MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key messages

To succeed with this paper, candidates need to have completed the full Core syllabus. Candidates are reminded of the need to read the questions carefully, focussing on instructions and key words. Candidates also need to check that their answers are accurate, are in the correct form and make sense in context.

General comments

This paper proved accessible to many candidates. There were a considerable number of questions that were standard processes and these questions proved to be generally well understood. Other questions were more challenging, for example problem solving aspects of questions such as **Questions 5** and **22**. Most candidates showed some working with the more able candidates setting their work out clearly and neatly.

Candidates must note the form in which answers are asked for, e.g. **Question 13** asks for the answer in terms of π, **Question 16** needs the fraction in its simplest form and **Question 17(a)** requires the answer as a power of 2.

When calculations of two or more steps are needed it is best if each step is shown separately for ease of candidates' checking their own work and for method marks to be awarded. This is particularly important with problem solving questions such as **Question 22** and those questions that explicitly say to show all your working such as **Questions 16**, **20** and **21**.

The questions that presented least difficulty were **Questions 1**, **2(a)**, **2(d)**, **3(b)** and **6(a)**. Those that proved to be the most challenging were **Questions 8** (exchange rates), **14** (a conversion from cm^3), **15** (bounds), **17(a)** (powers of 2), **19** (find an example of an irrational number) and **22** (a multi-step problem to find a distance).

Comments on specific questions

Question 1

This opening question was accessible to virtually all candidates. The form of a part circle was given in the first line of the table for candidates to follow. There were very few candidates who did not form a correct semicircle and quarter circle.

Question 2

(a) This was a very well answered question. There were a few candidates who square rooted 255 or 252 instead of the correct number.

(b) This was also a very well answered question. There were a few candidates who converted to a decimal giving 0.6 or 0.667. Others took $\frac{2}{3}$ from 1 giving $\frac{1}{3}$.

(c) In this part, the most successful candidates showed working, translating the word problem into fractions. Occasionally, an answer of $\frac{5}{12}$ was seen – this is $\frac{3}{4}-\frac{1}{3}$ not $\frac{3}{4}\times\frac{1}{3}$.

(d) Incorrect answers came from candidates ignoring the order of operations or rules dealing with double negatives. The brackets are resolved first, giving the calculation as, –7 – (–2) leading to –5.

Question 3

(a) In general, candidates either gave the correct answer or left this blank.

(b) This was answered better than the previous part with many drawing all four lines of symmetry. Occasionally, the diagonal lines were omitted. As the centre of the shape was clearly marked, all four lines had to go through this point.

Question 4

In general, candidates did not seem confident with stem-and-leaf diagrams. Many did not understand how to read the diagram as they ignored the 'stem' and just used the value of the leaves.

(a) Many wrote the 'leaves' in order and found the middle value, usually 4.5 but answers of 4 or 5 were given. Some used the diagram correctly but did not know how to cope with two middle values so answers of '27, 29' or '27 or 29' were seen.

(b) Candidates were more successful in this part. A common incorrect answer was 5, presumably from just considering the leaves.

(c) As with the previous part, if candidates only considered the leaves the range was given as 9 from 9 – 0.

Question 5

Most candidates made a good attempt at drawing a net. A significant number drew a 3D cuboid with some scoring partial credit for a correct height shown. Many scored partial credit for a correct base then drew the remaining faces with only some (or often none) of the correct dimensions. Unlike many questions on drawing nets this had a problem-solving element in that candidates had to calculate the height of the cuboid before attempting the drawing. This value did not have to be stated as the height can be implied from the correct net drawn.

Question 6

(a) A large majority of candidates were successful in this part.

(b) Candidates were relatively successful with the times, but not so successful in their reasoning. Candidates often gave the correct times but did not refer to the steepness of the line. It is not sufficient to calculate the gradient without saying that this section is the steepest.

Question 7

This question was generally answered well. A few candidates made arithmetic errors in subtracting 0.15 from 1 or wrote that the probably was 0.15 (the same) or zero. Some candidates subtracted 0.15 from 100 as if they were confusing decimals and percentages.

Question 8

There were two main errors seen in this question. Either candidates divided the number of dollars by the number of euros to give 1.12 (to three significant figures) or divided the correct way around but rounded the exact three figure value to 0.89.

