some used the Cosine of 42 rather than Sine. Others wrote the answer 6.5 without greater accuracy in the working, scoring 1 mark as non-exact answers need to be given to 3 significant figures as stated within the instructions on the front cover.

Question 24

The vast majority of candidates scored full marks for this question. Only a small number of candidates used subtraction and addition leading to an answer of 7.25.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/21
Paper 21 (Extended)

Key messages

Many candidates did not provide answers in the required format, especially in **Questions 8** (total interest was required) and **Question 17** (answers were required correct to 2 decimal places). It is crucial for all candidates to carefully read the question before providing their final answer.

Candidates should work to a higher degree of accuracy in their calculations than is required for the final answer. They should also be careful in the use of figures as using only two significant figures is insufficient.

General comments

There were instances when the formulae used were either incorrect or misapplied. Some examples of this were **Question 9** and **Question 16**.

In **Question 9** the formula $\frac{180(n-2)}{n}$ gives the internal angle for a regular *n*-sided polygon but many tried to use it with the external angle to find the number of sides. It is important to make sure to know the formula $\frac{360}{n}$.

In **Question 16** there were many different formulae used for the curved surface area of a cylinder such as πr^2, $\pi r^2 h$ or $2\pi rh + 2\pi r^2$.

There were also occasions in this paper when negative signs were misplaced during the course of the candidates' working, which invariably led to errors. This was particularly evident in **Questions 2** and **12**. It is also recommended to change a sign by overwriting it, minus can be easily changed to add or plus but not the other way round. This also makes assessing and marking work very difficult.

In questions which required several linked steps to reach the answer, in particular **Questions 14**, **16** and **20**, candidates sometimes lacked clarity in explaining their methods. This, once again, made accurate assessment and marking difficult.

It is recommended that candidates give a thorough explanation of the route or method they are attempting.

Comments on specific questions

Question 1

Most candidates correctly answered 22:32 or 10:32 pm as the solution. Some gave 22 hrs 32 min which is an expression of a period of time and so was not acceptable. Any answers that included notation that is used for degrees and minutes were also not awarded any marks.

Question 2

It was expected that $1\frac{1}{4}$ would be converted into $\frac{5}{4}$ and inverted, though many seemed to think they were merely being asked to undertake the first of those steps. Some that did produce $\frac{4}{5}$ felt that it required a negative sign in front of it.

Question 3

This was answered well by most. Those that were successful often showed some calculations, so finding $\frac{2}{7}$ = 0.2857142…from a calculator would have helped for the first part. Similarly using a calculator to check 99 divided by 900 and 1^3 and 4^0 should have made the other two parts straightforward.

Question 4

Most appreciated the need to divide 5.6 by the sum of 3 and 4 to produce 0.8, which they then multiplied by 4 to provide the solution. The most common error was to consider it as a proportionality problem and seek four-thirds or three-quarters of 5.6.

Question 5

(a) Most answered this correctly though some only multiplied the top element of the vector.

(b) This was answered well, a few seemed to be attempting some type of cross multiplication.

Question 6

(a) Most correctly found 58° by appreciating that 122° and *x* were angles on a straight line and so totalled 180°.

(b) Finding *y* = 39° proved more difficult for many. Some offered 58° which perhaps implies they saw some connection to **part (a)** or they thought that *y* and 122° were supplementary.

(c) Little working was shown in any of these three parts. In this part the easiest method involved subtracting the sum of *x*, 34°, and 17° from 360°. Alternatively, the value of *y* + 90° + 122° would also produce the solution.

Question 7

Most candidates produced the correct answer of 7(4*x* – 5). Those that did not usually appearing not to understand what was being requested or sometimes giving 1(28*x* – 35) as the answer.

Question 8

Most candidates found the simple interest correctly, though a common error was adding the original principal to the interest to give a final value of the investment. A few candidates did not recognise the question as simple interest and instead used the compound interest formula or attempted to find the value of the investment after three years by calculating the value year by year.

Question 9

Candidates who added the two angles of 132° + x and x together to equal 180° generally went on to get the value of x as 24°, although some of these appeared to be unfamiliar with the connection between the external angle and the number of sides. There were many who used various expressions involving $n - 2$, 180, x and n but they would usually write an incorrect equation down.

Question 10

(a) Those candidates who managed to obtain the correct answer used x as the probability of losing a game and then $2x$ as the draw. By writing this down, or mentally, they then solved $3x + 0.28 = 1$. The wrong answer of 0.36 occurred often as candidates just halved 0.72. The other common incorrect answer of 0.16 was from the wrong working of $1 - 0.28 - 0.56 = 0.16$.

(b) The majority of candidates gave the correct answer to this question. The most common mistake occurred where candidates used the answer they had obtained for the probability of a losing in the first part of the question, instead of using the 0.28 given in **part (a)**.

Question 11

The majority of candidates changed the mixed numbers to improper fractions and then found the common denominator. A small number dealt with the whole numbers first and then found a common denominator as well as dealing with the possibility of having whole numbers and a negative fraction.

Both methods were carried out very well. A number of candidates left the final answer as an improper fraction and not a mixed number. Most errors occurred from the conversion from the mixed number to the improper fraction.

Question 12

The two main methods used were firstly obtaining two numerically equal coefficients in either x or y in both equations and eliminating that variable by adding or subtracting the two equations together. The candidates who attempted this method overall did well but a noticeable number fell down when adding or subtracting the numbers.

This usually involved dealing with a double negative which many candidates did not do correctly. The second method was substituting one equation into the other once x or y had been made the subject. Most candidates managed to come up with the correct equation and achieved the correct substitution.

Once the substitution had been made, some of these candidates then could not manipulate the fraction part of the equation to obtain the correct value for x or y.

Question 13

(a) This was generally answered correctly, the two common errors were to find the first term of 2 or to calculate the second term incorrectly as $(3 \times 2)^2 - 1 = 35$.

(b) The first part finding the nth term for a linear expression was done very well by most candidates. The majority worked out the difference between each term in the sequence and used this well to obtain $4n - 10$. Only a small number of candidates gave the correct answer for the second part. Many candidates had the correct idea that they needed to keep on finding the difference between terms and many managed to find a third difference of 12 but very few were able to write the correct cubic expression, though some did know it was a cubic expression.

Question 14

In the majority of cases candidates used the linear relationship between the two heights given to find the missing volume. A large number of candidates did not recognise that to find the volume of the large statue, the units for density or mass had to be changed so they were both in the same units, either grams or kilograms.

Some candidates deduced volume incorrectly either by multiplying density and mass or dividing density by mass.

Question 15

(a) The majority of candidates manage to draw a box and whisker plot with the highest value, the median and the lower quartile correctly plotted. Many candidates could not work out the lowest value and the upper quartile value from the information in the question.

(b) Most candidates did compare directly the statistical terms given for marks in both tests P and Q, thus common answers included 'P had the greater median' and 'Q had the greater interquartile range'. The question asked for a comparison of the distribution of marks thus we required a description and comparison of what these two meant for the marks.

Question 16

Most candidates calculated the volume of the sphere correctly, but they often used the incorrect formulae for the cylinder. For the volume they would use $2\pi rh$ instead of $\pi r^2 h$ or they would use the correct formula but fail to take the square root. Few knew the correct formula for the curved surface area of the cylinder and would often use πr^2, $\pi r^2 h$ or $2\pi rh + 2\pi r^2$.

Question 17

A few candidates tried to factorise with no success whatsoever. Some of those who used the quadratic formula did not give the two correct answers because the fraction line did not include – *b*, the – *b* was given as – 7 not + 7, b^2 was calculated as – 49 not + 49 and the value of c was given as 16 not – 16. Some gave the answers to 1 decimal place and not 2 decimal places.

Question 18

(a) The correct answer usually came from $4^0 = 1$ hence $x + 3 = 0$. A common error was to work out 4^4.

(b) Many did not realise that they were solving $4^{x+3} = \frac{1}{16}$ and as $\frac{1}{16} = 4^{-2}$ thus $x + 3 = -2$. Common incorrect answers given were – 1 and – 3. Some attempted to use logarithms but were almost always unsuccessful.

Question 19

(a) The correct answer was seen quite frequently, though often with an additional number such as 1 or 3. Some gave the answer to **part (b)** here and gave this as the answer to **part (b).**

(b)(i) Not many gave the full correct answer as they would often omit the number 1.

(ii) Many gave the correct answer, but most showed no working at all so common incorrect answers were 1, 4 and 5. Some did not know the notation so they gave another set of elements.

Question 20

The most common error was to calculate *QS* from 18 × cos28° then 15.89 – 4 = 11.89 so the only mark available was the final method mark for a correct angle calculation from their triangle. Many candidates truncated or rounded too early and inaccurate numbers crept into their calculations, so they had the correct working but an inaccurate answer.

There was also much unnecessary working as some calculated angle *PSQ* then using cos 62° and in triangle *TQR*, instead of using the tan ratio, they would calculate *TR* then use either sin or cos.

Question 21

Many did not reach $\tan x = -\frac{4}{3}$ so they were unable to find the correct answers. Those who did usually gave the angle as –53.13…..° The correct answers were found by calculating 360° –53.13° and 180° –53.13°, some found the lower solution but not the higher one, others added or subtracted 53.13 from 270°.

Question 22

(a) The majority of candidates completed the initial expanding of two of the brackets to achieve either (x^2-2x+1) or (x^2+x-2) and this was multiplied by the third bracket. A few candidates made the mistake of writing the expansion $(x-1)^2=x^2-1$ and some replaced one of the $(x-1)$ terms with $x+1$.

(b) The first part involved rearranging $y=x^3-3x+2$ to $y=\frac{1}{2}\left(2x^3-5x\right)-\frac{1}{2}x+2$. As $\left(2x^3-5x\right)=0$, the required line is $y=-\frac{1}{2}x+2$. Drawing the line $y=-\frac{1}{2}x+2$ on the graph, the intersections of the cubic and the line gave rise to the required solutions of x. This proved difficult for most, though a number of candidates were awarded marks for a line with a *y*-intercept of 2 or for a line of the correct gradient even if it did not have the correct *y*-intercept. Some candidates solved $2x^3-5x=0$ algebraically to give the required solutions of x.

Question 23

Most did attempt this question by expanding the brackets, often getting $x^2-10x+25$ but they did not equate the coefficients of the powers of x. The common incorrect answers were 5 and −10 for p and 46 and −21 for k.

MATHEMATICS (WITHOUT COURSEWORK)

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

This paper was well attempted by the majority of candidates with many demonstrating good mathematical skills and presentation of method. Very few candidates were unable to cope with the demand of this paper. There was little evidence that candidates were short of time, as the vast majority attempted the last few questions. Candidates showed most success in the basic statistics and number skills.

The more challenging questions were generally geometry and mensuration questions. Many candidates showed little awareness of the dimensions of formulae they were using, as often mixed dimensions (e.g. an area + a volume) were seen in a calculation. Candidates were very good this year at showing their working it was rare to see candidates showing just the answers with no working.

Candidates are advised that if they work on additional pages, they should include the question number that the extra work refers to.

Candidates can improve upon the careful reading of the question and are advised to re-read the question as part of their checking process. This was noticeable in **Question 8**, where many found x rather than the size of the smallest angle; in **Question 12**, where many candidates did not read ‘directly proportional to the square root’ and either did the square or inverse, and also **Question 16**, where ‘a person is chosen at random from those who have a car’ and they calculated it out of the total.

Comments on specific questions

Question 1

This initial question was very successful with almost all candidates reaching at least one of $c = 3$ and $k = -39$ and the vast majority getting both correct. Of those that did not achieve full marks, it was most commonly from a slip such as forgetting the negative sign on the value of k.

Question 2

Almost all candidates gave the correct answer to this question. The most common incorrect answer was 137° from 180 – 43. Very occasionally $x + x + 43 = 180$ was the incorrect starting point resulting in another common incorrect answer of 68.5°. An error that occurred in a small number of cases was to assume that the missing angle was the same as the given angle so 43° was sometimes seen but was a less common incorrect answer.

Question 3

It was common to see candidates scoring 2 marks here, most usually for identifying the natural number and the irrational number. Most scored at least 1 mark (usually for identifying the natural number) although there were some who did not score any marks due to listing a number of answers for options when there was only one correct for each. The most common error for the reciprocal of 4 was to give $-\frac{1}{4}$ and less frequently giving –0.4 and for the irrational number 3.142 was fairly common, perhaps as it is an approximation for π.

Question 4

(a) The majority of candidates could read from the graph and answered this correctly, scoring 1 mark. A small minority read from the wrong axis and gave the most common incorrect answer of 46.

(b) The majority of candidates were able to correctly plot the given point representing 42 people and 33 rooms on the scatter diagram. Some candidates would benefit from using a sharper pencil for a more accurate plot. A minority of candidates plotted the point (33, 42) rather than the point (42, 33). The most common error was to misinterpret the scale, treating each small square as being worth 1 unit rather than 2 units when plotting their point therefore plotting their point. They did not always make this error consistently on both scales.

(c) (i) Where candidates drew a line of best fit, they were mostly accurate. Some candidates joined one point to the next with a succession of short lines and some did not realise that a line of best fit need not go through the origin. A very occasional curve was seen and a small minority did not attempt the question at all. Candidates should be reminded that they should use a ruler when drawing a line of best fit as freehand lines were sometimes seen.

(ii) Candidates who had drawn a line of best fit for **part (i)** were generally successful in using it to estimate the number of rooms in the building containing 45 people. Some candidates who had not drawn a line were still able to gain the mark in this part of the question for making an estimate based on the relative positions of the other points. Where incorrect answers were seen these were generally too high and perhaps came from reading the graph in the wrong direction (45 rooms rather than 45 people) as an answer of about 60 was common among the wrong answers

(d) This was the hardest part of **Question 4** for the candidates with quite a high omission rate. Whilst many candidates did answer using the word 'positive' there were a significant number of responses using terminology unrelated to correlation. Common answers which were not acceptable were 'linear', 'direct', 'increasing', 'proportional' or references to strength alone e.g. 'strong'.

Question 5

This was one of the more challenging questions on the paper. More able candidates performed better on this question as they understood the area scale factor element, less able candidates did not. 0.751, 0.0751, 751 and 75.1 were all common wrong answers with multiplying by 100 instead of 100^2 being the most common error. Quite a few candidates gave their answers in standard form: 7.51×10^4. However some candidates converted incorrectly to 7.51×10^{-4}.

Question 6

Correct responses to this question were widespread. Many candidates used the trapezium formula, some split the area into a rectangle plus a triangle, whereas a few resorted to a rectangle minus a triangle. A relatively common error when using the trapezium formula was to interchange 9.5 and 6.

This confusion may have come from the orientation of the trapezium in the diagram; candidates could improve by practising on 2D shapes with different orientations. Most candidates used an algebraic approach to finding x, others used trial and improvement. There were instances of the trapezium formula being misquoted and also of all dimensions simply being multiplied together and equated to 42.

Question 7

Almost all candidates showed correct working and gave the correct answer to the question. The most common method was to invert the second fraction and multiply, usually resulting in the correct answer. Some candidates showed common denominators, often leading to the correct answer, however this method more often went wrong than the method of multiplying by the reciprocal of the second fraction.

Many candidates showed cancelling before multiplying which is always more efficient, although in this case the numbers were easy enough not to cause any problems for those who multiplied first and then simplified. Some less able candidates inverted the incorrect fraction and others thought that common denominators were necessary for multiplying which led to some large values being used.

Question 8

This was successfully attempted by the majority of candidates, usually by equating the sum of the given two angles to 180. A small number unnecessarily doubled before adding and equated to 360. Most who reached $x = 11$ went on to score full marks although a few gave 11 as their final answer.

Those not realising the correct starting point made a variety of errors such as equating the two given angles, thinking the sum of opposite angles should be 360, or equating each angle to e.g. 90 or 180 and so obtaining two x values. Those with an incorrect initial equation were sometimes able to score M1 for simplifying an equation of the right form or for substituting their x value if it was in one of the acceptable ranges. A small number of candidates erroneously thought the product of the two given angles was needed.

Quite a few of the less able candidates did not offer any response to this question. Some candidates decided to introduce additional variables to represent the other two angles in the parallelogram usually leading to no marks being gained.

Question 9

This question was one of the most challenging questions on the paper with many of the less able candidates offering no response. Whilst there were still a good number of candidates able to give the required answer of 36π some who were able to calculate the area did not leave this in terms of pi as was required in the question.

A significant minority of candidates were not able to identify how to find the radius of the circle based on the area of the square. Some made a start to the process, but confused whether they were finding the radius or the diameter. Other common errors were to use the side length of the square as the diameter or radius of the circle or to work with a variety of other incorrect values.

Question 10

This question was well answered by most of the candidates. One of the most common incorrect answers was 1.66 or $\frac{7\sqrt{35}}{25}$ arising from finding the square root instead of the cube root or 1.24 from incorrect order of operations within the square root i.e. finding $\sqrt[3]{11.9 \times 0.16}$. Other answers were seen but as working was neither expected nor shown, it was not always easy to work out where these came from.

Question 11

(a) This question was successfully answered by many candidates, with a few gaining just B1 for a partial factorisation usually $3(8x^2 - 3xy)$ but sometimes $x(24x - 9y)$. Very occasionally 0 was awarded e.g. for those who only factorised for one term out of the two such as an answer of $3x(8x - 9xy)$.

(b) This was less successfully attempted than **part (a)**, although there was still a good proportion of fully correct solutions particularly among the more able candidates. Less able candidates often did not get beyond earning 1 mark for $7\left(9x^2 - 4y^2\right)$. The award of 2 marks for a partial factorisation was rare. It was common to see an attempt at the difference of two squares factorisation involving square roots e.g. $(3\sqrt{7}x + 2\sqrt{7}y)(3\sqrt{7}x - 2\sqrt{7}y)$.

Question 12

This was well attempted with around two thirds of candidates getting the correct answer. Successful candidates worked methodically through the stages of setting up the relationship, substituting to find the multiplier and then substituting into the final formula.

Some algebraic errors were made rearranging to find the multiplier but most candidates set out the working so that they could be awarded the two method marks. Candidates would sometimes use the correct relationship in the first instance and find the correct multiplier but then follow this with an incorrect relationship to find y.

For example, following a correct value of k = 3.5, an incorrect relationship such as $y = 3.5 \times 1.56$, $y = 3.5 \times (1.56 + 1)$ or $y = 3.5 \times \sqrt{1.56}$. Where candidates did not score it was often from incorrectly involved writing an incorrect initial equation involving k, such as $y = k(x + 1)$, $y = \frac{k}{\sqrt{x+1}}$, $y = k(x + 1)^2$ or $y = \frac{k}{(x+1)}$. Less able candidates made no use of the information given about y and x and went straight to $y = \sqrt{1.56 + 1}$.

Question 13

Whilst fully correct solutions were often seen among the more able, candidates should be advised to follow instructions carefully as many did not label their region R as instructed or shade as instructed. A number of candidates scored only 3 marks either by incomplete shading or indicating an incorrect region following three correct lines (often the wrong side of the diagonal line), or by drawing all lines solid, or by mixing up which lines should be solid and which dashed.

