MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key messages

To succeed with this paper, candidates needed to have completed the full syllabus. Candidates should have followed the rubric on the front cover about the correct value of π to use and the number of significant figures to give in their answers. They must have used a calculator as its correct use cut down arithmetic errors. Candidates should not have rounded values between the steps of a calculation as this lost accuracy marks and candidates needed to check that their answers were in the correct form, made sense in context and were accurate. Candidates are reminded of the need to read questions carefully, focussing on instructions and other key words.

General comments

There were a considerable number of questions that were standard processes and these questions proved to be well understood with minimal confusion about what was being asked. Successfully answered questions were where candidates showed working, setting out their solutions logically, with their numbers clearly formed. Others often jotted down calculations and values in various places and without any clear order so that their methods could be hard to follow. Candidates who used arrows or lines to show connections between numbers rather than forming equations tended not to perform as well, whilst those showing no working tended to perform the least well.

Comments on specific questions

Question 1

This opening question was done well by many candidates. Occasionally, candidates gave words which describe other angles.

Question 2

Very few candidates had difficulty with this question. Most recognised that the 8 had a value of 8000 and gave a correct answer in figures or in words. A tiny minority gave an incorrect place value, usually either tens, hundreds or thousandths.

Question 3

(a) Most candidates gave the correct answer. A few did not go far enough, giving 8 − 3 as their final answer, without evaluating it to reach 5.

(b) The majority of candidates answered this correctly. Some worked out that $y = 9$ and then gave this as their final answer.

Question 4

Most candidates understood what was required here, although there were a few errors. The most common error was 229.1… which is $3\times\sqrt{5832}$, rather than using the cube root function. Some candidates confused the square root symbol for a division sign and divided 5832 by 3.

Question 5

This was a well answered question by many. However, some candidates gave the new price ($10 416) rather than the discount.

Question 6

(a) This was the first problem solving question and it was found to be challenging. However, most candidates gained some marks, with a number giving a fully correct answer. Many candidates had difficulty in meeting all of the given conditions. Candidates tended to start correctly, for example, writing 15 in the middle position, but then including further numbers that meant 15 was no longer the median, or writing 8 and 17 but then including numbers that were greater than 17. Many were able to give 5 numbers that totalled 66, with 8 and 17 as the smallest and largest. Some had a total of 66 but included repeated values meaning there was now a mode.

(b) Candidates who correctly found 5×20 and 4×17 went on to reach the correct answer. Other candidates who reached either 68 or 100 looked to be unclear how to find the second value. Others opted to use trials, first finding four specific values with a mean of 17 and then using this answer to work out the additional value.

Question 7

A good number answered this correctly. Some were awarded a single mark as they expressed their answer in an incorrect form for time, for example, 1505 pm or 15h05 mins. Common errors tended to be numerical errors, errors in conversion of minutes to hours; or through not understanding whether to add or subtract the time periods.

Question 8

It was pleasing that most candidates reached the correct answer of 98. The most common error was to assume that x was one of the two equal angles, leading to $(180 - 41) \div 2 = 69.5$.

Question 9

Many candidates used the stem-and-leaf diagram efficiently, although some candidates attempted to write out the numbers in an ordered list even though the data is already ordered in the stem-and-leaf diagram. Some candidates based their answers on the leaves and did not use the stems.

(a) There were many correct answers here. The most common incorrect answer was 7, suggesting that these candidates had forgotten to refer to the stem.

(b) A good proportion of candidates obtained the correct range. Incorrect answers included ''16 to 31'' without calculation; incorrect calculations such as $31 - 17 = 14$, $30 - 16 = 14$ or $7 - 1 = 6$, giving the highest value, 31, or calculating the mode, mean or median.

(c) Many candidates gained this mark. There were a variety of errors, including, answering 5 (forgetting to refer to the stem), giving the mode or mean, answering 24.5 (or 4.5) and finding the average of the 7th and 8th numbers.

Question 10

There were many strong answers here. Candidates who used the diagram correctly often went on to reach the correct answer. Some were able to show one or more correct angles on the diagram and were awarded a mark, although, some candidates seemed unclear about which angles on the diagram were equal and which totalled 180°.

Question 11

This question was found to be particularly challenging. Many candidates gave the number correct to 2 decimal places rather than 2 significant figures, leading to the common wrong answer of 0.04. Some candidates incorrectly included trailing zeros, for example 0.03700.

Question 12

This question tended to be well done. The most common error was to add the cost per kilogram to the number of kilograms on the first line and then subtract when working out the cost per kilogram on the second line. Some candidates made an initial error but followed through correctly to complete the rest of the table.

Question 13

(a) Most candidates were able to identify the correct value of the car. Common errors arose from misreading the scale with answers such as 4400, 4900 and 48 000.

(b) The majority of candidates plotted this in the correct place. Inaccuracy arose from misreading the scales. A number of candidates drew horizontal and vertical lines meeting at the correct point but did not score unless a clear plot was shown.

(c) Most candidates correctly identified ‘positive’ for the correlation. A few attempted to describe the graph or the relationship rather than the correlation.

Question 14

This was done well, with a large number reaching the correct answer and others gaining a mark for a correct partial factorisation.

Question 15

Many candidates scored full marks, with most attempting to use prime factorisation. Some used a single table, better suited to finding the lowest common multiple rather than the HCF, and did not make it clear which numbers were prime factors of both 126 and 140, so they could not be awarded method marks. Common errors included giving the lowest common multiple (or other multiples) or slips with the arithmetic.

Question 16

(a) This was reasonably well answered. Common errors were n^5 (perhaps as candidates thought n was the same as n^0 rather than n^1) and $2n^5$ (as some thought the ns should be added rather than the indices).

(b) Most candidates were able to complete at least one step correctly, reaching a coefficient of 4 or resolving the x terms to x^4. A common incorrect response was 4^4, which scored no marks. A minority used very unclear notation, often writing the power of 4 above the x. In some cases, it was unclear whether they meant $4x^4$ or 4^4x.

Question 17

This question was found to be challenging. Some of those who used a correct method had premature rounding leading to an inaccurate final answer, or others gave the answer to only 2 significant figures. Others used an inaccurate value for π, often $\frac{22}{7}$ or 3.14. Some candidates omitted π altogether and divided 59 by 2 (or by 4), gaining 0 marks. Others started incorrectly by multiplying 59 by π as if the diameter of the circle was given in the question instead of the circumference. Some used the area of a circle formula.

Question 18

This question caused difficulty for many candidates. Either candidates did not read the question carefully enough or they were unsure how to express numbers to one significant figure. Many opted to round the figures to the nearest integer or to one decimal place. Other candidates put the numbers in their calculators as written in the question, then rounded the displayed value to 1sf. Candidates should be aware if the question states, ‘You must show all your working’ then marks are given for the method and zero for just an answer.

Question 19

There were some very good responses to this question. However, some candidates gained a method mark for the first step but then went no further or made errors. Candidates who started by writing $\frac{6000\times 4\times r}{[100]}=840$ almost always went on to reach the correct answer. The most common error was to use the final amount, \$6840, rather than the interest only, \$840, on the right-hand side of the equation. These candidates gained a method mark for showing $\frac{6000\times 4\times r}{[100]}$. Some were able to reach the stage where they calculated that the overall percentage increase was 14% but forgot that this was over 4 years and omitted the final step of division by 4. Some used trials to find the correct interest rate, often successfully.

Question 20

In this question there were some pleasing fully correct responses using the correct formula for the area of a trapezium. However, some who correctly wrote the formula, made errors in its implementation. Other candidates appeared uncertain of the formula.

Question 21

As with **Question 16**, some candidates wrote the indices in the incorrect position, whilst other candidates omitted decimal points or wrote two digits in front of the decimal point.

(a) (i) There were many correct solutions to this, but common errors were to give an incorrect power of ten, often 3, or there were two digits in front of the decimal point.

(ii) It was common to see candidates not using a negative power, giving for example, 6.3×10^3, whilst others got the power wrong.

(b) Many candidates successfully reached 123 000, others arrived at 12.3×10^4, both of which scored B1. However, they then did not go on to convert this to correct standard form.

Question 22

Many candidates understood what was required here gained at least one mark. Some candidates reversed the otherwise correct values and some gave two numbers that would round to 287, such as 286.5 and 287.4, rather than the bounds of the interval.

Question 23

Most candidates were able to give the correct probability. However, some made errors when simplifying or converting to a decimal or percentage, including those who reached a correct value for a percentage, but omitted a percentage symbol. The most common error was to select the wrong values, either finding the probability of selecting a right-handed person, or totalling some of the given numbers to make the numerator or denominator in their fraction.

Question 24

(a) This question was found to be very challenging. The majority of candidates used the conversion factor for metres to millimetres, rather than for m^2 to mm^2, leading to the very common wrong answer of 1200. Candidates need to remember that converting between square units is not the same as converting between linear units.

(b) In this question the successful candidates usually approached this by converting Sophie's speed into km/h; a few converted the speed limit into m/min or converted both speeds into comparable units, usually km/min. Some converted between m and km correctly but were then unsure whether to multiply or divide by 60.

Question 25

In this question there were many good responses with clear working leading to an accurate answer. Candidates who use $\frac{22}{7}$ or 3.14 in their calculations are placing themselves at a disadvantage. Other than this, the most common error was to use an incorrect formula, usually one of the formulas for circumference, but $2\pi r^2$ and $\pi^2 r$ were also seen.

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

Questions must be read with care to make sure candidates answer precisely what is being asked.

Answers should be checked to make sure they are sensible and possible within the context of the question or appropriate answers for lengths and angles on diagrams.

General comments

The majority of candidates attempted most questions. Straightforward questions testing aspects of the syllabus were generally well done. Questions requiring changing the subject of formulas before computation were tackled less well. Also, questions requiring reasons or explanations tended to found challenging. Operations with directed numbers could cause problems and the lack of writing angles on diagrams, where appropriate, would have helped more to score higher on these questions. Otherwise working was generally shown where necessary but rounding too soon and not giving inexact answer to 3 or more significant figures often lost marks unnecessarily. Some problems were experienced by Examiners in working out some figures on scripts, particularly with 3's and 5's very similar and 4's, 7's and 9's being poorly written. There were virtually no obvious cases of lack of time to complete the paper which would have given spare time for checking if answers were sensible for what the question asked.

Comments on specific questions

Question 1

Changing a simple fraction to a decimal was well answered. There were a few incorrect responses, for example, 0.08, $\frac{4}{5}$ or $\frac{1}{1.25}$.

Question 2

While most candidates knew they had to multiply hours by the rate and add the bonus, at times some added the bonus to the rate and then multiplied. A number of candidates multiplied hours by the rate and then by the bonus resulting in the answer of $1555.2 for a week's wages.

Question 3

(a) While a few misunderstood and gave the **part (b)** answer here, simply adding the difference of 7 to 18 was done correctly by the vast majority.

(b) Again, the vast majority understood the rule for the sequence, but a minority expressed it as the general formula or $n + 7$, $7n$ or $7n - 10$.

Question 4

The vast majority of candidates managed to find a fraction of a number successfully although some did not understand that 'of' meant they had to multiply the fraction by 180.

Question 5

Ordering items written in different ways is regularly tested and many coped well with this question. Most showed evidence of a decimal conversion but this did not always lead to a fully correct order. Some did not convert 18.7% to a decimal which caused a loss of a mark in the order. Others thought that shortest in decimals meant smallest resulting in misplacing 0.19 in a few cases.

Question 6

While there were many candidates who handled addition to a negative number well, it was common for the question to be misunderstood as evidenced by the answer 9 > – 23. Other common errors were subtracting 9 to give – 32 or assuming the question was 23 + 9 with the answer 32.

Question 7

(a) While many candidates clearly understood this relatively new topic, errors of missing a number or a value in the wrong section lost a mark often. A minority did not appreciate that the tens column should not be included in the leaf section of the diagram. Quite a large number of no responses showed that some candidates were not familiar with the topic.

(b) Since the mode could be seen from the original list this was done much better than **part (a)**. Unfortunately, many who did find it from the diagram gave the answer 6, just the leaf part, instead of the full answer.

(c) While most candidates understood the meaning of median, finding it correctly was challenging. Some wrote $\frac{17+18}{2}$ but did not evaluate this, or some found 17 + $\frac{18}{2}$. Again, some of those finding the median from the table omitted the stem part leading to an answer of 7.5.

Question 8

(a) Many candidates had no problem rounding up the answer and gave a correct 2 decimal places response. However, 24.07 and 24.10 were seen often. Quite a number did not realise that the second digit after the decimal point had to be the last so trailing zeros simply lost the mark. Decimal points were also often absent in responses.

(b) Only a small percentage were able to correctly interpret ‘to the nearest 10’ and so answers not in the ten times table, in particular, 24, were common. Others realised it had to be a multiple of 10 but rounded up to 30.

Question 9

This was another question involving the rules of directed numbers and there were many successful responses. After correctly substituting into the formula, it was common to see incorrect order of operations applied or even 30 – 2 + 7 worked out. Some incorrectly interpreted *rt* to mean 27 instead of 2 × 7.

Question 10

Not many candidates gained the mark for conversion of units. The most common error was to assume it was 62 000 metres to be changed to kilometres resulting in an answer of 62.

Question 11

While there were quite a number of candidates who put values for angles on the diagram leading to a correct response, many incorrectly assumed the triangle section was isosceles, leading to an answer of 48°. Many did enter values on the diagram which often gave one mark, even if the correct answer was not found. Those who did not enter values rarely scored a mark.

Question 12

(a) While it was clear that prime numbers were well understood, giving a clear explanation of why, specifically, 111 was not a prime number was found to be challenging. It was not sufficient to give a general description of prime numbers without any reference to particular numbers which divide into 111.

(b) Choosing a prime number was much better done but choosing any odd number often resulted in 117 and 119 being common incorrect responses. Some gave even numbers and others ignored the range within which the answer was requested. Misunderstanding of **part (a)** meant 111 was offered in **part (b)**.

Question 13

The topic of bearings is frequently found challenging. Candidates need to remember that a bearing from a point is measured clockwise from the north line. Some did mark that angle on the diagram, gaining a mark, but only some candidates went on to find a correct answer. Ignoring 'NOT TO SCALE' meant some tried measuring an angle or a length, while, again, marking angles on the diagram did result in 1 mark gained, even though finding a bearing was not understood.

Question 14

(a) There was a reasonable response to this correlation choice but many chose the incorrect type.

(b) The third type of correlation relating to no relationship between the two did not seem to be familiar to many candidates.

Question 15

Reading the question carefully was essential in producing successful responses to the interior angle of a regular polygon. Many gave 1260°, the sum of the interior angles. Also common was dividing 360 by 9 to give 40°, the exterior angle, without subtracting that from 180°.

Question 16

While most candidates read the question correctly and did a simple interest calculation, some used the compound interest formula, or did not add the capital to the simple interest answer. A small number subtracted, rather than adding the interest. Assessing whether answers are sensible should be done to avoid missing division by 100 in the calculation.

Question 17

(a) Most who knew what a tangent was were able to gain the mark, but some made no attempt or drew a chord or a radius Some drew tangents which were too far from being perpendicular to the diameter, but generally reasonable attempts touched the circumference.

(b) Working back from the given circumference to find the radius is demanding. Of those who realised they needed division often 22.3 was divided by π or just 2 alone. There was evidence of confusion between the formulas for circumference and area. Some candidates found a value for the radius to be greater than the circumference which could not be possible. Of those who did the calculation correctly, it was common to see 3.5 or 3.6 without the more accurate answer to 3 significant figures required.

(c) Quoting the property of an angle in a semi-circle was found to be challenging. 'Triangle in a semi-circle' and 'because it is a right-angled triangle' did not gain a mark.

Question 18

Most candidates tackled the expansion of brackets with confidence, gaining at least the mark for that part. Putting the terms together presented problems for some resulting in incorrect signs in the final expressions.

Question 19

Nearly all candidates showed confidence with subtraction of mixed numbers, although some showed errors in forming the improper fractions, the method chosen by the vast majority. Generally, some attempt was made at a common denominator with most making good progress. The instruction to give the answer as a mixed number was ignored by some who left their answer as $\frac{11}{8}$.

Question 20

(a) The candidates well versed in Venn Diagrams performed well on splitting the 20 candidates between the two sections correctly. However, some did not understand that the 20 had to be split.

(b) Many candidates did not realise that the n(….) notation meant the number in the bracketed set.

Question 21

Some confident trigonometry was seen from candidates reaching the correct answer to this more demanding question of finding the hypotenuse of a triangle. The first implicit equation, $\cos 34 = \frac{18}{x}$ was seen from most candidates but this was often followed by the incorrect $x = 18 \times \cos 34$. Some used the incorrect ratio, although a few did successfully then apply Pythagoras' theorem to find the length *AC*.

Question 22

(a) The majority of candidates correctly identified the coordinates of point *A*. The main error was to put the coordinates the wrong way round.

(b) Candidates were more successful at plotting (–2, 4) although (–2, –4) was seen plotted a few times.

(c) Many candidates knew the gradient was needed and this was usually found correctly. The difficulty came with the form of the equation of the line which was not, in this case, specified in the question.

Question 23

It was encouraging how many candidates gained the correct solution for this form of lowest common multiple question in a practical situation. However, most successful solutions, or at least one mark, were from lists of the times for each bell. Very often errors were made in adding on successive 22 minutes and 14 minutes respectively suggesting that finding the LCM would result in more correct answers. Quite a number did reach the correct number of minutes, 154, to add on but many of these gave answers such as 10:54.

Question 24

This question on similar triangles was well done. Looking at the diagram, it was evident that *x* had to be less than the corresponding longer side, 7.3, although some responses did not make this the case. Many did show a correct relation between the lengths but then made errors in re-arranging to produce an explicit expression for *x*.

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key messages

The whole syllabus must be covered in the preparation of candidates for the examination.

Premature rounding in calculations should be avoided.

Candidates need to understand how to represent information on a stem and leaf diagram.

Candidates need to understand the difference between simple and compound interest.

Candidates should be familiar with multi step questions and understand how to break them down.

General comments

Candidates should ensure they read the questions carefully and give the answer in the required form.

Candidates should ensure they show clear working, in many cases answers without working were evident and tended to be incorrect.

Presentation at times consisted of confused working which made it unclear what the candidate intended the marker to consider.

Partial rather than full factorisation led to marks being lost.

Comments on specific questions

Question 1

This was almost always answered correctly.

Question 2

(a) This was mainly correct. The most common error was missing 1 and 32.

(b) Most candidates answered this question correctly, with the most common incorrect answer being given as 0.125.

(c) Many candidates answered this correctly demonstrating a good understanding of place value. A small number had confused thousands and thousandths.

Question 3

The majority of candidates drew the correct lines, some also drew extra horizontal or 'vertical' line(s).

Question 4

(a) This was almost always answered correctly.

(b) This was almost always answered correctly.

Question 5

Most candidates gave the correct answer, but a small number were unable to express their answer in the correct form.

Question 6

(a) Those who understood range usually gave the correct answer, although 39 was a common incorrect answer.

(b) This question was found to be particularly challenging. Candidates did not interpret the information in relation to the question, simply referring to a smaller range or mean.

Question 7

(a) The construction was well done. A small number of candidates did not use compasses to show arcs, so only scored 1 mark.

(b) The correct answer of scalene was quite often given, but the names of other, incorrect, types of triangles were also seen.

Question 8

Several candidates gave the correct answer, but the combination of division by 6 and taking a square root proved to be too difficult for many. Some did realise division by 6 was required, but often then halved it. Division by 4 was also seen or just the square root of 73.5

Question 9

This was well answered by the majority, some showed working but made arithmetic errors. The most common incorrect answer was 300.

Question 10

(a) Those who knew vectors gave the correct answer. A small number had written a fraction line in their vector.

(b) The most common error was –2 rather than –6 as some treated the vectors as fractions.

Question 11

Those who were familiar with the term factorise often gained both marks. Taking out v was more common than taking out 3, for those who scored 1 mark. Some made errors, particularly $3v(5v - 3)$.

Question 12

(a) Nearly all understood probability and gained both marks.

(b) Many correct answers were seen. A small number of candidates gave an answer larger than 1800. Candidates should ensure they read questions carefully and check their answer is reasonable.

Question 13

Division of fractions was found to be challenging. Frequently there was a lack of clear working at the M1 stage with various approaches which lost marks for many. Several candidates did not gain A1 as they did not give the final answer as a mixed number.

Question 14

(a) Although many candidates gave the correct answer, parallelogram, rhombus, kite and rectangle were common incorrect answers.

(b) Some candidates were able to give the correct answer even if **part (a)** was incorrect. 1 mark was often gained for the angle of 24° on the diagram or from a calculation.

Question 15

This was well attempted by many candidates. However, several did not read the question carefully and added 67.5 to the original 750 giving a final answer of 817.5. A small number of candidates calculated compound, rather than simple interest.

Question 16

There were many correct answers for this question. However, some made errors with signs leading to answers of $4x = –10$ and $x = –22.5$.

Question 17

(a) This was found to be very challenging. However, many candidates scored 1 mark, usually for the *y* intercept, whilst others omitted *x* for the gradient writing $y = \frac{1}{3} + 1$.

(b) Ruled perpendicular lines were not often seen, with some answers outside the 2° tolerance. However, many candidates had drawn a parallel, rather than perpendicular, line.

Question 18

Whilst there were correct responses, many candidates did not realise the need to write an expression and wrote T= …. Some candidates had correctly written $3x + 5y$ but went on to give $8xy$.

Question 19

(a) This was almost always answered correctly.