Question 9

Both parts of this vectors question were well answered. Candidates must not put a horizontal line between the entries and treat the answer vector as if it was a fraction.

(a) In most cases candidates were correct with the top value but had more difficulty dealing with (–5) + (–1). Some did not treat these as vectors to be added and so calculations such as (–30) + (–8) or 11 and –9 from combining the entries in each vector together. Occasionally, the whole calculation was treated as if it was $\frac{6}{-5}+\frac{8}{-1}$.

(b) Misunderstandings of how to multiply vectors often led to answers such as 25, presumably from $4 \times 7 - 3$ or –84 from $3 \times -4 \times 7$ or $-1\frac{5}{7}$ from $3 \times -4 = -12$, then $\frac{-12}{7}$.

Question 10

Many candidates scored at least partial credit in this question. The order of the letters was intended to be an indication of a good approach to solving this. Angle *a* is vertically opposite to the 59°, angle *b* is corresponding to the 37°angle and angle *c* can be found be either using angles in a triangle add to 180° or angles on a straight line add to 180 with the given 59° and 37° and then angle *c* is the same using alternate angles.

Question 11

(a) Many candidates gave the correct polygon. Hexagon was also seen as the answer as well as heptagon, hectogon and rhombus.

(b) Candidates were less successful in this part and quite a few candidates left it blank. There is no diagram to help candidates visualise the situation. The most straightforward method is to work out the exterior angle of this polygon (360 ÷ 18) and then subtract this from 180 to give the interior angle.

Question 12

(a) Many candidates gave correct values for all three terms. There were quite a few candidates who did not understand that the *n*th term expression should have 1, then 2 and then 3 substituted in turn for *n* to give the first three terms of the sequence.

(b) Some candidates had correct, well presented workings out here. Some candidates substituted 422 for *k* into $6k - 4$ or subtracted 4 giving 416. Others knew they were supposed to find *k* by reversing the operations but divided by 6 before adding (or sometimes subtracting) 4. The value of *k* must be an integer as it is the position in a sequence although a decimal answer did not prompt the candidates to check their work. This part was left blank quite often.

Question 13

Many candidates were confident working out the circumference of the circle but the complication was the form of the answer which was to leave it in terms of π, i.e. 84π and not work it out as 263.8… Some candidates were confused as to which circle formula to use so worked out the area instead or used a combined formula. A few treated the given radius of 42 cm as if it were the diameter.

Question 14

Candidates found this question challenging. Most attempted the question but many divided by 100 (the length conversion factor for metres to centimetres) only instead of 100^3. In virtually all cases, answers contained the correct digits and were smaller than the original number but not the correct place values.

Question 15

This proved to be a challenging question for many candidates. There was a wide variety of incorrect answers implying that this concept was not fully understood. There was a general lack of appreciation of the rules of rounding with the majority only giving answers correct to two decimal places when three was required. It was acceptable, even desirable to convert the given length into centimetres (as this could be more understandable for candidates as there are fewer decimals to deal with) then find the limits (566.5 cm and 567.5 cm) and then convert back, as l is defined in metres. A few candidates knew what to do but then reversed the values in the answer space.

Question 16

Many candidates showed clear working and all the relevant steps required to work out the fraction calculation. A large majority were able to convert the mixed number to an improper fraction. A few then didn't convert to a common denominator or made simple arithmetic errors. If candidates chose 48 as the common denominator they had to cancel their answer of $\frac{26}{48}$ down to $\frac{13}{24}$.

Question 17

(a) This part was found challenging by many candidates. A small number of candidates did answer as required. Others worked out the value as a decimal or a fraction. The other common incorrect answer was 2^5.

(b) (i) Using the laws of indices, candidates had to solve the equation $18 - t = 6$. Many gave the answer as 3 or 3^3 presumably from solving $18 \div t = 6$.

(ii) In this part, candidates had to simplify the expression by multiplying the numbers and finding the power for w. Often the w was missed out as candidates gave an answer of 48^{15}. This was the most successful part of this question.

Question 18

Very few candidates attempted long methods, working out the value of the investment at the end of each year. Most attempted to use the formula with the most common error being to use 0.056 in the bracket instead of 1.056. Some substituted into the formula correctly and then did not seem to know how to proceed. Candidates should check whether questions like these ask for the total amount of interest or the total value of the investment as a very small number gave the interest only as their answer.