There was a small number who drew vertical rather than horizontal lines so could only score 1 mark for the diagonal line $y = x - 1$, which they often did.

Question 14

(a) This was answered correctly by the majority of candidates. Of those incorrect answers that were seen. the most common were 0.5, 0.2 and 20. These often came with working shown. Some candidates incorrectly used the full time shown on the graph (17 seconds) rather than 10 seconds in attempting to find the required acceleration.

(b) Most candidates appreciated that the distance travelled was found by calculating the area under the graph and many reached the correct answer. The most commonly used technique was to split the area into a rectangle and a triangle, with a smaller number of candidates opting to use the formula for the area of a trapezium. A few candidates quoted the correct formula but substituted values incorrectly. In some cases use of Pythagoras' Theorem was seen where the candidate tried to calculate the length of the given portion of the graph. The most common incorrect answer was 340, this generally coming from using distance = speed × time and other incorrect answers were seen.

Question 15

This question was answered well by about half of the candidates. The biggest error was to assume that the 15 per cent was constant each year. Therefore some found 15 per cent of 40 000 and then multiplied by 3, others did this in one go and found 45 per cent of 40 000 therefore the most common incorrect answer was 58 000 or 18 000. There were some misreads on this question as 4000 was sometimes used instead of 40 000. Some candidates rounded their value without showing the most accurate required answer of 60835. Candidates are advised there is an instruction on the front of the exam paper to round non-exact answers.

Exact answers should not be rounded. Some used an incorrect formula often $40000\left(1-\frac{15}{100}\right)^3$ instead of $40000\left(1+\frac{15}{100}\right)^3$.

Question 16

This was one of the more challenging questions on the paper. Virtually all candidates attempted this question, with only about half of them being successful. The most common error was not realising that the person was being chosen from those who have a car, and instead taking 51 as a fraction of the total, giving $\frac{51}{75}$ as a common wrong answer.

Question 17

Many candidates gave the correct answer to the question although there was also a significant number who offered no response. A few different methods were seen, the most common being to find the obtuse angle *AOC* and then use angles in a quadrilateral with the two right angles. Some chose to use two right-angled triangles rather than a quadrilateral, drawing a line from *O* to *D*, although a few forgot to double the value they found, giving $\frac{1}{2}x$ rather than x. Those who did not get the correct answer often gained 1 mark for showing the right angles correctly on the diagram or showing obtuse angle *AOC* = 128. Errors after 128 was correctly found usually involved taking the reflex angle of 232 and halving to give 116 for x or halving 128 to give 64 for x. Those who did not gain any marks often thought the answer was 64 with no other working or took 64 from 180, possibly misunderstanding and wrongly using the properties of a cyclic quadrilateral. Others were trying to find angles *BAO* and *BCO*.

Question 18

(a) Whilst many scored full marks, placing the numbers in the Venn was problematic for many others. A significant number of candidates gained 1 mark for correct conversion to decimal form and then went no further. Those scoring zero usually did not list equivalent decimals for the given numbers. Most successfully placed was 8×10^{-1} whilst there was often no significant pattern in the incorrect placement of the other elements.

A small number of candidates seemed to think, incorrectly, that they should write the *number* of elements in each part of the Venn rather than entering the elements themselves. A common error was ‘choice’ whereby candidates, frequently inadvertently, placed the same value in different positions of the Venn diagram.

For example 8×10^{-1} and 0.8 were often placed in separate sections. In some cases, this seemed to be due to candidates either misunderstanding the recurrence symbol, or possibly not noticing it. Quite a few seemed not to know that values can go outside the two circles, scoring 2 marks for three correctly placed but with 8 per cent either missing or placed inside a circle.

(b) This question was answered well by approximately two thirds of the candidates. Of those who shaded the diagram incorrectly a common misconception was to shade just AUC or just B’. Another common wrong answer was to shade the region (A ∩ C) ∩ B’.

Question 19

(a) There were a good proportion of fully correct answers seen. The volume of a sphere or a hemisphere was generally correctly calculated, although some candidates incorrectly used r^2 in their calculation rather than r^3. The volume of a cylinder was more challenging. Common errors here included multiplying the correct volume by 2 or working with r rather than r^2. Some candidates lost accuracy due to using an approximate value of π such as $\frac{22}{7}$ or by rounding in intermediate steps.

(b) This part of the question was more challenging for candidates than **part (a)** and fully correct answers were in a minority. Many candidates gained marks for $\pi \times 4.3^2 \times k$ which generally came from attempts at the curved surface area of the hemisphere or the area of one or more circles. A common error was to include more than one circular face in the calculation, miss the circular face altogether or to forget to halve the surface area of the sphere to find the curved surface of the hemisphere. Or a combination of those errors, so it was rare to award 3 marks. Candidates are advised to not leave answers in terms of π when answers are not exact. For example a few candidates gave the rounded answer 158π instead of the exact answer $\frac{15781}{100}\pi$.

Question 20

This question was a good discriminator, with the more able candidates answering it best. Many candidates scored at least 1 mark for recognition of terms being powers of 7. Many left their answer in an un-simplified form. A common error was to think this was a linear sequence or quadratic sequence and often the less able candidates tried to use differences to find an nth term involving $7n$.

Another error was to reach a correct expression $\frac{1}{7} \times 7^{-1}$ and then to incorrectly simplify $\frac{1}{7} \times 7$ so a common incorrect answer was 1^{-1}. Many candidates recognised that each successive term was 7 times the previous and either had $\times 7$ written between each term then stopped, or they wrote the next term in the sequence, 16807, as their answer.

Other very common incorrect answers were 7^{n-1} or 7^n. Many candidates preferred to attempt using a formula on this question, however it was common among the less able candidates to see the arithmetic rule: $a + (n-1)d$ used rather than the correct ar^{n-1}.

Question 21

This was one of the more successfully answered questions on the paper with many working clearly and methodically and obtaining 3 marks. The award of B1 was usually given for correctly multiplying out the first 2 brackets, this was then very occasionally followed by then expanding $x^2 + 8x + 15(2x + 1)$ rather than $(x^2 + 8x + 15)(2x + 1)$. Less able candidates often tried to evaluate the whole expression in one go multiplying various terms from various pairs of brackets and ending up with a string of terms that were not correct. Some expanded the three sets of expressions in pairs often the first two brackets and then the last two brackets followed by summing the outcomes.

When doing this, candidates had little appreciation that this resulted in a quadratic expression rather than a cubic expression. Many reasons for lost marks were careless errors, for example $8x \times 2x$ resulting in $16x$ rather than $16x^2$ or occasionally summing just one of the pairs of terms rather than finding the product. Having expanded all the brackets accurately and reached a correct answer several candidates did not correctly transfer this answer to the answer line.

Candidates are advised to check for transcription errors carefully as these are not allowed when the mark scheme says ‘final answer’ so this resulted in a loss of the final mark and for some candidates this was the only mark they lost on the paper. This was the main way of scoring 2 marks and 2 marks was rarely awarded otherwise.

Question 22

A large proportion of candidates found the correct equation of the line. Candidates worked methodically through the question, often showing detailed working so that marks could be awarded even when errors were made. If the correct answer was not reached, the most common mark awarded was 2, for finding the gradient of 5 and the gradient of the perpendicular of $-\frac{1}{5}$. From here it was extremely common for one of the given points to be substituted, so candidates should be reminded that the perpendicular bisector must go through the midpoint. Some candidates omitted the negative for the gradient of the perpendicular, but of those who knew that it had to change, the vast majority found the correct value.

Candidates of a lower ability found the gradient of 5 but then did not know how to proceed further and often gave the answer $y = 5x + c$, leaving c as the letter or a seemingly random value. Candidates often found the correct gradient of the perpendicular but then confused the two gradients, using the gradient of 5 to substitute with a point, either the correct midpoint or one of the given points, rather than $-\frac{1}{5}$.

Question 23

This was the most challenging question on the paper. Whilst correct answers were sometimes seen, many candidates achieved no marks. The most common error was to use the percentage increase as a linear factor reaching the incorrect answer of 6.05.

A common error among those realising they needed to cube root was to use factor 0.726 instead of 1.726. Those avoiding both these errors usually went on to reach the correct answer so part marks were not common. Other errors seen included cubing or square rooting rather than cube rooting. There was a high level of non-response for this question among the lower ability candidates.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/23
Paper 23 (Extended)

General comments

To succeed in this paper, candidates need to have completed full syllabus coverage, remember necessary formulae, show all necessary working clearly and use a suitable level of accuracy. It is also important that candidates read the question carefully to establish the form, units and accuracy of the answer required.

This examination provided candidates with many opportunities to demonstrate their skills. It differentiated well between candidates with a full range of marks being seen. Many high-scoring scripts were seen, and there was no evidence that the examination was too long. Some candidates omitted questions or parts of questions, but this was likely due to a lack of knowledge rather than time constraints. Some candidates' handwriting was not as legible as others, which may have contributed to the errors in their work. There were also instances where working was not shown clearly, showing working allows for the award of part marks when the correct answer is not seen.

It is important to take care when manipulating algebraic expressions. Some errors were caused by insignificant writing and some by not applying the laws of algebra correctly. For example, in **Question 10** where they were subtracting mixed numbers and working was required.

As in previous series, there were some questions where candidates rounded to an unsuitable level part way through calculations, this was particularly evident in **Questions 16**, **18** and **22**. Premature rounding sometimes led to inaccurate final answers. Candidates should keep greater amounts of accuracy in intermediate steps than they required for their final answer. Candidates should also be mindful that completing working in one line when they should use several lines, or not showing intermediate steps in working, means that they can miss the opportunity for method marks.

Comments on specific questions

Question 1

In part **(a)** of this question candidates were asked to identify a cube number from the list. Almost all candidates answered this correctly. A minority of candidates gave the answer of 4^3 for **(a)** which demonstrated understanding of cubing, but was not a cube number as required.

In part **(b)** of this question candidates were asked to identify a prime number from the list. The vast majority of candidates were able to answer this question correctly giving the answer of 61 or 67 or, in a minority of cases, both 61 and 67.

Question 2

This question, on calculating the time taken for a given journey, was answered well with the vast majority of candidates arriving at the correct answer of 7 hours 45 minutes. Many candidates worked out the correct answer without showing any working, some ‘counted on’ in half hours, whilst others calculated 30 minutes until midnight and then added 7 hours 15 minutes. Where incorrect answers were seen the most common of these were 8 hours 45 minutes.

Question 3

Here candidates were asked to simplify a linear algebraic expression. This was very well answered by the majority of candidates. Where working was shown this usually consisted of using a grouping method i.e., $3p - p - t - 4t = 2p - 5t$. The most common error seen was the answer of $2p - 3t$ from incorrect working with the two negative terms in t.

Question 4

This question was based upon a scale drawing representing the relative locations of two towns. In part **(a)** of the question candidates were asked to find the actual distance between the two towns. This was generally answered well with the vast majority of candidates able to give an answer in the acceptable range having measured the line accurately and then utilised the given scale factor.

A minority of candidates measured the length of the line incorrectly or measured it in mm then used this as the cm reading. Even where the line length was incorrectly measured, most candidates realised that they needed to multiply their length by 10, although a small number divided by 10, or even to tried to covert cm into km.

Part **(b)** of the question asked candidates to measure the bearing of town L from town K. This proved more challenging for candidates with only slightly over half able to give a bearing in the acceptable range. The most common incorrect answers seen were often attempts to give the bearing of town K from town L.

Question 5

Part **(a)** of this question required candidates to find the median from a frequency table. This was answered very well with incorrect answers rarely seen. Candidates generally did not show working. Where incorrect answers were seen the most common of these was an answer of 3 which is the median of the headings for number of coins (disregarding the frequency information).

In part **(b)** of the question candidates were asked to calculate the mean from the frequency table. This was also answered well with a high proportion of fully correct answers seen. Many candidates showed clear working either in the answer space provided or next to the table, this enabled the award of partial credit to the candidates who made an arithmetic error in or who incorrectly evaluated 0×3 as 3.

Question 6

In this question candidates were expected to calculate the size of an angle by using the sum of angles around a point. This was answered correctly by almost all candidates.

Question 7

The majority of candidates were able to correctly solve the linear equation presented in this question.

Where fully correct answers were not seen most candidates were able to show a correct isolation of terms in h and numerical terms for example $5h - h = 3 - 7$ or $7 - 3 = h - 5h$. It was not then uncommon to see $3 - 7 = 4$ or $h - 5h = 4h$ leading to the incorrect answer of 1.

Question 8

This question required candidates to write an expression for the cost described in the text. This question was answered well by most candidates. Some candidates gave answers of $b(12) + m(5)$ or $C = 12b + 5m$ which were both accepted.

Where incorrect answers were seen these were often the result of incorrect algebraic manipulation in an attempt to simplify the expression, for example $60bm$ or $12b5m$, or an incorrect expression combining the variables and constants in the question, for example $12 + 5 + b + m$.

Question 9

This question differentiated between candidates well. There were a high proportion of fully correct answers which commonly used either $180 - \frac{360}{15} = 156$ or $\frac{180 \times (15-2)}{15} = 156$ to find the size of the interior angle. Where the correct angle was not found common errors included finding the external angle 360/15 = 24 or finding $180 \times (15 - 2) = 2340$. Another incorrect approach was $\frac{180 \times (15-1)}{15} = 168$.

Question 10

In this question candidates were required to subtract two mixed numbers and to show their working, giving their answer as a fraction in its simplest form. This was well answered by the majority of candidates with most able to show clear working and obtain the correct answer in the required form. The most common approach used was to write the mixed numbers as improper fractions, $2\frac{1}{4} = \frac{9}{4}$ and $1\frac{11}{12} = \frac{23}{12}$, and then to find a common denominator of either 12 or 48. A small number of candidates dealt with the whole numbers and the fractions separately. This method was generally less successful. In a small minority of cases candidates were not successful in giving their answers in its simplest form.

Question 11

This question on solving a pair of linear simultaneous equations was well answered by most candidates, although some did find it challenging. Most candidates were able to find the two unknowns and incorrect answers were rarely seen. In a minority of cases candidates were able to find one of the two values correctly but made an error in process or arithmetic when finding the second value, these cases were equally split between those who made errors in p and those who made errors in q.

Question 12

This question differentiated well between candidates. There were a majority who were able to correctly rearrange the formula to write x in terms of V and y as required generally starting by cubing on both sides, before multiplying through by y. Some candidates struggled to deal with $\sqrt[3]{\frac{x}{y}}$ and incorrectly multiplied both sides by y before cubing obtaining $vy^3 = x$ or $(vy)^3 = x$. Others incorrectly used cube rooting rather than cubing as a first step and obtained an answer of $x = y\sqrt[3]{v}$.

Question 13

Question 13 required candidates to find the nth term of two sequences. In part **(a)** the nth term was $29 - 8n$ which was found correctly by a majority of candidates, although the answer was given in a range of different ways. A common error was to use $8n$ in the answer rather than $-8n$.

In part **(b)** the sequence had an nth term of $5 \times 2^{n-2}$. This question was less well answered with many candidates using the difference method in an attempt to find a quadratic or cubic expression. Those who realised that it was geometric sequence usually scored at least 1 mark for the expression 2^n .

Question 14

This question tested candidates understanding of circle theorems.

In part **(a)(i)** of the question candidates needed to recognise that angle *ADB* and angle *ACB* are equal due to being subtended by a common arc. A majority of candidates were able to correctly recognise that this was the case. Where incorrect answers were seen these were commonly due to assuming $x = 37$.

In part **(a)(ii)** of the question candidates needed to identify that the alternate segment theorem. This was less well answered than **(a)(i)** but there were still a good proportion of correct responses. Common errors were assuming $x = 41$ (perhaps from misunderstanding the alternate segment theorem) or came from assuming angle DAB was 90 degrees leading to an answer of 49 degrees.

Part **(b)** proved to be challenging for candidates and differentiated well across the range of knowledge and abilities. This was answered correctly by around half of the candidates. In order to answer this question candidates needed to use the fact that the angle at the centre is twice the size of the angle at the circumference. Where candidates were successful in answering the question they generally identified that *POR* = 230 and it was rare to see use of the alternative method using angles in a cyclic quadrilateral followed by angle at the centre being twice the angle at the circumference.

Common incorrect answers were 115 or 65 degrees. Many candidates incorrectly assumed that PORQ was a cyclic quadrilateral.

Question 15

(a) Candidates were asked to find the median height of the plants represented in the box-and-whisker diagram. This was well answered with the majority of candidates achieving full marks by reading from the diagram. Where incorrect responses were seen these commonly included an answer of 36.5 by finding the semi interquartile range and adding this to the lower quartile value i.e., 20 + $\frac{53-20}{2}$, finding the midpoint of the range i.e., $\frac{78-10}{2}$ = 34 or calculating the average of the highest and lowest values of the scale i.e., $\frac{78+10}{2}$ = 44 .

(b) In part **(b)** candidates were asked to find the interquartile range of the height of the plants represented in the box-and-whisker diagram. This was well answered with the majority of candidates achieving full marks by reading the appropriate figures from the diagram and finding the interquartile range. Where incorrect answers were seen the most common errors were giving the semi-interquartile range $\frac{53-20}{2}$ = 16.5, stating the median of 28 or the range of 68.

Question 16

In this question candidates were asked to calculate the shortest distance from point *C* to the side of the triangle *AB*. This was a generally well answered question with most candidates drawing the shortest distance on their diagram and indicating that it was the perpendicular distance.

Where candidates worked correctly most used the direct approach of 17.2sin [33.14], but a small proportion used a longer but correct method, calculating the length of other sides in the triangle before using Pythagoras to achieve their answer. Use of longer methods often led to a loss of accuracy for their final answer generally due to rounding in intermediate calculation steps. A small number of candidates calculated the area of triangle *ABC* using $\frac{1}{2}ab\sin C$ and then equated this to $\frac{1}{2} \times 20.3 \times h$, this method usually led to the correct answer. Where incorrect answers were seen some gained a mark for identifying that the required distance was the perpendicular distance, however not all candidates recognised this. Incorrect approaches often attempted to use Pythagoras' theorem or trigonometry in a range of incorrect calculations.

Question 17

In this question candidates needed to use laws of indices to simplify the calculations given.

(a) This part of the question was answered correctly by the majority of candidates. Where candidates did not gain full marks they were sometimes able to gain 1 mark most often for finding the correct coefficient of 6. A common error was to give an answer of the form ax^6 having divided the indices rather than subtracted them. A small number of candidates incorrectly gave their answer as 6^{15}.

(b) This part of the question was more challenging than **(a)** but was still answered well. The majority of candidates were able to use index laws to find the correct answer of $25y^{50}$. Some candidates were able to find the coefficient of 25 but were not successful in dealing with $(y^{75})^{\frac{2}{3}}$ or, less commonly, found y^{50} but unable to show correctly with the coefficient with answers such as $125y^{50}$ seen. An incorrect coefficient of 83 was also commonly seen.

Question 18

In this question candidates were told that there were two mathematically similar solids with volumes of 81 cm^3 and 24 cm^3 and that the smaller solid has a height of 4.8 cm. They were then asked to find the height of the larger solid. This question was answered correctly by around half of the candidates who commonly used $\sqrt[3]{\frac{81}{24}} \times 4.8$ (= 7.2) to find the required height. Only a few candidates achieved partial marks usually by early rounding i.e., $\sqrt[3]{81} = 4.33$ and $\sqrt[3]{24} = 2.88$ leading to $\frac{4.33}{2.88} = 7.22$ or by showing a scale factor of $\frac{3}{2}$ or $\frac{2}{3}$.