(b) (i) Most candidates labelled the diagram correctly.

(ii) This was found to be challenging. The most common error was to add the fractions, rather than multiply.

Question 20

This was found to be very difficult. Some candidates tried but used area, rather than circumference. Some correctly multiplied the arc length by 5 but then only divided by π to find the diameter rather than the radius.

Question 21

(a) Those who understood Venn diagrams often gained both marks. The most common error was to place the 2 in an incorrect position. A small number of candidates wrote the same number in more than one section.

(b) The ‘n’ notation caused difficulty in this question. Candidates tended to give the answer of 4, showing an understanding of $Q \cap R$, rather than giving the number of items in the intersect.

Question 22

Many candidates gave the correct answer or an answer earning B1. Correct tables and factor trees without results were common.

Question 23

Many candidates had some idea of how to solve simultaneous equations with a number gaining full marks. Those who tried to equate a variable usually multiplied the first equation correctly by 2 but often went wrong by adding to eliminate so did not earn the M1. Those who rearranged and then substituted usually gained M1 but sometimes struggled to solve their equation. A significant number of candidates scored the special case mark for 2 values satisfying one of the original equations.

MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key messages

Many candidates wrote partial results to only two or, at most, three significant figures and therefore their final answer was often inaccurate. In order to get an answer accurate to at least three figures, candidates need to keep more accuracy than this in their calculations and, where possible, keep the 'full' number on their calculators and use that in subsequent calculations.

General comments

Most candidates presented their work well and attempted to show full working, there were very few who only just wrote their answer down. In the geometry questions many candidates assumed properties of the shapes that were not correct. Some used classic trigonometry in triangles that did not have a right angle. In algebra many were not able to complete manipulation of equations and expressions correctly, particularly in algebraic fractions where a lot of incorrect cancelling was seen. A large number of candidates in the more challenging questions that deal with areas of sectors and triangles and trigonometry are still losing accuracy due to rounding or truncating too early as described in the key message.

Comments on specific questions

Question 1

Most candidates answered this question correctly, the common incorrect response coming from $\frac{180° - 41°}{2}$ or 69.5° and a few just gave the answer of 139°.

Question 2

(a) This was answered well, the common errors were to omit the stem and write the answer as 7 or 17 rather than 27. A few calculated the mean giving an answer of 24.3.

(b) Many candidates left their answer as 31 – 16 instead of actually subtracting it.

(c) A few miscounted and they put the middle between 24 and 25 so giving their answer as 24.5. Again a few calculated the mean as in part.

Question 3

(a) Again, this was well answered the main error was to write the answer as 8 – 3 rather than giving the answer as 5 and very occasionally $x = –5$ was seen.

(b) Sometimes the answer was given as the value of y, 9, rather than the value of $10y$, 90. Other wrong attempts seen included adding 3 to both sides to get $7y + 3 = 63 + 3$ and then $10y = 66$, or subtracting $10y$ and $7y$, and equating to 63 hence $3y = 63$ leading to $y = 21$.

Question 4

There were a great number of correct answers, some candidates made numerical errors, but we followed through any errors. Where the \$7.52 was not as expected it seemed that the multiplication needed for the entry on the top line had been calculated incorrectly, sometimes it seemed to be from using \$2.35 $\times$ 3.02 and on others by trying \$2.35 + 3.2. The common incorrect answers were those who showed 5.55, 7.99 and 5.19. There were a few that did an incorrect mixture of subtraction and multiplication, and as little working was shown it was difficult to see what had been attempted.

Question 5

(a) This part was answered very well as most candidates gave a correct full or partial factorisation. A few candidates left the *m* in the second term, so they wrote $7m(6k - 5m)$.

(b) Many candidates recognised the difference of two squares. Some gave incorrect alternatives such as $(h - 12)^2$, $(h - 72)(h - 2)$ or $(h - 1)(h - 144)$.

Question 6

(a) Many gave the correct answer, a few wrote 48 000 giving an extra 0. Some misread the scale and wrote 5000, 4600 or 4000. Some drew a line of best fit and read off it by tracing \$28 000 from the horizontal axis to their line.

(b) Most plotted the point accurately; some plotted it inaccurately whilst others did not plot the point at all, or they drew two lines but plotted no point.

(c) Most gave the correct answer, some others wrote the most common incorrect answer of 'negative' whilst others wrote 'strong correlation', 'linear', 'direct', 'ascending' and 'proportionate'.

Question 7

Most candidates achieved the correct answer. The few candidates who made an error tended to multiply the two figures given instead of doing the correct division. As a result, the wrong answer of 99.94 Singapore dollars was seen on a few occasions.

Question 8

Some candidates did not know how to deal with fractions or mixed numbers on their calculators. Some did the correct working but did not simplify their final correct fraction to get 24 such as $\frac{2640}{110}$ or equivalent.

Question 9

There was quite a variety of answers for this question with some candidates giving the correct answer, many did not. Some candidates gained one mark for either giving the answer 2 or 7 on the answer line or showing the prime factor decomposition working or stating the prime factor product form for 126 and 140. Many candidates who attempted listing the factors could not make complete lists or they missed out some of the factors. Some candidates found the lowest common multiple of 1260 instead but if they showed the prime factor decomposition then they would gain some credit.

Question 10

(a) This was very well answered. The most common incorrect answers were n^5, $2n^5$ and $n^5 + n$.

(b) This was generally well answered with most students attempting an answer. Most candidates understood that they had to treat the numerical part of $8 \div 2$ separately from the variable, although a common mistake was to either subtract both or divide both resulting in $4x^3$ or $6x^4$. Some candidates did part of the working but failed to complete the calculation for full marks, with an answer of 2^2x^4.

(c) This question caused more difficulty than the other parts of this question. Some candidates seemed to think that 243 was raised to the power 20 which caused many difficulties and resulted in a huge numerical answer, whilst $243 \times \frac{2}{5}$ was a common mistake giving a coefficient of 97.2.

Another common error was to leave the coefficient 243 completely untouched with a variety of powers of y. Incorrect answers often seen included $243y^8$, $97.2y^8$, y^{80} and $9y^{20.4}$.

Question 11

This was very well attempted. The most common error was to give the wrong inequality sign, or to just give 11 as the answer, even when the fully correct answer had been seen in the working. Some candidates had difficulty when their '*x*' term was negative and there was a need to reverse the inequality sign. Those who did not get the correct value for *x*, usually correctly expanded the brackets followed by errors on collecting the letters and numbers or they had arithmetic errors when adding 43 and 12.

Question 12

The correct method was written down well by many with most candidates choosing with $x = 0.4\dot{2}$ and then using either $10x - x$ or $100x - 10x$ and occasionally $1000x - 100x$. The bare working $\frac{42-4}{90}$ was seen often. A misunderstanding of the number by using 0.424242…. was also seen occasionally. A few candidates did not simplify their final answer of $\frac{38}{90}$ or $\frac{3.8}{9}$.

Question 13

Some candidates did not round their answer to the nearest whole number. A surprising number of candidates misread the 27 000 as 2700. Calculator errors were common with this question when evaluating $27\,000(0.97)^4$. This appeared to be primarily due to candidates evaluating 0.97^4 and then rounding or truncating it before multiplying by 27 000. Common errors included rounding the answer down to 23 902, using $27\,000\,(1+ \frac{3}{100})^4$ as their equation or using the same increase each year which led to 23 760.

Question 14

(a) The most common error made was to omit the 15 giving $5x + x + 5 + 12 - x = 52$ leading to $x = 7$. Another common wrong answer was 47 from candidates assuming that the intersection was 52 and $x + 5 = 52$. Other responses came up with a correct equation but then made errors in solving it giving an incorrect value of *x*. Several candidates correctly obtained $x = 4$ but either they did not realise how to use this to find the required value or substituted it into an incorrect expression.

(b) Most candidates were able to identify the central region and give the correct answer. Incorrect answers included every other combination possible, but more often the regions $(C \cap D) \cup (D \cap E)$ or $(C \cap D) \cup (C \cap E)$ or $(C \cap D) \cup (D \cap E) \cup (C \cap E)$.

Question 15

Only a few candidates answered this question completely correctly although most candidates attempted the question. Almost all candidates were able to draw the line $x = 2$ with a solid line. Most candidates were able to draw $y = 1$ but they used a solid line instead of a dashed line. Some candidates could not find the points on the line $y = x + 2$ so they drew the incorrect line. In the same way, most were able to shade $y > 1$ and $x \leqslant 2$ correctly but they struggled to give a correct shading for $y \geqslant x + 2$. Most use ruled lines although some candidates did not use a ruler, and a few did not draw any lines at all but just attempted shading up to where the line should have been.

Question 16

Many struggled with this question and especially with upper and lower bound of 9.5 ± 0.05 as they used 9.5 ± 0.5, but they usually showed 11 ± 0.5. Some others first attempted $2 \times 11 + 2 \times 9.5$ was worked out to 41 and then 0.5 added and subtracted to give 40.5 and 41.5.

Question 17

There were a number of correct approaches, some found angle *DCA* = 70° with angle *CBA* = 70°, angle *OCB* = 37° and angle *OBC* = 37° so that the required angle is 70° – 37° = 33°. Another method was angle *CAB* = 53°, angle *COB* = 106°, angle *OCB* = angle *OBC* = $\frac{180-106}{2}$ = 37° then required angle = 180° – (37° + 37° + 20° + 53°). A few used another isosceles triangle with angle *CAO* = 20°. For those who did not get the correct answer, we required either angles to be marked on the diagram or for angle identifiers to be used which was rare. Most did gain credit for correct angles identified.

Question 18

Most candidates knew how to apply the sine rule, and many fully correct solutions were seen, but unfortunately there were also quite a few who fully used the correct method, but it led to an inaccurate answer because of early truncation of figures. For those who were unaware of the need to use the sine rule, the most common mistake was to use basic trigonometry having assumed one angle to be a right angle.

Question 19

(a) There were a lot of very good cosine curves which had all the properties of the original. Some curves did not pass through (0, 1) whilst others did not pass through (90°, 0) or (270°,0). Some curves had the incorrect period whilst others did not have a minimum at (180°, –1). Some candidates did mark the points on the horizontal axis and others did not. A few curves had been drawn with a ruler which made them two straight lines.

(b) Most candidates realised that the acute angle was 77.9° or similar, though not all gave the angle to one decimal place. Only a few candidates subtracted *their* 77.9° from 360° to give the correct final answer. Many added it to or subtracted it from 180°.

Question 20

(a) Most successful attempts were made by those who factorised both fully at the same stage and then proceeded correctly to cancel common factors and then reaching the correct answer. Those who factorised only one initially were often then tempted to start cancelling incorrectly, for example $10x(x - 6)$ seen and then the10 would be cancelled with 30 or x cancelled into the $-x$ or x^2. Most common errors were, factorising the denominator with signs reversed and omitting the x from the numerator on the answer line.

(b) The most successful candidates were those who combined the fractions straight away using brackets on the numerator, such as $7(8x - 1) + 5(x + 3)$, which were then expanded and simplified to the correct numerator. Those who kept them as two separate fractions often did not get the required correct common denominator. There was no requirement to expand the denominator but some, who did, sometimes made errors. There were also some errors in expanding the numerator.

Question 21

Most candidates did not interpret the requirement to find angle *BHA* and instead attempted to find angle *BHD* or *DBH*. In most cases the truncating of the result for sides *AH*, *BD* or *BH* led to inaccurate answers. Many candidates tried to find BH using a calculation for *BD* and then they used a truncated figure to find *BH* led another inaccurate result. Those who successfully found either *AH* or *BH* then often used the incorrect trigonometry function to find the required angle.

Question 22

The usual correct method was to find the area of the triangle *ABC* and the sector area *ABC*. The area of the rhombus which is twice the area of the triangle subtract the area of the sector gave one half of the shaded area then doubled gave the required answer. Some subtracted the area of the triangle from the area of the sector which gives half of the unshaded area, doubled gives the unshaded area and subtracted from the area of the rhombus gives the required answer. Another method to find the area of the rhombus is to find the length of the diagonals using trigonometry and to multiply them and divide by two. One problem was the number of calculations and the tendency for candidates to truncate or round results to just 2 or 3 figures which led to inaccurate answers. Some candidates did not interpret the diagram correctly. They saw two isosceles triangles with the unshaded area as part of a circle, so they attempted to find the radius of this 'circle.' Many just find one or both areas of the triangle and sector and then they stopped working as they could not work out a way to find the required area.

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key messages

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

General comments

There were a significant number of excellent scripts with many candidates demonstrating an expertise with the content and showing good mathematical skills. There was little evidence that candidates were short of time, as the vast majority attempted the last few questions. Nearly all candidates were able to cope with the demand of this paper. Candidates showed particular success in the basic algebra and number skills. The more challenging questions included the topics of area scale factor, Venn diagrams and set notation, LCM for algebraic terms, bounds, histogram, simplifying algebraic fraction, the derivative question and the vectors question. 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.

Comments on specific questions

Question 1

(a) The majority of candidates were correct here. Occasional errors were truncation to 24.07 or rounding to 2sf instead of 2dp. More rarely these incorrect answers were seen 24.09, 24.1 or 24.10.

(b) A few more errors were in evidence than in **part (a)** with some incorrectly giving 20.0, but the most common errors wer rounding to the nearest whole number i.e. 24 or rounding to the nearest tenth rather than ten, i.e. 24.1. Less common but occasionally seen was rounding to 30.

Question 2

Most candidates answered this question correctly. The two most common incorrect answers were –32, where there was either a confusion about the negatives or the word ‘greater’, and 9 > –23, where they thought that they were being asked to write ‘9 is greater than –23’ in symbols.

Question 3

This was the best answered question on the paper with incorrect answers rarely seen. The error very occasionally seen appeared to be misreading the value of *a* as 2 instead of –2.

Question 4

This question was well answered, with many showing each step from mm to cm to m to km. A small number of candidates wrote an answer of 62 having divided 62 000 by one thousand only. Other candidates wrote 6.2 or 0.62 as the final answer usually without any working. A very small number of candidates multiplied 62000 by 1 000 000 rather than dividing. A small minority used standard form for their answer, not always successfully.

Question 5

This question required candidates to combine knowledge of angle facts – angles on a straight line, vertically opposite angles at a point, angles formed by parallel lines and transversals – to find the unknow angle. There were a number of different possible routes through the problem with the most direct being to use corresponding angles and to subtract 50 from 114. This was not the most popular method. Most used alternate angles together with angles on a straight line. There were a good number of candidates who were able to successfully find the correct answer of 64°, often working efficiently when they did. Some candidates could not fully complete the process to find the required angle, but were able to get 1 mark for finding one of the other missing angles which could be used in order to find the required one. Common incorrect answers were 16°, 48°, 80° and 114°. 16° was due to the assumption that co-interior angles were equal rather than supplementary. 48° from assuming the triangle was isosceles and that both base angles were 66, using the working 180 – 2 × 66 = 48. 80° from assuming the triangle was isosceles and that both base angles were 50, using the working 180 – 2 × 50 = 80. 114° from assuming that *x* was alternate to 114.

Question 6

(a) This question was challenging and occasionally more so for the more able candidates who tended to give an attempt at a description of a composite number in general e.g. 'it is divisible by more numbers than 1 and itself'. This explains why any number is not prime but not why 111 is not prime. Those who were most successful went for a simple explanation such as 'It is divisible by 3' or '3 and 37 are factors of 111'. Where candidates were less successful, it was often because they gave insufficient detail giving responses such as 'It is divisible by other numbers' without giving an example. Some tried to give the inverse of the definition of a prime, writing 'It is not divisible by itself and 1'. A small number of candidates also gave responses to try and show that 111 is a prime number, such as 'It is only divisible by itself and 1'.

(b) This question was well answered with many candidates identifying 113 as the prime number between 110 and 120. Where candidates did not obtain the correct answer, they generally gave more than one answer, often including 117 or 119. A very small number of candidates picked an even number or 115, and fewer still picked a number that was outside of the given range.

Question 7

This question was a more challenging than the previous angles question however just under two-thirds of candidates scored 2 marks. Those that scored 1 were generally due to correctly indicating the bearing correctly on the diagram or for correctly ascertaining that the bearing of *P* from *Q* was 51. Common errors were 321 from 360 – 39; 51 giving the answer as the bearing of *P* from *Q*; 219 from 180 + 39; 141 from 180 –39; 129 from 180 – (90 – 39) and 309 from 360 – (90 – 39).

Question 8

About a fifth of candidates scored 2 marks on this question. The vast majority of those followed a correct method to reach $\frac{11}{8}$, then left this as their final answer without converting into the required mixed number.

For those that did convert to a mixed number, almost all did so correctly and showed full working meaning approximately two-thirds of candidates scored full marks. Most candidates chose to work with 8 as the common denominator, although 16 and 32 were also popular and very occasionally 24. Mistakes were sometimes seen in converting the given mixed numbers in the question into improper fractions. Most candidates showed adequate working so it was rare to see an answer alone. Very few attempted to work in decimals.

Question 9

Approximately two-thirds of candidates understood how to write a number as the product of prime factors and were awarded 2 marks. Most used a diagram, either a factor ladder or factor tree to find the prime factors and those who got this far usually showed a correct multiplication of the products on the answer line. Occasionally some listed the prime factors with commas instead of multiplication signs or showed the prime factors added. There were many weaker candidates who did not understand the requirement of the question and wrote down all factors or found factor pairs of 90 and quite a few offered no response.

Question 10

Nearly all candidates answered this question correctly, with both forms of the answer, $5w - t$ and $-t + 5w$, seen equally often. The small number of candidates who did not receive full marks usually scored 1 mark for a correct first step, showing either $2t + 2w$ or $3w - 3t$ in the working. A common incorrect answer was $5w + t$, but this was very rare.

Question 11

(a) This was commonly found correctly using the scale factor of $\frac{5}{9}$. A small number lost accuracy by changing the factor to a truncated or rounded decimal and so not reaching the exact answer of 3.5. Among the errors a common mistake was to treat the shape as a rectangle and use the area given in **part (b)** giving the answer $\frac{16}{5}$ or 3.2 which could score no marks. Candidates need to be aware that they should have all the information that they need to answer an earlier part of a question without needing to use information given for a later part of a question. A very small number used the difference between corresponding sides to subtract 4 giving an incorrect answer of 2.3.

(b) This was one of the more challenging questions on the paper with about a half of candidates answering it correctly. Of those candidates who were able to find the correct area, sometimes they unnecessarily rounded the exact answer of 51.84 to 51.8. Candidates are advised that the instruction on the front of the exam paper is to 'Give non-exact numerical answers correct to 3 significant figures.' As this was an exact answer it should not be rounded. Some reached the correct answer by using their answer to **part (a)** in a scale factor of $\frac{6.3}{3.5}$. It is sensible for candidates to use given values where possible ($\frac{9}{5}$ here) in favour of ones they have found (which could be wrong or inaccurate). The most common error seen was to use the length scale factor, rather than squaring it for area scale factor, hence reaching the incorrect answer of 28.8. A less common error was those who treated the shape as a rectangle multiplying the dimensions of the large shape to reach 56.7. Another error included realising that squaring was required but squaring the wrong part of the ratio i.e. writing $\frac{x^2}{16^2} = \frac{9}{5}$ rather than $\frac{A}{16} = \frac{9^2}{5^2}$ leading to the incorrect answer 21.5.

Question 12

(a) This was well answered, with most candidates giving the correct answer of 2.5 however this was often seen as a negative value. Some thought that an area was required and 20 was seen occasionally. Another fairly common error was to give the reciprocal i.e. 0.4 as the answer. A third incorrect response, seen reasonably often, was to find the length of the sloping line using Pythagoras giving the incorrect answer of 10.8. A small number had a correct idea that a quotient was required but used incorrect values in their calculation giving answers such as $\frac{10}{16} = 0.625$ or $\frac{10}{12} = 0.833$ instead of the correct working $\frac{10}{4}$.

(b) This part was better answered than **part (a)** with most candidates understanding that the area beneath the graph gave the distance. Almost all gained at least 1 mark for one correct area. Those candidates who used the formula for the area of a trapezium were less successful in this question as they often chose incorrect lengths to use in the formula. Candidates who split the shape into a rectangle and triangle to find the area of these shapes separately tended to make fewer errors. Common errors were to calculate the area of the triangle as 4 × 10 or 4 × 2.5, or to just calculate one of the areas. From those who did not score any marks, the most common error was to find the area of a rectangle with dimensions 16 by 10 and not to subtract anything from this area. In many cases candidates wrote $d = s \times t$ followed by 16 × 10 not realising they needed to find the area under the graph.

Question 13

(a) This was generally answered well by the more able candidates. Weaker candidates found this much harder with about a fifth of candidates scoring no marks. A common error seen regularly was a candidate incorrectly multiplying 3 by 3 to get 9 when trying to simplify $3^{3p} \times 3^{2p}$. Often, these candidates then compared 9^{5p} with 9^3 giving their answer as $p = 0.6$, or they could not continue from their incorrect expression 9^{5p}. A few candidates incorrectly multiplied $3p$ and $2p$ together, sometimes wrongly, and then compared either 3^{6p} or 3^{6p^2} with 3^6, solving either $6p = 6$ or $6p^2 = 6$ to give an answer $p = 1$. They did gain 1 mark for having correctly reached 3^6. Some candidates managed to simplify $3^{3p} \times 3^{2p}$ correctly to get 3^{5p} for 1 mark but were unable to proceed from here either not knowing what the next step was or being unable to write 729 as 3^6.