Question 19

This question was challenging to many candidates. Of those that answered, most chose a three significant figure number between 31 and 32 such as 31.7 or more commonly 31.5 and all such numbers are rational. Candidates could look for the square root of a number between 962 and 1023, for example, $\sqrt{1001}$. Some started with a number such as 31.5 then squared it to give 992.25 and then wrote $\sqrt{992.25}$, which is a rational number.

Question 20

This question directed candidates how to proceed, i.e. round each number correct to one significant figure. Many did not do this for all four numbers or made more than a single error. Many wrote zeros in the places where there had been digits before they rounded. Some did not round at all and inputted the calculation into their calculators. They then rounded the answer obtained to one significant figure. All workings must be shown here to earn the method mark and then the accuracy mark.

Question 21

Like the last question, this question requires candidates to show all their working. Clear algebraic methods leading to fully correct solutions were seen in many cases. Candidates should be able to analyse the equations to see which method is the simplest to use. The simplest elimination method with these specific equations is to multiply the first equation by 5 then add. It is possible to multiply the second by 2 but then candidates must subtract and errors can be made with the signs. A significant number attempted to eliminate by equating one variable but made arithmetic errors or were inconsistent in the subtraction or addition. Of the candidates who didn't reach the correct solution many had no strategy to solve the equations and made no attempt to equate either variable. Some left their answers in terms of the other variable.

Question 22

A few candidates reached the correct answer with easy-to-follow workings. This problem-solving question needs some sort of diagram to understand the situation. One possible starting point was that Maxi will cover 20 km in the 30 minutes before Pippa starts so that leaves 110 km between them. They will pass when Pippa has travelled 55 km or Maxi has travelled 75 km from town *A*. Another approach is that the total time to cover 130 km is 3.25 hours so subtracting the time Maxi has been travelling means 2.75 hours divided by 2 before they pass each other. This method has a lot of places that errors can be made with the time calculations as many interpreted 3.25 hours as 3 hours and 25 minutes and 30 minutes became 0.3 hours. Quite a few candidates got as far as calculating the 20 km or the total time and then were not certain how to proceed further.

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

To succeed in this paper, candidates need to have completed the full Core syllabus. Candidates are reminded of the need to read the questions carefully, focussing on instructions and key words. Candidates also need to check that their answers are in the correct form, make sense in context and are accurate.

General comments

Most candidates presented their work clearly.

Accuracy of answers suffered from rounding in the middle of a calculation requiring two or more stages, as well as the rubric not being followed to give answers to 3 significant figures.

Comments on specific questions

Question 1

A few candidates drew more than one line (horizontal or diagonal) and many did not rule the line. While freehand and dashed lines were not penalised, reasonable accuracy was expected. While most gained credit, a considerable number who knew where the line was didn't draw it within a generous tolerance.

Question 2

The list of factors was well answered but often one factor (usually 1 or 42) was missing. Some candidates lost credit for a missing pair (often 3 and 14 or 1 and 42). Only a few gave incorrect factors but quite a number gave less than six factors which resulted in no credit.

Question 3

Whilst a few candidates drew a parallel, instead of perpendicular, line, most errors were from a line far from 90° to the given line. Some candidates constructed the bisector of the line which did not pass through the point, *P*. A tolerance was allowed but many did not use their protractor carefully enough or simply drew any line through the point, *P*. However, there were many who knew what perpendicular meant and drew a correct line.

Question 4

Finding the mean of a set of numbers was answered well but quite a few candidates either could not add 5 numbers, or divide by 5, correctly. Incorrect use of a calculator often resulted in just the last number being divided by 5. Otherwise some confused mean with the median value of 270 or gave the middle value of the unordered list, 185.

Question 5

The main challenge was to understand that 65 had to be substituted for *C* in the formula and not to replace the 9, which led to an answer of 45. Some replaced *F* with 65. Incorrect order of operations also led to errors, but many correctly substituted and resolved the formula.

Question 6

This question specifically tested order of operations and while it was quite well answered, many did assume the operations needed doing in the order they occurred instead of following the BODMAS convention. This commonly produced the answer of 47 from 9 + 5 calculated first. Since the method mark was for seeing the results of 5×7 and $4 \div 2$ or these bracketed, the answer of 42 could not have credit if preceded by incorrect working. **Part (b)** was answered more successfully although there was a significant number of blank responses to this part.