Where incorrect answers were seen these commonly used the linear scale factor and found $\frac{81}{24} \times 4.8 = 16.2$. Other incorrect approaches included square rooting the scale factor $\sqrt[2]{\frac{81}{24}} \times 4.8 = 8.81$ and cubing the scale factor $\left(\frac{81}{24}\right)^3 \times 4.8 = 184.528125$.

Question 19

This question was on inverse proportionality and asked candidates to find an algebraic proportionality relationship. This was answered correctly by around half of the candidates. Where fully correct answers were not obtained, there were a good proportion of candidates who were awarded 1 mark for the expression $y = \frac{k}{\sqrt{x+2}}$. Common incorrect approaches included working with direct proportionality rather than inverse proportionality, $y = k\sqrt{x+2}$, or wouldn't be able to recognise the need to calculate a value of k leading to an answer of $y = \frac{1}{\sqrt{x+2}}$. There were a number of instances of candidates making arithmetic errors when calculating the value of k.

Question 20

In this question candidates were asked to solve the equation $\tan x + 2 = 0$ for $0° \le x \le 360°$. This differentiated well between candidates. There were a good number of fully correct answers seen, however there were also significant numbers of candidates who gained only partial marks or who were not able to make any progress with the question.

Many candidates were able to write $\tan x = –2$, often going on to find one correct value which was awarded B2. However, many struggled to find the second value in the range. Some candidates were not able to find a correct angle who wrote $\tan x = –2$ but did gain the SC1 mark for two angles with a difference of 180° in the range 0° to 360°. Some candidates did not seem to know how to find the angle from $\tan x = –2$ and it appeared that in some instances they had used trial and improvement to try to find x from this stage in working, others incorrectly calculated tan (–2).

Question 21

This question was based on a Venn diagram and set notation.

(a) Candidates were asked to use set notation to describe the shaded region of the Venn diagram. This was not well answered with the majority of candidates giving incorrect answers. The answer of $(B \cup C) \cap A'$ was the most common of the correct responses seen, however equivalents such as $(A' \cap B) \cup (A' \cap C)$ were also seen. Common incorrect responses were $B \cup C \cap A'$ or $(B \cup C) \cup A'$ or $n((B \cup C) \cap A')$.

(b) This part of the question was answered correctly by a greater proportion of candidates than **(a)**. Slightly more than half of candidates were able to correctly give $n(A \cap B \cap C)$ as 5. Common incorrect responses were 1, perhaps because the candidate thought 5 was the element not the number of elements, or 4, maybe because the candidate thought of the number of values presented within the intersections of the Venn diagram.

Question 22

This question asked candidates to calculate the angle between the diagonal *PB* and the base *ABCD* of a cuboid. This was generally a well answered question with many candidates scoring full marks. Candidates achieving 3 marks usually prematurely rounded their answer for the length PB, leading to an inaccurate final answer.

Most candidates were able to gain at least 2 marks, calculating the length of *PB* and/or the length *BD*. It was not uncommon to see candidates calculating the length of *AP* and/or *PC* but gaining no credit as these lengths were not required to find the required angle.

It was common to see incorrect trigonometry used, including calculating the angle *BPD*. Many candidates were able to achieve 1 mark for recognising the angle that they needed to calculate and labelling this on the diagram, although some incorrectly indicated the required angle as *PBA*.

Question 23

This question on completing the square was answered correctly by around half of the candidates. A common incorrect answer was $(x + 4)^2 – 9$ or $(x + 4)^2 + 9$, both of which gained 1 mark for $(x + 4)^2$. Other incorrect responses struggled to make a start and could not find the value of a.

Question 24

This question was on calculating with bounds. Candidates were told the area of a rectangle correct to the nearest square metre, the length of the rectangle to the nearest metre and asked to calculate the upper bound for the width of the rectangle. This was answered correctly by a majority of candidates achieved full marks on this question. Where incorrect answers were seen the most common errors were not using bounds in the calculation and finding $\frac{150}{22}$ = 6.818181… which was sometimes approximated to 7. Other incorrect answers came from using only one correct limit in a dividend e.g., $\frac{150.5}{22.5}$ or $\frac{150.5}{21.5}$. Many candidates were able to gain partial credit for a correct bound being seen for either the area of the rectangle or the length of the rectangle.

Question 25

This question on simplification of an algebraic fraction proved challenging for most candidates with only a minority ably to give a fully correct answer. Many candidates were able to gain partial marks for the correct factorisation of terms in the numerator and/or denominator.

Many candidates gained 1 mark for the partial factorisation of the numerator but struggled to fully factorise. This was then often followed by incorrectly cancelling only one term in the numerator with the same term in the denominator i.e., $\frac{3x(1-y)-2(1-y)}{(1-y)(1+y)} = \frac{3x-2(1-y)}{(1+y)}$ or $\frac{3x(1-y)-2}{(1+y)}$. A small number of candidates partiality factorised the numerator and correctly cancelled leading to the correct answer $\frac{3x(1-y)-2(1-y)}{(1-y)(1+y)}$ $= \frac{3x-2}{(1+y)}$. A common incorrect attempt to factorise the denominator was $(1 – y)(1 – y)$.

Question 26

This question on vectors was found to be challenging by most candidates with only a small minority able to find the required vector. A significant number of candidates were not successful in interpreting the ratio AK:KB, others incorrectly gave the vector $\overrightarrow{AB}$ as ***a*** – ***b*** or $\overrightarrow{BA}$ as –***a*** + ***b***. There were also a number of attempts which were unable to show what routes given in working represented. It was common to award 1 mark for a correct vector route for AC along lines in the diagram or for finding $\overrightarrow{AK} = \frac{2}{3}$(–***a*** + ***b***). In some cases, candidates wrote expressions which were not vectors including products of vectors and incorrect attempts at using Pythagoras' theorem with the vectors given in the question.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/31
Paper 31 (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 communicate their answers effectively.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. There was enough time given for the majority of candidates to complete the paper, attempting most questions. The standard of presentation and amount of working shown was generally good. In a multi-level problem-solving question, the working needs to be clearly and comprehensively set out, particularly when done in stages. Centres should also encourage candidates to show which formulae was used, substitutions made, and calculations performed. Attention should be made to the degree of accuracy required. Candidates should avoid premature rounding as this often leads to an inaccurate answer. Candidates need to read questions carefully to ensure the answers they give are in the required format and answer the question set, using common sense to check if answers are reasonable, e.g. **Question 9(b)**. Candidates must write digits clearly and distinctly and, when correcting errors, rewrite their answers rather than writing over the original answer.

Comments on specific questions

Question 1

(a) This question was well-attempted, with most students responding correctly and demonstrating a clear understanding of place value. Common errors included too many or too few zeros between 6 and 3 or misplacing the 3 e.g. 6 300 000.

(b) Rounding to 2 decimal places was generally well-attempted, however only around half of the candidates answered this correctly. The most common error was omitting the zero, giving an answer of 7.9 instead of 7.90 when the question was explicitly asking for two decimal places.

(c) (i) Most candidates answered all parts to **(c)** well, understanding they needed to choose a number from the list provided. Weaker candidates, however, often gave values not in the list of numbers. Identifying a multiple of 16 was well answered with the majority identifying 48. The most common wrong answer was 8, a factor rather than a multiple.

(ii) More candidates were able to identify a factor of 24 from the list, although the most common error was to give a multiple of 24 instead of a factor.

(iii) Identifying a cube number from the list was the least successful part of **(c)**, the most common error was choosing 25 or 36, confusing square and cube numbers.

(iv) More candidates were able to identify the prime number in the list, although common wrong answers were to choose the odd numbers in the list (25 or 39). Prime numbers not in the list were also common wrong answers given by weaker candidates.

(d) Putting a pair of correct brackets in the statement was the most successfully answered part of question 1, with most candidates getting it correct. The use of more than one set of brackets was seen, but rare. The most common error was placing the brackets around the (12 ÷ 4). This question was not attempted by several candidates.

(e) This question was found to be challenging for candidates. It required both accurate rounding to 1 significant figure and careful calculation. Around a third of candidates managed to complete it correctly, showing each value rounded to 1 significant figure and a correct answer of 10. The most frequent errors seen were not rounding all numbers correctly to 1 significant figure, e.g. 596 or 6 instead of 600, 8.7 instead of 9 or 0 instead of 0.05. Adding trailing zeros to decimal numbers was also common, e.g. 9.00 or 0.050 instead of 9 and 0.05 or using calculators to perform the full calculation before rounding at the final stage, which did not follow the instructions given in the question.

(f) Many candidates were able to use their calculators to type in the values given and get an answer of 240 000 but most then struggled to turn this back into standard form. Therefore, the most common wrong answers given were 24×10^4 or 240×10^3 or 240 000. Candidates who converted each number from standard form to an ordinary number, then performed the sum and then converted back to standard form were less successful than those who multiplied 8 and 3 and 10^6 and 10^{-3}.

(g) This question required students to express 2160 as a product of prime factors. Around half of the candidates correctly multiplied the prime factorisation of 216 by 2 × 5. Many candidates did not use the fact that 2160 = 216 × 10 and used factor trees or tables to factorise 2160 from scratch – this often led to the correct answer but many candidates went wrong with the number of 2's or 3's in their answer. Candidates who did recognise that 2160 = 216 × 10 often left their answer as $2^3 \times 3^3 \times 10$ instead of factorising the 10 to 2 × 5.

Question 2

(a) (i) Most candidates were able to identify *x* as 38° however fewer were able to give the geometrical reason including the key words 'alternate angles'. Many referred to the angles as 'alt' or 'alternative' or as a 'Z' angle, none of these gained a mark. Common errors were 52 (angles adding to 90) or 142 (angles adding to 180).

(ii) Similar to part **(a)(i)** candidates were generally good at finding the missing angle but not as good at stating the geometrical reason. As before, 'F angles' was seen frequently but gained no mark. The most common wrong answers were 38, or 111 (180–69) or 90.

(iii) Around half of the candidates were successful in finding the value of *z* to be 31. The most common wrong answer was 73 from 180 – 69 – 38. 111 was awarded B1 if seen in the correct place on the diagram, however this was rare. Candidates who could answer **(a)(i)** and **(a)(ii)** with the correct angle, usually went on to score 2 marks here. Candidates who used the diagram, by adding missing angles, tended to do better than those that did not.

(b) (i) The vast majority of candidates correctly gave the mathematical name of line XY as tangent, although many alternative spellings were seen and condoned. Common errors were 'chord' or 'straight line'.

(ii) Fewer candidates gave the correct name for line SR although around two thirds did identify it as a chord (or cord – which was condoned). Common wrong answers were sector, diameter, arc or rope.

(iii) Giving a geometrical reason to explain why shape RST was not a right-angled triangle was one of the most challenging questions on the whole paper, with few correct answers seen and many candidates not attempting the question. A significant number of candidates tried to explain by measuring or noting that none of the angles were right angled and therefore not a right-angled triangle. The question required the application of a circle theorem and explanation of why the criteria was not met, not simply saying one of the angles was not a right angle. Some candidates attempted to use the correct circle theorem statement but did not state what was incorrect about Toby's statement. Others attempted to use the wrong circle theorem statement about the right angle formed between a radius/diameter with a tangent. The most successful answers simply said that 'line ST did not go through the centre of the circle'.

Question 3

(a) (i) Nearly all candidates correctly identified the percentage from the bar chart.

(ii) Most candidates correctly used the percentage from the bar chart to calculate the number of people who use a bicycle as 392. The most common errors involved the calculation of 40% of 980 (often seen as 980 / 40), or the correct method spoilt by finding 40% (392) and then subtracting this from 980, therefore calculating 60% and scored no marks.

(b) The majority of candidates were able to gain part marks by calculating the total time by multiplying 18 by 23 (414) minutes, but many then struggled to convert this to hours and minutes. The most common errors seen were 6h 9mins from 414 / 60 = 6.9 hrs or 4 h 41 mins. Some weaker candidates were confused by the phrase ‘trips in one year’ and included facts from a year – 365 days, 12 months or 52 weeks, which were not needed to complete the question.

(c) (i) Most candidates were successful in filling in the missing angles for the pie chart. Some weaker candidates made errors with the angle calculations, either due to poor arithmetic or calculating the percentages, rather than the angles. Few candidates showed any working out so, if they did not get the correct values, few method marks were awarded.

(ii) Completing the pie chart was well-attempted by most candidates. Presentation was good with most using a protractor, ruler and pencil to complete the pie chart. There was a FT available from the table, although this was rarely given due to most errors on the table leading to values that did not add to 360°. Candidates generally lost marks for inaccurate drawing of the sectors – with many sectors more than the allowed 2° tolerance.

(d) This question was well-attempted by most candidates, with a significant number solving it correctly. Most successful candidates found the 1/5 of \$720 first, then subtracted from \$720 and finally divided by 16. Common wrong answers included, 9 (from $1/5 \times 720 = 144$, 144 / 16 = 9) or 45 (either from 720 / 16 or 720 – 0.2 = 719.8 and 719.8 / 16 = 44.9875 rounded to 45). A significant number of candidates misread the question or misinterpreted the ‘one-fifth of the cost’ and used \$150 instead of $1/5 \times 720 = 144$. This led to an answer of 36 but from incorrect working (720 – 150 = 570, 570 / 16 = 35.625 = 36 monthly payments) and did not gain full marks.

Question 4

(a) Constructing the triangle ACD was challenging for most candidates. Successful candidates drew clear arcs from A and C and completed the triangle by using a ruler to join A to D and C to D. Some candidates drew a correct triangle but with no arcs or rubbed them out. There was also some confusion with the notation used, resulting in the lines being interchanged. Those who used arcs generally did it correctly and, if not, got B1 for a correct arc, an incorrect arc and a triangle drawn. However, weaker candidates often just drew the line AC or drew various arcs around the diagram, none correct. A significant number of candidates did not attempt the question.

(b) (i) This part was answered reasonably well with most candidates able to identify the given transformation as a translation, although common wrong answers were ‘translocation’, ‘movement’ or ‘shifted’. Only stronger candidates were able to give the vector, either as a column vector or in words. Errors given were usually incorrect format (often given as a co-ordinate), order of numbers or incorrect negative signs.

(ii) Fewer candidates were able to rotate the shape with most struggling with the centre of rotation being one of the vertices. Many did manage to rotate the shape by 90° anticlockwise but using a wrong centre. This allowed them to gain 1 mark for a correct orientation. The other most common error was to rotate through 180° or reflect.

Question 5

(a) (i) True was given correctly by most candidates, but many struggled with the reason, which was often not specific enough to get the mark. Many referred to the scatter graph rather than describing the shape of the points or just a definition of positive correlation instead of giving a reason that relates to the graph. A lot of comments such as 'it's going up' were seen. The most successful answers linked the distance and cost e.g. as the distance increases so does the cost.

(ii) Around half of the candidates identified the correct point, while a large proportion incorrectly circled (9.6, 22.5).

(iii) Only around a third of all lines of best fit drawn were accurate enough to gain the mark. Although most lines were long enough, the gradient was usually too steep and not within the tolerated area of the overlay. Most lines were borderline, however, did not gain the mark because they started at (0, 0). There was also a significant number who joined all the points.

(iv) Most candidates were able to estimate the cost of an 8 km journey, even if they had not gained the mark for the line of best fit. Most gained the mark for an answer in the acceptable range or with a correct follow through. Some weaker candidates did not gain the mark through misreading of the vertical scale, using 0.1 for each square instead of 0.5.

(b) (i) Most candidates gained this mark with the correct answer of \$8.80. \$13.2 (0) was the only common incorrect answer where the candidate had divided by two instead of three.

(ii)(a) Many candidates were able to give a simplified ratio but not the simplest form. The correct answer was seen rarely with the overwhelmingly most common answer of 4 : 1 : 2.5 gaining 1 mark. Some candidates worked out the share for each person and used those values for the ratio, although this should have been done in part **(b)(ii)(b)**.

(ii)(b) Most candidates were able to gain part marks but only the strongest candidates gave complete solutions, remembering to find out how much more he paid. Many candidates scored B2 for 14.08 or M1 for a correct calculation using their ratio but did not then subtract the answer to **(b)(i)**. A common error was rounding prematurely, for example, using the multiplier 1.17 instead of 1.17333… (26.40/22.5) gave the answer of 14.04 instead of 14.08 and therefore could only gain 1 mark for use of the ratio.

(c) Most candidates attempted this question although there was a 50–50 split between those that attempted compound interest and those that attempted simple interest. Those that attempted compound interest generally gained one or two marks, but few were able to gain full marks as they did not round to the nearest dollar, commonly giving 20 579.68. Those who did simple interest did not gain any marks. A proportion of candidates subtracted 18 600 to give the interest only and only gained one mark.

Question 6

(a) (i) The majority of candidates were able to calculate the amount of milk needed for 10 people. 2700 was a common mistake by multiplying the volume of milk by 10. Another common answer was 1620, by multiplying by 6, or 1080 from 270 x (10 – 6). Those who used the correct method, usually went on to score both marks, so M1 was rarely awarded.

(ii) Candidates were equally successful at calculating the mass of the mixture after heating. B1 for 165 was given frequently, by calculating 15%, but not subtracting from 1100. The method of using a 15% reduction as a (100–15) % = 85% multiplication was rarely seen, but usually candidates were successful in gaining both marks by either method.

(iii) Most candidates correctly found the difference in the temperatures as 23 or –23 degrees. The most common wrong answer was (–)13. Candidates need to know that 'difference' requires a subtraction, but there are two ways of doing this: –18 -5 = -23 or 5 - –18 = 5 + 18 = 23. The second method often led to the incorrect answer (–)13.

(b) (i) Most candidates answered this question correctly. Incorrect methods included: working out how many tubs were packed in an hour rather than a minute, dividing by 8, but not 60 (giving 3240), or dividing by 60, but not 8 (giving 432) and $8 \times 60 = 4800$ not 480, with the answer of 5(.4) instead of 54.

(ii) Around half the candidates were successful at finding the number of tubs on the truck. The most frequent incorrect methods were seen in which only two of the three given values were used to multiply or divide.

(c) (i) Only the strongest of candidates were able to gain full marks on this probability question, however most candidates gained 1 mark, generally for calculating the total relative frequency of the missing items as 0.36. Many who found 0.36 then did not know how to find the relative frequency for chocolate and banana. Most divided by 3, rather than 4, so a common wrong set of answers were 0.36 and 0.12 or 0.24 and 0.12. Similarly, candidates understood that the two solutions had to add to 0.36 but made errors in this calculation – e.g. 0.3 and 0.04 or 0.27 and 0.9 (instead of 0.09).

(ii) This question was generally answered well with many candidates giving the answer of 81. The most common error was dividing by 0.18 rather than multiplying, even though this gives 2500 out of a total of 450. Candidates should use their time to make sense checks of their answers.