(b) This part was answered better than **part (a)** with most candidates scoring 2 marks. Common errors were where candidates knew the power to a power rule and simplified $\left(x^{10}\right)^{\frac{1}{5}}$ correctly, but they did not calculate $32^{\frac{1}{5}}$ as well, simply leaving the constant as 32 giving $32x^2$ as their final answer. Others found $\frac{1}{5}$ of 32, giving $6.4x^2$ as their response.

Question 14

This question was well answered with most candidates showing the correct steps to make w the subject in the formula. In some instances, the work appeared to be correct but the final answer was written carelessly, giving the impression that the square root was being taken of the numerator only. When this occurred, the final mark was not given. Other candidates who did not score full marks did so for a variety of reasons. Some rearranged incorrectly at the start, with a sign error giving $2w^2 = -y - x$ or $2w^2 = y - x$ while others went from $2w^2 = y + x$ to $2w = \sqrt{y+x}$. Candidates do better if they make their steps clear in the working. Often the steps are written as if two moves are being attempted at once, and if there is an error, both marks are lost.

Question 15

(a) This was one of the most challenging questions on the paper with fewer than half of candidates giving the correct answer. One of the main problems being that candidates did noy appreciate that if they work out the union of set P with something else it must include all of *P*. The two most common errors were to omit shading of $P \cap Q$ from an otherwise correct answer or to misinterpret the notation and shade $P \cap Q'$ rather than the required $P \cup Q'$.

(b) This question was better answered than **part (a)** with approximately two-thirds of candidates scoring 1 or 2 marks. Quite a few candidates were able to meet the requirement of $n(A) = 12$ and $n(B) = 10$ and $n(A \cap B) \neq 0$ for award of 1 mark. A common incorrect answer was to simply use the figures in the question in the regions on the Venn diagram having not recognised the significance of the overlapping aspects of the regions.

Question 16

This question proved to be a challenge for many candidates with less than a third scoring 2 marks. Candidates lacked confidence finding the LCM when a variable is involved. About a quarter of candidates scored 1 mark, usually for being able to work with the numbers and giving the value of the coefficient as 24. There were many different solutions seen for the power of *x*, including x^{24} and x^{20}. Quite a few candidates seemed to be trying to find the HCF and answers such as $2x^2$ or $4x^4$ were quite common. Some responses lost the variable altogether and simply gave a numerical answer. There was quite a high non-response rate particularly among the weaker candidates.

Question 17

(a) This question most commonly scored full marks for correctly working out that the triangle was an isosceles formed with 2 radii thus *OAB* was also 28. This led to correct working of 180 – 28 – 28 = 124 for *AOB* and then halving this to reach *ACB*. Those who scored only 1 mark often stopped at the point of finding 124. Some mistook *AC* to be a diameter and used angles in a semicircle to then assume *CBA* was 90. A small minority created a right-angled triangle *ABE* with diameter *AOE* then used 90 – 28 = 62 and then angles in same segment to get *AEB* = *ACB* = 62. Occasionally candidates made the mistake of thinking *AOB* = *ACB*.

(b) A well answered question using alternate segment theorem usually using the fact that *RQP* = 47 or less frequently that *UPQ* = 52. These resulted in, respectively, angles in a triangle or angles on a straight line being used to get the correct result of 81. The most common error was to think that angle *QPU* was 47 degrees, leading to a common incorrect answer of 86 degrees.

Question 18

This was another question where about half of the candidates did not score full marks with among those the most common scores being 0 or 1. The most common mistake was to only include one circle, giving the fairly common answer of 105π or 329.8. Another fairly common mistake was to use the incorrect formula πrh rather than $2\pi rh$ for the curved surface area. A fairly frequent error was to find the volume instead of the surface area, or even to mix the two, using formulae such as $\pi r^2h + \pi r^2$. Very few candidates scored 3 marks as those who had a fully correct method usually reached the correct answer as well, there were only occasional accuracy issues or keying the expressions incorrectly into the calculator. 2 was not commonly scored either.

Question 19

(a) This was very well attempted with the majority gaining both marks. Those using the formula sometimes got confused with the negative outside the bracket and the lack of a bracket around the negative number often resulted in an incorrect expression usually $11 + (n-1) - 3$ instead of $11 + (n-1)(-3)$. Some did not appreciate that the sequence was decreasing by 3 and so their expression contained $3n$. There were far fewer candidates who had the misunderstanding of the answer $n - 3$ this session compared to previous years.

(b) Fewer candidates understood how to write the *nth* term for the geometric series in **part (b)** but it was also well attempted with just under two-thirds of candidates gaining both marks for a correct expression. Many gained 1 mark for understanding that 5 raised to a power was involved, for example giving 5^n as an answer or showing 5 to various powers in the working. Many candidates did not appreciate the nature of the sequence and showed lots of working looking at differences, leading to quadratic and cubic expressions. $5n$ was also a common incorrect term in a final expression.

Question 20

The quality of the responses to this question varied. While about half of candidates scored full marks, many lost marks by calculating the bounds incorrectly. Many candidates simply assumed a need to add or subtract 0.5, giving the bounds for the area of the rectangle as 55.7 or 60.2, and then divided by the lower or upper bound for the length of the rectangle. Another fairly common error was to find the lower bound for the area and divide by either the lower or upper bound for the length. Some candidates did not find a bound for the rectangle area but simply divided the given area by the lower or upper bound for the length. In quite a few cases candidates gave the upper bound of 55.2 as 55.24, which, if divided by 8.5 led to the award of 2 method marks. Of those who did not score full marks 0 or 1 were most commonly scored. 1 for a correct bound seen but weaker candidates appeared not to understand the nature of the question and merely divided the given area by the given length of the rectangle. Many of these left their answer as 6.13 but some then tried to find a bound for that figure, sometimes flowing 6.13 by the answer 6.5 but with no correct working shown this would not score marks.

Question 21

Many candidates correctly navigated the necessary steps in this question and scored full marks. The most successful method was to equate $x+1$ with x^2+x-3. Having reached a simplified quadratic it was more common to see $x^2-4=0$ factorised correctly than to see it rearranged to $x^2=4$. Of those rearranging to $x^2=4$ it was common for the negative square root to be omitted and sometimes $x^2-4=0$ was factorised to $(x-4)(x+4)$ instead of $(x-2)(x+2)$. Some lost marks for incorrect simplification after forming a correct initial equation in *x*. Others made it harder by substituting to find an equation in *y* rather than *x*, although this was sometimes successful it was more commonly unsuccessful. Among attempts not scoring, common was to apply the quadratic formula to the equation of the curve with *y* replaced with 0. Other attempts looked for intersections with the axes by setting *x* (and sometimes *y*) to 0. Some attempted by sketching or trial and error, usually without success. Quite a few candidates offered no response to this question.

Question 22

This question was well answered with many candidates scoring the 2 available marks for correctly finding the constant of proportionality, *k*, and then writing the equation as $\frac{12}{\sqrt{w}}$. Where candidates obtained only 1 mark this was generally for correctly finding the value of *k* = 12 but then writing the answer as $\frac{12}{\sqrt{16}}=3$, or leaving *k* in the final answer and writing $\frac{k}{\sqrt{w}}$. Those who scored 0 often had a bit of an idea about proportion but used either direct proportion or they used the square rather than the square root of *w*. The final answer was occasionally seen with denominator rationalised, $\frac{12\sqrt{w}}{w}$, or in index form, $12w^{-\frac{1}{2}}$ both scoring full marks but occasionally attempts to re-write the answer in this way resulted in an error. Candidates are advised it is acceptable to leave an answer as an algebraic fraction with a square root in the denominator.

Question 23

Correct answers were seen from able candidates, but many incorrect responses were seen also. About two-fifths of candidates scored 2 marks but much more frequent was the score of 0. The errors made were varied. Some candidates did calculate the frequency density for both bars correctly to gain 1 mark, or had $\frac{18}{6}$ and $\frac{16}{4}$, or the reciprocal of both, seen in their working. Some candidates only had one of $\frac{18}{6}$ or $\frac{16}{4}$ which was not far enough through the method to score a mark. One of the common errors seen by candidates included stating that $\frac{7.5}{18}=\frac{x}{16}$, or similar, and then calculating x to be 6.67 cm. Another common error seen was where a candidate effectively used the height of the block and the corresponding class width as a ratio, such as $7.5:6=x:4$ followed by a common incorrect answer for the height of the $6<t\leqslant 10$ block as 5 cm. There were also many other incorrect answers stated and a high number of non-responses on this question.

Question 24

This question required candidates to use factorisation of the algebraic expressions in the numerator and denominator to simplify the fraction. A slight majority of candidates gave fully correct answers, however there were also significant numbers who struggled with the question. It was common for candidates who were not able to fully simplify the fraction to recognise the difference of two squares in the denominator or to be able to partially factorise the numerator. Many candidates struggled to fully factorise the numerator and a common error was to write $a(x-2)-(x+2)$ and some struggled with factorising the difference of two squares with the incorrect $a(a-1)$ being common. Some candidates had partial factorisations of the numerator (either correct or incorrect) which they then went on to incorrectly cancel with the denominator by cancelling e.g. $\frac{x(a-1)-2(a-1)}{(a+1)(a-1)}$ to $\frac{x(a-1)-2}{a+1}$.

Question 25

Just under two-thirds of candidates scored 2 marks on this question with about a third scoring 0. About 10 per cent of candidates offered no response to this question which was the highest rate of non-response on the paper. Weaker candidates, who usually scored 0, often started by equating the expression to its derivative, leading to very messy algebraic expressions and candidates ending in quite a muddle. The most successful candidates began by writing $7 \times 2ax^6 + 3kx^{k-1}$ or better, then equated coefficients.

Question 26

Stronger candidates had no problem with this vectors question, often showing very little working because they understood that because of the ratio and parallel lines, QX must be $\frac{1}{3}$a. Others showed lots of working with ratios and the similar triangles to reach the same conclusion. Many chose the more complicated route of $OP + PK + KX$, often successfully, but more often getting no further than $OK = a + \frac{3}{4}$b for 1 mark. Many got confused interpreting the ratio 1: 3 thinking that QX was $\frac{1}{4}$a, and so b + $\frac{5}{4}$a was a very common incorrect answer whichever route was taken. Many candidates gained a mark by writing a correct route as a starting point, even if they could get no further. Candidates are advised that vectors have a direction as some appeared to be treating, for example, OT and TO as the same thing leading to incorrect signs in the working. Quite a few were unable to get further than a correct route because they could not see the similar triangles aspect of the question. Weaker candidates did not understand the term position vector and so could not give a correct route.

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key messages

To succeed in this paper, candidates need to have completed full syllabus coverage, remember necessary formulas, 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 and to identify key points which need to be considered in their solutions (for example the requirement to find the total amount of simple interest rather than the final amount of money in **Question 4** or the requirement for the obtuse angle in **Question 19**).

General comments

This examination provided candidates with many opportunities to demonstrate their skills. Some candidates omitted questions or parts of questions, but this was likely due to a lack of knowledge rather than time constraints. It would have been helpful if candidates had written their numbers more clearly, as some of them were difficult to distinguish, particularly 4s and 9s, and 1s and 7s.

It is important to take care when manipulating algebraic expressions. Some errors were caused by not applying the laws of algebra correctly.

There were some questions where candidates rounded to an unsuitable level part way through calculations, this was particularly evident in **Questions 11**, **16** and **19**. Candidates need to be mindful that completing working in one line when they should use several lines, particularly when performing two steps of algebraic rearrangement in one line, which means that they can miss the opportunity for method marks.

Few candidates were unable to cope with the demands of the paper. However, candidates need to take care to read and understand the specific requirements of each question. Not following these requirements often led to marks being lost.

In general, candidates showed a good amount of working in most questions. However, occasionally this was insufficient, as was evident in questions that demanded that all work be shown (**Questions 7** and **22**).

Comments on specific questions

Question 1

The vast majority of candidates were able to answer this question correctly. Where errors were seen, the most common was forgetting the pm when giving the answer 7:23. A small number of candidates gave their answer as 17:23 pm or 17 hours 23 minutes.

Question 2

In **part (a)** of this question candidates were asked to write down a cube number from the list provided. The majority of candidates were able to correctly do this.

Part (b) of the question was again well answered, with the vast majority of candidates able to select a prime number from the given list. The most common wrong answer of the few encountered was 63.

Question 3

This question required candidates to find the median (**part (a)**) and mean (**part (b)**) from the stem and leaf diagram provided. Candidates were often successful in both parts of the question.

In **part (a)** the most common incorrect answer was 122, the answer obtained if the key was not correctly interpreted, which scored 0.

In **part (b)** the majority of candidates scored full marks. Where candidates did not obtain the correct answer of 12.1, they were often able to score 1 mark for 121 which was the mean obtained if the key was not correctly interpreted. Some candidates did not show their working for this question which meant that the method could not be checked when an incorrect answer was given.

Question 4

In this question candidates were asked to find the total amount of simple interest earned after five years. This question was well answered. Where incorrect answers were seen, the main error was adding the answer of 67.5 onto 750, thus not giving the interest but rather the total amount. Another common error was calculating the compound interest and not simple interest.

Question 5

In **part(a)** the question asked candidates to identify the name of the quadrilateral formed when the given triangle was rotated by 180° about centre M. Most candidates attempted to draw triangle ACD. Those who added the rotated triangle ABC to the diagram correctly usually wrote 'parallelogram,' however if angle D looked 90°, then they were more likely to write 'rectangle'. Those who drew an incorrect diagram which was kite-shaped tended to write 'kite.' Other common incorrect answers were rhombus and rectangle and occasionally cyclic quadrilateral.

In **part (b)** of the question candidates were required to work out one of the angles in the quadrilateral. Those who responded with 'parallelogram' in **part (a)** were most likely to achieve full marks in this part. The most common misconception was to assume ABCD was a kite, and that angle CAD was 24° and angle ACD was 44°. So, 48° was the most common wrong answer. Most candidates gained an M1 mark for $180° - 112° - 44°$ or indicated that angle BAC was 24° on their diagram.

Question 6

In **part (a)** of the question candidates needed to use the sum of the probabilities of exhaustive events to find a missing probability. The vast majority of candidates were able to correctly find the missing probability.

Part (b) of the question required candidates to use a probability to find an expected frequency. This was also well answered by candidates. Occasionally candidates would give the answer 5.76 having divided by 100.

Question 7

In this question candidates were required to divide a mixed number by a proper fraction. This question required that candidates show their working without use of a calculator. The majority of the candidates scored full marks and it was rare to see a correct answer without supporting method. The most successful method was calculating $\frac{11}{6} \times \frac{15}{11}$. A common error was to leave the final answer as a top heavy fraction i.e. $\frac{5}{2}$ and a small number gave a decimal answer.

Question 8

This question asked candidates to find the highest common factor of 48 and 80. Nearly all candidates showed working and the most common approaches were factor trees for each of 48 and 80, 'factor pairs' or a list of factors, such as 48: 1, 2, 3, 4, 6, 8, 12, 16, 24. Many candidates were able to correctly answer this question and gave the answer as 16, it was very uncommon for candidates to leave their answer as a power of 2. Where candidates did not reach the correct final answer, this answer was usually 8- a common factor, but not the highest common factor. A minority of candidates gave an answer of 240 indicating confusion between the lowest common multiple and highest common factor.

Question 9

This question required candidates to substitute into a formula and rearrange to find the positive value of *y*. The rearrangement and substitution could be done in either order. This question was generally well answered by candidates. Where incorrect answers were seen, common errors related to solving the equation obtained after substitution with $324 = 16y^2$ incorrectly followed by $324 - 16 = y^2$ or by $y = \frac{\sqrt{324}}{16}$.

Question 10

Part (a) required candidates to find a scalar multiple of a given vector. This was answered correctly by the vast majority of candidates. A small number of candidates incorrectly included fraction lines inside the vector or missed the negative sign on the -9.

Part (b) required candidates to work out the magnitude of the given vector. This was again well answered, with most candidates achieving the correct answer. The most common error was failing to place the –3 in brackets, which is calculating the value of $\sqrt{7^2 + -3^2}$. A common incorrect method was $7 \times -3 = -21$. A small number of candidates found the length of the answer to **part (a)**.

Question 11

This question required candidates to use information about the radius and density of a sphere to find its mass. Candidates were expected to give the answer in kilograms correct to the nearest gram. Nearly all candidates showed clear working and were able to find at least the volume of the sphere using $\frac{4}{3} \times \pi \times 3.6^3$. A few miscopied the volume formula given and wrote 3.6^2 instead of 3.6^3. The majority of candidates went on to correctly work out $\frac{4}{3} \times \pi \times 3.6^3 \times 8.05$, but inaccuracy in working or incorrect subsequent steps were sometimes seen.

Many candidates were able to go on to find the mass of the sphere in grams, 1573…. , but made errors in converting to kilograms or giving their answer to the nearest gram- often giving 3 significant figures rather than to the nearest gram.

Question 12

In this question candidates needed to perform a reverse percentage change calculation and then find a percentage. There was a significant proportion of incorrect answers for this question with the main error being to calculate a percentage of an amount when the reverse percentage was required, working out 22 percent of 305 to obtain 67.1 and then taking this value from the one given.

Question 13

For this question candidates needed to draw lines representing the given inequalities and identify the region satisfied by all of them. This question proved relatively challenging for candidates. This question differentiated well between candidates - there were many instances where candidates gave fully correct answers, however there were also a variety of errors in partially correct attempts and some candidates failed to make significant progress. Candidates found plotting $4x + 3y = 12$ more challenging than $y = 1$, although some did incorrectly plot $x = 1$ rather than $y = 1$. Where correct lines were plotted the most common error was not drawing a dotted/dashed line for $4x + 3y = 12$ and it was common for a single mark to be gained for $y = 1$ as a solid line. Where correct lines were drawn (with correct or incorrect solid / dashed lines being drawn) candidates often did not identify the correct region with many assuming that the required part of the graph was the region that lay within all of the lines – the small triangle in the first quadrant. Some candidates made little progress with the question, failing to draw any lines and giving arbitrary shading.

Question 14

This question required candidates to interpret a box and whisker plot. In **part (a)** of the question they were asked to give the mass of the heaviest parcel. The vast majority of candidates were able to find this value correctly, reading the position of the end of the upper whisker from the scale.

In **part (b)** of the question candidates were asked to find the interquartile range. This was again well answered, but candidates did find it more challenging than **part (a)**. Nearly all candidates were able to read from the box plot accurately and wrote 2.4 and 1.85, but some then made errors in subtracting or performed an incorrect calculation with these values such as finding the mean of the two. Some candidates gave an incorrect answer of 1.9 from calculating 3.3 – 1.4.

Question 15

In this question candidates were required to rearrange a formula to change the subject. The vast majority of candidates were able to do this correctly. Where the final answer was not fully correct the most common error was to make a sign error when isolating the term in *d*, going from the correct $T^2 = 3d - e$ to $T^2 - e = 3d$ before correctly dividing by 3. Another common error was where candidates did not deal with the square root, incorrectly moving from $T = \sqrt{3d - e}$ to $T + e = \sqrt{3d}$ and then giving $\left(\frac{T+e}{3}\right)^2 = d$ as their answer.

Question 16

Candidates were given the height and curved surface area of a cylinder and asked to find the volume. This question discriminated well between candidates with some candidates able to give a full correct answer, some only partial progress and some making no progress. The main error seen in was candidates applying the formula volume = correction section area $\times$ height but using the curved surface area of the cylinder as the cross-sectional area. Another common error was to include $2\pi r^2$ in the surface area. Some candidates who started correctly did not find the radius of the cylinder, but instead found the diameter. Candidates often incorrectly labelled the diameter as the radius, but they usually then gained a method mark for the correct use of volume formula for a cylinder.

Question 17

In **part (a)** of this question candidates were asked to simplify $\left(64y^{27}\right)^{2/3}$. There was a considerable proportion of fully correct answers. Where the answer given was not fully correct the partially correct answers of ky^{18} or $16y^k$ were both equally likely. Common errors included 2/3 by 0.6 or by calculating $\frac{2}{3}\times 64$.

In **part (b)** candidates were asked to simplify $\frac{x-5}{x^2-25}$. This required candidates to factorise the denominator of the fractional expression by using the difference of two squares. There were a good number of fully correct answers seen. Where the answer given was not correct, the most common wrong answer was $x+5$ which invariably followed cancelling the $x-5$ after showing the working $\frac{x-5}{(x-5)(x+5)}$. A few candidates incorrectly factorised the quadratic as $(x-5)(x-5)$. It was noted that the vast majority of candidates were able to identify the need to factorise the denominator and few merely incorrectly cancelled the 5 and 25 and the x and x^2.

Question 18

In this question candidates were told that *F* is proportional to the product of *m* and *a*. They were asked to find the percentage change in *F* when *m* is increased by 40 per cent and *a* is decreased by 25 per cent Candidates found this a relatively challenging question and it differentiated well between them. Common incorrect answers were obtained by writing $F = m + a$, $F = m + 40\% \times a - 15\%$ or giving an answer of 25 per cent $(40\% - 15\% = 25\%)$.

Question 19

In this question candidates were given a triangle with an angle and two sides labelled and were asked to calculate a missing obtuse angle. This required candidates to use the sine rule. As would be expected common incorrect approaches included attempting to use the cosine rule and working with sine, cosine or tangent having not recognised that these could not be applied as the triangle was not right angled.