Question 7

While this question was well answered with nearly all candidates demonstrating understanding of subtraction of vectors, most errors came from handling directed numbers. This was most noticeable with the first component being 3 instead of 7 from 5 – (−2). A fraction line was seen occasionally.

Question 8

Once again, handling directed numbers caused errors to be made in both parts of this question. While most responses were correct, quite a number put the whole calculation, rather than a single value, in the answer space. The wording of **part (b)** was more demanding and that was reflected in the responses, the common answer being 5.

Question 9

While the question was quite well answered, many wrote a whole number answer rather than 3 significant figures as in the rubric. Although the question required 3 bar totals to be added, it was common to see 2 or 4 bar totals added. Changing to a percentage was a significant challenge for some with division by 100 and multiplication by 55 often seen. Some rejected the given total of 55 and added all the bars incorrectly.

Question 10

This question was answered well although some candidates changed the fraction to a decimal and then gave an answer of 0.7 instead of subtracting that from 1.

Question 11

Many candidates were able to find the fourth root of a number but those unfamiliar with the notation usually calculated $4 \times \sqrt{0.0256}$ resulting in an answer of 0.64. Another error seen was calculating the square root, leading to 0.16.

Question 12

While there were a considerable number of candidates who could interpret the stem-and-leaf diagram correctly and knew how to find the required statistical measures, many did not gain full credit. Leaving off the stem part in the responses was quite common. Finding the median was the most challenging with a mean often calculated or 11.5 for those who thought the middle came between 11 and 12. Mode and range were usually correct for those who could interpret the diagram, although occasionally 20 – 3 was given for the range.

Question 13

(a) While many candidates did understand the meaning of reciprocal, the answer was often left as $\frac{1}{0.2}$ instead of working out the division. Responses to the prime number were more successful although occasionally even numbers were given. The incorrect answer of 91 was often seen and some candidates gave numbers (not always prime) outside the required range of 90 to 100. Some thought that there was more than one prime number in the range.

(b) Most candidates were able to select the irrational number but $\sqrt{9}$ was often seen. Again, some assumed there was more than one irrational number. Many did not understand irrational resulting in a variety of incorrect choices.

Question 14

Common incorrect answers were 5 from 9 − 4 and 36 from 4×9 but many did find the correct value for x. However, some gave 7^{13} as the answer.

Question 15

(a) The vast majority of candidates chose the option 'negative correlation'. Ringing the crosses or adding crosses to the diagram were seen, indicating a lack of understanding of the question.

(b) This part was answered correctly by the majority of candidates but a small number of candidates had little understanding of what a line of best fit was by choosing diagrams B or D.

Question 16

Many candidates made a good start to this question with division of the volume by 12. However, many then did not realise they needed to find the square root and divided by 2, 4 or 6. Some who calculated the square root rounded the division by 12 to 3 significant figures producing inaccuracy in their answers. Since the question involved a volume, a significant number found the cube root. While some tried to start with an equation, this was rarely worked successfully and often dividing the volume by 12^2 was seen.

Question 17

Candidates who understood that the given line was a diagonal and that the sides had to be 6.5 cm and constructed using compasses gained full credit. Some gained partial credit from a correct rhombus but no construction arcs. Just one triangle constructed on the diagonal as base was occasionally seen. There was a significant number not attempting this question.

Question 18

Most candidates started correctly by changing the mixed number to an improper fraction. While that led to full credit for many, some did not show the working for either the invert and multiply or division with common denominator method. Other errors seen were inverting the wrong fraction and writing the answer as a decimal. Of those gaining 2 marks for a correct method, more errors were made resolving the division method than invert and multiply.

Question 19

(a) Few candidates gained full credit but the clear majority did gain partial credit for a correct first branch. The wording 'puts it back in the bag' should have stopped the many second branch probabilities being out of 7, instead of 8. Working in decimals was acceptable but very often produced errors. Some of those who realised the two fractions that were needed put them on the wrong branches. Others, lacking understanding, just wrote colours or whole numbers on the branches.

(b) Many candidates added, rather than multiplied the two probabilities. Many could not attempt this part as they did not have two probabilities from **part (a)** while some gave probabilities greater than 1.