(iii)(a) This question was answered well with most candidates correctly completing the tree diagram. There were a variety of incorrect responses, e.g. 0.7 or 0.35 for each, values >1 and different values in each of the three spaces.

(iii)(b) This question was one of the most challenging of the whole paper, with few correct answers seen. The most common incorrect methods were 0.7×2 or $0.7 + 0.7$, or just 0.7 given. Many answers greater than 1 were seen, which again should encourage candidates to revisit their method.

Question 7

(a) Most students correctly calculated the perimeter of the triangle by adding up the given side lengths. Common wrong methods involved multiplication, maybe confusing area for perimeter.

(b) This more complex area question was well-attempted but only the strongest candidates gained full marks. Nearly all candidates showed that they needed to break down the shape into smaller rectangles, however most made errors in calculating the individual areas correctly. Common errors were, not dividing the complex shape into appropriate smaller rectangles (multiplying the given values together) or made errors in calculating the area of each rectangle (usually using the wrong length side). Some weaker candidates multiplied the length and width but then also multiplied by 2 for each rectangle. Common errors in splitting into wrong rectangles included $7 \times 4 + 7 \times 4 + 9.5 \times 4.6$ and $18.6 \times 4 + 13.5 \times 4.6$. Most candidates who did make errors in calculating the area of the rectangles were still able to gain a mark for finding the missing lengths of 9.5 or 4.6.

(c) This part was challenging to all but the strongest of candidates. Most candidates however managed to apply the formula for the area of a triangle correctly. The most successful solutions were done in two parts. The first calculating the height of the triangle (AB), either using Pythagoras theorem or trigonometry correctly. The second, applying the area of a triangle formula using their height and base. Candidates who omitted the first part and simply used 27.2 and 24 as the height and base gained no marks. The most common error in the first part was to apply Pythagoras' theorem incorrectly, $27.2^2 + 24^2$ instead of $27.2^2 - 24^2$. Most candidates who used trigonometry were only able to find an angle and did not go on to find the height AB. A few candidates were successful in calculating the height as 12.8 but then did not go on and find the area of the triangle.

(d) Around half the candidates were able to successfully apply the formula for the volume of a sphere. Most candidates showed understanding that they needed to calculate the radius first by dividing the diameter by 2. Most candidates then substituted their radius into the formula. However, many lost accuracy at this point by rounding 2.625 to 2.63 or 2.62 or 2.6 and therefore, did not gain full marks. Many candidates showed correct substitution but then gave wrong answers – either due to incorrect rounding or incorrect use of their calculators. Some weaker candidates were unable to substitute correctly often doing π^3 or r^2 instead of r^3. The most common wrong method was $4/3 \times \pi \times 5.25^3$.

Question 8

(a) (i) The majority of candidates knew that the solid was a cuboid or rectangular prism. Cube was the most common wrong answer.

(ii) A similar number of candidates successfully found the volume of the solid. A common error was to find the total surface area (192). 40 or 400 or 16 were seen often from 4×10 or $4 \times 10 \times 10$ or 4×4.

(iii) Most candidates found this question challenging. Many candidates gave the correct expression for the volume but then spoilt it by adding = 160. Candidates need to be aware of the difference between an expression and an equation.

(iv) Candidates were more successful at finding the value of *x*. The candidates who gained the mark in **(a)(iii)** often went on to gain marks here. Some candidates wrote down the correct formula in this part, even though they did not in part **(a)(iii)** and then went on to gain a mark or both. Many candidates wrote 6 without any working or $6 \times 6 \times 10$ [= 360] was seen as the working, leading to an answer of 6. A common algebraic error was $x \times x = 2x$, leading to an answer of 18. A large proportion of candidates did not attempt both **(a)(iii)** and **(a)(iv)**.

(b) (i) Most candidates were able to gain full marks by completing the table correctly. The few errors seen involved an attempt to make a straight line with the points already given, e.g. treating it as a linear sequence going up in 7s (17, 24, 31) or going up in 5s (15, 20, 25).

(ii) Most candidates gained full or part marks as they were able to plot the points correctly, with only occasional slips in accuracy. The curves were generally well drawn with the most common error being to join the points with straight lines. Other common errors seen were plotting the points with no curve or not plotting $x = 0$.

(iii) Around half the candidates were able to give a value for *x* in the correct range. Some candidates tried solving the equation instead of reading from their graph, as stated in the question. If this led to a correct value for *x,* it gained full marks – although this was rare. Despite having drawn clear graphs, many candidates did not attempt this question.

Question 9

(a) Most candidates found drawing the travel graph for Samir's journey challenging. Very few, fully correct, answers were seen but many candidates were able to gain 1 mark for a horizontal section lasting 1 hour. Ruled lines were used by most candidates but some freehand lines were seen. There were a variety of incorrect first lines, the most common error was finishing at 6 km, but not at 2.45 pm or finishing at 2.45 pm, but at 8 km. The third line was more successfully drawn, however most candidates found it hard to finish the line at 4.36 pm (the most common wrong time was 4.39 pm).

(b) Calculating Samir's average speed proved the most challenging question of the whole paper. Most candidates showed understanding that they needed to divide distance by time, but a high proportion of candidates used 6 km instead of 12 km, meaning they gained no marks. Those who did use 12 km found converting 2 hr 36 mins into hours challenging and it was common to see 2.36 instead of 2.6. A significant proportion of candidates did not attempt this question.

Question 10

(a) This solving question was well answered by most candidates. Common errors included incorrect rearrangement of the equation ($4x = 3 - 7$) or not fully processing the answer, leaving it as 10/4.

(b) (i) Around half the candidates were able to apply the correct law of indices to this simplification question. A common error was x^8, where the candidate had added the powers instead of multiplying. x^3 was also occasionally seen where the candidate had divided the powers.

(ii) A similar number of candidates were able to simplify this more complex expression. The most common wrong answer was $10x^6y^8$ from multiplying the powers rather than adding them. Many candidates correctly dealt with the powers of x and y but kept the 5 and the 2 in their answer, e.g.

$5x^5 2y^6$ or added 5 and 2 to get 7. Some left multiplication signs in their simplified expression, which was condoned. A large number of weaker candidates attempted to multiply out the two brackets using a FOIL method and gained 4 different terms instead of just one.

(c) (i) Candidates were slightly more successful at expanding and simplifying the two brackets. The most frequent wrong answer was 2a + 3 (+3 coming from 5 – 2). Candidates had most difficulty dealing with the signs, with 3a and 6 being common in wrong answers.

(ii) Again, around half the candidates were able to successfully expand and simplify the double bracket. Most managed to correctly multiply out the brackets, giving a correct 4-term expansion for 1 mark but then lost the second mark as they struggled to simplify the +7d and –3d giving +10d or –10d instead of +4d.

MATHEMATICS (WITHOUT COURSEWORK)

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, attempting most questions. The standard of presentation and amount of working shown was generally good. Candidates should realise that in a multi-level problem-solving question, the working needs to be clearly and comprehensively set out particularly when done in stages. Centres should also continue to encourage candidates to show formulae used, substitutions made, and calculations performed. Attention should be made to the degree of accuracy required. Candidates should be encouraged to avoid premature rounding in workings as this often leads to an inaccurate answer. As well as this, candidates should be prepared to use an algebraic approach when solving a problem-solving question and should use correct time notation for answers involving time or a time interval.

Comments on specific questions

Question 1

(a) This part was generally well answered with a good number of candidates able to score full marks. The common approach was to work in stages. Common errors included incorrect calculations, incorrect operations, and the final required subtraction omitted.

(b) This part was generally very well answered. Common errors included the incorrect time notation of 11 hours 23 minutes, subtracting the 36 minutes to get a time of 10 11.

(c) This ‘show that’ question proved difficult and challenging for many candidates. The required fractional manipulation of the information given in the question was rarely seen. Some were able to gain 1 mark for a partial explanation. A number correctly found 4.66 litres or 2.33 bottles but could not show enough detail to prove that 3 was the required number of bottles.

(d) Around half the candidates were able to answer this part. The common error was a misinterpretation of the information given, shown by the incorrect division of 40 by 8, resulting in the incorrect answer of 15.

(e) This part on percentage increase was generally answered well. The most common approach was to find 35% and then add this on to the original amount, rather than the more efficient method of multiplying by 1.35. The most common error was leaving the answer as 182.

(f) This part on money conversion was well attempted. Those candidates who used the more efficient direct conversion were generally successful, although the answer was sometimes left as $845. Those who used the longer method usually left their answer as 21 ringgits.

Question 2

(a) (i) This part was generally very well answered. Common errors included 3.142, 14 and 56.

(ii) This part was generally very well answered, although it was very common for candidates to choose 56, giving the multiple, rather than the factor.

(iii) The majority correctly identified 121 as the square number, although $\sqrt{87}$ or 87 were also given by candidates.

(iv) The majority correctly identified 41 as the prime number, although 3.142, 14 and 117 were also chosen by candidates.

(v) The majority correctly identified 117 as the multiple of 9, although a variety of the other values were seen.

(b) This part was generally very well answered. Common errors given were 0 and 5.

(c) This part was generally answered well. However, the common errors included writing pairs of factors (2×30, 3×10, 5×12, 60×1), and answers written as a list. A common method was to use a factor tree or table, but this was not always correctly expressed as product of factors.

(d) The majority correctly calculated the value as 54, although a common error was to square root, rather than cube root.

(e) This rounding question proved challenging for many candidates. Successful candidates were able to identify that the initial step was to obtain the values of 70, 2, 6 and 30 and then went on to score well. Common errors include using 68, rounding each number to 1 decimal place and calculating the exact value, then rounding.

(f) (i) The majority of candidates correctly identified 2.04×10^9 as larger than 9.78×10^8. The most common method seen was to convert both values into normal form and compare. A few appreciated that all that was required was to state 'it has the larger power' to compare the numbers. The reasoning included a range of responses with either no comparison, or where there were misconceptions of what the parts in standard form represented.

(ii) The two ways of performing this calculation were seen, with both possible answers credited in the mark scheme. Many candidates were unable to give their calculated answer in standard form.

(g) This question proved challenging for many candidates and proved to be a good discriminator. Some candidates appreciated that the LCM of 96 and 120 was the first step in this problem-solving type of question. Common errors following this method included leaving 480 as the answer, incorrectly converting the value of 480 as 8 hours, and 960. A very common, valid approach was to list the times or multiples of 96 and 120 up to 08 45 or 480. Though arithmetic errors often occurred using this method. Common errors included 96 + 120 = 216 leading to answers of 3 m 36 or 0840 or 08 40 36, 120 = 2 minutes leading to 08 39 or 08 35.

Question 3

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

(ii) This part was generally answered well. Common errors included 8 and 10 with a variety of other values seen.

(b) (i) This part was generally answered very well. Common errors included 39 and 36, 4 and 3.

(ii) This part was generally answered well. Common errors included add 7, $n - 7$, and $39 - 7n$.

(c) (i) This part was generally answered less well. Candidates who were able to understand the link between the common difference and the nth term were mostly successful. Common errors included add 3, n + 3, 3n and 17.

(ii) This part was generally poorly answered with few candidates recognising the cubic sequence. Common errors included 125, attempting a linear sequence, with a significant number of candidates not attempting this part.

Question 4

(a) Recall of the correct formula was the key to answering this question. Quite a few multiplied the two numbers given, leading to an incorrect answer of 117. Others who identified that π was involved did $\pi \times 7.8 \times 15 = 367.6$. Those that attempted a formula relating to a cylinder often used the incorrect one. Some gave the surface area and others gave the area of the curved face. Occasionally, a candidate gave the answer of double the volume, from a formula stated of $2\pi r^2h$.

(b) Most found this challenging, and few considered the cube root of 3375. Those realising a side length was 15 often gave this as their final answer or went on to multiply their value of 15 by 6. Some went a step further and correctly found 225, often missing the final step to multiply by 6. It was most common to see $3375 \div 6 = 562.5$.

(c) Very few candidates were awarded any marks in this question. It was most common to see candidates divide or multiply by 100, treating the values as lengths rather than areas, resulting in $37000 \div 100$ or 5.4×100 or both. Some candidates gave a correct list of conversions between mm, cm, m and km for length but often could not apply this to the areas in the problem. It was common to see the values squared as an area was involved. A number of candidates gave an unsupported answer of either A or B.

(d) A low proportion of candidates gave a correct answer. Of the candidates who identified that the problem required use of trigonometry, a good number chose the correct trigonometrical ratio. Others had problems with notation, it was common to see candidates writing sin (7/15) rather than sin-1(7/15) and sin 90 = 7/15 was also seen. Some gave the inverted fraction sin = 15/7 and, discovering that this was not solvable, some just divided 15 by 7 to give the answer 2.14. Candidates who used the correct method sometimes rounded to the nearest degree rather than to 1dp, as stated in the instructions on the front of the paper. If a more accurate value was not shown in the working, they could not be awarded the final answer mark. Many candidates jumped straight into the use of Pythagoras as the question involved a right-angled triangle and found a length, usually BC, rather than an angle.

(e) Some candidates identified this as a Pythagoras problem. There were some fully correct answers and some who correctly found the missing length of the rectangle but then either forgot to find the area or used it incorrectly. This usually involved finding the area of a triangle or use of perimeter. Candidates who started with the correct relationship of 31.22 – 122 generally completed the calculation correctly to find the correct length. It was common to see Pythagoras used incorrectly with 122 + 31.22. Those who made an attempt to use Pythagoras or trigonometry to find the missing length often gained the final method mark for using their length correctly to find the area of the rectangle.

Question 5

(a) (i) Few candidates gave a correct value for the mode. As the categories were numerical, many candidates gave the frequency value, rather than the value of the mode. Another common error involved 7, as it was the only number that appeared twice in the table.

(ii) Few candidates used a fully correct method to calculate the mean, with some making the occasional slip in the numeracy, usually in finding the total number of guesses. Some had a vague idea of what was needed and were able to calculate the total number of guesses but then divided by 6. In other cases, candidates either calculated the sum of the 6 categories or the sum of the frequencies before dividing by 6.

(b) (i) Candidates were more successful in this part and a large majority gave a correct stem-and-leaf diagram. Common errors usually involved the omission of one of the values (quite often 24) or completing the diagram with the actual values. A few candidates did not order the values.

(ii) Finding the correct median proved more challenging. Some were able to follow through correctly from their incorrect diagram. A common error involved the omission of the stem and answers such as 1, 2.5 and 4 were seen. Others identified the central pair and gave 21 and 24 as their answer.

(c) A good proportion of candidates showed a good understanding of pie charts, completing the chart correctly with each radius ruled. Others attempted the pie chart but small inaccuracies in one or more sectors resulted in the loss of marks. Candidates should be encouraged to show workings and angles, as incorrect angles with no working cannot be awarded any marks and a significant number of candidates did not show any angle calculations.

Question 6

(a) This was well attempted with many fully correct nets drawn. The most common layout was to draw four faces vertically with a 4 by 2 face off either side of the given face. Candidates should be advised not to draw tabs on the net as these can be confused with further faces. Those not scoring full marks often scored 2 marks for the 4 correct faces surrounding the given face or 1 mark for the upper and lower 4 by 2 faces. Some candidates who did not score on this question tried to draw a 3-D cuboid from the given face.

(b) Candidates that understood the steps required for this question often gained full marks. Some calculated the 108 degrees but were then unsure how to use the 108 to find the missing angle. A common response seen was 360 divided by 5 = 72 and using this exterior angle as an interior angle of the pentagon. Some attempted to use the formula (180(n–2)) / n but used 15 for n, counting the total number of sides in the 3 pentagons. A significant number of candidates left the question blank or wrote an incorrect answer without showing any working.

(c) (i) Very few candidates were awarded both marks for this question. When the correct angle of 58 was given, the wrong reason was usually given, often that they were alternate. More often, the calculation was given in place of a worded geometrical reason. Some discussed that the angle was the same (but didn't say to what) or said that the lines were parallel as a justification.

(ii) A minority of candidates got the correct value for the missing angle. Successful candidates showed angles on the diagram and often showed working using the triangle, or more succinctly just showed the angle vertically opposite 35 degrees and used co-interior angles or used the angle adjacent to y, corresponding to the given 35. Some candidates gained 1 mark for labelling an appropriate angle on the diagram, most commonly 122 on the straight line.

Question 7

(a) (i) Few candidates scored full marks for this question. Candidates were often able to place the 17 and/or 82 correctly. The most common error was to place 105 in the subset for maths only. Others correctly calculated 105 – 82 = 23 but mis-placed this in the subset for science only. Two numbers were sometimes placed in the same subset and there was little regard that in completing the diagram $n(M \cup S)$ was often more than the total number in the group. The value 142 often appeared in $(M \cup S)'$ alongside 17.

(ii) Few correct answers of 125 were given. Those who understood they needed to add the numbers in the three sections were often not awarded the follow through mark either because their total was greater than 142, or because they had omitted to place a value in the subset for science only. There were many varied incorrect answers; the most common being to give their value for $M \cap S$.

(iii) A minority were awarded the mark for this part, either for the correct probability or for a correct answer following through from their diagram. Many varied incorrect answers were given; many of which were fractions with incorrect denominators. Many answers were integers, ignoring the fact that a probability must be between 0 and 1. A small but significant number omitted this part.

(b) Candidates were more successful in this part with many correct answers seen. The most common errors included A ∪ B, an integer value, ∪, ∩, a word description such as ‘intersection’, ‘union’, ‘both’, while some gave no response.

(c) A few gave a correct interval, others gave the correct bounds but in the reverse order. Many varied incorrect values were given. For the lower bound the most common were 10 599.5, 10 500.5, 10 500 and 10 595 and for the upper bound these were 10 600.5, 10 700 and 11 000.

(d) Many candidates were able to calculate the correct percentage increase, 8%, and some gained partial credit for reaching 108 or 0.08. The most common error was to calculate the number of students in 2022 as a percentage of those in 2023: $\frac{15\,800}{17\,065} \times 100 = 92.59$ or to find the increase, 17 064 – 15 800 = 1264 and to give the answer 12.64. Some candidates used the years 2022 and 2023 in their calculations.

(e) This part was answered well by the majority of candidates and many others scored one mark for finding one part as 3680. The most common error was to divide the total, 18 400, by 4 ratio parts instead of 5.

Question 8

(a) (i) A minority were able to find the correct equation. Some candidates were able to write an equation of the form y = mx + 2 with correct intercept but incorrect gradient. A common incorrect answer was y = 2, and some gave the gradient as 2 rather than $\frac{1}{2}$.

(ii)(a) This part was answered very well with a large majority finding the correct values.

(ii)(b) There were many correct, ruled, line graphs drawn. A significant number gave no response.

(iii) The large majority of those who had drawn a correct line in the previous part were able to identify the coordinates of the point of intersection. A few read the scales incorrectly and some gave the coordinates in reverse.

(b) (i) The majority completed the table correctly. The common error being not using brackets on the calculator when substituting x = – 1 and getting the value for y as – 1 instead of + 1.

(ii) Many fully correct graphs were drawn. To score full marks, graphs needed to be a smooth, unruled curve, passing accurately through the points plotted and parabolic in shape. Partial marks were awarded following the incorrect plot (–1, –1), for having ruled sections or for plotting the points but omitting the curve.