Many candidates started this question by substituting the values correctly into the sine rule. Having done this there were a number of candidates who could not manipulate the sine rule expression correctly, however most could. Where candidates had correctly used the sine rule, a common error was to prematurely approximate $sin^{-1}\left(\frac{18\sin 42}{13.5}\right)$, however most candidates did maintain accuracy in their working for angle PRQ. Many candidates gave an answer of 63.1° having not considered the ambiguous case of the sine rule, some candidates were not aware of how to find the other solution, but others may have failed to identify the importance of the reference to obtuse in the question. Consequently 63.1 was by far the most common answer.

Question 20

In this question candidates were asked to find values of *a*, *b* and *c* such that $(x+a)(x+2)(2x+3)$ was equivalent to $2x^3 + bx^2 + cx - 18$. This question was found to be one of the most challenging questions on the paper.

The most successful attempts at this question involved a correct expansion of $(x+a)(x+2)(2x+3)$ followed by comparing coefficients. This usually happened by expanding one double set of brackets and simplifying then multiplying by the second set.

In other successful attempts the candidate realised the value of –18 was achieved by multiplying the last term in each bracket together. Then realising *a* was –3 substituted into the expression and expanded.

A common incorrect approach was to multiply the terms in all three brackets pairwise.

Question 21

Part (a) of this question required candidates to use Pythagoras' theorem in three dimensions. This was generally well answered with many candidates scoring full marks. A common error for those candidates who broke up their calculations was rounding the value for an intermediate calculation such as $\sqrt{5^2+8^2}$, leading to a loss of accuracy in their final answer.
Candidates who calculated the required length in a single calculation were far more successful.

A small number of candidates failed to realise that they needed to use $\frac{14}{2}$ and not 14 in their calculations.

Part (b) of the question required candidates to find the angle between the line *BM* and the base *ABCD*. Candidates found this more challenging than **part (a)** of the question and this discriminated well between them. Some candidates could not identify the angle required leading to the most common error of finding an angle other than that required, with other angles including BMF and FBM.

There were many correct answers seen, with those not scoring full marks often achieving two marks for correct trig ratio using their incorrect value for **(a)**. The most common correct trigonometric ratio used was sine.

Question 22

This question was found to be one of the most challenging on the paper. Candidates were asked to find the coordinates of the point of intersection of the given line and curve and were required to show their working.

Those who understood that they needed to equate the $9-4x$ and $5-x^2$ were usually successful in manipulating the equation to obtain the quadratic and gained M2. Where candidates made errors, this was usually due to a sign error when trying. Once a quadratic equation was obtained the factorisation was less demanding, so this was by far the preferred approach (rather than using the formula).

Some tried to do a rough sketch of the two lines on the same graph and some achieved $x = 2$ and $y = 1$ for their answers using this method. However, this did not meet the requirement for working to be shown and so often only gained partial credit. Similarly, some candidates opted for a trial and improvement approach and were often successful in finding the point of intersection required.

Incorrect algebraic attempts took a range of forms and working was often poorly set out.

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper, making an attempt at most questions. However, a number of candidates did not attempt all parts of the paper. The standard of presentation and amount of working shown was generally good. In a multi-step problem solving question the working needs to be clearly and comprehensively set out particularly when done in stages. Centres should encourage candidates to show formulas 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 again to ensure the answers they give are in the required format and answer the question set. Candidates must write digits clearly and distinctly.

Comments on specific questions

Question 1

(a) The majority of candidates were able to write the number correctly in figures. Common mistakes were, $6\frac{1}{2}$ 000 000, errors with the number of zeros, misplacing the 5 or using a 3 (half of 6) in place of the 5.

(b) This question was answered well by most candidates. Errors were, rounding to 1 or 3 significant figures (40 000 or 37 500) or incorrect rounding to 2 significant figures (37 000). Other common wrong answers were 8000, 3800 or 8508.

(c) (i) Most candidates answered all parts to **(c)** well, understanding that they needed to choose a number from the list provided. However, some candidates often gave values not in the list of numbers. Identifying a factor of 18 was the most successfully answered, with the vast majority identifying 6 or 9 or both as a factor. The most common wrong answer was 36, a multiple rather than a factor.

(ii) Many candidates were able to identify a multiple of 12 from the list, although the most common error was to give a factor of 12 (6) instead of a multiple (36).

(iii) Identifying a square number from the list was as successful as **(c)(ii)**. The most common error was choosing $\sqrt{100}$, showing understanding that 100 is a square number but not taking the root into consideration.

(iv) More candidates were able to identify the prime number in the list, 31, although common wrong answers were 9, $\sqrt{1000}$ or 28. Prime numbers not in the list were also common wrong answers.

(v) Many candidates were able to identify the irrational number ($\sqrt{1000}$). Common errors were $\sqrt{100}$ and 31.

(d) (i) Putting a pair of correct brackets in each statement was well answered by the majority of candidates. **Part (i)** was slightly more successful than **part (ii)**.

(ii) This was well answered by the majority of candidates. Common errors were to put the brackets around the 24 and 4, or not to attempt the question.

(e) Nearly all candidates were able to write the fraction as a decimal, with very few wrong answers seen.

(f) Candidates were as successful in finding the fraction of the amount, with very few wrong answers seen. Some candidates made arithmetic slips with the division part of the question, many from not using their calculator or using their calculator incorrectly.

(g) Writing down the reciprocal of a value was the most challenging part of **Question 1**, with not many candidates gave the correct answer of 2 or 2 / 1. Common wrong answers were $\frac{1}{2}$ or 5 / 10. Some candidates showed some understanding of 'reciprocal' by answering 1 / 0.5. However, this did not gain the mark as it needed simplifying.

(h) This question was well presented by the majority of candidates, with most showing the required amount of working out. However, the most common error was giving the final answer as an improper fraction rather than a mixed number as instructed. Most successful solutions involved converting to improper fractions, then to common denominators, subtracting and then converting back to a mixed number. Errors were seen in all stages, but most candidates were able to gain one mark for correct conversion of at least one fraction to an improper fraction or converting their improper fractions to common denominators.

Question 2

(a) (i) This part was well answered with most candidates correctly calculating the radius. A few candidates tried to calculate using π to find the area or circumference, or by doubling the diameter instead of halving.

(ii) Almost all candidates who attempted to draw a chord were successful. However, a significant number of candidates did not attempt this question. Tangents, secants and radii were seen. A few candidates labelled the chord and some gave a choice of answers, e.g. a radius and chord were both drawn with this only gaining the mark if the chord was clearly labelled.

(b) (i) Many candidates gained at least one mark, most commonly for the correct distance. Candidates should be reminded that they must clearly mark where C is with a line, cross or dot, not just writing the letter C. Many candidates placed C outside the question area. Candidates should be aware that the correct answer will appear in the space provided, not in the text surrounding it or with other parts of the question.

(ii) Calculating the actual distance of ship C from ship A was done well with many gaining the full marks, including from a follow through from an incorrect position of ship C in **part (i)**. A common error was to add the distances from A to B and B to C rather than measuring the direct distance from A to C.

(c) (i) Showing that the interior angle of a regular octagon was 135 degrees was done well by those that attempted it. However, a significant number of candidates did not attempt this question. Candidates showed a good knowledge of which formula to use and how to use it. Most candidates used $(8 - 2) \times 180 / 8$ rather than $180 - 360 / 8$. Some lost the mark by not showing enough working, e.g. $1080 / 8 = 135$ without $(8 - 2) \times 180$ or used 6 without showing $8 - 2$. Candidates should be reminded that in a 'show that' question they should not use the value they are trying to 'show' in their solution.

(ii) Showing that the three shapes met at a point with no gaps was the most challenging question on the whole paper. A significant proportion of candidates did not attempt this. Candidates did not understand what they were being asked to do, often putting a circle around the shared point, or redrawing the diagram with extra shapes to show tessellation. Candidates who were successful showed with a calculation that the three interior angles of the shapes added to 360 degrees.

(d) Whilst some candidates did well on this question, many candidates assumed EDF was an isosceles triangle and gave an answer of 82 from 180 – 49 – 49, or an answer of 49. Many candidates did not understand the notation and thought that 'angle EDF' meant all three angles had to be given on the answer line, or the total of all 3 angles, 180.

Question 3

(a) (i) The first three parts in **part (a)** were very well answered with most candidates gaining full marks. The most common error was reading the vertical scale incorrectly with 8.5 often seen instead of 9, in **part (i)**.

(ii) Nearly all candidates identified India as having the largest number of students.

(iii) Most candidates were able to find 7 more students lived in China than in Australia. The most common error was reading the vertical scale incorrectly with half a square as 0.5 students instead of 1 student.

(iv) Finding the percentage of students living in the USA was the most challenging part of this question. The most common error was by rounding or truncating answers without writing the unrounded answer down. Answers of 24 or 23.7 with no working gained no marks. Centres must remind candidates that exact answers must be written down, along with the working. Some candidates used a total of 100 rather than 80, so (19 / 100 $\times$ 80 =) 15.2 was seen frequently. Also 79(.2) was given regularly by candidates using the total of 24, not 80.

(b) (i) This was very well answered, with most giving a correct answer of 10 (or -10). The most common errors seen was 4 from 7–3 rather than 7 – –3.

(ii) This part was again well answered, with the most common incorrect answer being 5 instead of –5. Other errors included 22 (or –22) or 9 (12 – 3).

(c) Completing the pie chart was challenging for some candidates, with many not drawing angles accurately or using a protractor. There were many completely correct pie charts seen, well drawn with a pencil and ruler. However, more commonly, candidates gained 2 marks for a correct sector (usually 54) or correct angles seen. There were sectors drawn 3 or 4 degrees out. Candidates should be reminded that the tolerance allowed on drawing angles is $\pm$2 degrees. A significant proportion of candidates worked out percentages rather than angles and gained no marks. Several candidates included a 'Total' as a sector and therefore had 4 (or more) sectors in their pie chart. Common wrong answers were sectors of 12, 26, 42 ,80 or 15, 32.5, 52.5, 100.

Question 4

(a) (i) Most candidates could draw all or some of the correct faces of the net, although many candidates constructed a 3-dimensional view of the cuboid. The most common mistake was to draw the height 1 cm and not 2 cm with faces 5 $\times$ 1 and 3 $\times$ 1 instead of 5 $\times$ 2 and 3 $\times$ 2. Occasionally the cuboid was drawn without a top face, drawing an open box, not a cuboid. Most nets were drawn well using pencil and ruler.

(ii) Many candidates found this part challenging. Some candidates gained one mark for the partial solution of 31, the area of 3 rather than 6 faces. However, the most common wrong answer was 30, the volume of the cuboid. Some candidates used π, despite there being no circles. Many who understood surface area struggled to use the correct dimensions and it was common to see 2 $\times$ (5 $\times$ 3 + 2 $\times$ 3 + 3 $\times$ 5) or 2 $\times$ (2 $\times$ 3) + 4 $\times$ (5 $\times$ 3).

(b) Finding the value of *x*, the base of the triangular prism, was challenging with all but a few candidates scoring full marks. The most common errors seen involved the calculation of the triangular prism, most treating it as a cuboid and not dividing by 2. However, most understood the concept that the cube and triangular prism had equal volume, so needed to equate the volumes of both shapes. 6 was a very common incorrect answer when a candidate calculated the volume of the cube correctly and equated it to their expression, usually 36*x*. Some candidates gave incorrect answers with no working and gained no marks. Centres must emphasise the need to show all working, in a systematic order. Some candidates attempted to use trigonometry or Pythagoras (with 4, 6 or 9) to find the length. 36, or 1296 were often incorrect volumes for the cube and 216 was sometimes seen from multiplying the 3 given numbers, $9 \times 4 \times 6 = 216$, for no marks.

Question 5

(a) The majority of candidates correctly identified the correct time that train B left Cove. Although some gave the wrong answer of 14:48, the arrival time of train B at Town.

(b) Most students were successful, finding that train A stopped at Port for 4 minutes. However, a significant number answered 5, the number of lines, or identified the time of arrival at Port 14:18.

(c) Many candidates found that train A takes 2 minutes more than train B to complete the whole journey. Most candidates did this with correct (40 – 38) or no working, but many candidates found 2 minutes using incorrect values (18 – 16) and therefore gained no marks. Common wrong answers were 8 minutes, the difference between finishing times, or 10 minutes, the difference between start times, whilst others compared only parts of the journey or gave the answer as a time of day (14:40 or 14:48) rather than a period of time.

(d) Nearly all candidates found that the two trains passed each other at 14:25. In **parts (a)** and **(d)** most candidates gave answers, as expected, in 24-hour times, matching the information in the question. However, several candidates chose to change to 12-hour times, which scored full marks if given with pm, however some gave answers of 2:10 and 2:25 in **parts (a)** and **(b)** and therefore scored no marks. If candidates choose to change time formats, they must be correct.

(e) Calculating the average speed of train A proved to be challenging for many candidates. Many did not use the correct formula, whereas others had difficulty finding the appropriate time in hours (2 / 3 hour) but often gained 1 mark for dividing by an appropriate time, although in the wrong units (40 minutes). A very common error was rounding the time prematurely (0.67, 0.66, 0.7 hours) and therefore lost accuracy when dividing. Candidates should be reminded not to round fractions to decimals but to use the time in fractions rather than decimals. Some candidates often divided by the time of day (14:40) rather than the time taken. Most candidates correctly found the distance travelled to be 23 km, although, some used 24 km instead.

Question 6

(a) 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’, ‘shifted’. However, only some candidates were able to give the vector, either as a column vector or in words. Most errors were in an incorrect format, often given as a coordinate, or the numbers were in an incorrect order, or there were incorrect negative signs. A number of candidates described a double transformation (translation and rotation) or used non-mathematical descriptions.

(b) More candidates were able to identify the given transformation as an enlargement although few were able to correctly state all three required components. The centre of enlargement proved the most challenging with a significant number omitting this part. The answer of 1 / 3 for the scale factor was the most common error. A significant number gave a double transformation (enlargement and translation), which gained no marks.

(c) Fewer than half the candidates were successful in drawing the image of triangle A after a reflection in the line $y = 6$. A significant number of candidates did not attempt the question or did not draw the triangle even after correctly drawing the line $y = 6$. Most candidates drew the image after a reflection in the y axis or attempted to reflect in the line $y = 6$ but ended up translating the triangle rather than reflecting it.

Question 7

(a) This simplification question was well answered by the majority of candidates. Common errors seen were 7a + b, 7a – 7b or 7a + –b, these all gained one mark for a partial solution. Candidates should be reminded that leaving a double sign (+–) in their expression will not gain full marks. Some candidates had squared terms or an ab term in their answers. 1b was condoned for b.

(b) Finding the value of *x* was equally well answered by most candidates. Most candidates gained at least one mark for a correct substitution of 21 and –5. However, some candidates added rather than multiplied 3 by –5. Sign errors were seen when rearranging to find *x*. The most common wrong answer was –4.5 from $8x = -36$. Many candidates gained the method mark but then made errors in solving the equation. A few candidates did 21 – 5 = 16 from the numbers in the question, only substituted the P = 21 then rearranged to (x =) $(21 - 3y) / 8$ or substituted $x = 21$ then calculated P (= 153).

(c) Candidates found making *v* the subject of the formula the most challenging part of this question. The most common error was to square root first. A common misunderstanding was that kv^2 meant that the *k* and the *v* were both squared, so square rooting gave $\sqrt{S} = kv$ and subsequently $v = \frac{(\sqrt{S})}{k}$. Another error was to divide by *kv* or to subtract *k* rather than divide by it. The square root sign had to cover the whole of S / k to gain full marks, with 'short' square root signs seen and not gaining full marks, despite correct steps shown in the working. The notation : or ÷ for division was accepted. Some candidates made a correct first step and reached $v^2 = S / k$ but then did not know how to deal with the square.

(d) Many candidates were able to expand and simplify the double bracket successfully, with most candidates gaining at least 1 mark for a partially correct expansion or correct expansion and an incorrect simplification. Common errors were with signs ($5x - 3x$ or 15 instead of –15) or simplifying ($-3x + 5x = -2x$). $x^2 - 15$ was commonly seen from some candidates by doing First and Last only, rather than the complete FOIL method.

(e) This forming and solving equations question was challenging for most candidates with many varied responses seen. Most candidates who found the value of *x* to be 18 did so by forming a correct equation, from the information given and then solving. However, candidates could gain full marks by using a trial and improvement method. Most candidates were able to gain the first mark, but many were unable to gain the next mark as their equation did not involve three terms in *x*. Once candidates had formed an equation in the required form $ax + b = c$ they were then successful at solving for *x* and gaining follow through marks. The most frequent wrong answer was $x = 35$ from $3(x + 15) = 150$. Other common errors were; $15x$ for Selina; $x + 15 \times 3$ for Hanif and then simplify this to $x + 45$; equate the expressions for only 1 or 2 people to 150; combining *x*-terms to get powers of *x*. Few candidates checked their answer for *x* with the original information to see if they were correct.

Question 8

(a) Many candidates did not answer in the correct format ($mx + c$) and therefore gained no marks. Those that did use this format produced a variety of answers with only some gaining both marks. Several lost a mark by giving the solution $2x + -5$, without simplifying to $2x - 5$. Common errors were entering coordinates wrongly into the correct formula for gradient, or making errors with subtracting negative numbers, gradients of $\pm1 / 2$ from difference in x / difference in y.

(b)(i) Drawing the line $y = x$ was one of the most challenging questions. This could have been because there was no table of values to complete and very few candidates chose to draw their own. Most lines drawn were either horizontal or vertical lines, most commonly the axes, or having a negative gradient. It was difficult to see many candidates attempts as they often drew over top of the axes. Candidates should be reminded to use a ruler and pencil and make their answers clearly stand out, possibly through labelling their line.

(ii) Although few candidates drew the correct line in the previous part, a larger number of candidates were able to gain a follow through mark by identifying the point where their line crossed $y = 2x - 5$. A common error was to identify the coordinates where $y = 2x - 5$ crossed the axes and merge them as (2.5, –5).

(c) (i) Nearly all candidates were able to gain full marks by completing the table correctly. The few errors seen involved missing minus signs or an attempt to make a straight line with the points already given.

(ii) Most candidates gained full or part marks as they were able to plot the points correctly with occasional slips in accuracy, particularly on the non-integer coordinates. The curves were not as well drawn with many incorrectly passing through or running along $x = -1$ or $x = 1$ for more than 5 small squares, joining points with straight lines or joining the two separate sets of points.

Question 9

(a) Most candidates found this problem-solving question very challenging. However, many candidates did gain part marks by multiplying some of the correct numbers together. A small number of candidates omitted to identify which value was higher or did so incorrectly. Most candidates made more than one attempt at this question, often using the $204 in a second calculation and then comparing the wrong values.

(b) The vast majority of candidates gained full marks. However, common errors included dividing by 21 instead of 36, or incorrectly working in percentages,

(c) (i) Most candidates placed the values 18 and 11 in the correct regions and therefore gained one mark. However, only some candidates were able to correctly complete the Venn diagram. Most candidates gave the 'only gold' value as 46 and therefore calculated 'only silver' as 35. A small number of candidates used tallies or dots instead of numbers which gained no marks.

(ii) Many candidates did well on this question. Although, some gave the total for G (46 or 64) and a smaller number gave other values from the diagram or variations of incorrect set notation. A common wrong answer was 1. This showed a misunderstanding of the Venn diagram and notation as they had counted how many numbers in the intersection rather than the number of people in the intersection.

(iii) Most candidates scored full marks from a correct follow through answer from their incorrect Venn diagram. A few candidates attempted to give their answer as a percentage, with some losing the mark due to insufficient accuracy, giving to 2 sf instead of 3 sf, or missing the % sign. Common wrong answers were: an answer of 1 / 46 or 1 / 110; placing the correct value over 99 or 100 instead of 110, or using an incorrect numerator by choosing the wrong value or sum of values from their diagram.

(d) Many candidates were able to identify the correct region and use the correct notation. However, a variety of errors were seen including 'intersection' of sets (E ∩ F), addition of a complement symbol (E U F)'; use of a preceding 'n', n(E U F) ; or using the letters from the previous Venn diagram (G U S).

Question 10

(a) Candidates who were able to calculate the correct scale factor usually went on to gain full marks. Many candidates added or subtracted numbers, 17.6 from 12.8 + 14.4 – 9.6, or matched the wrong sides as similar, 28.5 from 21.4 × 12.8 / 9.6. Many candidates had the right idea but used the ratio the wrong way up, so 9.6 / 14.4 × 12.8 = 8.5. Some candidates tried to involve 180° or Pythagoras or trigonometry unsuccessfully. The side UV (= 21.4 cm) was used by some candidates even though it was not relevant to the solution.

(b) Not all candidates recognised that Pythagoras was required to calculate BC. Successful solutions subtracted the squares and went on to score full marks. Some candidates incorrectly added the squares. Long methods using trigonometry were seen but were usually unsuccessful.

(c) Many candidates realised that trigonometry and cos 35 was required and achieved full marks, with full working shown. However, some completely correct methods did not gain full marks due to rounding the answer to 6.9, or 6.8 which lost the accuracy mark, unless they showed 6.88 or better in the working. Many candidates attempted a long method using sin to find DE and then Pythagoras to find EF. Again, this was often spoilt by premature rounding. The sine rule was seen often with 90 degrees, rather than the usual sine ratio. Common errors included using sin instead of cos, or 35 without cos, or inverted the cos ratio. Confusing the angle and side in a trignometric ratio was often seen, for example, 35cos(8.4).

(d) Only some candidates were able to show a correct method to find the angle JKL. Many calculated side KL, the hypotenuse, using Pythagoras, and gave that as their answer for the angle. Some of those who used tan often gave the fraction as 8 / 10 instead of 10 / 8, thereby finding the wrong angle.