Question 20

This question asked candidates to show the calculations involved to show that the cylinders were similar. Many candidates did what was required, but in a wide variety of ways. Finding or using the scale factor or proportion factor in two expressions was the key to success but often more lengthy explanations were seen. Missing out steps in the solution was an issue for some since while they clearly understood the relationship, the detail was absent from their explanations. Those who went into volumes or areas did not make any progress towards what was required. Many candidates did not attempt this question.

Question 21

(a) The change to standard form question was well answered but an index of 3, instead of −3 was often seen. Some did not understand standard form, giving answers such as 654×10^{-5} or answers having no resemblance to $a \times b^n$. It was common to see rounding of 6.54 to 6.5.

(b) This part was found challenging and it was a very different type of question on standard form. A few candidates started to write it as an ordinary number but soon gave up. Some did realise that it was simply 102 – 3 but most gave answers of 102, 3 or a variety of numbers.

Question 22

This question was quite challenging since this type of question in the past has asked for an equation to be formed and then solved. Here the approach was not directed but many did start with an attempt to add the angles, although some multiplied them. It was common to see $6x = 75 + 87$ with no reference to angles in a quadrilateral. Errors were made specifically dealing with the x terms, finding $8x$ rather than $6x$. Those who did go the step further to an equation often gave an incorrect total for angles in a quadrilateral or the total without the right angle. There were a few who worked out the correct answer by trial and improvement.

Question 23

While there was a sensible, correct approach, factor trees or ladders, to this question, many didn’t find the LCM, giving the answer as the HCF. The few who formed lists of multiples, using their calculators, nearly always found the correct answer.

Question 24

Again, may candidates found working with directed numbers challenging in this expand and simplify question. An easy first bracket expansion did enable most candidates to gain partial credit but few reached the correct final answer. Expanding $-3(x - 5)$ and then combining with the first bracket terms led to many errors. Even some reaching the correct answer then combined the two parts into a single term.

Question 25

(a) Arc length and area of a sector were found challenging. However, a significant error was working with area in this part and circumference in **part (b)**. While many did work out the circumference, few knew to multiply by $\frac{72}{360}$ and instead tried fractions such as a quarter or a third. Some candidates used 3.14 or $\frac{22}{7}$ for π.

(b) Candidates who worked **part (a)** correctly usually had success with the area of the sector. However, some worked with $2\pi r^2$ as the area formula. Both parts were not attempted by a significant number of candidates.

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

Key messages

Candidates should not round or truncate in the middle of a question.

Candidates should show working; just writing the answer means method marks cannot be awarded if the answer is incorrect.

Candidates should be encouraged to attempt all questions and check their work when they have completed the paper.

General comments

Candidates need to ensure they read the questions carefully. **Question 7** required the net of an open box; the word open was in bold, yet many drew the net of a closed box. **Question 13** asked for the answer correct to 2 decimal places and many had not attempted to round their answer.

Candidates should be reminded of angle facts; many used 180 as the total of angles round a point.

Comments on specific questions

Question 1

(a) Many correct answers were seen although some candidates appeared not to understand how to read the scale on a protractor.

(b) Many correct answers were seen with the correct spelling. A small number stated acute. Some candidates answered in a language other than English.

Question 2

(a) This question was answered correctly by the majority of candidates. However there was a variety of answers including diameter, radius, sector, segment, and straight line.

(b) There were not as many correct answers as expected for this straightforward question. Some candidates did find the radius but then used it to calculate the area. Several candidates did not attempt the question.

Question 3

Many correct answers were seen mainly from the more able candidates. Other candidates had not understood the question and answers of 24.6 and 21.4, from subtracting 1.6 from 23, were common.

Question 4

(a) The majority of candidates were able to answer this question correctly. Common errors were not giving the fraction in its simplest form or giving the answer as a decimal.

(b) The most common errors in this part were giving the fraction as $\frac{1}{25}$ or writing 0.004 in standard form.

Question 5

A range of answers were seen here. Candidates should write the full word corresponding . Incorrect answers were alternate, parallel, and the same.

Question 6

Most candidates gave the correct answer and errors were usually arithmetical.

Question 7

(a) Many candidates were able to draw the correct net. A significant number did not read the question carefully to realise that the net of an open box was required, scoring partial credit. The majority of candidates understood the term net, with only a small number giving a 3D diagram.