(iii) A small minority gave the correct equation of the line. Some gave the answer as 2 or as y = 2 and a significant number of candidates gave no answer.

(iv) Few candidates were able to fully answer this part of the question. Common errors included omitting the minus sign from the negative solution, rounding to the nearest integer values and incorrect reading of the scale.

Question 9

(a) The majority of candidates that attempted this question, translated the triangle correctly. A common error was to start the translation from the origin and a few inverted or rotated the triangle.

(b) This part was generally answered well with the majority recognising the transformation as a reflection, though the correct identification of the line of reflection proved more difficult. Common errors included just –1, y = 1 or x = –1, and describing the transformation as a rotation.

(c) The large majority of candidates recognised the transformation was a rotation and many gave a fully correct description, remembering to include all information needed. Most other candidates gained 2 marks having omitted either the centre of rotation or the angle. Candidates attempting to describe the transformation as a rotation followed, for example, by a translation, did not score as a single transformation was required.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/33
Paper 33 (Core)

Key messages

This paper tests a wide range of skills and mathematical understanding across the syllabus. Many candidates were able to demonstrate knowledge and competency across each of number, algebra, shape and space and probability and statistics, and achieved very good scores on this paper. Candidates had enough time to complete the paper with very few questions left unanswered.

Candidates should spend time reading the questions carefully and ensuring they answer the question asked, and not answering a question they are presuming is going to be asked. In addition, they should spend time choosing an appropriate method rather than trying lots of different methods without careful consideration as to which is most appropriate.

General comments

Candidates should be using multiplication and division effectively, rather than adding and subtracting many times. Examples where this was seen included: **Question 1(a)(i)** candidates were adding 2.29 to reach 20 rather than dividing 20 by 2.29, **Question 1(a)(ii)** candidates were adding 615 five times rather than multiplying by 5, **Question 6(f)** candidates should ideally subtract the 22.60 and then divide by 4. In these three examples, had the numbers been such that more lots of addition and/or subtraction were required, candidates would have lost time and be open to more errors.

Candidates should choose efficient methods. Examples where inefficient methods were chosen included **Question 1(c)(ii)** and **Question 2(h)** and consequently, errors were made; premature approximation was seen, and unnecessary time was used.

Candidates should use algebraic methods rather than an extensive list or trials. Trials were seen for **Question 4(d)**, simultaneous equations, **Question 5(d)(i)**, the length of the shelf and, **Question 7(d)**, the surface area of the sphere. All three of these questions can be solved efficiently using algebraic methods, such as setting up an equation and rearranging.

Candidates need to be able to work with time. This includes converting between hours, minutes and seconds and expressing time correctly, **Question 2(h)**, **Question 3(c)** and **Question 6(e)**.

Mathematical phrases and terminology also need to be used correctly for geometrical reasons **Question 7(c)(i)** and when describing transformations **Question 9(a)** and **Question 9(b)**.

Candidates should be consistent in their use of commas and decimal points. Some candidates were writing, for example 2,500 for 2500, **Question 1(a)(iii)** and then 1.024 for 1024, **Question 2(c)(i)**.

Comments on specific questions

Question 1

(a) (i) Almost all candidates answered this question correctly. Whilst the most efficient method is to calculate 20 ÷ 2.29, a number of candidates used alternative methods such as repetitive adding of \$2.29 to reach \$20 or repetitive subtraction of \$2.29 from \$20 or the use of trials. Had the number of boxes been larger, these methods would have been unsuitable. The most common errors included leaving the answer as 8.73 or finding the cost of 8 boxes as \$18.32.

(ii) Almost all candidates were able to work out the total mass as 3075g. Many converted correctly to kilograms. The most common incorrect conversions included dividing by 100 to give 30.75 or dividing by 1000 to give 3.75. Others gave inaccurate answers such as 3.08, 3.1 and 3. A minority of candidates used the incorrect operation and calculated 615 ÷ 5 = 123.

(iii) Most candidates correctly found the surface area. The most common errors included 50, from adding the values, 1450, finding the surface area or various values such as 25, 250 and 0.25 where some conversion had been used.

(b) Many candidates drew complete and accurate nets. The most common error was to omit one of the 6 by 3 or 6 by 1 faces or to have two adjacent 6 by 3 faces. A minority of candidates added tabs to their nets which should not be included in a net diagram and others tried to draw a 3-dimensional drawing of the cuboid. A small proportion of candidates did not attempt this question.

(c) (i) The majority of candidates answered this correctly. The most common incorrect answer was 36 per cent.

(ii) The pie chart was completed accurately by a fair number of candidates, with a carefully measured sector angle and a ruled radius. Candidates were seen to work out the angle of 216 from both 60 per cent × 360 or $\frac{60\%}{10\%} \times 36$, the latter method using their answer from **part (c)(i)**. The most common errors included not dividing the sector (assuming it was all carbohydrate), drawing the carbohydrate angle as 60° (from the 60 per cent), dividing the sector into two equal parts or drawing the angle as 144° (by going the wrong direction on the protractor scale).

(iii) Less than half of all candidates answered this part correctly. The simplest method was $\frac{68}{360} \times 30$. Many used correct longer methods such as converting to percentages: $\frac{68}{360} \times 100 = 18.9\%$ then $\frac{18.9}{100} \times 30 = 5.67$; others did not use the pie chart directly in connection with the 30g but went back to the 615g with a longer correct calculation such as $\frac{68}{360} \times 615 = 116.16\ldots$ then $x = \frac{116.16\ldots}{615} \times 30$ = 5.67. Candidates using these less efficient methods often lost a mark due to premature rounding, such as 116.16…as 116, in the middle of the process. Most other candidates were able to score at least one mark for either correctly measuring the sector angle for protein or for demonstrating a correct method using their sector angle. Some candidates gave answers with no clear evidence of where their numbers came from so could not score.

Question 2

(a) Many candidates answered this correctly with accurate spelling of all the words. Some candidates gave the 845,000 as ‘eight hundred thousand and forty five thousand’ where the word ‘thousand’ needed to be written only once. Other common errors included using the word ‘millions’ or having the words ‘hundred’ and ‘thousand’ in the wrong order. Other candidates need to be careful about their spellings with eight being seen as eighty and forty being seen as fourth.

(b) This part was answered well by most candidates. The most common error arose from $\frac{7}{18}$ evaluated inaccurately as either 0.38, 0.39 or 0.388. It needed to be worked out to at least 3 significant figures as 0.389 or as 0.3888.. or 0.3889 for candidates to be able to correctly compare it with both 0.388 and 39 percent.

(c) (i) Almost every candidate answered this part correctly.

(ii) Most candidates answered this part correctly. The most common incorrect answers were 6 and 0.

(iii) Almost every candidate answered this part correctly.

(d) Almost all candidates answered this part correctly, using correct algebraic techniques. The few errors that were seen usually arose from arithmetic slips or from adding, rather than subtracting, the 5 from 29 or after $6x = 24$, subtracting, rather than dividing by the 6.

(e) Less than half of the candidates answered this correctly. A very common error was to round the 4 numbers to the nearest integer as $\frac{3 \times 42}{9-5}$ rather than to 1 significant figure as $\frac{3 \times 40}{9-5}$; these candidates scored one mark. However, many candidates did not score as they calculated the answer using the given figures as 26.6… with no attempt to round any of the numbers.

(f) Most candidates answered this correctly. A minority gave the answer 4 with the misconception that the powers were multiplied to make 20. Some candidates successfully used trials to find x, and others tried to find x by evaluating and reaching $3^x = \frac{3486784401}{243}$ but often could not get any further.

(g) Around half the candidates answered this correctly. The most common incorrect answers included x^7, $3x^{12}$, $12x$ and x^{64}.

(h) The most efficient method to answer this question was to find the lowest common multiple of 16 and 34. Candidates using this method often scored full marks or reached 272 but were unable to convert this to hours and minutes with $272 \div 60 = 4.533$ then being used as 4 hours and 53 minutes. Some candidates scored one mark for 16×34, a common multiple, but not the lowest common multiple. However, most candidates attempted to solve the problem by writing out long lists of times and, although most of them were able to write out the first few times for each boat, frequent slips were made, a lot of time was spent and the common time of 12 02 was never found. For full marks, candidates needed to express the time 12 02 correctly with, for example, 12 02 am and 12h 02m not accepted.

Question 3

(a) While some answered this correctly, many candidates also drew diagonal lines inside the rectangle and did not score. In addition, candidates should draw the lines carefully because lines of symmetry where the two halves were not clearly intended to be equal, were not rewarded.

(b) A good proportion answered this correctly. Some scored one mark for a correct but unsimplified fraction. Common incorrect answers included $\frac{4}{7}$, $\frac{7}{4}$ and $\frac{11}{4}$.

(c) Many candidates answered this part correctly. The most common errors included slips with arithmetic or writing the time in an incorrect format with, for example, 1605 pm, 4.05 and 16h 05 min not accepted.

(d) Almost all candidates answered this part correctly. The most common incorrect answer was 99.88 percent.

(e) (i) The majority of candidates completed the stem-and-leaf diagram correctly. The most common errors included the omission of one or more numbers or having unordered rows. A small minority of candidates incorrectly placed the whole numbers, rather than just placing the unit part of the numbers, into the table.

(ii) This part was answered well. The most common error was an unevaluated answer such as 48 – 16. Other errors included giving the highest value of 48 or -32 or finding the wrong statistic such as the mean, median or mode of the numbers.

Question 4

(a) The majority of candidates answered this question correctly. Most others obtained one mark for substituting the given values correctly into the equation. The most common errors were usually using the wrong operation when trying to isolate *r*.

(b) Around a third of candidates factorised the expression correctly. Some candidates scored one mark for taking out either the *p* or the 5 correctly. A very common misconception seen was the answer $5p(4pq)$ where the -1 was missing and some gave $5p(4^2q-1)$, where they left the power floating, rather than reducing to *p.* Others gave answers with no brackets where they had tried to simplify the expression.

(c) Only a minority of candidates answered this correctly. The preferred answer was $35x+14y$, but other answers such as $x35+y14$ or similar were accepted. Some showed the correct expression and then spoilt their answer with incorrect further working. Others gave answers that included either $35x$ or $14y$ and some gave an answer in dollars, namely $0.35x + 0.14y$ all of which scored 1 mark. The most common incorrect answer was $x+y=49$, with a wide variety of other incorrect answers seen.

(d) Working was required for this question but only a minority evidenced a clear method to score full marks. Working needed to show either two equations with a common coefficient for x or y and correct subtraction of their equations, or the correct rearrangement of one equation followed by its substitution into the other equation. Common errors included adding rather than subtracting equations or slips when tidying up, for example, $5\times\frac{(59-3y)}{8}+7y=83$ where candidates did not multiply both the $7y$ and the 83 by 8. Many candidates were able to find the correct values for *x* and *y* by trials, rather than an efficient algebraic method and were awarded only one mark.

Question 5

(a) (i) It was rare for a candidate not to answer this part correctly. Very occasionally a candidate gave the number of cars as 32, rather than giving the colour blue.

(ii) Almost all candidates found the correct number of yellow cars. The errors seen were usually a slip when using the key, such as 16 + 4 or 9 × 8.

(iii) Again, almost all candidates answered this part correctly. As with the previous parts, the occasional errors usually arose through slips with the key.

(b) A minority of candidates answered this part correctly with candidates often using the exchange rate incorrectly, multiplying when they needed to divide or dividing when they needed to multiply. In addition, a common misconception was to convert the exchange rate of 1 euro = \$1.12 to \$1 = 0.88 euros rather than 1 euro = $\$\frac{1}{1.12}$. Others found the difference in dollars rather than euros, with a common incorrect answer of 0.48.

(c) A good number of candidates answered this part correctly with many others scoring one mark for a correct, unsimplified, ratio. Ideally candidates should have written down 57:12:42 and simplified from here, keeping integer values for all the parts. Exact fractions, but not rounded decimals, were accepted for the method mark with answers such as $\frac{57}{111}:\frac{12}{111}:\frac{42}{111}$ frequently seen. Candidates should also recognise the importance of keeping the parts in the correct order.

(d) (i) Less than half of candidates answered this part correctly**.** The best solutions were those that started with the equation $\frac{1}{2}\times y\times 0.75=0.3$ and rearranged. Others were successful using trials, although this was not as efficient. The most common incorrect answer seen was 0.4, but candidates were also seen to try to use trigonometry or Pythagoras' theorem but could make no progress as only the length 0.75 was explicitly given.

(ii) Many candidates correctly converted the length to centimetres. The most common incorrect answers included 1350, 13.5 and 0.0135.

Question 6

(a) This part was answered correctly by around half of the candidates. However, it was very common for candidates to omit either or both of the 5m and 7m sides, with common incorrect answers being 40m, 45m or 47m. Others divided the shape into two or more rectangles and added in one or more extra 6m and 8m, lengths. Other common incorrect answers included finding areas or finding the product of the 4 given lengths or assuming that both of the missing lengths were the same.

(b) (i) It was rare for a candidate to answer this part incorrectly. Very occasionally a candidate would give their answer as -5, which did not score as the name of the night was required.

(ii) It was rare for a candidate to answer this part incorrectly. The most common incorrect answer was -1 from adding the two temperatures.

(c) There were some excellent, clear and full solutions to this 'show' question which required candidates to clearly evidence $45 \div 5 (= 9)$ to score any marks. A complete solution then needed to show a clear addition, such as, $9 \times (7 + 5 + 2)$ or $7 + 5 + 2 = 14$ and 9×14 or $9 \times 7 = 63$, $9 \times 2 = 18$ and $63 + 45 + 18$. Candidates who started by using the 126, for example, $126 \div 14 (= 9)$, did not score. A noticeable number of candidates did not attempt this question.

(d) Many candidates answered this question correctly or scored 1 mark for the answer of 36 percent. A common response was to find the actual decrease as $120 - 43.2 = 76.8$ but not to proceed to the percentage decrease. Errors seen included $\frac{120}{43.2}(\times 100)$ and $43.2 \times 120 (\div 100)$.

(e) Most candidates recognised that they needed to multiply the time by the speed and were awarded a method mark. The common errors that occurred were the answer 71.3, without the exact answer 71.25, writing $1\frac{1}{4} \times 57$ but calculating this as $1 \times \frac{1}{4} \times 57 = 14.25$, using an incorrect formula, often, $\frac{57}{time}$ or using an inaccurate time such as 75, 0.75 and 1.15.

(f) A high proportion of candidates answered this part very well, reading the question carefully and often obtaining the correct number of days. Candidates giving an answer of 4 were usually rewarded 2 marks because their answer was more often than not supported by clear working and it was usually evident that the candidates had just overlooked adding on the first day.

Question 7

(a) Almost every candidate gave the correct mathematical name for the solid. Candidates who gave a description of the solid, for example, a 'circular based prism' were not rewarded.

(b) (i) Most candidates measured the angle accurately. A common incorrect answer was 140, which was not accurate enough; candidates should be trying to measure to the nearest degree. 43 was also seen from reading the wrong part of the scale on the protractor.

(ii) The majority of candidates gave the correct mathematical name for the angle. The most common incorrect answers were acute and right angle.

(c) (i) Only a small minority of candidates gave a correct geometrical reason when answering this question. Many gave detailed descriptions using suitable words such as triangle, right angle, circle, chord, circumference, diameter and perpendicular, but none of these were rewarded as the correct geometrical reason, 'angle in a semicircle is 90° ', was required. A common error was to write angles in a semicircle 'add' to 90, which was not rewarded.

(ii) Some candidates scored full marks on this question. Others scored one mark for using the correct formula for the circumference but giving an inaccurate answer, usually 34.5, either because they had truncated their answer (rather than rounding to 3sf) and/or perhaps used an inaccurate value for pi, such as 3.14. Incorrect answers very often came from finding the area or sometimes an incorrect formula such as $2\pi \times 11$. Some candidates did not use the information given in the question but measured the radius as 3.4 cm or similar. These candidates did not score as the diagram was not drawn to scale.

(iii) Because this was a 'show' question, 11^2 and 5^2 needed to be seen before 121 and 25 were used. Many candidates did show clearly $11^2 - 5^2$ but only a minority of these evaluated $\sqrt{96}$ accurately enough as either 9.79….or 9.80. Without one of these values, it could not be justified that $AC = 9.8$ to 2 significant figures. A common error was to start with 9.8 and work towards 11. Units did not need to be included in the working, but where they were included, they needed to be correct, with candidates not realising that 11^2 cm is the same as $(11\text{ cm})^2$ but not the same as 11 cm^2. Around a third of candidates did not attempt this part.

(d) A fair number of candidates started from $250 = 4\pi r^2$. The most efficient method was rearranging to find *r* and many candidates were successful in doing this. Others tried to find *r* using trial and improvement, which is not mathematically a good method. Nevertheless, some were successful but often their answer for *r* lacked accuracy. Other errors included using an inaccurate value for pi, rather than the one on the calculator or 3.142, and premature approximation during the calculations rather than at the end. A common calculator error was to work out $\frac{250}{4 \times \pi}$ as $250 \div 4 \times \pi$. Around a fifth of candidates did not attempt this part.

Question 8

(a) (i) Most candidates were able to complete the table correctly.

(ii) Many candidates drew excellent curves that were smooth, accurate and had the correct curvature for a parabola. The most common errors included: using a ruler to join all the points, accidentally missing the plotted point at (0, 0) when drawing the curve, mis-plotting one or more of the points and curves that were not smooth, had gaps or multiple lines and/or feathering. Candidates should use a pencil when drawing a curve so that they can rub out any part they wish to redraw.

(iii) Some candidates answered this correctly, giving both solutions to the equation within the required tolerance. The most common incorrect response was to give the values 0 and 4, the coordinates where the curve crossed the *x*-axis rather than finding the intercepts with the line $y = 1$. Around a third of candidates offered no response.

(b) Some candidates gave the correct equation for line *L*. However, the majority of other candidates were able to score at least 1 mark for having some part of the equation correct. Common errors included a gradient of $\frac{2}{3}$, omitting the $'y = '$ or having one or other of the gradient and intercept incorrect. A very common incorrect answer was $y = \frac{3}{2} - 1$. Some candidates gave coordinates or calculations which had no relevance to finding the equation of the line.

Question 9

(a) Less than half of all candidates gave the correct mathematical name for the shape. Some candidates gave answers such as quadrilateral and polygon, but these did not describe the shape specifically and did not score. Common incorrect answers included trapezoid, rhombus and parallelogram.

(b) Few candidates were able to describe the transformation mathematically and completely. The question states the shape has been transformed using a **single** transformation so candidates should start by choosing **one** of the words enlargement, rotation, reflection and translation. Having selected enlargement they then need to write 0.5 and (2, 1), for the scale factor and the centre.

Many gave long descriptions as to how the shape had become smaller and had moved across the grid, using words such as dis-enlarged, unenlarged, dilation and shrunk, none of which scored.

(c) Again, few candidates answered this well. Again, **one** type of transformation, here translation, needed to be selected. There are no alternative acceptable words for translation with words such as translocation, transferred and transportation not scoring. Common errors included writing the vector as a coordinate, including a fraction line in the vector, having incorrect signs within the vector or having the components of the vector reversed.