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key messages

To succeed in this paper candidates needed to have completed the full syllabus, remembered necessary formulas, shown all working clearly and used a suitable level of accuracy. Particular attention to mathematical terms and definitions would help a candidate to answer questions from the required perspective.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper making an attempt at most questions. The standard of presentation and amount of working shown was generally good. 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 formulas 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 and the loss of the accuracy mark. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. They should also be reminded to write digits clearly and distinctly. Candidates should be prepared to use an algebraic approach when solving a problem solving question. They should use correct time notation for answers involving time or a time interval.

Comments on specific questions

Question 1

(a) (i) This part was generally answered very well. A small number of candidates omitted the bar and only a few drew the bar incorrectly.

(ii) This part was generally answered very well. The most common error was 17, the height of the bar for January. Other common errors included 10.5, 6, and 23 from adding the bar heights for October and January.

(b) This part was generally answered very well. Common errors included 79 (the total number of goals) and 20 (the number of goals for the tallest bar). A small number calculated the median or the mean number of goals per month.

(c) (i) This part was again generally answered well with many achieving the fully correct answer. Common errors included giving the final answer in an incomplete format such as 40 hours 75 minutes, 41 hours 25 minutes or 41,25 hours, working with a 7 day working week to achieve an answer of 57 hours and 45 minutes, stopping at 8 hours 15 minutes worked in a single day, adding the given times of 09 00 and 17 15.

(ii) This part was answered extremely well with just a few arithmetic errors made by a small number of candidates.

(d) (i) This part was generally answered very well with the majority calculating the correct total cost. Common errors included arithmetic slips made in the multiplications and leaving the answer as separate totals for the three groups.

(ii) This part was found to be challenging with many candidates not appreciating what values they needed to calculate the percentage and many varied calculations involving 25, 750, (25×30), 7400 or 250 were seen. The most common errors were $\frac{750}{7400} \times 100$, $\frac{25 \times 30}{100}$ and $\frac{30}{750} \times 100$.

(e) This part was generally answered very well. However, candidates needed to clarify times using the 24 hour clock, or by using am or pm, and so an answer such as 4.45 did not score full marks. A common error was to add 90 minutes but subtract 15 minutes assuming the 'break' would not be counted. Confusion with time notation resulted in the answer 1605 frequently seen.

Question 2

(a) (i) This part was generally answered very well. Common errors included hexagon, octagon, rhombus, and a variety of other polygon and quadrilateral names.

(ii) This part was generally answered well. Common errors included parallelogram, rhombus, and a variety of other quadrilateral names.

(iii)(a) This part was generally answered very well. Common errors included acute and reflex.

(iii)(b) This part was generally answered very well. Common errors included angles outside the allowed tolerance, usually 120°, or the acute angle measured as 57°.

(b) This part was generally answered well with many candidates able to show the two correct lines of symmetry. The common error was to draw four lines, which included the two incorrect diagonals.

(c) (i) This part was generally answered very well. Common errors included finding the surface area, or simply adding the three dimensions together.

(ii) The fully correct completion of the net was only drawn by a small number of candidates. However, partial marks were often awarded for one or more correct faces correctly placed. Common errors included inaccurate drawing of pairs of faces, four faces measuring 6 by 3 drawn, or an attempted 3-D diagram.

Question 3

(a) This part on writing the given number in figures was generally answered very well. Common errors included place value errors such as 1497, 140097, 1400097.

(b) This part on finding a common multiple was generally answered very well. The common correct answer was the lowest common multiple of 85, with 170 also seen. Common errors included 1 (the HCF), 5, 17 and 22.

(c) This part on writing a decimal as a percentage was generally answered very well. Common errors included 25/100, $\frac{1}{4}$ and 2.5.

(d) (i) This part on evaluating indices was generally answered extremely well. The common error was multiplying 7 and 5 to give 35.

(ii) This part on evaluating indices was also generally answered very well. Common error included 0 and 8.

(e) This question on the use of fractions was found challenging by many candidates. The most successful method was a ratio method of 5:190, 1:38, 11:418. The most common error was $5/11 \times 190 = 86$.

(f) This part on factorisation was found to be challenging, although a number of fully correct answers were seen. Common errors included the partial factorisations of $3(5x^3y - x)$ and $x(15x^2y - 3)$, $3x(5x^2y)$, $3x$, $12xy$ and $5x^2y$.

(g) Changing the subject of a formula was found to be challenging by many candidates. The most common error was a final answer of (t – V) / 3. A number of errors were seen in the first line of working with $3n = t - V$ and $n = 3V + t$ being common.

(h) This part was generally answered very well with candidates showing a good understanding of the rules of indices. Common errors included 24, 135 and 117 649. A small number of candidates showed working evaluating the terms, but this usually resulted in an incorrect answer.

Question 4

(a) The table was generally completed very well with the majority of candidates giving two correct values. The common error was in substituting $x = –2$ into the given quadratic, usually resulting in a y value of 2. Candidates should be encouraged to look at the general shapes of different groups of graphs as the majority followed through their error to plotting.

(b) Many curves were very well drawn with very little feathering or double lines seen. A few joined some or all of their points with straight lines.

(c) Using the graph to solve the given equation was found to be very difficult with many candidates not appreciating how to read the required values accurately from their curve. Common errors included misreading of the scale, omission of the negative sign for one of the values, and incorrect values such as 4 and 2 from attempting to use the given equation. A small number of candidates tried to solve the equation algebraically, which was not the required method and is beyond the requirements of the core syllabus, and this was rarely successful.

Question 5

(a) This part was generally answered well with many candidates realising that a quarter of the pie chart represented red cars and were then able to give the correct answer of 125. However, some candidates equated the number of cars to the angle and gave the incorrect answer of 90.

(b) This 'show that' question was found demanding by a number of candidates, although a good number of correct calculations were seen. Common errors included using a reverse calculation with the given 25.2, and use of 100.

(c) Completing the pie chart was generally well answered with many candidates finding the required angles of 108° and 126° and drawing their angles accurately. Common errors included inaccurate drawings, and incorrectly drawing angles of 175° and 150°. Candidates who showed working such as 175 / 500 × 360 tended to be more successful.

(d) This part was generally answered well with many candidates appreciating that the required values to be used in the calculation of 35 and 500 were given in the question. Few candidates used the alternative method using the values of 25.2 and 360. Common errors included incorrect use of 100 or 360, not giving their answer in the required format as stated in the question and answers of 35 / 100 or 7 / 100.

(e) This part was found to be challenging with many candidates not appreciating the calculations to be used. Common errors included 320 – 175 = 145 to 500 – 320 = 180 or 108 / 360 × 500 = 150.

(f) This part proved to be challenging for a number of candidates, although a number of correct solutions were seen. Common errors included 61 / 6, 204 / 6, 61 / 21 and 204 / 21.

Question 6

(a) This part on algebraic simplification was generally well answered. Common errors included a^3, $2a^3$, $5a - 3a$, $a + a$ and $-2a$.

(b) This part, also on algebraic simplification, was not as successful, with a number of candidates confused on how to apply the order of operations when algebra was involved. Common errors included $56b - 4$ and $28b$.

(c) This question on algebra and geometry was found demanding by many candidates, although a small number of correct calculations were seen. Candidates should realise that in a multi-level problem solving question, such as this, the working needs to be clearly and comprehensively set out. Although many appreciated that the 5 sides had to be added together to find the perimeter as the first step, common errors at this stage included arithmetic errors leading to $24x + k$ or $kx + 12$, algebraic errors such as $7x + 3 = 10x$, and attempting to multiply together 2 or more of the given terms. Few candidates were aware of the significance of the information given about the square. The second stage of the working of setting up an equation in the form $24x + 12 = 4s$, where s was the side of the square was rarely seen. Other common errors seen at this stage included attempting to solve equations such as $24x = 12$ or –12, $24x + 12 = 360$ or 180.

(d) The majority of candidates had the mathematical knowledge and skills to gain some credit in this question on simultaneous equations with many successfully gaining full marks. The most common and most successful method was to equate one set of coefficients and then use the elimination method, and the majority of candidates showed full and clear working for this. It was less common to see a rearrangement and substitution method which is where more algebraic mistakes occur. Common errors included failure to write the given information in a correct algebraic form, a range of numerical errors, incorrect addition/subtraction when eliminating, lack of working, and the apparent use of a trial and improvement method which was largely ineffective.

Question 7

(a) This question on ratio was found to be difficult by a number of candidates, although a reasonable number of correct calculations were seen. Those who used the simplified ratio of 5:8:3 tended to be more successful. Common errors included 40 000 / 3, (40 000 – 16 000) / 3 or 5 or 8, 40 000 / 5000 or 8000 or 3000, and 16 000 / 40 000 $\times$ 5 or 8 or 3.

(b) (i) This part on probability was generally answered well. Common errors in **part (a)** were arrows at 0.4 or 0.8. Common errors in **part (b)** were arrows at 0 or 0.2.or 0.4. Common errors in **part (c)** were arrows at 0.5 or 0.6.or 1.

(ii) This part on bounds was generally answered well. Common errors included $115 \leqslant t < 125$, $119 \leqslant t < 121$, $119.95 \leqslant t < 120.05$, $70 \leqslant t < 170$, all showing an understanding of calculating a bound but misinterpreting the ‘nearest metre’.

(c) This part on exchange rates was generally answered well with the majority of candidates sensibly attempting to answer this question in stages. Common errors included incorrect first steps of 5.80 $\times$ 1.37, 4.50 / 1.37 and 4.50 $\times$ 1.37. A small number did not give their answer correct to 2 decimal places.

(d) (i) This question on area was found to be challenging by a number of candidates, although a reasonable number of correct calculations were seen. The majority of candidates sensibly attempted to answer this question in stages, though not all appreciated the three required stages of finding the area of the square, then the area of the circle, and finally the correct subtraction in order to find the shaded area in the diagram. Common errors included premature rounding for the area of the circle which lost the accuracy of the final answer, use of 18 for the radius, area of the square as 4 $\times$ 18, incorrect formulas for the area of the circle, and only finding the area of the circle. Candidates should be reminded of the rubric instruction which states ‘For π, use either your calculator value or 3.142’.

(ii) This part on percentage profit was generally answered well. Common errors included starting correctly with [20.25 – 12.50] but either stopping at 7.75 [$\times$ / ÷100 in some case] or using 20.75 as their denominator and using an incomplete method ending with answers of 0.62 or 162.

Question 8

(a) (i) This part on the construction of a triangle was generally well answered with many accurate diagrams complete with visible arcs. Common errors included omission of arcs, drawing over their arcs which caused ambiguity, possible erasure of arcs. Centres should stress that construction lines should be left in and that they should not go over the arcs freehand and to avoid using short arcs in such constructions.

(ii) This part on measurement was found to be challenging with a significant number not appreciating which measurement was required or the units to be used. Common errors included the correct length measured but left in cms, incorrect or no conversion, and measuring the sides of the triangles.

(b) This part on the scale of a map was found to be difficult with many candidates not appreciating the conversion method to be used, Common errors included $8.5 \times 50\,000$ giving 42 500, 50 000 / 8.5 or 50 000 / 8500.

(c) This part on angle properties was generally answered well with the majority of candidates able to correctly calculate the required angle. Those candidates that used the diagram to write in each angle found tended to be more successful. The most common error was to do 180 – 118 and give 62 as the answer. Other common errors included using $x + x + 118 = 180$, $x + x = 118$, and 180 – 62.

(d) This part was generally answered well with the majority of candidates recognizing the need to use Pythagoras' theorem. As a 'show that' question working was required to show correct squaring, subtraction and square rooting. Common errors include omission of one or more of these steps, addition of the two values, going straight to 7.5 and not showing a more accurate answer first. Occasionally a trigonometrical route was attempted, but in these instances either the 90° angle was incorrectly used or only the first ratio was written down when the use of two trigonometrical ratios were required for a full method.

Question 9

(a) This part was generally answered well with the majority of candidates able to identify the given transformation as a rotation and many were able to correctly state the three required components. The identification of the centre of rotation proved the more challenging with a significant number omitting this part, and (0,–1), (–1,1) and (–1,–1) being common errors. The angle of rotation was sometimes omitted with 90 (anticlockwise) and 180 being the common errors. A small number of candidates gave a double transformation, usually enlargement and translation, which resulted in no credit. Some candidates attempted to use non-mathematical descriptions.

(b) The majority of candidates were able to identify the given transformation as an enlargement but not all were able to correctly state the three required components. The identification of the centre of enlargement proved the more challenging with a significant number omitting this part, and (0, 0), (–4, 1) and (0,–6) being common errors. The scale factor also proved challenging with 2, 3 and 2 / 3 being the common errors. Again, some candidates gave a double transformation or used non-mathematical descriptions**.**

(c) This part was generally answered well with candidates able to draw the given translation. Common errors included only one of the vector components drawn correctly, reversing the directions, incorrect orientation, or an enlargement.

(d) This part was found to be challenging with only some candidates able to draw the correct reflection. Common errors included reflection in $x = -2$, reflections in a variety of incorrect horizontal lines often $y = -1$ or $y = 2$ and drawing a variety of rotations. Those candidates who drew the line y = –2 on the given grid tended to be more successful.

MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key messages

This paper tests a wide range of skills and mathematical understanding across the syllabus. Candidates need to be able to demonstrate knowledge and competency across each of number, algebra, shape and space and probability and statistics in order to achieve a good score on this paper.

Candidates need to read the questions carefully and ensure that they answer the question that is asked.

Candidates should take care to copy given numbers correctly from the question, especially being careful that they have the correct number of zeros.

Candidates should always show their methods and working when producing solutions. An incorrect answer with no working is very unlikely to score any marks. An incorrect answer with working can be awarded method marks.

General comments

Overall, there were some very good responses with many candidates demonstrating a range of mathematical skills and knowledge across the syllabus.

It is important to be able to work securely with units. For example, with time, candidates need to be able to subtract and add time being aware that there are 60 minutes in an hour (**Question 2(b)(i)**) and be able to convert between hours, minutes and seconds such as converting 1 hour 20 mins to $1\frac{1}{3}$ hours (**Question 2(b)(ii)**). For example, with metric units, be able to convert between kilograms and grams (**Question 3(a)(i)(b)**), and litres and millilitres (**Question 3(a)(ii)**).

Correct mathematical language should be used, with correct spelling. For example, trapezium, not trapezoid, (**Question 6(a)(ii)**), even numbers, not paired numbers and odd numbers, not uneven numbers (**Question 7(b)**).

When describing single transformations, candidates should give the mathematical name of the transformation, for example ‘rotation’ or ‘enlargement’, and not a description of where or how the shape has moved on the grid (**Question 6(b)(i)**, **6(b)(ii)**). In addition, single transformations, such as the rotation and the enlargement on this paper, need to have the correct centre rather than a rotation (or enlargement) around another point and then a translation.

Solutions to questions should look to use an efficient method rather than extensive lists or trials. For example, in **Question 3(e)**, the lowest common multiple should have been found using the given prime factorisations rather than writing out the lists of multiples. In **Question 7(d)(ii)**, the number of lines should be found using an *n*th term expression rather than working out the number of lines for every diagram up to Diagram 41. In **Question 8(c)**, the most efficient method is to solve the problem by setting up an algebraic equation rather than trials.

Comments on specific questions

Question 1

(a) (i) Almost all candidates completed the bill correctly. The few errors seen were usually slips when reading the numbers or slips when putting the numbers into a calculator.

(ii) Almost all candidates found the correct percentage. A small number of candidates did not read the question carefully and found the cost of soup as a percentage, using their answer to the previous part, rather than the cost of drinks.

(b) (i) Most candidates answered this correctly. Errors were rare but included \$6000 from $\frac{5}{2}\times 2400$ or \$480 from $\frac{1}{5}\times 2400$.

(ii) Whilst many candidates answered this part correctly, there were two common errors. The first was where candidates found the decrease as $0.18\times 3450 = 621$ but did not subtract this from 3450 and the second where candidates merely found 3450 – 0.18 = 3449.82.

(c) Not all candidates who used the compound interest formula scored full marks because many overlooked the requirement to give the total value of their investment to the nearest dollar. Others subtracted the capital and gave the value of the interest. A common method error was to work out the interest in year one and multiply this by 5. In other words, these candidates were finding simple interest, giving incorrect answers of \$1120 or \$15 120.

(d) (i)(a) The majority of candidates answered this question correctly. The most common incorrect answers included 70, 76 and 78 from misreading the Swiss francs scale.

(i)(b) The majority of candidates answered this question correctly. The most common incorrect answers came from misreading one, or both, of the scales.

(ii) The best responses included statements such as: 'use the graph to sum the number of francs for \$200 and \$160' or 'use the graph to convert \$120 into francs and multiply by 3' or '\$40 = 36 francs so \$360 is 9 lots of 36 francs' or 'use the gradient of the graph to find the exchange rate and multiply this by \$360'. Candidates who talked about 'extending the graph up to \$360' or who talked about 'for every \$40 you take off 4' without mention of having to do this 9 times, did not score.

Question 2

(a) (i) Most candidates measured the line accurately and were able to convert this to an actual length. Common errors included measuring the line but forgetting to use the scale, inaccurate measuring of the line, or measuring the line in millimetres rather than in centimetres.

(ii) A good proportion of candidates were able to mark the position of Westbridge accurately on the scale drawing. Some candidates scored one mark for either having the correct bearing or the correct distance. The most common errors were to measure the bearing of 155 anticlockwise, rather than clockwise, from the north or to have angle *MNB* = 155°.

(b) (i) The majority of candidates gave the correct time. The most common error was to evaluate $13:07 - 11:45$ as a decimal calculation and give an answer of either 01 h 62 min or 2 h 2 min. Other errors were usually arithmetic slips with the number of hours with answers such as 2 h 22 min commonly seen.

(ii) Many candidates calculated the correct speed. Almost all candidates attempted to calculate using the correct formula $speed = \frac{distance}{time}$, with only a few using formulas such as $distance\times time$ or $\frac{time}{distance}$. However, the most common errors arose from candidates using either inaccurate values for the number of hours, such as 1.3 or 1.33 rather than $\frac{4}{3}$ or using 1.2 hours or working in minutes and not converting 80 into hours.

(c) (i) Almost all candidates answered this correctly. A minority of candidates did not read the question carefully and gave the answer \$138.75 as the cost for the 15 people or calculated $\frac{138.75}{9.80}$.

(ii) A good number of candidates recognised that the cheapest method for buying tickets for 24 people required buying a group ticket for 15 people and a group ticket for 6 people and three one person tickets. A very common incorrect answer was $6 \times 57.30 =$ \$229.20 from buying four group tickets for 6 people, without considering that these group tickets were more per person. Other incorrect answers included $24 \times 9.25 = \$222$ (by assuming that the group ticket could be proportioned up for more than 15 people), $138.75 + 9 \times 9.80 = \$226.95$ and $24 \times 9.80 = \$235.20$.

Question 3

(a) (i)(a) Most candidates answered this part correctly, including giving the fraction in its simplest form. Some candidates did not realise that only the tea bags needed to be considered and found fractions that involved amounts of sugar and/or milk.

(i)(b) Many candidates correctly found the amount of sugar left. The most common errors generally arose from candidates not reading the question carefully with candidates finding the amount of sugar used, finding the fraction of sugar used or the fraction of sugar left. Other errors came from an incorrect conversion of $\frac{1}{2}$ kg into grams, usually 50 g or 5000 g or using 8 g of sugar rather than 25×8 g of sugar.

(ii) Most candidates answered this part correctly. The most common incorrect answers were 80, because there were 80 tea bags, and answers with figures 25 because candidates did not recall that there are 1000 millilitres in one litre.

(b) This part was answered well. The most common incorrect methods seen were to either share the \$6875 equally into three or to find $\frac{6875}{6}, \frac{6875}{8}$ and $\frac{6875}{11}$.

(c) (i) The correct answer to this part was rarely seen. Whilst a good proportion evaluated the answer correctly as 1, candidates did not go on to express this as a power of 3, namely 3^0 as required. Other common incorrect answers seen included 1^3 and 3^1.

(ii) This part was answered well. Candidates who did not give the exact answer, but who gave a rounded answer, such as 0.06 or 0.063, did not score.

(d) (i) This part was answered well. The most common incorrect answer was b^8 which came from adding, rather than multiplying, the powers.

(ii) Candidates were very unsure as to how to simplify the expression. Common unsimplified answers included $\frac{4^{-2}}{m^{-2}}$ where only the brackets had been removed, $\frac{1}{\frac{16}{m^2}}$ as a tiered fraction and $\frac{m}{16}$ where only part of the fraction was squared.

(e) A good number of candidates found the lowest common multiple, but many were looking for factors rather than multiples. Hence, a very common error included final answers of 2 or 3 where an attempt at the lowest common factor, other than 1, had been found. Candidates were expected to use the given prime factorisations to make the shortest inclusive product. Some candidates chose to write out extensive lists of consecutive multiples of 30 and 85 which was not the intended method for this specific question.

(f) Most candidates demonstrated an understanding of the term 'irrational' as evidenced by $\sqrt{7}$ being frequently selected.

Question 4

(a) (i) The majority of candidates completed the table correctly. Other candidates recognised that the two angles needed to add to 90 and gave answers such as 50 and 40 but, without a correct method, these did not score.

(ii) The majority of candidates completed the pie chart accurately with a ruled radius. Those candidates having two incorrect angles in their table, which added to 90, were frequently awarded a follow through mark.

(iii) This was well answered. The most common incorrect answers included 14.4, the number of degrees represented by magnesia on the pie chart, 40%, the percentage of magnesia within the 'lime and magnesia' and 6% ,the percentage of lime within glass.