(b) The candidates who drew the correct net in **part (a)** often gave the correct answer here. A common error was to calculate the volume.

Question 8

The majority of candidates were able to give the correct answer, with others scoring partial credit for subtracting 100 from 360. The main error was to use 180 rather than 360 as the angle total.

Question 9

(a) Almost all candidates attempted this question with the majority able to give the correct answer. The most common incorrect answer was 49, with some appearing to confuse square and cube numbers.

(b) Most were able to give the correct answer. 91 and 49 were common incorrect answers.

Question 10

(a) (i) This vectors question was almost always correct. Fraction lines were rarely seen.

(ii) Again, the majority of candidates were able to give the correct answer.

(b) Many candidates who gained full credit in **part (a)** scored in this part. The most common incorrect answer was (8, –8).

Question 11

This question was not well answered with very few candidates gaining full credit. 100*y* was rarely seen and it appeared many had not realised the payment was in dollars. Some scored partial credit for $y - np$, although there were a multitude of incorrect expressions. Some candidates who had an idea of what to do wrote brackets in their expressions, e.g. $10(y - np)$. This question was not attempted by a significant number of candidates.

Question 12

The majority of candidates who knew to add the values in the table and then subtract from 1 were usually successful in gaining full credit. Others thought it was a pattern question and looked at differences, so 0.03 and 0.16 led to them adding 0.29 to 0.37 and giving the answer 0.66.

Question 13

Many candidates gave the correct answer. The main error was to round 162.07 to 162.1. Others multiplied rather than divided.

Question 14

Many correct answers were seen but some had not realised the simplicity of the question despite it being worth just one mark and complex polygon calculations were seen. Some used 180 rather than 360 in the calculation.

Question 15

A considerable number of incorrect solutions were seen in this question. Many candidates only scored partial credit either for $6t - 6q$ or for $4t$ in the answer. Often candidates who managed to expand the brackets correctly still had $4t - 12q$ as their final answer. Less able candidates scored partial credit for $6t - 6q$ but often had $8t$ in their final answer.

Question 16

Most candidates were able to give the correct answer although a small number converted their fraction to a decimal. Some arithmetic errors were seen. Others had some very confused calculations and some did not show sufficient working going from improper fractions directly to the answer. Candidates should be encouraged to set out their working in a clear and logical way.

Question 17

Many correct answers were seen in this sequences question. The most common incorrect answers were $3n + 4$ and $n + 4$. Of those not giving the correct answer, many gained partial credit, usually for the term $4n$. A small number did not include the letter n and gave the answer as 4.

Question 18

(a) Candidates who knew the formula generally gained full credit. A variety of incorrect formulae were seen, double and half the correct area, and some calculating the circumference. Some used 3.14 as the value of π, and a smaller number used $\frac{22}{7}$. Candidates should be encouraged to use the π button on their calculator.

(b) Many candidates divided by 100 or multiplied by 1000 or did not attempt to answer the question.

Question 19

(a) Many correct answers were seen, although the index of 4 or 5 was seen a number of times rather than the correct –4. Some appeared not to understand that standard form only has one number before the decimal point as 74 was often given rather than 7.4.

(b) Few candidates gained full credit in this part and many appeared to find dealing with standard form and two significant figures at the same time challenging. Often only partial credit was awarded for either standard form 3.082×10^8 or figures 31.

Question 20

(a) (i) Many candidates found this Venn diagram question challenging. Although several were able to correctly place 27 and/or 19, it was common to see 61, the total for maths, placed where 34 (just maths) should be and 13 was often given for just English rather than 40.

(ii) Some candidates were able to score the follow through mark for their total but it was common to see the number they had written in the just English section.

(b) Those familiar with sets usually gained this mark. Some gave union and others gave a description, such as ‘in both’. Many candidates appeared to be unfamiliar with set notation.

Question 21

(a) A negative gradient which was also a fraction was found challenging by all but the most able candidates. Many others had 2, 4 or 0.5 for the gradient. These candidates often gained partial credit for the correct intercept of 2. Some had the correct values but omitted the *x*, giving their answer as –0.5 + 2.

(b) Very few candidates gained this mark. Incorrect answers were many and varied; some gave 3*x* but it was rare to see +17, while others omitted *y* =.