(d) A fair number of correct responses were seen with many rotating the shape correctly about the origin. Many others rotated the shape through 90 clockwise but placed it in the wrong position, commonly with a vertex at the origin, perhaps misunderstanding the instruction 'rotate about the origin'. A minority of candidates scored one mark for rotating the shape anticlockwise about the origin. Some candidates did not answer this part.

(e) Some correct responses were seen and others scored 1 mark for a reflection about an incorrect vertical line, commonly the y-axis, or occasionally a reflection in $y = 1$. Some candidates did not answer this part.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/41
Paper 41 (Extended)

Key messages

To achieve well in this paper, candidates must be familiar with all aspects of the extended syllabus. They must be able to recall and apply formulae and mathematical facts in both familiar and unfamiliar contexts. Additionally, they must be able to interpret situations mathematically and problem solve unstructured questions.

Work should be clear and concise. Answers should be written to at least three significant figures unless otherwise instructed. Exact answers should generally not be rounded.

Candidates should show full working, writing values to at least 3 significant figures throughout. They should store accurate values in their calculators to ensure that method marks are considered for incorrect answers. Candidates should not round intermediate calculations.

Candidates should not erase or cross out working unless it is being replaced. When starting a new approach to a question, candidates must clearly indicate which method they want the examiner to mark.

In 'show that' questions, candidates must ensure that no steps are missing and must show a more accurate value than the given value.

It is important that candidates take sufficient care with the writing of their digits and mathematical symbols. Candidates using π as $\frac{22}{7}$ or 3.14 are likely to achieve answers out of range.

Candidates must show their working when solving quadratic equations. If using the quadratic formula, they must show the substitution of values for a, b, and c. The calculator's quadratic equation function should not be used.

In all questions, candidates must show their method using correct mathematical operators, not symbols like crossed arrows or dashes. This applies to unit conversions and proportional reasoning.

General comments

Candidates scored across the full mark range and appeared to have sufficient time. A small minority of candidates were less prepared for the demands of the extended paper. In general, if candidates could not answer one part of a question, they still made a significant attempt at other parts.

Solutions were usually well-structured with clear methods shown in the space provided on the question paper. Very few candidates offered solutions without working out which meant it was possible to award part marks to many responses which were not fully correct, however the situation of e.g. $\frac{x}{y} = \frac{p}{q}$ without then writing $xq = py$ is seen quite frequently and if an error is made by the candidate in their calculation, we do not imply the method mark without the $xq = py$ being seen.

Throughout the paper a common reason for candidates to lose marks was through rounding answers too early; using truncated or rounded values in multi-step calculations often led to answers which were outside the range of tolerance and so did not gain full marks. This was particularly evident in **Question 6(b)** when using sine rule, **9(c)** and **(d)** when using Pythagoras theorem followed by trigonometry or further Pythagoras, and in **6(c)** which required a multi – step solution.

Aspects of the paper that were tackled well by many candidates included the mean from grouped data, recall and use of the cosine rule, recall and use of the sine rule, volume and surface area of a cuboid and the angle between a diagonal and the base. Generally, diagrams were neat, ruled and accurate and this was seen in the transformation and inequality questions.

Difficulty was found with applying rates of change and percentage decrease in context in **Question 4,** calculations with bounds, and visualising right angled triangles to use Pythagoras in 3 dimensions. Sketching graphs was also a challenge.

Candidates also need to be aware that a ratio in its simplest form should be written using integer values only. In 'show that' questions such as **10b(i)** candidates must never use the value they are trying to establish as part of their method. In **Question 6(a)** candidates were required to establish the result to the nearest integer and so for full marks needed to show their value to at least 1 decimal place to achieve this.

In **Question 10(b)(i)** where they were required to establish the value to 1 decimal place candidates who correctly re-arranged a quite complex equation often did not finish by showing their value to at least 2 decimal places to achieve full marks.

Comments on specific questions

Question 1

(a) (i) This part was correctly answered by almost all candidates. A few candidates gave the list of the prime factors instead of a product.

(ii) This part was also well answered although not as successful as **part (i).** Many candidates without the correct answer did gain the method mark for breaking 112 into its prime factors. So, almost all candidates earned 1 or 2 marks.

(iii) This lowest common multiple involving algebra proved to be more challenging. There were many correct answers, and many candidates earned one mark by giving the correct lowest common multiple of 70 and 112. A small number of candidates found the correct lowest common multiple of the x^4y^2 and x^3y^5 but gave an incorrect lowest common multiple of 70 and 112.

(b) (i) Almost all candidates were successful with this straightforward index division. It is pleasing to note that very few candidates divided the indices.

(ii) This product of algebraic fractions was found to be more challenging than perhaps expected. There were many correct but unsimplified answers such as $\frac{bc}{8b}$. Such answers earned the method mark. A surprising number of candidates thought they needed to find a lowest common denominator.

(c) This straightforward equation was very well answered by almost all candidates.

(d) This equation involving an algebraic fraction was more challenging. There were many correct answers and these usually came from multiplying $(4 - x)$ by 5 as a first step. A common error here was to write this as $20 - x$. This error lost the first method mark but most candidates did earn the second method mark by simplifying their four term equation into the form $ax = b$.

Another quite common error was to move the $-x$ to join the $2x$ without realising that the $2x$ was part of a fraction.

(e) (i) This substitution into a formula was generally well done with candidates correctly squaring –8. The omission of brackets to give the incorrect notation $7+\sqrt[3]{-8^2}$ often led to the error 7 + –4 = 3 and gained no marks.

(ii) This rearrangement of a formula was challenging but there were many fully correct answers. The first step needed was to move the *d* to the left-hand side. Then candidates could cube both sides instead of cubing separate terms. Many candidates did take a square root for the final step, but this depended on an attempt at cubing in the previous step. The most common error was cubing separate terms, but another error seen was to take the cube root instead of cubing and similarly squaring instead of taking a square root. This part was a good discriminating question.

Question 2

(a) (i) This reflection was usually correctly drawn. The errors which did gain a mark were to reflect in the line $y = 1$ or in the line $x = 0$. A few candidates reflected the triangle in the line $y = 0$ but this gained no marks.

(ii) This enlargement with a fractional scale factor was more challenging. There were many correct images and many triangles with the correct orientation but in the wrong position. The latter gained one mark. There were images with incorrect scale factors and a few candidates omitted this part.

(b) This description of a single transformation was generally well answered. Almost all candidates stated that the transformation was a rotation, and many gave the correct angle. Some described the angle as 90° anticlockwise and some stated 90° but omitted the clockwise. The centre of rotation was more challenging, and many candidates gained two of the three marks.

A small number of candidates described the transformation as a rotation followed by a translation. The word single is emboldened on the question paper and so combining transformations did not gain any marks.

(c) This part was probably the most challenging question on the whole paper. Only the strongest candidates scored full marks. Many candidates did not attempt this part.

Incorrect answers were often numerical or included the inequality.

Few diagrams were seen and so most candidates could not find an approach to find the *y*-coordinate. A few candidates realised that the *x*-coordinate would be unchanged and so did gain one of the two marks.

Question 3

(a) There were many fully correct solutions with care taken to show a clear method. Whilst the majority of candidates applied the correct method to obtain the correct answer, errors included: Summation and evaluation errors; incorrect mid-points being used seemingly without consideration that these often lay outside some or all of the boundaries of the intervals (e.g. using the interval widths 10, 10, 20, 10, 30 as the midpoints or dividing these results by 2 and using 5, 5, 10, 5, 15 as the midpoints); using the end points of the intervals as mid-points; dividing by a value other than 120; giving an answer of 30.8 or 31, following correct working, without a more accurate answer being seen; adding together the correct mid-points and dividing the total by 5.

(b) The second part of the question was more challenging to candidates. Some candidates opted to miss out this part of the question completely and others drew a bar of incorrect height without showing any working at all. Some candidates drew two bars of differing heights within the space of the interval. A small number of candidates drew the heights of the bars outside of the grid lines (with a frequency density greater than 2). Occasionally, when the correct height had been obtained, this was not drawn accurately, with the top of the bar not touching or only partially touching the correct grid line. Various incorrect methods were seen. For example, using the width of the interval divided by the total number of patients as the height $\left(\frac{20}{90}\right)$, or the reverse $\left(\frac{90}{20}\right)$. The best solutions indicated with clear working the frequencies for each bar on the histogram. Some candidates then appeared to be confused between the number of patients and the waiting time.

Question 4

(a) (i) Expressing the number of lengths swum by Enzo as a percentage of the total number of lengths was completed successfully by most candidates.

(ii) This question part required a three-part ratio to be expressed in its simplest form. Many candidates did not express the ratio using integers only and so did not score. A minority of candidates correctly reached the ratio 45:75:80 but did not complete the process by dividing through by 5 to get the simplest form.

(iii) (a) Many candidates showed the correct method for finding Blessy's average speed and expressed their final answer as the simplified fraction $\frac{5}{9}$ or as a decimal with accuracy of at least 3 significant figures. Many other candidates gave an answer of 0.5, 0.6, 0.55, 0.56 or 0.555 which did not gain the final accuracy mark. The correct method required candidates to use the given table to find the number of lengths swum by Blessy, 20 and multiply this by the 25 m length of the pool to find the total distance. A common error was to use 20 alone or 25 alone. Many of these candidates correctly divided by 900 to express their speed in metres per second but others omitted the division by 60 to convert from metres per minute to metres per second.

(b) To find the time taken for Rashid to swim a total of 5 km the most successful candidates used the given table to find the number of lengths swum by Rashid in 15 minutes, 18.75 and multiplied this by the length of the pool, 25 m to first find the distance swum in 15 minutes. Almost all these candidates correctly converted 5 km to 5000 m and completed the calculation 5000 ÷ (18.75 × 25) to find out how many sets of 15-minute swims were needed.

The final multiplication by 15 to find the total time in minutes, 160 and conversion from this to 2 hours and 40 minutes was then usually completed correctly. Instead of this approach many candidates chose instead to try to find Rashid's speed in metres per second or metres per minute. These candidates sometimes lost accuracy by prematurely rounding Rashid's speed to 0.52 m/s or 31.3 m/min.

A common misinterpretation of the question was that Rashid continues to swim at the same rate *as Blessy* and the mark scheme catered for this. Candidates who separated the distance he covered in the first 15 minutes at a speed of 31.25 m/minute using the information in the table, from the distance covered for the rest of his swim at a speed of $\frac{5}{9}$ m/s were still able to score full marks. However, most candidates incorrectly simplified the problem by assuming Rashid swam at a speed of $\frac{5}{9}$ m/s for the whole of the 5 km.

(iv) Candidates found this question part challenging. Although correct answers were seen from use of $20(1-\frac{5}{100})^3$, the answer 16.3 was very common from using $20(1-\frac{5}{100})^4$ or the equivalent step by step process of reducing the number of lengths swum by 5 per cent after each 15-minute swim. Candidates focused on there being four 15-minute swims in one hour and did not account for the final 15-minute swim being only the 3rd reduction. Other candidates used a power of 15 in the formula. Another common error was to reduce the number of lengths by 5 per cent of *20* repeatedly, so by 1 length each 15 minutes. Some candidates worked with distance covered instead of the number of lengths.

(b) This calculation with bounds question was also found to be challenging by many candidates. Most candidates were able to write down a correct upper or lower bound for 450 m to the nearest 25 m or 10 minutes to the nearest minute. The required calculation to find the minimum distance in one hour was $\frac{437.5}{10.5} \times 60$. The two 'times' in this calculation were confusing for some. Common errors seen were $\frac{437.5}{9.5} \times 60$, 437.5 × 9.5 × 60, $\frac{437.5}{10.5 \times 60}$ or attempts to apply bounds to the 60 such as using 59.5. Some candidates chose to work with seconds instead of minutes and made conversion errors. Some candidates did not consider bounds at all and evaluated $\frac{450}{10} \times 60$.

Question 5

(a) This question was answered correctly by almost all candidates. Most chose to answer with a fraction with a small minority working with decimals or percentages. Some of the candidates who used decimals gave the answer 0.6 instead of the more accurate 0.625, which had an impact on the remainder of the question.

(b) (i) Many candidates were able to complete the first section of the tree diagram successfully however many did not achieve full marks. The biggest issue amongst the candidates scoring only 1 of the 2 available marks was a failure to recognise that this was a 'replacement' scenario; had the first ball not been replaced then they would have scored full marks. A less common error was to use the number of each colour in the bag at each stage, rather than the probability.

Many candidates who had chosen to work with decimals in **part (a)** switched back to fractions to complete the tree diagram.

(ii) Candidates generally showed a good understanding of how to combine 2 events. Some candidates who had completed the tree diagram without replacement recovered to a correct solution by not using their tree diagram. Most candidates who did use their original tree diagram followed it through correctly to score both method marks.

Some candidates knew to multiply to combine two events but then either stopped working or multiplied their two fractions together instead of adding. It was pleasing that candidates usually showed the products of the fractions they were using in both **part (b)(ii)** and **part (c)** so that method marks were available.

There were a few answers greater than one by candidates who added the fractions for each colour of pen.

(c) Candidates found this part of the question much more challenging. The most common error was to include only 1, or sometimes 2 of the 3 possible combinations. For a significant number of candidates there seemed to be a lack of understanding of how to deal with a third event with many of those trying to add the third fraction or to ignore the third step altogether.

Some candidates recognised that the denominators of their fractions reduced by 1 each time but did not correctly reduce the numerator for blue or reduced the numerator for red unnecessarily. There were also some solutions where the numerator decreased by one, but the denominator stayed the same.

Very few candidates treated the problem as a 'with replacement' situation.

Question 6

(a) Most candidates were able to apply the cosine rule correctly in this question, but it was notable that some candidates had memorised the alternative version of the cosine rule reserved for calculating an angle. The subsequent re-arrangement proved challenging for many, and errors with signs etc. were seen regularly if this method was employed.

A significant majority of candidates did not fully demonstrate that the answer was 1028 as we require their answer to be shown to more accuracy than the stated value in this type of question. Candidates should appreciate that they need to show an answer which has at least one more significant figure than given in the question.

There were relatively few attempts at using an incorrect cosine rule formula.

(b) This part proved to be accessible for most with many candidates achieving at least three out of four marks. There were many successful attempts at using the sine rule in the correct triangle, but some candidates misread the question and attempted to find an incorrect angle (albeit with a correct method). The most common omission in this part was when interpreting the calculated angle *ACB* to find the obtuse angle, with many candidates seemingly unaware of how to convert their acute angle into the correct obtuse angle. An answer of 81 was seen often.

(c) This part proved to be the most challenging in this question. Most candidates began by attempting to find the area of triangle *ACD* using $\frac{1}{2}ab\sin C$. Then they began the process of dividing this area by 10 000 and then dividing 41500 by their result.

Although candidates appreciated the process needed, transcription errors in accuracy when carrying forward calculated values in subsequent calculations, and premature rounding, were all seen on a regular basis. Some candidates misread the question and used triangle *ACB* instead. The final detail which requested answers be given to the nearest dollar was often missed.

There were also some attempts at using $\frac{1}{2}$ base × height scoring no marks.

Question 7

(a) Most candidates were able to interpret the given inequalities correctly and gave the correct values. A few candidates included the inequality signs.

(b) The majority of candidates tried to create the correct inequality and show that it could be simplified by dividing by 6 for the 1 mark available. The most common error was to try to use numerical values to demonstrate the inequality.

(c) Candidates were able to make a good attempt at this question. Most were able to draw the lines $x = 180$ and $y = 90$ accurately. Candidates were aware of using solid/broken lines but sometimes got them the wrong way around. Sometimes, because of overzealous shading, it was difficult to distinguish between dashed and solid lines. Most candidates were able to draw the $x + y = 240$ line, but accuracy was sometimes a problem. Candidates needed to ensure that the line would intercept the axes at (240,0) and (0,240).

Candidates found drawing the line $2x + 3y = 450$ the most challenging. To ensure sufficient accuracy it is advised that candidates use $x = 0$ and $y = 0$ to find the intercepts with the axes. Candidates usually followed the instruction to shade the unwanted regions, but some forgot to label their region *R*.

(d) This part was not as well answered, and some candidates omitted this part completely. Some got the correct answer without using their graph and calculated the profit from 150 scientific and 90 graphical calculators.

Other candidates were awarded the method mark for using values that lay in their region and multiplying them correctly by \$10 and \$30. Some failed to be awarded this mark as they used a point that was not in their region.

Question 8

(a) (i) This question was generally well answered by candidates. Most candidates scored 2 marks here by adding 16 and then taking the square root, recognising two solutions were required. Some candidates chose to subtract 20 and then factorise using the difference of two squares.

These were just as successful. A small number of candidates still only achieved B1 by giving positive 6 as a correct solution and something else or a blank space was left for the second root. Some candidates found $g(20)$ instead of solving $g(x) = 20$.

(ii) This question part was very well answered. Some candidates dropped the negative when dividing or rearranged incorrectly at the start but generally they understood what was required. There were very few cases of candidates giving the reciprocal of $f(x)$ instead of the inverse function.

(iii) Most candidates understood the correct order to process the composite function *gf*(*x*) and we marks for the initial substitution with many going on to be awarded full marks. Some candidates made errors when expanding $(7-3x)^2$ such as $-9x^2$ or just $9x$ and some writing $(7-3x)^2 = (7-3x)(7+3x)$ Others expanded correctly but did not subtract 16 or add one. A few candidates obtained the correct simplified expression but then went on to solve $9x^2 - 42x + 34 = 0$.

A small minority of candidates did not understand composite functions and instead began with $g(x) \times f(x)$.

(iv) The full range of marks were awarded for this question part. Most candidates knew the general shape, and many were able to identify either the roots or the y intercept. Some candidates produced parabolas that curved back in at the top. Some knew where the y intercept was but did not make this an obvious minimum turning point. The best solutions had a sketch of a smooth curve in all four quadrants with clear labelling of any intercepts and the turning point.

(v) This question part proved to be challenging for many candidates. The need to differentiate to find the gradient was not obvious in the context of the question. The strongest candidates had a clear strategy of using differentiation to find the gradient followed by substitution to find the *y* value when $x = -3$. This then invariably led to the correct solution.

Candidates who did not see the requirement to differentiate to find the gradient could usually still find the *y* value at $x = -3$. The common error from these candidates was usually to attempt to find the gradient by using two points on the curve.

(b) (i) There were a variety of responses to this question including parabolas and reciprocal graphs. If candidates knew the correct shape, to gain both marks they needed to indicate that their graph tended towards the *x* axis. In many cases following the candidate knowing the general shape they produced a diagram which did not tend towards the *x* axis but was horizontal over much of the 2nd quadrant. Another common error was for the sketch to have the correct shape but only exist in the first quadrant, stopping at the y axis.

Candidates were not required to label the y intercept, but it was common to see it labelled incorrectly as (0,3). In both question parts requiring sketches some candidates worked out a table of values and then attempted to plot these points, often resulting in the correct general shape but making it difficult to produce a fully correct smooth sketch.

(ii) There were not many correct responses to this question as it was hard to gain credit if the shape of the graph in **(b)(i)** was not known. Those candidates that understood answered correctly with $y = 0$ rather than stating the *x* axis.

Question 9

(a) Nearly all candidates made a positive start and multiplied the dimensions correctly to calculate the volume.