(iv) Whilst some candidates answered this well, most candidates did not go back to the table and use the information to deduce that the amount of silica used is $\frac{75}{15}$ or 5 times that of soda. In addition, some candidates, who chose to work in degrees rather than percentages, lost accuracy by working in stages, finding 1° as $\frac{8.25}{54} = 0.1527\ldots$, then $0.153 \times 270 = 41.31$. The required answer was the exact answer of 41.25.

(b) A fair number of candidates scored full marks on this question. Common errors included working out $A = 1.14$ but then substituting 1.14^2 into the equation, using $T = 0.6 \times 8$ or misreading 8mm as 8m or converting 8 mm to 0.8 cm or 0.008 m and using 8000, 0.8 or 0.008 respectively in the equation.

(c) Many candidates demonstrated that they can write large numbers in standard form. The most common incorrect answers included 13×10^7 and 130×10^6 and those that did not read the question carefully and gave an answer in words, namely 'one hundred and thirty million'.

(d) (i) The majority of candidates completed the bar chart accurately, shading the target rate bar. Common errors included drawing the 55% at 52.5%, drawing the bars in the wrong order, not shading the target rate bar, or drawing the bars in the wrong space.

(ii) Most candidates selected both plastic and wood. The most common error was to include metal which had a target rate of more than double the recycling rate.

Question 5

(a) (i) Almost every candidate gave the correct value for the mode.

(ii) Most candidates found the correct value for the median. The majority of candidates who did not score full marks usually scored a method mark for an ordered list of at least the first or last 7 values or for clearly selecting 3 and 5. Others calculated the mean.

(b) Although some candidates scored full marks in this part, many did not appreciate that there were 6 parcels. Some candidates did not understand that the four parcels with a mean mass of 5.01 had a mass of 4×5.01 to be added to $4.6 + 6.2$. Common incorrect answers included
$\frac{4.6+6.2+5.01}{3} = 5.27$, $\frac{4.6+6.2+5.01}{6} = 2.635$ and $\frac{4.6+6.2}{2} + 5.01 = 10.41$.

(c) Although the majority of candidates answered this part correctly, some candidates incorrectly multiplied 105 by 0.84 to get $88.2. Candidates should look at the exchange rate to observe that since 1 > 0.84 the number of dollars should be greater than the number, 105, of euros.

(d) A minority of candidates answered this correctly. Whilst most candidates found the increase in cost, $44 - 22.68 = 21.32$, many divided this by 44, the final cost, rather than the original cost.

(e) (i) The net was completed very accurately by some candidates. However, a common incorrect response was to correctly add the 3 cm by 2 cm face but then to have four 6 cm by 3 cm faces rather than two each of 6 cm by 3 cm and 6 cm by 2 cm.

(ii) Almost all candidates correctly found the volume of the cuboid. A very small minority of candidates found the surface area and gave an answer of 72.

Question 6

(a) (i) It was not common for candidates to give a geometrical reason such as 'angles *QPS* and *RST* are corresponding'. Most responses gave descriptions such as 'parallel lines go on forever' or 'parallel lines do not meet' or 'the angles are the same', which did not score. In addition, those that assumed that the shape was a trapezium and, hence, stated 'the lines must be parallel' did not score.

(ii) Relatively few candidates could name the shape correctly as a trapezium. Incorrect answers included trapezoid, parallelogram, rhombus and four-sided shape.

(iii) A number of candidates approached this successfully by using the geometrical property that the four interior angles of a quadrilateral sum to 360°. A few used alternate angles, for example, extending line *PQ* or *QR* and using the geometrical property that angles on a straight line sum to 180°. Some candidates showed *PST*=66° but made no further progress and others incorrectly assumed that $3y = 114$.

(b) (i) Many candidates recognised that the transformation was a rotation but only a minority of candidates were able to completely describe the rotation by correctly giving both the centre and angle of rotation. A common error included stating a rotation of 90 but not including the word clockwise or not writing -90. A number of candidates did not give a single transformation and those who described more than one transformation, usually a rotation about $(2, -2)$ followed by a translation, did not score.

A few candidates did not read **Questions 6(b)(i)** and **6(b)(ii)** carefully and gave what could have been correct answers in the wrong parts.

(ii) Many candidates recognised that the transformation was a translation but not all candidates used the correct language with incorrect words such as move, go, and transported seen. Some vectors were upside down, some had fraction lines and others had one or more of the components incorrect. Some used language such as 3 right and 8 up, and these candidates should express the translation as a vector. As in the previous part, a number of candidates did not give a single transformation and those who described more than one transformation, did not score.

(iii) The best responses often had carefully drawn construction lines through the centre of enlargement and the vertices of triangle *A*. Other candidates were able to correctly enlarge triangle *A* but were unable to draw the triangle in the correct place with many seeming to disregard the centre of enlargement. Some candidates tried to draw an enlargement but did not enlarge the sides by the same scale factor with the result, that their enlarged triangle was not similar to triangle *A*.

Question 7

(a) Almost every candidate completed the table correctly.

(b) Most candidates were able to clearly explain that there cannot be 51 small squares because '51 is an odd number and the values in the table are all even'. Other acceptable phrases included '51 is not a multiple of 2' or '2 is not a factor of 51'. Some candidates wrote the word 'uneven' when they should be using the word 'odd'. Others called even numbers 'paired' numbers which was not accepted. It was sufficient to write 'the squares go up by 2' since the odd numbers also go up by 2.

(c) Most candidates were able to correctly solve the equation $3x + 3 = 249$, even if the majority solved it without setting up a clear equation. Common errors included rearranging the equation

$3x+3=249$ incorrectly as $3x=249+3$ and $x=84$, or dividing 249 by 3 before subtracting 3 and $x=80$, but only those showing the correct starting equation could score a method mark. A minority of candidates substituted $n=249$ into $3n+3$ and gave the incorrect answer 750.

(d) (i) A good proportion of candidates scored full marks in this part. Most of the other candidates scored one mark for answers of the form $5n+k$ or $kn+2$. A few candidates worked out the *n*th term for the number of squares, *2n,* and added this to $3n+3$, the number of dots, wrongly assuming that this total, $5n+3$, gave them the sum of the lines. Incorrect answers included $2n+5$.

(ii) Most candidates were able to find the number of lines in Diagram 41 by correctly substituting into and evaluating using their expression from the previous part. Some were able to obtain 207 by restarting or even writing out all 41 values, which was not the intended method.

Question 8

(a) (i) Most candidates expanded the brackets correctly. The most common errors included slips with arithmetic or signs, expanding the brackets but not simplifying or misreading the question and multiplying rather than adding the two parts of the expression.

(ii) Many candidates expanded the brackets correctly. Common errors again included slips with arithmetic or signs.

(b) The majority of candidates were able to rearrange the formula correctly. The most common first step was to write $p-3=4t$ and most went on from here to give the correct answer. However, candidates need to ensure that the whole of $p-3$ is divided by 4 either by using a long fraction line, $\frac{p-3}{4}$, or brackets, (p-3)/4, as an answer such as $p-3/4$ was not accepted. Candidates who attempted to divide by 4 as their first step were less successful as, frequently, they forgot to remember to divide the 3 by 4.

(c) This part was completed well. Although the question did not suggest an algebraic approach, this was the best method and most candidates produced eloquent and clear algebraic solutions, setting up an equation and solving it correctly. A good number of candidates used trial and improvement methods and were often successful.

Question 9

(a) (i) Many candidates were able to correctly calculate the area of the triangle. The most common error was to forget to multiply by a half. A number of candidates used the 20.4 from the next part in a variety of calculations. Candidates should be aware that questions should be answered without the need for information from questions that are further on in the paper.

(ii) A good proportion of candidates were able to show a clear use of Pythagoras' theorem, evidencing squaring both sides, adding together and square rooting. The most common errors included subtracting rather than adding the square numbers, calculator slips or incomplete longer alternative methods using trigonometry. Those candidates starting with the 20.4 did not score.

(iii) Whilst a number of candidates could accurately find the shaded area, this question was done less well. Errors were seen in the formula for the area of a circle, with some finding the perimeter and others using the given numbers in a variety of calculations. Others had the correct formula but used the diameter instead of the radius or forgot to halve their answer for a semicircle.

(b) There were a number of complete, accurate solutions to this question with many candidates demonstrating an excellent understanding of trigonometry. Candidates were often able to find *QR* but *XY* was harder with candidates sometimes using 34 × tan46 rather than 34 ÷ tan46. Some candidates again attempted longer alternative methods by first finding *PR* or *YZ* but these methods were often incomplete. Other incorrect methods were seen attempting to use ratios, or similar triangles or the angles as multipliers without any sight of trigonometry.

Question 10

(a) A minority of candidates were able to give the line of symmetry. A number of candidates recognised that they needed to find the midpoint of the two given coordinates with evidence such as a '1' marked on the *x*-axis or a calculation such as $\frac{-1+3}{2}$ or an attempt at the coordinate of the lowest point on the graph or even the line of symmetry drawn, but few were able go on and give the required equation. Some candidates repeated the given equation of the graph.

(b) (i) A clear calculation, such as $6^2 - 2\times 6 - 3$ was needed to show, that when $x = 6$, $k = 21$ and most of the candidates who attempted this question succeeded in doing so. However, many candidates did not attempt this question.

(ii) It was rare for any candidate to answer this part correctly. Most candidates did not recognise that this part related to the previous part and that the symmetry of the graph needed to be used to find the value of *p.*

(c) Only a minority answered this part correctly with most not recognising that $x = 0$ needed to be substituted into the equation of the graph to find the *y*-coordinate.

MATHEMATICS

Paper 0580/41
Paper 4 (Extended)

Key messages

To achieve well in this paper, candidates need to be familiar with all aspects of the extended syllabus. The recall and application of formulae and mathematical facts and the ability to apply them in both familiar and unfamiliar contexts is required as well as the ability to interpret situations mathematically and problem solve with unstructured questions. Work should be clearly and concisely expressed with answers written to at least three significant figures unless instructed otherwise. Exact answers should not normally be rounded. Candidates should show full working writing values with at least 3 significant figures throughout, while storing more accurate values in their calculators, to ensure that method marks are considered where answers are incorrect. Candidates should not approximate within the working of a question. Candidates should not erase or cross out working if it is not going to be replaced. In 'show that' questions candidates need to ensure that no steps are missing and should not take short cuts to answers or just aim to achieve the exact answer as given in the question. If a numerical value is given, then they must evaluate their answer to a greater degree of accuracy 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. When solving quadratic equations candidates should show their working. If the quadratic formula is used then they must show the values of a, b and c substituted into the formula. The calculator function for solving quadratic equations should not be used in these circumstances. In all questions candidates should show methods using correct mathematical operators and not, for example, crossed arrows instead of multiplication in conversion of units questions.

General comments

Candidates scored across the full mark range however many candidates found the application of mathematical skills to less familiar contexts a challenge. Candidates appeared to have sufficient time and only a small minority of candidates were clearly not ready for the demands of the extended paper.

Solutions were usually well-structured with clear methods shown in the space provided on the question paper but too many marks are lost by candidates rounding values too early when they note them down in the working of a multistep solution. An increasing proportion of candidates are leaving answers in the fractional or surd form as given on their calculators. If the question is in context candidates need to give numerical answers to an appropriate degree of accuracy.

The first three questions contained some straightforward parts and almost all candidates were able to accumulate a good number of marks at this stage. In Statistics, estimation of the mean from a grouped frequency table and drawing a histogram was accessible to most but Probability was more challenging. In Mensuration many candidates did not understand the physical process of forming a cone from a sector of a circle. In Geometry many candidates did not make use of the volume scale factor for similar solids, instead attempting to find new component volumes with the new length measurements. In Vectors many did not understand the importance of direction, both in using and interpreting vector notation and in following vector journeys. The concept of equating coefficients of vectors was also challenging. Some candidates lack precision and correct language when describing transformations. In Algebra, differentiation of ax^n to nax^{n-1} was done well and many candidates understood that at stationary points the gradient is 0, however most candidates were not able to determine the nature of stationary points with enough rigour. Many aspects of functions were well executed but the distinction between $g(x^2)$ and $(g(x))^2$ was not well applied.

Comments on specific questions

Question 1

(a) (i) Many candidates correctly identified the single transformation as a translation. Correct vocabulary is expected so for example translocation, transportation or move are not acceptable. The correct column vector $\begin{pmatrix} -7 \\ -1 \end{pmatrix}$ was identified by many but there were also instances of incorrect signs and/or the components reversed. The co-ordinates $(-7,-1)$ are not accepted. The errors $\begin{pmatrix} -6 \\ -1 \end{pmatrix}$ and $\begin{pmatrix} -8 \\ -1 \end{pmatrix}$ were also seen.

(ii) Most candidates correctly identified the rotation of 90° although a significant number incorrectly stated the direction as anticlockwise. Although many candidates correctly found the centre of rotation at (5, 1) many others omitted the centre completely or gave an incorrect point. The vector $\begin{pmatrix} 5 \\ 1 \end{pmatrix}$ is not accepted for (5, 1)**.** Candidates who state or imply more than a single transformation cannot score. For example, 'rotation 90 clockwise and move $\begin{pmatrix} -1 \\ 5 \end{pmatrix}$' scores 0.

(b) (i) This reflection in the line $y = 2$ was done well. Occasionally reflection in $y = k$, $k \neq 2$ or in the line $x = 2$ was seen. Some candidates reflected triangle C instead of triangle A.

(ii) Candidates found this negative enlargement a challenge. Some candidates omitted it completely while others produced an enlargement of scale factor 0.5 or 2. Some candidates completed a correct transformation of two vertices using two guidelines from the object through the centre, but then misplaced the third vertex to get an image of the correct size but incorrect orientation.

Question 2

(a) Almost all candidates evaluated s correctly. A very occasional error seen was $\frac{1}{2}(9.8\times 20)^2$.

(b) Most candidates expanded $5(4y - 3) = 15$ and solved this equation correctly. Several candidates reached $20y - 15 = 15$ but then made a sign error to reach $20y = 0$.

(c) Many candidates correctly expanded and simplified $3(5x-8)-2(3x-7)$ to reach $9x-10$. The most common error was the sign error $15x-24-6x-14$ to reach $9x-38$ and some other candidates after expanding the brackets, equated to 0 and solved their equation.

(d) There were a lot of very good responses to this question. Most candidates understood the order of operations and the steps required to rearrange the equation. Many candidates took the recommended approach of writing a line of working for each step in re-arranging to make c the subject of $A = 2b^2 - 3c^3$. This ensured that marks could still be awarded for relevant work after a sign error had been made. The error $A - 2b^2 = 3c^3$ was common, or after the correct $A - 2b^2 = -3c^3$,the incorrect $\frac{A-2b^2}{3} = c^3$. Other errors included square rooting instead of cube rooting for the final step. It is possible that this was caused by lack of attention to the notation for cube root as some other candidates were seen to switch from the correct notation of $\sqrt[3]{}$ to the incorrect $\sqrt{}$ for their final answer. Another common issue with notation concerned a lack of appreciation of the difference in meaning between the expressions $\frac{\sqrt[3]{2b^2 - A}}{3}$ and $\sqrt[3]{\frac{2b^2 - A}{3}}$. When writing such expressions, it is essential that the cube root clearly extends below the fraction line to avoid any ambiguity. The most common error in the process for re-arranging was to make $3c^3$ the subject but then to cube root before dividing by 3.

(e) This question had a mixed response. Many candidates successfully factorised $6pq - 4q - 3p + 2$ to $(3p-2)(2q-1)$ or equivalent but many others did not know what to do with this sort of expression. When first factorising, many candidates did not realise they needed to have the same expression within the two brackets if they were to factorise further. This was generally due to not being able to deal with a negative common factor. So, for example $2q(3p-2)+1(-3p+2)$ *or* $3p(2q-1)+2(1-2q)$ were often seen which could not then be progressed correctly.

Question 3

A number of candidates misread the data in the table by not looking closely at the headings.

(a) (i) Almost always correctly answered.

(ii) This was also well answered. The five-figure answer was exact, and many candidates gave this answer. Other candidates rounded to three significant figures. This was not penalised, but candidates should be aware that an exact answer should not normally be rounded.

(iii) This was generally well answered although a significant number of candidates lost this mark by giving their answer to one or two significant figures.

(iv) This was also generally well answered. The answer when rounded to three significant figures was 3000 and so many candidates understandably gave more accurate answers which were accepted. The most frequent error was to find the Earth's distance as a percentage of Neptune's distance. This was probably because candidates did not expect to be calculating the larger quantity as a percentage of the smaller quantity.

(v) The introduction of astronomical units (AU) was implemented well by many, but some candidates used diameters of planets instead of distances from the Sun. The direct method was to multiply the 5.20 AU by the distance from the Sun of Mars divided by the distance from the Sun of Jupiter and this method was seen from the stronger candidates. The other efficient method was to find the number of kilometres equivalent to 1 AU and divide the distance of Mars from the Sun by this value. A small number of candidates had fully correct working but gave their answer to only two significant figures.

(vi) This reverse percentage question was found to be quite challenging, possibly because of the context of the question. A significant number of candidates used the distance of Mars from the Sun instead of the diameter. Many candidates treated the diameter of Mars as 100% and calculated 1.392×6800 or 0.608×6800.

(b) (i) This was a 'show that' question and candidates are expected to show all the steps in a calculation. The conversion of years into seconds was frequently either simply stated as 31 557 600 or with the product $365.25 \times 24 \times 60 \times 60$ only partially shown. 3600 was accepted for 60×60 but $86\,400 \times 365.25$ was often seen and was not sufficient. The other common error was to omit a value to more than four significant figures to show that it rounded to the value given in the question.

(ii) This part proved to be challenging with many candidates dividing the given distance in kilometres by the speed of light, which was given in kilometres per second, thus giving their answer in seconds. Some of the stronger candidates realised that this answer was in seconds and divided by 31 557 600 to convert into years, possibly recognising that this is what they did in part **(i)** Candidates should be encouraged to look at a link between parts when the earlier part was a 'show that' question. The stronger candidates did realise this connection and simply divided the distance of the Andromeda Galaxy to Earth by the given value in part **(i)**.
As in part **(a)(v)** some candidates gave their answer to only two significant figures.

Question 4

Candidates should be aware that any probability greater than 1 cannot be correct and should prompt a second look at the method they have used.

(a) (i) Many tree diagrams were correctly completed, however, in some, whilst 2/5 was given as the probability for the first branch, on the second branches the 5/9 and 4/9 were the wrong way around, either for one pair or for both pairs. In other cases, incorrect probabilities were given for the second branches and these probabilities often did not add up to 1 for each pair of branches. Occasionally, candidates did not have 2/5 as their probability of spinner *A* landing on a number that is not prime.

(ii)(a) The correct method $\frac{3}{5}\times\frac{5}{9}$ was usually used by candidates to find the required probability. In a few cases, the correct probability was doubled in error, or probabilities were added rather than multiplied. The incorrect answer of $\frac{8}{14}$ from $\frac{3}{5}+\frac{5}{9}$ was relatively frequent.

(ii)(b) Many candidates interpreted this question as 'the probability that the two numbers are <u>both not</u> prime' instead of the required 'the probability that the two numbers are <u>not both</u> prime' and so $\frac{2}{5}\times\frac{4}{9}=\frac{8}{45}$ was a very common incorrect answer. Some candidates did however correctly follow through their answer in **part(ii)(a)** using the efficient method of subtracting this from 1.

(b) Most candidates obtained the correct answer in this part. Common incorrect answers included $\frac{72}{120}$, $\frac{2}{5}\times 120=48$, and $\frac{120}{3}$.

(c) Candidates found this question part challenging. A common error was to only consider some, not all, of the relevant possibilities so partially correct methods, such as $\frac{4}{9}\times\frac{2}{9}\times 2$ or $\frac{4}{9}\times\frac{2}{9}$, or $\frac{4}{9}\times\frac{2}{9}+\frac{2}{9}\times\frac{2}{9}$ were seen. Other candidates included too many combinations in their methods, giving rise to, for example, $2\left(\frac{4}{9}\times\frac{2}{9}+\frac{2}{9}\times\frac{2}{9}\right)$ or $4(\frac{4}{9}\times\frac{2}{9})$. Where candidates attempted to list the possible outcomes, there were invariably many omissions and possibility diagrams were not always drawn correctly, with values missing or the relevant possibilities not highlighted. A significant number of candidates omitted this question part or attempted to use 'non replacement' probability methods.

(d) This was found to be one of the most challenging question parts on the paper**.** Many candidates omitted the question part completely or gave common incorrect answers using $\frac{4}{9}n$ or $\left(\frac{4}{9}\right)^n$. Some attempts, though incorrect, demonstrated some understanding of what was required with answers such as $\left(\frac{5}{9}\right)^n\times\frac{4}{9}$ or $\left(\frac{4}{9}\right)^n\times\frac{5}{9}$

Question 5

(a) Many candidates were able to answer this question successfully with careful and well thought out strategies set out in clear steps. A small number of candidates clearly understood the strategy and steps required but lost the final mark because of premature rounding.

For those candidates who did not get maximum marks, the vast majority were able to use right - angled trigonometry or the sine rule with angle 38 and 52 or 90 to find the length *BD* or *AB*. Incorrect attempts to find *CD* or angle *ACD* then often followed by incorrectly treating triangle *BCD* as right-angled. Some candidates began incorrectly by assuming *AB* was equal to *BC*.