Question 22

Many candidates successfully used proportion and gained full credit. The most common incorrect answer was 79 from subtraction. A small number used area or perimeter.

Question 23

Many correct answers were seen with the most common incorrect answers being $12x^{12}$ and 12^7.

Question 24

Many candidates gained full credit in this question. Some went straight from $\sin x\,[=]\,\frac{18}{30}$ to 36.9 and didn't show a more accurate answer. A small number found the third side using Pythagoras' theorem and then used tan *x*. Candidates need to realise on a 'show that' question that they cannot start with what they have to show, in this case 36.9.

MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key messages

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

General comments

There were many very good scripts with a significant number of candidates demonstrating an expertise with the content and proficient mathematical skills. Very few candidates were unable to cope with the demand of this paper. There was no evidence that candidates were short of time, as almost all candidates attempted nearly all of the last few questions. There were very few occasions of non-response. Omissions were due to lack of familiarity with relatively new topics, such as **Question 19a**, or due to difficulty with the question, rather than lack of time. Candidates showed particular success in the basic skills assessed in **Questions 1b**, **2**, **4**, **5**, **6a** and **8**. The more challenging questions were **Questions 13**, 1**6c**, **18**, **19** and **20**. Candidates were very good this year at showing their working, especially where the question required it, and so in the majority of cases it was easier to award method marks when answers were not correct or were inaccurate. Some candidate lost marks due to misreading or not following the demands of a question, this was particularly evident in **Questions 10a**, **12** and **14**.

Comments on specific questions

Question 1

In **part (a)** of the question candidates were asked to give the order of rotational symmetry of the diagram. The correct answer of 4 was the most common response seen. Incorrect answers were not uncommon however and included 2, 1 and listing possible angles of rotation such as 90°, 180°, etc.

Part (b) of the question was generally more successful for candidates, with most adding all four lines of symmetry. Some candidates were only able to identify some of the lines of symmetry, commonly these were the horizontal and vertical lines of symmetry. Only a small number of responses gained no credit.

Question 2

This was found to be one of the most accessible questions on the paper with most candidates giving the correct answer. Very few failed to subtract the given probability from 1.

Question 3

Candidates were generally able to interpret the stem and leaf diagram and find the required values although the median in **part (a)** was the most problematic. Greatest success was seen with **part (c)** in finding the range. Where incorrect answers were seen these were either due to errors in calculations performed, for example calculating the mean rather than the median, or incorrectly interpreting the stem and leaf diagram by only using the leaves.

Question 4

This was a very accessible question for candidates with most responses fully correct. A small number gave the answers to angles *b* and *c* the wrong way around and a handful treated the triangle as isosceles, finding *b* equal to *c*.

Question 5

In **part (a)** of this question candidates were asked to add two vectors. The majority of answers for this were correct. Where incorrect answers were seen they in some cases appeared to be treating the vectors as fractions, attempting to find a common denominator and adding. A small number of candidates made errors when adding the two negative values and obtained –4 rather than –6.

Part (b) of the question was to calculate a scalar multiple of a vector, and this also was generally done well with many candidates giving a fully correct answer. A small number of candidates incorrectly treated the column vector as a fraction and subtracted this from 3 rather than multiplying.

Question 6

Part (a) was well done although a few candidates used the previous term as a starting point for their *n* in the subsequent calculation. A small number of candidates started with a first term of zero.

In **part (b)** most candidates knew that the sequence was reducing by 7 but some found it difficult to express this in a general form; $n - 7$ was the most frequently offered incorrect answer. Whilst many got the correct expression some produced $25 - 7n$, failing to find the 'zero term'.

Question 7

The majority of responses showed working as was required by the question. Elimination was a more common approach than rearrangement and substitution when attempting to solve the simultaneous equations. There were a good number of fully correct answers with appropriate working shown. Where candidates were not successful this was commonly due to not multiplying one or both of the equations to match the coefficients of *x* or *y* in order to eliminate through subtraction or addition. For those who did multiply up equation(s) other common errors were arithmetical or inconsistent adding/subtracting when trying to eliminate (adding some terms and subtracting others).

Some candidates with errors in finding their first number were successful in finding a second number to reach a pair that satisfied one of the two equations given in the question. This gave them 1 mark for the special case.