(b) Again, many correct responses were seen. Some candidates who found the areas of the three different faces first, sometimes omitted the final multiplication by 2. Another common error was to presume that four of the faces were the same dimensions, leading to answers such as 17 × 8 × 4 + 10 × 8 × 2 or other combinations in a similar form.

A small proportion of candidates got volume and surface area mixed up completely and the answers in **(a)** and **(b)** were reversed.

(c) Candidates did well on this familiar style of question and usually identified the correct angle within a right-angled triangle in 3D. Most used Pythagoras correctly to find the length of AC which would have been enough to calculate the required angle using tan. Candidates often failed to retain accuracy here and if they then used 12.8 instead of $2\sqrt{41}$ then sometimes their final answer fell out of range.

This was even more apparent with candidates who went on to use Pythagoras again to calculate *AG* to use sine or cosine. Cases of finding angle *AGC* instead of angle *GAC* were relatively rare; those that made errors in recognising which angle was required usually thought it was angle *GAB*.

(d) Candidates found this part extremely challenging, and it was rare to see a fully correct response. Visualising a correct right-angled triangle proved to be very difficult for the majority. Most thought the point vertically below *Q* was directly opposite *P* and just used $17^2 + 8^2$ even if they had identified *QG* = 2.

Those that identified '3' as the missing length on the horizontal right-angled triangled, usually went on to achieve a correct answer, but that step was missing from most of the responses.

Many other attempts at Pythagoras were often seen e.g. $17^2 + 2^2$; $5^2 + 8^2$ etc. Some candidates worked with triangle *QPC* which was not right-angled and did not have the required angles to allow the use of the sine or cosine rule. Most candidates did however get 1 mark for identifying *QG* = 2.

Question 10

(a) (i) Nearly all candidates understood that the area of a rectangle was length × width and wrote their first line as $(2x + 3)(x + 1) = 190$

Many were able to expand the brackets correctly and collect terms to obtain $2x^2 + 5x - 187 = 0$.

A few made errors when multiplying out the brackets and/or rearranging.

Using the formula was the most popular method used to solve the resulting equation and was usually well done.

Those candidates who chose to factorise were also successful.

Often the negative root was given as well as the required answer 8.5 and not all candidates clearly rejected this negative root to achieve full marks.

A handful of candidates attempted completing the square with their quadratic = 0.

(ii) The correct answer was seen often although some candidates made errors in the substitution of 8.5 or only completed an algebraic answer of $6x + 8$.

(b) (i) In this part of the question it was necessary to subtract the area of the triangle from the area of the sector and equate to 30. Although some candidates were able to do this, the resulting rearrangement to show the radius as 23.7 proved to be too challenging for many. Those who managed to rearrange successfully often did not give their answer to enough accuracy.

To ‘show that ‘ r = 23.7 we need to see an answer which has more accuracy than the value given in the question. Many just equated one of the formulae to 30, generally the sector area. Other candidates substituted r = 23.7 into their formulae to establish equality to 30.

No marks were awarded for using the value that they have been asked to show.

(ii) In this part candidates needed to calculate the length of the arc *AB* and the length of the chord *AB*. This was completed by many, but some just found one of them, generally the length of the arc. Successful attempts at finding the chord came equally from use of the cosine rule and use of the sine rule in triangle *AOB*.

A few candidates used a formula for an area instead of a length for this part.

Some candidates misunderstood the question and added a value equivalent to 2 radii onto their other working which was usually their attempt at finding the arc *AB*.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/42
Paper 42 (Extended)

Key messages

To do well in this paper, candidates need to be familiar with all aspects of the syllabus. They must be able to recall and apply formulae and mathematical facts in both familiar and unfamiliar contexts. Additionally, they must be able to interpret situations mathematically and problem solve unstructured questions.

Work should be clearly and concisely expressed with intermediate values in calculations not rounded and only the final answer rounded to the appropriate degree of accuracy.

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

General comments

There were many candidates that demonstrated strong knowledge and skills across the breadth of the paper. Most candidates were well prepared for the paper and their solutions were usually well presented. There were, a small number of candidates who wrote down their numbers that were very difficult, or impossible to read and in a few of these cases the candidate misread their own numbers. All candidates appeared to have sufficient time to answer the questions.

When answering 'show that' questions, all steps in working must be clearly shown without any omissions. It should also be noted that when answering 'show that' questions, where the answer is given, they must not use the given answer in their solution and must show all working to more accuracy than the given answer, only rounding at the end e.g. **Question 7(a)(iii)**.

When a question asks candidates to show all of their working then each step must be shown as answers obtained from calculators only will not be credited for method marks e.g. **Question 3(d)**.

Premature rounding within calculations continues to be an area to address for a number of candidates and leads to a loss of marks for inaccurate final answers. Where a method step is not shown and values are given instead, two significant figure values are insufficient to imply a correct method.

The topics that were answered well were:

- percentage reduction
- non-linear simultaneous equations
- non-linear graph drawing
- use of trigonometry ratios including sine and cosine rules
- basic algebraic manipulation and solving linear equations
- interpreting cumulative frequency diagrams
- solving quadratic equations by factors or formula
- upper and lower bounds
- finding turning points of graphs.

The weaker areas were:

- reverse percentages
- bearings
- properties of angles in circles
- using the correct terminology in geometrical reasoning
- harder vector work
- Manipulation of directed terms in composite functions
- maximum/minimum properties of graph turning points
- ‘show that’ questions.

Comments on specific questions

Question 1

(a) (i) This question was answered very well with most candidates scoring both marks and showing clear working. A few candidates did not interpret the percentage 7.5 per cent as a decimal or fraction and were therefore unable to score marks unless their evaluation was correct. Common errors included giving 2118 as the answer or adding 2118 to 28240 instead of subtracting.

(ii) There was a mixed response to this part. Many correct answers were seen but not all candidates understood how to set up a correct equation for this reverse percentage question. Common errors included working out 72 per cent, 28 per cent or 172 per cent of 45.

(b) Many candidates were successful in this part but some had difficulty using all of the given information. Most candidates correctly calculated 47 × 330 as their first step but some made no further progress. Common errors included subtracting 11490 and 47 × 330 from 28000 rather than 31900. A minority of candidates worked out a percentage of 31900 rather than 28000.

(c) Many candidates were successful in this part and scored full marks. Some common errors were adding $\frac{2.5}{64}$ and $\frac{6}{128}$ and dividing 192 by 8.5. Some correctly divided 8.5 by 192 but then gave an insufficiently accurate decimal answer.

(d) This part was very well-answered with most candidates scoring full marks. The most common error was finding 65 per cent of 46500.

Question 2

(a) Almost all candidates answered this part correctly.

(b) This part was answered very well with most candidates accurately plotting the points and drawing a smooth curve through them. Occasionally candidates plotted points incorrectly and a small number connected their points with straight line segments.

(c) (i) The majority of candidates appreciated what was required here and drew an accurate tangent line at their point on the curve at $x = 1$. The tangent was usually drawn at (1,1). Some candidates were not accurate with the tangent because they had a gap between their tangent and the curve, or because their tangent was a chord.

A minority of candidates omitted this part or drew an incorrect line, such as $y = 1$ or $x = 1$.

(ii) The majority of candidates identified two points on their tangent line and correctly calculated the gradient using the vertical and horizontal displacement between the two points. Errors were sometimes made in reading the coordinates from the grid.

A few candidates erroneously used differentiation to obtain the gradient and weaker candidates struggled with the scales on the two axes to calculate their gradient.

(d) This part proved to be more challenging with only the stronger candidates gaining full marks. A number did not appreciate that a rearrangement of the equation $x^3 + 4x^2 - x - 6 = 0$ into the form $x^3 + 4x^2 - 4 = x + 2$ would allow them to use the plotted curve and the line $y = x + 2$ to obtain approximate solutions to the equation.

Of those who did attempt to rearrange, slips occasionally led to incorrect lines such as $y = x + 6$ and $y = x - 2$. A small number of candidates misunderstood the purpose of the rearrangement and proceeded to set $x + 2$ equal to 0 to find x.

Stronger candidates were able to draw the required line on their graph and understood that the intersection points would give them the desired solutions. Those who plotted an inaccurate curve in **part (b)** seldom obtained answers within the required range of accuracy.

Many candidates were unable to rearrange the equation correctly and resorted to solving the cubic equation by calculator.

Question 3

(a) (i) This part was usually very well-answered but not all candidates noted the instruction to simplify their answer, with some candidates giving an answer of $(3 - 4)m + (8 - 5)n$.

(ii) The vast majority of candidates answered this part correctly. Some candidates incorrectly simplified the powers of a and c by adding the powers rather than multiplying them.

(iii) This part was answered well by many but not all found a correct common denominator and those who did sometimes worked with a common denominator of 150 or 750 rather than the LCM of 30. Some candidates incorrectly multiplied the expression by 30. Sign errors were sometimes seen; for example, some candidates added the last two fractions first and then subtracted their answer from $\frac{4x}{5}$, earning partial credit. Others lost the x in the final answer. Some did not simplify their answer, with answers of $\frac{475x}{750}$ and $\frac{95x}{150}$ sometimes seen.

(b) Most candidates were successful in this part. The majority formed the correct linear equation and solved it correctly, although some candidates omitted one of the side lengths. A small number of candidates attempted to multiply side lengths together instead of adding them.

(c) Candidates often understood what was required in this part but sometimes lost marks for insufficient working or inaccurate answers.

A minority of candidates used an incorrect formula. For those who did know the formula, brackets were sometimes omitted around –4, the fraction line was not always long enough and the square root sign did not always cover all of the terms within it.

Many candidates gave an inaccurate decimal answer of –0.47 for the negative root. Centres and candidates should note that inexact answers should be given to at least 3 significant figures.

(d) Candidates fared well on this part and many obtained full marks. Most candidates favoured the easier method, which was to substitute $y = 2x - 3$ into the first equation to obtain a quadratic equation in x. Those who worked in y were generally less successful and often struggled to simplify their equation to a 3-term quadratic. This part required candidates to show all of their working. The majority showed a correct method for solving their quadratic equation, though occasionally the roots were seen without any working.

Question 4

(a) The majority of candidates answered this correctly. A common error was to use 180° and not 360° for the angle sum of the quadrilateral.

(b) (i) Most candidates scored either 0 or 2 marks in this part. The most common error was to assume that *PQ* and *BD* were parallel, making angle *ABM* = 45º, leading to an answer of 30. Less common was to assume triangle *BMA* was isosceles and give the answer 37.5º. Partial marks were earned by those candidates that recognised angle *ABM* = 49°.

(ii) (a) Many were successful in this part. The most common error was to assume *QAD* = 45º and get an answer of 90. A small number of candidates earned partial credit for recognising that angle *BDA* was 45º, or angle *DAQ* was 49º, using the alternate segment theorem.

(b) Candidates were required to use the correct geometrical terminology in their reason and state that the angle in a semicircle is 90° within their response. The majority referred to the angle *BAD* not being 90 or that the line *BD* did not pass through the centre.

(c) (i) Candidates should note that in order to show that the angle was 108.12 correct to 2 decimal places, they must give an answer to a greater degree of accuracy. This was a common error leading to a loss of marks within an otherwise correct method. The concise method was to use the cosine function triangle AOT before multiplying by 2. Many chose unnecessarily longer methods which, although often correct, took time and led to a loss of accuracy in the angles.

(ii) Most candidates answered this part well. An error on occasions was the use of 54.06 instead of the given angle. A few candidates made no attempt at this part.

(iii) Many candidates answered this well. A few used longer methods, usually whole circle area subtract the minor sector. The most common error was to find the major arc length or the minor sector area

In both **parts (c)(ii)** and **(c)(iii)** some candidates attempted to work in radians. In almost all cases this was unsuccessful and candidates gained no credit. The syllabus does not include the use of radians and candidates are advised to work in degrees.

Question 5

(a) (i) (a) This part was usually correctly answered. Some candidates misread the scale when reading the answer from the distance axis, leading to an incorrect answer such as 1450 or 1460. A small number gave the answer as 1200, the midpoint of the distance axis.

(b) Most candidates gave the correct answer for the interquartile range. A few gave the upper or lower quartile as the final answer and there were some misreads of the scale for the lower quartile. Instead of reading the distance at the upper quartile and lower quartile and subtracting, some candidates are making the error of subtracting first the frequencies first (60 – 20) and then reading off the value at frequency 40, the median.

(ii) There were many completely correct solutions to this probability question. Some candidates obtained 72 from the cumulative frequency axis but did not subtract this from 80 and gave an answer of $\frac{72}{80}$. Other gave 72 or 8 as the final answer.

(b) Almost all candidates understood that to find the average speed the distance is divided by the time. A very small number multiplied the distance by the time. As the distance is given in kilometres it is necessary only to convert the time, given as 1 min 18s, into hours and many candidates did this correctly earning full marks. A common error was to give the time as 78 seconds but not convert this correctly into hours. A small number of candidates gave the time as 1.18 minutes.

Some who used a correct method, dividing 1.3 by 60 to convert the time into hours, evaluated this but not to a sufficient degree of accuracy and so divided 1.504 by 0.021 or 0.022. In order to obtain an answer within the acceptable range at least 4 significant figures must be used.

(c) (i) Many candidates used frequency density × class width correctly to earn the mark. Some gave $\frac{x}{40} = 0.2$ but did not write down the next step. Candidate should note that an explicit calculation is required to justify a result given in the question.

(ii) This part, to find an estimate for the mean top speed was somewhat different to the standard question on this topic and the previous part was designed to provide an indication that it was necessary to find the frequencies from the histogram as a first step. The majority of candidates showed a correct method with just an occasional error seen. The most common error was to give the frequency for the second block as 20 × 1.2 = 24.

Most candidates who gave the correct frequencies used these correctly and scored full marks for this question. The working was generally very well set out and few arithmetic errors were made. Some candidates either used the class widths or the upper bounds rather than the midpoints in their calculations. A few attempted unsuccessfully to use the frequency densities as the frequencies within the calculation.

Question 6

(a) Most candidates answered this correctly. The majority of errors seen were due to slips with signs or arithmetic usually evidenced by one of the values being correct. A range of misconceptions were also seen. These included treating the vectors as fractions and only multiplying the top number in the first vector by 2 or not using 'order of operations' and first finding the difference of the two vectors and then multiplying by 2.

(b) (i) Many candidates answered this correctly and often these candidates had either drawn a vector triangle sketch or had written $\overrightarrow{ON} = \overrightarrow{OM} + \overrightarrow{MN}$ to help them understand that they needed use addition. The most common errors came from finding the difference of the two vectors giving incorrect answers of $\begin{pmatrix}8, -9\end{pmatrix}$, which is $\overrightarrow{OM} - \overrightarrow{MN}$, or $\begin{pmatrix}-8, 9\end{pmatrix}$, which is $-\overrightarrow{OM} + \overrightarrow{MN}$.

(ii) A good proportion of candidates answered this correctly. Others scored one mark for showing $(-6)^2 + 4^2$ but then either not square rooting or giving an inaccurate answer such as 7.2. Common errors included to omitting, and not recovering, the brackets and evaluating $-6^2 + 4^2 = -20$ or calculating $(-6)^2 - 4^2$.

(c) (i) (a) Many candidates answered this correctly. The most common incorrect answer was $2c + a$ which often followed the correct vector route but with $\overrightarrow{AO} = a$ **,** or followed the incorrect vector route, $\overrightarrow{AB} = \overrightarrow{OA} + \overrightarrow{OB}$. Other common misconceptions included an alternative correct route, $\overrightarrow{AB} = \overrightarrow{AC} + \overrightarrow{CB}$ but then $\overrightarrow{CB} = -a$, and the occasional use of Pythagoras**,** $\sqrt{(2c)^2 + a^2}$.

(b) A good proportion of candidates answered this correctly. Most candidates chose to use the correct route $\overrightarrow{CB} = \overrightarrow{CA} + \overrightarrow{AO} + \overrightarrow{OB}$ but some either did not simplify $-c - a + 2c$ or they gave an answer of $a + 3c$ because they did not reverse the signs for $\overrightarrow{CA}$ and $\overrightarrow{AO}$. Others used the route $\overrightarrow{CB} = \overrightarrow{CA} + \overrightarrow{AB}$, and their answer to the previous part, with similar success or lack of simplification or sign errors. Others found $\overrightarrow{BC}$ with an answer $a - c$ and, as in the previous part, some assumed that $\overrightarrow{CB} = -a$.

(c) A good number of candidates scored full marks in this part. Others were able to show a correct route such $\overrightarrow{OP} = \overrightarrow{OA} + \overrightarrow{AP}$. Those using $\overrightarrow{OP} = \overrightarrow{OB} + \overrightarrow{BP}$ were more likely to make sign errors, not taking into account that $\overrightarrow{BP} = -\frac{4}{5}\overrightarrow{AB}$. Other errors included interpreting the ratio incorrectly as, for example, $\overrightarrow{AP} = \frac{3}{4}\overrightarrow{AB}$, including $\frac{1}{5}$ or $\frac{4}{5}$ standing alone in an answer or having in the final answer, for example, *A* or *C* which are vertices rather than ***a*** or ***c***.

(d) Again a good number of candidates scored full marks in this part and there was a high correlation of success in this with the previous part. Others were again able to score one mark for any correct route evidenced, the most direct being $\overrightarrow{QP} = \overrightarrow{QA} + \frac{4}{5}\overrightarrow{AB}$. Similar sign errors, not taking into account the importance of the direction of a vector, and incorrect interpretation of the ratio were again seen.

(ii) There were some excellent answers to this part with candidates clearly stating 'parallel' and the correct relative ratio of lengths. Answer stating the lines 'are mathematically similar' or 'are an enlargement of each other' were not precise and did not score.

Common incorrect statements included 'they are perpendicular', 'they are collinear' or a ratio given with the parts in the reverse order. Other candidates could 'guess' from the diagram that the lines were parallel, but without evidence to support this in the previous two parts, they did not score.

Question 7

(a) (i) This part was well answered and almost all candidates earned the mark. A few did not show the subtraction to obtain the 81° and stating only 60 + 39 + 81 = 180, but this was very rare.

(ii) This was very well answered by the almost all of the candidates who demonstrated confidence in the use of the sine rule. A small number attempted a right-angled trig calculation.

(iii) This 'show that' question proved more difficult to gain full marks for candidates. Many candidates were confident with setting up the cosine rule correctly and with rearranging and accurately simplifying it but many did not give a more accurate solution than 31.6 which was required.

Candidates that recalled the angle version of the cosine rule were more successful than those that used the side formula as they were some errors in rearranging. Some longer methods were used, for example finding angle *BAD* using the cosine rule and then using this in the sine rule to show that angle *ABD* = 31.6°, and these methods were also generally successful but often without giving the more accurate solution.

(iv) There were many correct answers and most candidates recognised that the distance required was the perpendicular from *A* to *BD* even if they could not get any further with the trigonometry.

(v) Responses here were varied. Some stronger candidates seemed to have a solid understanding of bearings and showed working on the diagram leading to the correct answer. A number of others were unable to recognise the bearing required. Candidates who annotated the diagram to give them a clearer understanding often scored at least partial credit.