(b) Many candidates were able to locate the midpoint of FG as the centre of the circle. Common errors included placing a cross at the centre of the triangle or on one of the vertices. Many candidates tried to draw the circle using compass constructions even though this was not required.

Very few candidates were able to use 'angle in a semi-circle is 90°' or similar as the correct reason for the placement of the cross. Many of the incorrect explanations were focused on compass constructions rather than a circle theorem.

(c) Most candidates were successful in gaining some marks for this question part. In triangle *LMN* many candidates correctly used the ratio of angles and the sum of angles equal to 180 to find the largest angle 72. The error of using the sum as 360 was seen and other candidates found the angles of triangle *PQR* first and then tried to apply the ratios to these angles to find those in triangle *LMN*, for example $\frac{6}{15}\times 82.8$. In triangle *PQR* many candidates understood that the cosine rule was needed and of these many were able to recall this correctly. Candidates should be aware that no marks can be gained for quoting the cosine rule until relevant values have been substituted in. Candidates who do not show the substitution and then give an inaccurate value for the cosine or the angle, will not score. Some candidates did not appreciate that the largest angle is opposite the longest side and so often all three angles were calculated. Alternatively, the cosine rule was used to find angle *P* and/or angle *Q* and then the sine rule or angle sum of a triangle to find angle *R*. Inefficient methods usually lost accuracy. A minority of candidates tried to use right angled trigonometry for this question despite both triangles being non-right angled.

Question 6

(a) Sequence *A*: Most candidates were clearly familiar with tackling problems with linear sequences and were able to state the next term as 9. The common difference of 4 together with trial and error or using $a + (n – 1)d$ usually resulted in the correct n^{th} term, $4n – 11$. Weaker candidates often tried to use term to term rules and a common wrong answer was n+4.

Sequence *B*: Using 1st and 2nd differences candidates were able to deduce the next term correctly, but deriving the formula for the nth term was more of a challenge. Many candidates correctly showed second differences of 4 and deduced that the sequence was quadratic but not all were then able to reach the correct n^{th} term $2n^2 + 5$. The most successful candidates were ones that understood that a second difference of 4 indicates the coefficient of n^2 is 2.

Sequence *C*: This proved to be challenging for many students. Some saw the patterns that the numerators were increasing by 1 each time and the denominators were each three times greater and so were successful in finding the next term. An attempt could then also be made at finding the n^{th} term using powers of 3 in the denominator. Candidates should be very careful when writing powers so that for example $3n$ and 3^n are clearly distinguishable. Candidates who used ar^{n-1} for a geometric progression usually achieved the correct denominator $27\times 3^{n-1}$ but other candidates made errors in manipulating numbers in index form such as $9\times 3^n = 27^n$. Some candidates appeared not to consider a power sequence at all and instead attempted to find a cubic sequence.

(b) This part was done well. Many candidates understood the information given and processed it well.

Question 7

(a) Finding an estimate for the mean from a grouped frequency table is a familiar question and many fully correct answers were seen. It is recommended that candidates show the working $\frac{217.5\times 9 + 221.5\times 14 + 229\times 14 + 239\times 2 + 254\times 3}{42}$ so that minor errors in mid-values or slips when entering data to the calculator do not prevent method marks from being awarded. A slightly incorrect total for $\sum fm$ with no previous working shown will score 0. Errors seen included using the upper or lower bounds instead of mid values, using group widths instead of mid-values, and occasionally adding mid-values or frequencies and dividing by 42 or 5. Some of these methods gave a value for the average that was outside the range of the data instead of somewhere in the centre of the data but this appeared not to have been considered.

(b) Many fully correct histograms were accurately drawn. Some candidates showed correct calculations for frequency density but misinterpreted the vertical scale for one or more blocks. Other candidates drew blocks at the correct heights but ended the first block at time 225 or started their third block at 235. Other candidates looked for other connections between the heights of the blocks and the frequencies. Using the first given block they deduced that frequencies should be divided by three and extended the grid to draw blocks at height above 4 or used the last given block to divide the frequency for group $234 < t \leqslant 244$ by 20.

Question 8

(a) (i) In this 'show that' question candidates were expected to show every step in their working before evaluating their final volume to at least 4 significant figures to show that when rounded to 3 significant figures the volume of the solid would be 692. Many correct formulae for the volume of a hemisphere and the volume of a cylinder, with correct values substituted, were seen but candidates who did not then show the addition of the three volumes and went directly to the given value of 692 lost both a method mark and the accuracy mark. Candidates who wrote down values rounded to only 2 or 3 significant figures for each volume in their working or used 3.14 or 22/7 for π usually lost the accuracy mark. Some candidates omitted the division by 2 for a hemisphere as opposed to a sphere. Recall of the formula for the volume of a cylinder was mostly good but the errors $2\pi rh$, $2\pi r^2$ and $2\pi rh + \pi r^2 h$ were seen.

(ii) A large proportion of candidates did not understand the significance of the first line of the question which stated that the solids were mathematically similar. Many candidates just used the new radius on the cylinder and kept all the other dimensions the same. For those that did understand that all the dimensions had changed, most approached the problem by trying to calculate the new volume with the new dimensions. Very few used the length/volume scale factor relationship which was the intended method and the most efficient. Recalculating all the volumes inevitably led to issues with accuracy. Most candidates realised that they needed to multiply their new volume by 10.49 to find the mass and gained the SC mark.

(b) (i) Many candidates showed a correct method in this question part but of these, a significant number did not give their answer as a multiple of π and so did not score full marks. Other common errors included using the formula for area instead of circumference or finding the minor arc using angle 144 even though this was not shown on the diagram provided.

(ii) This question part was very demanding for many candidates. Candidates appeared unable to visualise how the 2D shape could be manipulated into a cone. Candidates who drew a sketch of the cone were usually more successful in finding an approach to solving the problem. Their first step needed to equate the length of the arc from **part (b)(i)** to $2\pi r$, to find the radius of the cone. This could then be used in Pythagoras' theorem together with the slant height of 10 to find the height, but common errors included attempts to use the angle 216 or 144 in some way to find either the radius or the height. Candidates who successfully found the radius and the height usually went on to complete the substitution in the given formula correctly to find the volume. The most common error was to simply substitute 10 as the height and/or radius into the given formula.

Question 9

(a) (i) Most candidates responded to this question and answered it correctly. Common incorrect answers were '+ 20' after processing multiplication of positive and negative numbers incorrectly, and '2' from correctly substituting the value x=0 into all 3 brackets but then adding rather than multiplying (i.e., '1 + 5 – 4')

(ii) The vast majority of candidates responded to this question and answered it correctly. Common errors arose from processing the '-3' in $g(x) = 2x - 3$ incorrectly, leading to the answer $y = \frac{x-3}{2}$
Many candidates began by stating $x = 2y - 3$ correctly but then continued with $x - 3 = 2y$. A few candidates began with $y = 2x - 3$ and correctly rearranged into $x = \frac{y+3}{2}$ but then did not state the inverse of g in terms of x.

(iii) Many candidates understood the composite function notation and began by finding $h(2) = 64$ and then finding $g(64)$. The most common incorrect answer seen was '64' arising from substituting $x = 2$ into both functions g and h separately and then multiplying the answers.

(b) Many candidates responded to this question and answered it correctly. A common error amongst candidates who responded incorrectly was to form the equation $2(2x – 3) = 7$, leading to $4x – 6 = 7$ and an answer $x = 3.25$, instead of forming $2(2x) – 3 = 7$, leading to $4x – 3 = 7$ and the correct answer of $x = 2.5$.

(c) Many candidates found this part more challenging. Some misinterpreted the meaning of $g(x^2)$ and proceeded to expand $(2x – 3)(2x – 3)$, instead of beginning their working with $2x^2 – 3$. If candidates processed $g(x^2)$ correctly, the most common error was incorrectly dealing with the *gg(x)* term. A final answer of $2x^2 + 4x - 8$ arose from misinterpreting *gg(x)* to be $2(2x – 3)$ instead of $2(2x – 3) – 3$.

(d) Candidates found this the most challenging part of this question. It was rare to see correct answers. Common errors included substituting $x = 16$ into *h(x)* and giving the answer 4^{31} or $4.6116\ldots \times 10^{18}$. Other candidates completely misunderstood the h^{-1} notation and interpreted this as a reciprocal, giving the answer $\frac{1}{4^{31}}$ or 4^{-31}. Others attempted to deal with the inverse function and ended up calculating the 31st root of 4 (= 1.045…). Some candidates began correctly with $4^{2x-1} = 16$ but did not know how to progress from here. Most candidates that reached $4^{2x-1} = 4^2$ continued to a correct answer.

(e) Of those candidates who attempted this part, the ones who were most successful were those who set out their working clearly and began by expanding one pair of brackets then, after simplifying, set out clearly the multiplication of this quadratic and the third bracket to form the cubic expression. Inconsistent use of brackets, e.g., not surrounding their answer to the expansion of the first two brackets, led to errors when multiplying their answer by the 3rd bracket. A small number of candidates expanded the 1st and 2nd brackets and then the 2nd and 3rd brackets to arrive at two quadratics that they either attempted to multiply or simply add. Some candidates stated the correct cubic but, in the answer spaces for *a*, *b*, *c* and *d*, did not transfer their answers correctly, often omitting the negative signs for *c* and *d*.

Question 10

(a) The absence of a given diagram created a challenge for many candidates. There was plenty of space on the page for candidates to draw their own diagram to help in this part.

(a) (i) The direction of the given vector, $\overrightarrow{CA}$, created the need to adapt and look at the direction from *A* to *C*. Many candidates did not realise this and the answers (–7, 22) and (–15, –6) were frequently seen instead of (15, 6).

(ii) Again, direction proved to be a challenge with the absence of a diagram. Many candidates gave the vector $\overrightarrow{AB}$ $\begin{pmatrix} -3 \\ -24 \end{pmatrix}$, or $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$ from adding the coordinates of *A* and *B*, instead of the vector $\overrightarrow{BA}$.

(iii) The calculation of the modulus of a given vector was more successful with most candidates knowing this was a Pythagoras calculation. Some candidates had -11^2 instead of $(-11)^2$ and some candidates did not recognise the modulus notation and gave a column vector as their answer.

(b) (i) Vector geometry is always a challenging part of the syllabus. Many candidates were able to gain some credit for stating a correct route for $\overrightarrow{OR}$ such as $\overrightarrow{OM} + \overrightarrow{MR}$. As in part **(a)**, direction was occasionally a problem with for example $\overrightarrow{MN}$ = **a** – **b** instead of **b** – **a** sometimes seen. Most candidates dealt with the ratio correctly with the fractions $\frac{2}{5}$ or $\frac{3}{5}$ usually seen correctly with $\overrightarrow{NM}$ or $\overrightarrow{MN}$.

(ii) This was one of the most challenging questions in the whole paper.

(a) This part proved to be very challenging and discriminating. Equating two expressions for $\overrightarrow{OT}$ was rarely seen. Another difficulty was notation and it appeared that *c* was being treated as a vector. The stronger candidates did obtain the two expressions for $\overrightarrow{OT}$ and most went on to equate the coefficients of **a** and **b**.

(b) This part was well answered by the few candidates who had succeeded in part **(a)** and also by a few candidates who used –**a** + **b** + the given $\overrightarrow{NT}$ and correctly followed through with their value of *k* in part **(a)**.

Question 11

(a) Most candidates differentiated the cubic correctly. The most common wrong answers were, $3x^2 - 8x$ and $3x^2 - 8x - 3x$.

(b) Candidates followed through their answer to **part (a)** and began the process of finding the two stationary points by equating to 0. Many used the quadratic formula correctly and some were able to factorise. The question demanded that candidates showed all their working so candidates were required to show how the quadratic equation was solved. Stating the solutions alone did not earn method marks. If using the quadratic formula candidates must show relevant values for *a*, *b* and *c* substituted in, and care must be taken to process $(–8)^2$ and not $–8^2$. Once solved most candidates knew that they needed to find the corresponding values of y. (3, –18) was often found correctly but errors in the substitution process made (–1/3, 14/27) a less frequent answer. Some candidates lost the accuracy mark due to stating the co-ordinates to only 2 significant figures.

(c) It was rare to see completely correct responses in this part although many candidates seemed to understand a method for deciding if the points were maximum or minimum. The most frequently seen method was to substitute their x values into the second derivative. After evaluating these expressions most candidates jumped to their conclusions without a rigorous explanation. For full marks it is necessary to state <0 or >0 for each derivative and then to write the co-ordinates of each stationary point with the conclusion maximum or minimum. The alternative efficient method to gain all marks is to draw a reasonable sketch of a positive cubic and write the co-ordinates of the stationary points in full with the conclusion of maximum or minimum, but this was not seen very often.

MATHEMATICS

Paper 0580/42
Paper 4 (Extended)

Key messages

To do well in this paper, candidates need to be familiar with all aspects of the syllabus. The recall and application of formulae is required, as well as the ability to interpret situations mathematically and problem solve with unstructured questions.

Work should be clearly and concisely expressed with intermediate values written to at least four significant figures 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 produced excellent work across the breadth of the paper. Most candidates were well prepared for the paper and their solutions were often 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.

Premature rounding within calculations continues to be an area to improve for some candidates and can lead to 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 included:

- transformation geometry
- statistical measures of mode, median, mean of grouped data and range
- factorising quadratic equations
- forming and manipulating equations involving fractions
- sine and cosine rules
- equations of straight lines.

The weaker areas included:

- statistical measure of interquartile range
- reverse percentage
- problem solving with mensuration
- exponential change
- trigonometry involving angles of elevation
- probability of combined and conditional events
- using the correct terminology in geometrical reasoning.

Comments on specific questions

Question 1

(a) (i) Most candidates were successful in this part. A small number either translated the triangle correctly in one direction but not the other or translated the triangle using the vector $\begin{pmatrix} 1 \\ -7 \end{pmatrix}$.

(ii) This part was also answered well. Of those candidates who did not earn the mark some gave an answer of $\begin{pmatrix} 7 \\ -1 \end{pmatrix}$ and others gave an answer of 'translation' or the vector, but not both.

(b) Almost all candidates answered this part correctly. Those that did not generally used an incorrect reflection line such as $x = 4$ or a line of the form $y = k$ with k not equal to 4.

(c) Many candidates were successful in this part. Almost all the incorrect answers were as a result of rotating the triangle about an incorrect centre. A clockwise rotation about a centre other than the origin was a more common error than anticlockwise rotation about the correct centre. A small number of candidates got one or two vertices correct but then drew one side of the triangle with an incorrect length.

(d) (i) This part proved to be more challenging but was still answered correctly by many candidates.

A number of candidates drew two vertices in the correct place but made an error with the third vertex. There also some who used an incorrect scale factor of $\frac{1}{2}$ or used the correct scale factor with an incorrect centre.

(ii) The majority of candidates recognised that they needed to reverse the transformation and so gave some form of enlargement as their answer, usually with the correct centre. The most common error was to give the scale factor as either 2 or $-\frac{1}{2}$.

Question 2

(a) (i) Most candidates were successful in this part. Some subtracted the lowest frequency from the highest frequency and so gave an answer of 18 and others subtracted the lowest number in the complete table from the highest number and so gave an answer of 19.

(ii) This part was also answered very well. The most common incorrect answer given was 19, the highest frequency.

(iii) Another part answered well with a just a small number of candidates giving the most common incorrect answer as 17.5.

(iv) Almost all candidates earned full marks on this part supported by correct working.

(b) (i) Candidates generally showed an excellent understanding of stem and leaf diagram**s.** A very small number used the given numbers in the main body of their diagram as the 'leaves' or did not order the leaves in their diagram.

(ii) Almost all candidates gave the correct answer for the median. Some did not use their stem and leaf diagram but wrote down the eleven numbers in order before writing down the median. A small number of candidates identified the leaf of the median as 1 and gave this as the answer.

(iii) Many candidates found this part challenging. Some gave the correct lower quartile but gave the upper quartile as 25 or 27.5 for example. Some gave the range, coming from 34 – 18, as the answer and a few gave $\frac{3}{4} \times 11 - \frac{1}{4} \times 11$.

Question 3

(a) (i) This part was answered very well with most scoring full marks, A small number of candidates calculated 769.5 and either gave this as the final answer or added it onto 7695. A few rounded their answer, giving 6926 for example, without showing the more accurate answer in the working.

(ii) There was a mixed response to this inverse percentage question. A number of candidates gave $0.9x = 7695$ and obtained the correct answer but many either gave 7695×1.1 or the equivalent incorrect method of adding 10% of 7695.

(b) Many candidates were successful in this simple interest question. A number of candidates calculated the correct interest of \$60 and gave this as the value of Ali's investment. A small number of candidates calculated the compound interest.

(c) The majority of candidates had a good knowledge of this type of compound interest question and were able to write down an equation $500 \times (...)^{12} = 601.35$. A small number added \$500 to one side of this equation. Those who had the correct initial equation often went on to earn full marks. Some candidates were not awarded the final mark as they only gave the answer to 2 significant figures and others attempted to take the 12th root before dividing both sides by 500.

(d) (i) This was a more discriminating question with only the stronger candidates gaining full marks. Some candidates gave the answer 73.7, the percentage remaining, rather than the overall percentage decrease. A large number of candidates gave an incorrect answer of 30% coming from an assumption that the loss of mass of the substance was 3% per day.

(ii) This part was also quite challenging and some candidates did not offer a response**.** The most common error was to ignore 'decreases exponentially' and so make the same incorrect assumption. as in **part (d)(i)**, that the loss is 3% per day leading to an answer of 17 days.

Stronger candidates were able to produce an equation of the form $0.5p = p\left(1-\frac{3}{100}\right)^n$ that they then solved using the method of trial and improvement. A small number of candidates who had a knowledge of logarithms, which is not required on the syllabus, were able to use this as an alternative method.

Question 4

(a) Many candidates understood the connection between the sector and cone. Most of these used the circumference of the base and equated it to the expression for the arc length and they were usually successful at finding the angle, although a few worked with decimal values and gave an inaccurate final answer. Fewer candidates worked with corresponding areas and some of those had difficulty with finding the required curved surface area; some used an incorrect formula or included the base area of the cone. A significant number of candidates attempted to use triangles and various erroneous trig methods to find the angle.

(b)(i) The majority of candidates found this part challenging. Most struggled to link the given values to a right angled triangle within the shape and there were attempts at incorrectly manipulating 17 and 8 to arrive at 30. Some tried to work with formula's for the volumes of cylinder and sphere. The small proportion of candidates that used Pythagoras' were able to show the required steps to establish the given value 30.

(ii) This was a very well answered part with a considerable number of candidates able to both find the separate volumes and then use them in order to find the correct percentage. The most common error was to use an incorrect formula for the volume of the cylinder e.g. $2\pi r^2h$ or even $2\pi rh$.

(iii) This part was also well answered by many candidates. The most common approach was to calculate the volume of the sphere and then subtract this from volume of water before dividing the answer by the area of the cross section, 400. The most common misunderstanding was using 15 cm instead of 20 cm for the lengths of the tank. A number of candidates, having found the volume remaining, incorrectly, cube rooted to find the depth.

Question 5

(a) The vast majority of candidates were able to form an equation and reach the correct answer. An occasional error was in expanding $10(x + 2)$ to give $10x + 2$ leading to a final answer of 2. A few linked the number of books with the wrong costs giving $10x = 11(x + 2)$ and a negative answer.

(b) (i) Most candidates were successful. Those who formed the correct equation for the total number of books involving algebraic fractions in terms of y usually went on to gain full marks. Algebraic manipulation was done well with few errors noted. Occasionally a slip was seen with a sign or value, missed brackets, or a few failed to show each line of working as a full equation. Some candidates introduced further variables for the number of fiction and reference books sold but many were unable to eliminate them to reach an equation in y. Weaker candidates often attempted to use linear equations while others solved the given quadratic equation.

(ii) This part was well answered. Most were fully correct and a few solved the equation as well as factorising it. Some had reversed signs within otherwise correct factors while others factorised only the first two terms giving $y(6y – 109) – 95$.

(iii) There were many correct answers. Some candidates did not interpret the solutions in the context of the original problem and gave both the positive and negative roots of the quadratic equation.

Question 6

A significant number of candidates were able to tackle this question successfully, gaining full marks. Some candidates made a good start with correct use of Pythagoras' to link the expressions for the three sides. A number did not reach the correct quadratic equation as they failed to expand $(2t + 3)^2$ correctly giving $4t^2 + 9$ rather than $4t^2 + 12t + 9$. Some did gain credit for showing a correct method to solve their equation but others did not as they only showed a calculator generated solution without a method. Most candidates were able to earn the partial credit for use of their t value in a trig calculation to find the angle w. While most used standard trigonometry there were some who used the sine or cosine rules. Others rounded their positive value of t to 1.06 before using trigonometry leading to an inaccurate final answer.

Question 7

(a) (i) Many struggled with finding the angle of elevation**.** Those candidates who understood which angle was required were able to reach a correct answer. Longer methods such as finding the hypotenuse and using sine or cosine were attempted by a number of candidates often successfully, but premature rounding frequently lost the accuracy mark. However, many candidates were confused by 3D geometry and the term 'angle of elevation'. Some calculated angle $QXR = 68.5$ while others showed a wide variety of calculations involving only angles when viewing the diagram as a 2D figure.

(ii) Candidates had less success with this two step part of the question. Those who placed 21° correctly on the diagram usually used correct trigonometry and Pythagoras' to reach the correct answer. However, the angle of 21° was regularly incorrectly shown as angle RPQ or as angle PXR or as the bearing 021° at P and no valid progress was made.