(vi) Candidates generally used correct methodology to find the area of each triangle using the formula area = $\frac{1}{2}ab\sin C$. Sometimes errors were made in selecting the correct angles or side lengths to use. After finding the areas of the two triangles, many candidates were successful in finding the total area and then converting this to hectares and multiplying by 1100 to find the number of trees. Premature rounding was made by some candidates in the final stage of the method which led to an incorrect answer.

(b) A large number of candidates were able to tackle this part successfully and showed full method leading to the answer 126. The common errors included correctly showing both the upper and lower bounds of both the given area and length but then using the wrong combination. Some showed the division using the values given in the question 9400 ÷ 80 and then attempted to adjust their answer ± 50 or ± 5.

Question 8

(a) (i) This part was invariably answered correctly with simplified or unsimplified fractions and a few giving decimals or percentages. Candidates do not need to convert or simplify probabilities unless the question directs them too.

(ii) This part was again answered very well.

(b) (i) Many candidates were successful. The common error was calculating black, white and white, black leading to an answer of $\frac{8}{35}$. A few assumed replacement giving $\frac{24}{225}$ while others added the correct fractions rather than multiplying them.

(ii) Candidates found this part more challenging but there were many correct The most frequent method was P(GW) + P(GB) + P(WB) where some calculated all six combinations while others only three and doubled their answer. The common errors were in only using some of the required products or only giving half the answer by not considering e.g. WG as well as GW etc. The method of 1 – P(same colour) was less common even though it was the most concise. Very few used the method of P(GG′) + P(WW′) + P(BB′). A few treated the problem as using replacement.

Question 9

(a) (i) Almost all candidates were successful.

(ii) Almost all candidates were successful.

(iii) Most candidates gave the correct inverse function. A few gained credit for a correct first step which was usually $x = 2y - 5$. Common errors were with signs or not changing y to x at some stage. A few treated $f^{-1}(x)$ as $\frac{1}{f^{-1}(x)}$.

(b) Answers were varied on this question. The most successful candidates usually gave the single full expression before attempting to deal with the brackets. Others split the problem into separate parts, expanded brackets and then joined the results together but this was less successful and errors with signs were more frequent e.g. $3x^2 - 6x$ and $4x - 10$ were correctly seen expanded separately but then errors when placed into the full expression as $-3x^2 - 6x$ and $-4x - 10$. A few made errors with the expansion $(2x - 5)^2$ giving $4x^2 - 25$ or $4x^2 - 10x + 25$.

Question 10

(a) The majority of candidates correctly differentiated the equation with a small number giving only the first two parts of the derivative. Some only factorised the equation and a few of these used the correct derivative in **part (b)**.

(b) There were many good responses to this part. Equating the derivative to zero was either seen or implied by solving the quadratic equation involving the derivative from **part (a)**. Most were able to factorise the derivative and reach the correct solutions. Others chose to use the formula with a few using completing the square method. Some did not show the method to solve the equation and simply stated the solutions and in those cases only partial marks were earned.

(c) There was a mixed response to this part. Many candidates understood the approach needed but a significant number struggled to access this question. The most common method was to use the second derivative of $6x - 18$ to find it's value at their turning points.

Most candidates managed to gain 2 or 3 marks using this approach. Some omitted to show whether the calculated values were negative or positive as the reason for maximum or minimum.

A few others were successful in using sketch graphs which were usually correct with the turning points in the correct quadrants. This is a concise method and should be encouraged. The method of evaluating and comparing values of y or the gradients on both sides of the stationary points was rarely seen. A common error was to assume that (–2, 52) was the maximum and (8, –448) was a the minimum because 52 > –448.

This could only gain credit if accompanied by a sketch of the cubic. Weaker candidates often just stated maximum or minimum alongside the turning points or gave no response.

MATHEMATICS (WITHOUT COURSEWORK)

Paper 0580/43
Paper 43 (Extended)

Key messages

To do well in this paper, candidates need to be familiar with all aspects of the syllabus. They must be able to recall and apply formulae and mathematical facts in both familiar and unfamiliar contexts. Additionally, they must be able to interpret situations mathematically and problem solve unstructured questions.

Work should be clearly and concisely expressed with intermediate values written to at least four significant figures with only the final answer rounded to the appropriate level of accuracy.

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

General comments

There were some very good scripts in which candidates demonstrated a clear knowledge of the wide range of topics tested. However, there were some poorer scripts in which a lack of expertise and familiarity with some topics resulted in high numbers of no responses.

The standard of presentation varied considerably. On some scripts a lack of clear working made it difficult to award method marks. There was no evidence that candidates were short of time, as most candidates attempted nearly all the later questions.

The areas that proved to be most accessible were:

- Sharing in a ratio.
- Surface area of a cone.
- Average speed.
- Expanding brackets.
- Mean of a continuous distribution.
- Drawing a histogram.
- Probability and expectation.

The more challenging areas were:

- Monthly compound interest.
- Algebraic expression linking speed, distance and time.
- Setting up a quadratic equation based on the area of a trapezium.
- Finding the equation of a tangent using a derivative.
- Sine rule to find an obtuse angle.
- Perimeter of a quadrilateral with a complex diagram.

Comments on specific questions

Question 1

(a) Most candidates were able to calculate the correct mass, but a common error was to divide the mass of the vegetables in the ratio 9:8, leading to 25.4 kg. In a small number of responses the total mass of fruit and vegetables was given as the answer.

(b) Many candidates found this part challenging with roughly half of the candidates finding the correct amount. Those that formed a correct equation usually completed the question successfully with just a few giving the answer as 139 after forgetting to add on 3 to their value of *c*. Some multiplied the parts of the ratio leading to a quadratic equation $(c + 3)(c - 1) = 280$. Many candidates tried to apply the standard method for sharing in a ratio and it was common to see $\frac{280(c+3)}{c+3+c-1}$. Some stopped at this point, some restarted, some tried trial and improvement but almost all resulted in no progress toward a correct solution.

(c) The majority of candidates started with a correct calculation. Some of these gave the correct answer of 8.02 per cent but a significant number gave an incorrect answer of 8 per cent without a more accurate figure being shown. A significant number of candidates attempted to calculate the percentage profit by calculating the profit as a percentage of the selling price.

(d) Candidates generally fared better on this part but there were still many who did not identify the reverse percentage and calculated either 1738 – 10 per cent of $1738 or 90 per cent of 1738.

Question 2

(a) (i) This part was very well answered with many candidates giving the correct midpoint. Occasionally, candidates subtracted the coordinates of *A* and *B*, sometimes dividing by 2, sometimes not.

(ii) A variety of answers were given with 4 and 2 often present, sometimes positive values rather than negative, and sometimes reversed. It was unusual to see a fraction line in any vector. There were also a few different values, sometimes the midpoint of *AB*, but usually without any working to show how they had been found.

(iii) The values ±12 and ±6, or the equivalent follow through values, were regularly seen in the working, but there was less success in using those values to get to the correct answer. Candidates were expected to subtract the components of the vector $3\overrightarrow{AB}$ from (3, 7). A minority did this correctly but some reversed the subtraction while others subtracted the components of $3\overrightarrow{BA}$.

(b) (i) Many correct answers were seen, possibly helped by the rotation being around a point on the original shape. Some candidates rotated shape *P* around an incorrect point and these images were seen in a variety of places on the diagram.

(ii) Candidates were slightly less successful with this reflection. Many had drawn the line of reflection and were able to use it to good effect. A common incorrect reflection showed the shape in a horizontal orientation rather than the expected vertical orientation starting from the common point (1, 3).

(iii) Many candidates recognised this as an enlargement. Some gave the correct properties of the enlargement but forgot to state enlargement. The most common error occurred with the scale factor and –2 was frequently seen and to a lesser extent $\frac{1}{2}$ was also seen. Some candidates gave more than one transformation, usually including a rotation.

Question 3

(a) Those candidates that stated a fully correct method almost always went on to find a correct value of r resulting in a significant number of correct answers being seen. Treating the 675 as the interest earned was the most common error. Some candidates did not start with $675 = \frac{500 \times r \times 14}{100}$, preferring to work with $675 = 500 \times r\% \times 14$ leading to $r\% = 0.025$. Some candidates dropped the per cent sign and gave their answer as 0.025. A few attempts at compound interest were also seen.

(b) The vast majority of candidates had no difficulty in using the compound interest formula. Forgetting to subtract the original £400 was very common. Many of the weaker candidates were unsure how to proceed and some random calculations were seen, many of which involved simple interest

(c) This was a challenging question for candidates, with many not taking note of the interest being paid monthly. Those that did take account of this were often able to set up a correct equation but many were unable to solve it correctly. Some of those candidates that did not take account of the monthly interest were able to demonstrate a correct method for calculating the rate of interest and earned some partial credit.

Question 4

(a) Almost all candidates were able to calculate the correct mass of the box. Some calculated the total mass of the 50 cuboids and gave that as their final answer.

(b) Candidates found this question quite challenging and only a minority calculated the correct amount of water. Many did not take note of all the information given in the question and calculated the amount of water poured in to reach the top of the larger cube. It was common to see $6^3 – 4^3 = 152$. Others attempted to draw diagrams and break up the volume into cuboid sections but these were rarely successful.

(c) Many candidates had a good understanding of how to calculate the volume of the prism and how to use the volume to find the mass of the prism. For many calculating the area of the cross-section proved more difficult. Some used $\frac{1}{2}$absinC correctly and some used $\frac{1}{2}$bh correctly. Incorrect attempts at Pythagoras such as $4^2 + 2^2$ or taking the height and base as 4 resulted in many incorrect areas. The majority however, did proceed to correctly multiply their incorrect area by the length of the prism and then by the density.

(d) (i) Many candidates successfully calculated the total surface area. They were asked to show that it rounded to 1131 cm^2 but many just gave the value 1131 rather than the more accurate value of 1131.9 that was required. Some did not reach a correct area as they used the vertical height of the cone instead of the slant height to calculate the curved surface area.

(ii)(a) Many candidates gave 0.15, rather than the more accurate value of 0.151, as their final answer, often without showing their method.

(b) Only a minority of candidates obtained the correct number of cones. Others knew how to obtain the answer but the incorrect conversion of the units resulted in many incorrect answers. Some divided the area of a cone by the coverage of the tin.

Question 5

(a) Many correct answers were seen. Incorrect answers resulted from premature rounding of some values and incorrect conversions, usually converting the time to hours and occasionally for the distance to kilometres.

(b) Fully correct solutions were in the minority. Some candidates correctly calculated the distance for the first part and the time for the second part. When trying to combine the various parts some used an incorrect value. Others made errors when trying to find the total time. Some only calculated one of the two parts and weaker candidates just found the mean of the two speeds given in the question.

(c) This proved to be a challenging question and correct answers were in the minority. Some understood that they needed to find the time to travel a total distance of $p + q$ metres but dealing with the different units for time and speed was a step too far for many. Some were able to convert the speed in km/h into m/s but used an incorrect distance.

A significant number of candidates made no attempt at a response.

Question 6

(a) Only a minority of candidates gave a fully simplified response. Some multiplied the fractions to reach $\frac{240u}{15uy}$ and went no further while others only partially cancelled with $\frac{80}{5y}$ frequently seen. Weaker candidates treated the fractions as if they were adding, finding a common denominator and adjusting the numerator to match.

(b) Many candidates made a good attempt to expand the three brackets and went on to obtain the correct answer. Some expanded the first pair and then made errors when combining the result with the final bracket. About the same number of candidates expanded correctly but the collection of the terms introduced some errors.

(c) Many candidates had no difficulty in showing the required working when solving the equation. There were a few instances where candidates used an incorrect formula. Other errors usually involved mistakes with the signs either with the '$-b$' or with the discriminant. It was obvious that some candidates gave up working with the formula and used their calculator to state the correct answer without adequate working to support their answers.

Question 7

(a) (i) Many correct answers were seen with most using the formula for the area of a trapezium.

(ii)(a) The better responses displayed clear working laid out in a logical order. Weaker responses tended to be more haphazard making it more difficult to follow the progression in the working. It was common to see essential brackets omitted such as $\frac{1}{2} \times 2y + 5 \times y + 2$, although in many cases candidates did recover to earn method marks by multiplying the expressions correctly. Some candidates omitted the $\frac{1}{2}$ from their formula. Those that attempted to subdivide the trapezium into a rectangle and one or two triangles fared no better when it came to including brackets. A higher-than-average number of candidates made no attempt at a response.

(b) Fully correct answers were in the minority as many candidates struggled to find the correct factors for the given equation. It was obvious that some candidates gave up trying to find the correct factors and resorted to using their calculator to find the solutions.

(b) Many candidates had a good understanding of sectors and arcs and most obtained the correct arc length. Many of these continued and gave the correct perimeter but a significant number stopped at the arc length. Some candidates used the area formula instead of $2\pi r$.

(c) Some candidates clearly worked through the solution to leave the answer in the required form. Others undertook the correct calculation, but were too eager to use a calculator for the area of the quadrant, giving the answer as a decimal. Some wrongly assumed that the radius of the quadrant was 5 cm. Many of those with an incorrect quadrant area did have a correct area for the two triangles.

Question 8

(a) Many correct answers were seen. The most common error was giving an angle for the wrong interval, usually $40 < v \leqslant 45$.

(b) Most candidates were able to set out their calculations clearly and went on to obtain the correct value for the mean. Occasionally some candidates made slips, either with a midpoint or with the numeracy work. Some candidates mistakenly use the interval boundaries or the interval widths in an otherwise correct method. In some responses candidates gave their answer without showing all the steps in their working. Candidates risk losing all the marks if their answer is incorrect.

(c) Many correct histograms were seen. The most common error involved dividing all the frequencies by 5 instead of the interval widths, to obtain frequency densities of 3, 7 and 6. A small number made no attempt.

Question 9

(a) (i) Almost all candidates found the correct probability. The most common error was giving the probability that the ball is black.

(ii) A large majority of candidates had a good understanding of expectation and found the correct number of times the ball would be white. Some had the correct method but made arithmetic errors, some attempted to give a probability and some gave the number of times the ball would be black.

(b) (i) A small majority of candidates found the correct probability with clear working shown. Many of the errors seen resulted from the assumption that the first ball was not replaced. Some candidates obtained the two correct products but then multiplied them instead of adding them. A few had a partial understanding of replacement and $\frac{3}{8}\times\frac{2}{8}+\frac{5}{8}\times\frac{4}{8}$ was seen occasionally. Other errors usually resulted from slips with the arithmetic.

(ii) Most candidates understood they only needed to subtract their answer from the previous part from 1 and did so correctly. Some ignored the previous part and instead to consider the probabilities of picking a white and a black. Some were successful but a significant number only considered the probability of white then black or black then white, forgetting that their answer needed to be multiplied by two. A higher than average number of candidates made no attempt at a response.

(c) A small majority of candidates showed an understanding of the probabilities involved. Not all candidates who reached a correct product of three probabilities realised there were three possible combinations. Many worked with only 1 or 2. Some made the mistake of working with replacement. The weaker candidates who drew tree diagrams did not make it sufficiently clear which were the possible combinations

Question 10

(a) Many of those attempting the question were able to find the correct derivative. Others equated *y* to zero and attempted to solve a quadratic equation and others attempted some form of substitution. Many did not understand derivative resulting in a far bigger proportion of candidates than normal made no attempt at a response.

(b) (i) Candidates found this part of the question far more challenging. Only the stronger candidates were able to give a full answer with the derivative used correctly, followed by substitution and a convincing calculation for the y intercept. Many chose to put the derivative equal to zero rather than substituting the value of –1 into their derivative to find the gradient. Others merely stated that the gradient was 4 and in both cases no progress was made. It was common just to see the coordinates (–1, 0) substituted into the given equation to show that 0 = 0. A significant proportion of candidates made no attempt at a response.

(ii) Candidates fared better in this part of the question. Those attempting a response generally used the correct gradient of $-\frac{1}{4}$ and substituted (–1, 0) with the occasional slips when finding the intercept. A few made the error of finding the midpoint of *AB* using this a point on the perpendicular instead of (–1, 0). A significant proportion of candidates made no attempt at a response.

(c) Again, candidates fared better in this part compared with the two previous parts. A variety of methods were used. Some used symmetry, realising that the maximum point was half way between the *y*-intercept and point *B*, often giving their answer with little or no working. Others used their derivative, equating it to 0 and solving to find the *x*-coordinate. Some of the weaker candidates equated the equation of the curve to zero not realising that they were calculating the intercepts on the x axis, one of which they had been given. Some incorrectly used the second derivative as the *x*-coordinate.

Question 11

(a) Almost all candidates found the correct value with just an occasional slip seen.

(b) Most recognised how to find f(x)g(x) but less could write down fg(x). Mistakes were not uncommon when finding f(x)g(x), in particular the $4x^2$ term which was often written as $2x^2$ or $4x$. Another error involved fg(x) which was sometimes written as gf(x), i.e. $1 – 2(2x + 5)$. Careless mistakes were often seen, including losing the final '+1'.

(c) Most candidates had no difficulty in obtaining the correct inverse function. Common errors included leaving the answer in terms of y, incorrect signs when rearranging and reciprocal answers such as $\frac{1}{1-2x}$.

(d) Most candidates understood how to find hh(1). Some left their answer as $\frac{1}{1.5}$ or gave it to 2 significant figures only. The most common mistake was in writing hh(1) as $\frac{1}{2} \times \frac{1}{2}$.

(e) A majority of candidates were aware of how to write the expression as a single fraction and many went on to obtain a correct answer. Sign errors were common, for example, writing the numerator as $x + 1 – 2x + 5$. A significant number of candidates expanded the brackets in the denominator and, for some candidates, this introduced errors unnecessarily.

(f) Some candidates were able to set up the equation $2^x = \frac{1}{32}$ and go on to solve it correctly. Some candidates wrote $\frac{1}{32}$ as 2^5 instead of 2^{-5}.

(g) The idea that $j^{-1}(x) = 0$ leads to $x = j(0)$ was unfamiliar to many candidates and fully correct answers were in the minority. Many of those that attempted a response gave the answer 0. A significant proportion of candidates made no attempt at a response.

Question 12

(a) Most candidates understood that the cosine rule was needed and were able to apply it correctly. Having reached $AC^2 = 301.8…$ many went on to give the answer $AC = 17.37$ rather than the more accurate value of 17.372 that was required. Some weaker candidates used an incorrect cosine formula and, in some cases, attempted to use the sine rule.

(b) Many began this question correctly by using the sine rule to find angle *AEC*. Most reached a value of 33.027 but many did not know how to proceed. Some stated that angle *AEC* was 33.027, others stated that angle *AEC* was 180 – (20 + 33.027), and others as 90 – 33.027. Some stated that angle *ACE* was 33.027. Only the stronger candidates stated *AEC* was 180 – 33.027 and went on to find the correct value for angle *ACE*.

(c) This proved to be very challenging for most candidates with many making no attempt at a response, especially those that had experienced difficulties in the previous part. Some, however, used a correct approach. Using their acute angle *ACE* and 17.37 the sides *AD* and *DC* were then found. It was more likely that candidates would use the sine rule to find the length of *AE* before applying trigonometry to find the sides *AD* and *DE* using *AE* and their acute angle *AED* in triangle *ADE*.