(b) Most candidates recognised this as a sine rule problem and many gained full marks. Some who stated the initial formula correctly were unable to rearrange it to the explicit form and others lost the accuracy mark due to excessive rounding within the calculation. Some candidates saw this as a right angle triangle or incorrectly attempted to use the cosine rule.

(c) (i) Full marks were not often gained on this 'show that' part. Most candidates were able to show $\frac{1}{2} \times 12.3 \times 21.5 \sin A = 62.89$ and gained the method mark but very few showed the solution to greater than one decimal place which was required to justify the given answer 28.4 for the accuracy mark.

Some candidates used a longer method, calculating CD from the use of $\frac{1}{2}$ base $\times$ height = 62.89, followed by $\sin A = CD \div 21$, but very often rounding of CD led to an inaccurate final answer.

Occasionally candidates just wrote the method in terms of letters as $\frac{1}{2} \times AB \times AC \times \sin A = 62.89$.

Centres and candidates should note that method marks are only earned after a numeric substitution into the method.

(ii) Most candidates who used the cosine rule were successful in giving a correct answer. Some others had an error in the formula or made an order of operations error within the calculation. Some used a longer method finding *CD* and *BD* followed by use of Pythagoras' but this method was prone to premature rounding errors and often only method marks were gained as the final answer was incorrect.

(iii) A variety of methods were seen with this part. Some found *AD* and subtracted 12.3. Others focussed on the right-angled triangle *BCD* and used Pythagoras' with previously calculated values or trigonometry after finding an angle in this triangle. Here again, for many candidates, premature approximations within the method lost accuracy.

Question 8

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

(ii) Again virtually all candidates were correct with the occasional incorrect answer of $\frac{25}{150}$.

(b) (i) A mixed set of solutions in this part. There were many candidates who added the correct products of $\frac{3}{6}\times\frac{3}{6}$ and $\frac{2}{6}\times\frac{1}{6}$ to gain full marks. However, many others only gained a partial method mark as they multiplied these products by 2 or 3 before adding. A few very successfully used sample space diagrams highlighting the required outcomes and giving the correct probability while others gained some credit when they listed the 11 required outcomes

(ii) This proved extremely difficult for most candidates and fully correct answers were rarely seen. A significant number of candidates did not consider the conditional nature of this question and did $\frac{2}{6}\times\frac{1}{6}$ to give an answer of $\frac{1}{18}$.

(c) This part proved difficult to most candidates. There were a small number of correct answers and often those that were correct did not always come from a clear written method. A few candidates wrote $\left(\frac{4}{6}\right)^{n-1}\times\frac{2}{6}=\frac{32}{729}$ with some using logs (this is beyond the syllabus) to solve the equation. More often $\left(\frac{4}{6}\right)^{n}\times\frac{2}{6}=\frac{32}{729}$ was seen leading to an answer of 5 where candidates had calculated the numbers of rolls where the spinner did not land on 3 and had forgotten to add on 1 for the roll where it did land on 3. Many candidates attempted to divided $\frac{32}{729}$ by $\frac{2}{6}$ but were unable to make any further progress.

Question 9

(a) This was very well answered. A few made an error with an index or with the coefficient in the second term. A more common error was to take the second derivative to get to $24x-12x^2$.

A small number of candidates appeared to misread the question and factorised the original expression.

(b) A significant number of candidates scored full marks in this part, equating their answer to **part (a)** to zero and then finding the solution for *x* before obtaining the correct coordinates. There were a number however that made no attempt or scored no marks. The most common mistake was to equate the original function to 0, or to use the second derivative and start with $24x-12x^2=0$. A few gained partial credit for obtaining $x = 3$.

(c) Fewer candidates gave fully correct answers in this part. Many found that the x value at point A was 4 but then the common error was to try to work out the gradient using the 2 sets of coordinates for B and A instead of substituting $x = 4$ into the derivative. Another common error in finding the value x at point A was to start by equating their answer to **part (a)** to 0, instead of the given function.

Question 10

(a) Almost all scored full marks in this part. Those who did not often chose to use triangle *BCD* again in the second line.

(b) This was a structured question leading candidates through a method to prove that two triangles were congruent. Almost all candidates scored at least partial credit but only a few gave a fully correct answer. Most scored 2 or 3 marks on this question, usually for giving *OQ*, *OQT* in the first two lines and for saying 'equal' or 'same length' for the tangents *TP* and *TQ* in the final line. The other 2 parts proved more challenging. In the 3rd line candidates often omitted to mention both tangent and radius which were the key terms. In the 4th line many stated an incorrect criterion with SSS and SAS being the most common incorrect answers. A common error in the final line was to say 'same' or 'congruent'.

Question 11

(a) This part was invariable answered correctly.

(b) Almost every candidate was able to state that $f(x – 2) = 1 – (x – 2)$ but not all candidates went on to simplify the expression correctly. The most common errors were to incorrectly simplify to $1 – 3x – 6$ or $–2(x – 2)$ or $1 – 3x – 2$ or to spoil an otherwise correct answer by solving $–3 + 7x = 0$.

(c) A significant number of candidates answered this part correctly. Most candidates gave a correct first correct step, usually $y – 1 = –3x$. Common errors from there were either errors with the negative signs or forgetting to exchange the x and the y at some point in their working.

Candidates should also ensure that they give their final answer accurately since $-\frac{x+1}{3}$ is not the same as $\frac{-x+1}{3}$ and this was an error made by a number of candidates. A minority of candidates did not understand the notation and treated $f^{-1}(x)$ as $[f(x)]^{-1}$ giving the answer $\frac{1}{1-3x}$.

(d) Most candidates started by showing $(1-3x-1)^2-(x-1)^2(1-3x)$. Others worked out the two parts and put them together later. While some candidates scored full marks, most of the errors seen arose from slips with the negative signs when multiplying out the brackets or omitting to subtract some or all of the second part. It was very common to see errors arising from the first part with many candidates expanding $(1-3x-1)^2$ term by term rather than first simplifying to $(-3x)^2$. Some also having written $(x-1)^2(1-3x)$ then expanded $(x^2-1)(1-3x)$.

(e) A minority of candidates scored full marks in this part. Most candidates attempted to use a common denominator of x but, as with previous parts, sign errors were seen. The most common error was to overlook the double minus for the $3x^2$ term after correctly showing $\frac{3}{x}-\frac{x-3x^2}{x}$.

(f) Candidates often correctly started by showing $\frac{3}{x^n}=3x^7$ but many could not go on to find the value of n. Common incorrect answers included 7 and $\frac{1}{7}$.

Question 12

(a) (i) This part was answered correctly by the vast majority of candidates. The most common error was to give the *x* and *y* components of the vector the wrong way round.

(ii) This part of the question was also answered correctly by the majority of candidates. The most common error was to give the *x*-component as +6 and the *y*-component as –4.

(b) Many candidates found the correct equation of the line *AB*. Most candidates found the correct gradient using the coordinates of *A* and *B* and then were able to substitute the coordinates of *A* or *B* in $y = mx + c$. The most common error was in manipulating the fractional constant.

(c) Many candidates successfully found the coordinates of the mid-point of *AB* and also the gradient of the perpendicular bisector by finding the negative reciprocal of the gradient of *AB*. These candidates invariably went on to give a correct equation. A number of candidates were able to correctly find the gradient but used either point *A* or point *B* to find the '*c*' value and did not attempt to find the midpoint of *AB*.

(d) Parts **(b)** and **(c)** were answered correctly by many candidates, but fewer candidates realised what was needed to answer this part and that the distance was a vertical line. Many of those candidates who made an attempt at this part used Pythagoras' as they were finding the distance between two points and this often led to errors. For those attempting the concise method a common error was to give $\frac{19}{3} - \frac{9}{2}$ rather than $\frac{19}{3} - \left(-\frac{9}{2}\right)$.

MATHEMATICS

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. The recall and application of formulae in varying situations is required as well as the ability to interpret situations mathematically and problem solve with 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 was evident and a lack of familiarity with some topics that resulted in high numbers of no responses. The standard of presentation varied considerably. For many scripts it was generally good, however there were occasions when a lack of clear working made it difficult to award some 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.
- Pie charts.
- Completing tables of values and drawing graphs.
- Simple percentage calculations.
- Translations and reflections.
- Expand and factorise simple expressions.

The most challenging areas were:

- Drawing a suitable line to solve an equation.
- Equation of a perpendicular bisector and its interpretation.
- Harder factorisation.
- Setting up a quadratic equation.
- Interpretation of a derivative and gradient.

Comments on specific questions

Section A

Question 1

(a) Most candidates had no difficulty in calculating the amount. In some cases candidates incorrectly divided by the exchange rate. Forgetting to round answers to the nearest rupee was the most common error.

(b) Again, most candidates had no difficulty in calculating the amount. Forgetting to rounding answers to the nearest cent along with rounding to the nearest ten cents or the nearest dollar were the most common errors. Some candidates decided to work out the exchange rate for yuan into dollars and

1 yuan = 100 ÷ 671.2 = 0.1489… which was rounded before converting 5400 yuan resulting in an incorrect final answer.

(c) (i) Most candidates had no difficulty in calculating Gretel's spending on travel.

(ii) This proved more challenging as a double exchange was required and this was reflected in fewer fully correct answers. Most errors were a result of applying only one of the currency exchanges or applying both but with the wrong operation. A few mistakenly worked out the amount she spends on travel.

(iii) As this part required candidates to use one upper bound and one lower bound this proved to be the most challenging part of the question. Some were able to identify both bounds that were needed and went on to find the correct flight time. Others only found one of the correct bounds with some unable to find either. In many of the incorrect responses it was common to see either both upper bounds or both lower bounds used.

Question 2

(a) Most candidates had no difficulty in finding the correct percentage. Some gave the answer to two significant figures only and in a few responses, some calculated the angle for the pie chart instead.

(b) (i) Most candidates were able to find all three angles correctly frequently without showing any working.

(ii) Again, most candidates were successful in completing the pie chart. Errors were not common but most were due to misreading the scales on the protractor, for example reading at 68 for 72.

(c) Correct answers were in the minority with an answer of $2.625 \times 8 = 21$ the most common. Some did realise that this was just the increase and went on to add on the original number.

(d) (i) Most candidates converted 1500 million correctly to standard form. Common errors included the answers 1.5×10^3 and 1.5×10^8 in roughly equal numbers and to a lesser degree the answer was given as a normal number.

(ii) Most candidates were aware of the correct method to find the average number and many went on to obtain the correct answer. Not all candidates chose the easier option of 1500 ÷ 21.2 and some attempted to convert both numbers to ordinary numbers or both to standard form. This increased the likelihood of errors and some answers were too small or too big by a factor of 10. Some showed the correct calculation but then gave their answer to the nearest whole number. A small number divided the area by the number of birds.

Question 3

(a) A large majority of candidates named the transformation as a rotation. Identifying the correct centre of rotation proved more difficult than identifying the angle and direction of rotation. Candidates would be well-advised to use coordinates to define the centre rather than using a column vector. A significant number of candidates ignored the request for a single transformation and gave two, usually rotation followed by a translation.

(b) (i) Many correct reflections were seen. Some candidates demonstrated an understanding of reflections but used an incorrect line of reflection, usually $y = 0$ and $y = 2$ and $x = 1$.

(ii) Many correct transformations were seen. Most errors usually involved an image displaced one square, horizontally or vertically, from the correct position. In a small number of cases the translation using the vector $\begin{pmatrix} 7 \\ -5 \end{pmatrix}$ was seen.

(iii) When drawing the enlargement candidates were less successful than in the previous two parts. A majority drew the correct image but some others drew an enlargement with an incorrect centre. Some of these centres were close to the correct centre but others had centres that were way off the grid, suggesting that candidates drew an enlargement randomly on the grid. A few attempted enlargements that went off the grid or had negative scale factors.

Question 4

(a) Most candidates clearly understood how to find the interior angle of a polygon and many correct answers were seen. Most opted to find the sum of the interior angles. Common errors included 36, usually from those attempting to find the exterior angle. Most other incorrect answers were random multiples of 18.

(b) Candidates found the complexity of the diagram quite challenging and fully correct answers were in the minority. Angle y was found to be the most difficult with far fewer reaching a correct value. Incorrect assumptions were common, such as BE is the diameter, $\angle BDE = 90$ and ΔACD is isosceles. Candidates would be well advised to clearly label the diagram with known angles.

Question 5

(a) Many candidates demonstrated a good understanding of histograms and a majority of fully correct answers were seen. The most common error was based on the first interval where the frequency was found by multiplying 2.8 by 10. Candidates did the same for the next interval to obtain 30 and divided the remaining frequencies by 10 to obtain frequency densities. These candidates did not seem to realise that something was wrong when the third bar would not fit on the grid.

(b) Most candidates were able to set out their calculations clearly and went on to obtain the correct value of 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. Those that made errors in completing the table were able to earn credit for a correct method. In some responses candidates gave their answer without showing all or any working. Candidates risk losing all the marks if their answer is incorrect.

(c) Most candidates missed the point that the maximum time was within a range and that the exact values were not known. Many of the answers referred to traffic conditions or that all workers were not included in the data.

(d) A majority of candidates demonstrated some understanding of the probabilities involved. It was common to see $\frac{95}{107}$ and $\frac{12}{106}$, although some candidates worked with replacement. Not all candidates reaching a correct product of three probabilities realised there were three possible combinations. Some worked with 6 or 2 but most worked with 3 or 1. Weaker candidates often selected from the total of 180 rather than 107. Others worked with decimal probabilities, usually to two decimal places, without showing the equivalent fraction. In such cases it was impossible to determine whether the method was correct or not.

Question 6

(a) (i) This was answered very well with most candidates giving the correct answer of 7.

(ii) Many candidates answered this correctly. Others found $f(0.5) = –0.5$ and went on to write $g(–0.5) = 64^{0.5}$, omitting the minus sign which led to the common incorrect answer of 8. Occasionally some candidates substituted into the wrong functions or used f and g in reverse. Others treated it as the product $g(0.5) \times f(0.5)$.

(b) This proved to be more difficult for candidates and fewer correct answers were seen. Those reaching the second stage correctly almost always continued to the correct answer. Others made a correct step but could not make further progress. A few candidates simply inverted the original fraction.

(c) Some candidates demonstrated a good understanding of indices and were able to reach the correct answer. Just as common were those who were unsure of how to proceed and they made no progress.

(d) Most candidates were able to set up the correct expression from the given functions. Some attempted to the write expression as a single fraction and a smaller number opted to write it as two separate fractions with a common denominator. This latter method was more prone to sign errors when finally converting to a single fraction. Algebraic or numerical slips in either the numerator or denominator were common. When both were correct further errors were seen in the simplification of the numerator. Expanding the brackets in the denominator was not required but several attempted to do so and made errors in the process. For weaker candidates this part proved more challenging.

Question 7

(a) Completing the table was almost always correct.

(b) Most candidates were able to plot the points correctly with just the occasional slips in plotting. Most of the curves were well drawn with few resorting to straight line segments. Poorer curves were characterised by the use of blunt pencils producing thick curves.

(c) Most candidates gave an answer in the required range with most using their graph appropriately. A small number solved the equation algebraically.

(d) The question asked candidates to solve an equation by drawing an appropriate line. This proved to be a challenging question and only the strongest candidates were able to determine the equation of the line and daw it successfully. Some responses had slips in the rearrangement of the equation and could only earn partial credit. Most of those that found the correct equation for the line drew it accurately but in some responses a lack of accuracy resulted in incorrect solutions. A higher-than-average proportion of candidates made no attempt at a response.

Question 8

(a) (i) Many candidates were able to use a correct method to find angle *BOC* and give its value to at least two decimal places. A significant number of responses only gave the answer as 19.5. Most candidates used the sine ratio but several used less efficient methods such as Pythagoras and trigonometry and/or the cosine rule. A few used a circular argument, using the 19.5 to find angle *OBC* = 70.5 and then used the 70.5 to find angle *BOC*.

(ii) Most candidates had a good understanding of how to calculate the area of a sector but not all did so for the major sector. Several calculated the area of a sector based on angles of 135, 225 or 154.5 and some calculated the area of a triangle, either *BOC* or *AOD*.

(iii) Most candidates realised that to calculate *AD* they first needed to find *OD*. Several did so successfully but it was common to see the value rounded prematurely. Weaker candidates assumed *OC* was 6 and so OD was 12. Others applied Pythagoras or trigonometry incorrectly to obtain *OD*. Once *OD* was found many candidates used the cosine formula, usually successfully. Premature rounding, both at the first stage and with some values in the cosine rule often resulted in final answers that were outside of the acceptable range.

(iv) Most candidates were able to make a start on finding the area of the shape. Of the two triangles, triangle *BOC* was least likely to be correct as many simply used the radius as the height of the triangle. For triangle *OAD* the use of $\frac{1}{2}ab\sin C$ was the most common method with several others opting for a less efficient method by calculating the perpendicular height from *O* to *AD*. Whichever method was used, premature rounding led to answers outside of the acceptable range.

A higher-than-average proportion of candidates made no attempt at a response.

(b) Two methods were used to find the area of the large sector. The first method involved finding the angle of the smaller sector and using this to find the area of the larger sector. Many were successful but premature rounding often led to an inaccurate final answer. Some were not successful as they used an incorrect formula for the area of the sector. More candidates opted to use the ratio of areas was equal to the square of the ratio of the radii. Almost all were successful in reaching the correct area. Weaker candidates often forgot to square the ratio of the radii and 400 was a common incorrect answer.

Question 9

(a) Most candidates attempted to calculate the lengths of the sides using Pythagoras. Those that calculated all three lengths were usually successful but a small number opted to give a conclusion based on only two lengths. Fewer candidates opted to use vectors but many did not make a statement that *AB* and *BC* have the same magnitude as they had the same components. A significant number attempted to calculate the gradients of the lines and there many attempts at a scale diagram.

(b) (i) Many candidates gave a correct equation for the line *AC*. Common errors included using a wrong method to find the gradient such as inconsistent subtraction of the coordinates or dividing in the wrong order. Some of those with the correct gradient went wrong when trying to find the value of the intercept, usually making an algebraic slip when working with the coordinates of point *A* or *B*. Some of those with an incorrect gradient also obtained the correct intercept if they used point *A* to do so. In a small number of cases candidates gave the answer as $y = -\frac{1}{2} + 2$.

(ii) Candidates found this part more difficult and fewer fully correct answers were seen. Most started correctly by finding the gradient of the perpendicular line with some inverting the previous gradient but forgetting to change the sign. Many seemed to forget that the line was the bisector of *AC* and used either point *A* or point *C* to find the intercept. When a midpoint was found it was often seen without working.

A higher-than-average proportion of candidates made no attempt at a response.

(iii) Those candidates that realised that *D* was a point on the perpendicular bisector of *AC* usually found the correct coordinates if they had the correct answer to the previous part. Some candidates earned partial credit for using a correct method with their incorrect equation. A few candidates realised that the lengths *AD* and *CD* were equal and set up equation based on these distances. Few were successful in finding the value of w due to slips in the working. Many other candidates drew diagrams but did not know where to start.

Some found this challenging and this was reflected in the higher-than-average proportion of candidates making no attempt at a response.

Question 10

(a) Most candidates had no difficulty in expanding and simplifying the given expression. Common errors included incorrect signs such as $-6x$ and/or $+18$ instead of $+6x$ and -18 and forgetting to multiply both terms in a bracket. In a few responses candidates expanded to give the expression $(8x - 4)(-18 + 6x)$ before expanding this double bracket.

(b) (i) Candidates fared better and a greater number of correct answers were seen. Common errors included incomplete factorisation by taking out factors such as 3, $3x$ or similar.

(ii) Some started by factorising in pairs and obtained $(2x - y)(2x + y) + 4(2x + y)$. Not all continued by factorising further. Few spotted that the first two terms were the difference of two squares and rearranged the terms before factorising the two *x*-terms and the two *y*-terms which led no further. Few fully correct responses were seen. Some found this challenging and this was reflected in the higher-than-average proportion of candidates making no attempt at a response.

(c) (i) Only the stronger candidates made much progress in obtaining the quadratic equation. These candidates used the distance and speed formula correctly with exact times. Others started correctly with the algebra but achieved limited success by using inexact times such as 4.3 and 4.33. In some cases candidates used 260, the time in minutes. Many of the weaker candidates attempted to solve the quadratic instead of deriving the equation.

Some found this challenging and this was reflected in the higher-than-average proportion of candidates making no attempt at a response.

(ii) Candidates fared better in this part and a greater number of correct answers were seen. Incorrect answers resulted from incorrect use of the formula with -620 seen instead of $-(-620)$ and -620^2

used instead of $(–620)^2$. Some of those that used the formula correctly then forgot to give their answer correct to one decimal place. A higher-than-average proportion of candidates made no attempt at a response.

Question 11

(a) Most candidates attempted to find one or more of the coordinates of the intercepts. Those that solved the quadratic equation correctly usually went on to fine all three correctly. Others had difficulties in solving the quadratic resulting in only B being correct. Not all candidates attempted to solve the quadratic, preferring to trial different integer values of x. In many cases these candidates had A and B correct only.

(b) Many correct answers were seen. Common errors included the inclusion of a third term, often 18, or slips such as $5 + 4x$. A higher-than-average proportion of candidates made no attempt at a response.

(c) Not all candidates with an answer in the previous part realised that they needed to equate their derivate with 17. Those that did usually obtained $x = -3$ and then the correct pair of coordinates. Those that did not, often substituted 17 either into the equation of the curve or into the derivative.

Some found this challenging and this was reflected in the higher-than-average proportion of candidates making no attempt at a response.