Question 8

A very high number of correct solutions where given with nearly all appreciating the need to show full working as instructed. This was found to be one of the most successful questions for candidates. Those that did not change the mixed number into a fraction first sometimes had a problem dealing with their negative result of the calculation $\frac{3}{8} - \frac{5}{6}$

Question 9

In **part (a)** whilst there were many correct midpoints seen there were also a number of incorrect answers. Some candidates did not understand the demand of the question, instead attempting to calculate a gradient and sometimes using the numerator and denominator of the resultant fraction as the coordinates. Other errors seen included averaging the *x* and *y* coordinates of each pair of coordinates to obtain two values.

In **part (b)** there were a pleasing number of fully correct answers with candidates using Pythagoras' theorem to find the distance required. Some candidates did not give sufficient accuracy in their answers, instead rounding to 8.9 without a more accurate value being seen; usually they gained 2 marks for the method shown. Errors in the method included omitting the squaring steps, incorrect subtraction of the –5, or multiplication rather than addition of the two squared parts of the calculation. A small minority of candidates misunderstood the demand of the question, instead attempting to find the equation of the line through the given points.

Question 10

There were many creditable answers given to **part (a)**, although quite a few omitted or had incorrect one or more of the required elements (most commonly the centre of rotation in **part (i)**, or less often the centre of enlargement in **part (ii)**). Candidates do need to be reminded to use correct terminology when describing transformations. A number of candidates failed to gain credit in **part (a)** as they missed the demand in the question for a **single** transformation. This was the most common reason for a mark of 0.

Part (b) was quite well done by many candidates, although a few only moved the triangle correctly in one direction (often vertically), whilst others mixed up x and y attempting a translation of $\begin{pmatrix}10\\2\end{pmatrix}$.

Question 11

In **part (a)** many candidates were able to correctly work with indices and write the expression in a simplified form. Common errors included only using the power 4 with one or two of the parts of the expression within the brackets to obtain answers such as $4ab^{20}$ or $256ab^{20}$.

In **part (b)** candidates were asked to find the value of p in $2p^{\frac{1}{3}} = 6$. Many candidates were able to correctly find the answer 27 for this. Common errors included incorrect inverse steps in calculations or attempting to deal with the power $\frac{1}{3}$ before dealing with the 2 leading to $2p = 6^3$ as an incorrect first step.

Part (c) asked for the value of t in $81^2 \div 3^t = 9$. Where candidates answered this successfully it was often following use of index laws, although others seemed to rely heavily on calculator use or a trial and improvement approach. A small number of candidates were able to begin the process of solving the equation by use of index laws and gain 1 mark but not find the correct final value. Incorrect answers generally involved incorrect manipulation of the indices.

Question 12

This question was found challenging by many candidates. A common error was dealing with the small percentage change, with some candidates using a multiplier of 0.91 rather than 0.991 for a 0.9 per cent reduction. Some candidates inefficiently attempted a year on year reduction which was acceptable but the calculation was not always completed accurately. Sometimes an increase in the profit was attempted instead of a decrease.

Question 13

This question proved very challenging and was the least successful on the paper for the majority of candidates, with only a few correct answers were seen. The most common error was to use the scale factor given and multiply the area of the lake of the map by this. Candidates need to be aware that area scale factors are not the same as linear scale factors.

Question 14

Candidates who began with $y = k \times \sqrt{x-3}$ usually succeeded, although their working was not always clear. There were a number of candidates who did not work with a constant, whilst quite often the square root was ignored by others. Some misread the question and seemed to be looking for inverse proportion whilst a few used squaring rather than square root.

Question 15

Rearranging the formula to make h the subject proved challenging for many of the candidates. A large number of the responses gained 1 mark for a correct first step of either expanding brackets or division by g. Those expanding first tended to be more successful, as division by g first resulted in a fraction that they then found it hard to deal with. Some candidates isolated an h as necessary but had h remaining in the other side too (e.g. $h = -\frac{2mh}{g}$). It was very common to see incorrect steps in attempts to collect terms or cancel terms. Candidates need to be aware that in such a question where the new subject appears twice, there is always a need to collect terms with the new subject and factorise.

Question 16

In **part (a)** the easiest coordinates to use to find gradient were (0, 2) and (4, – 1), leading to the exact answer of $-\frac{3}{4}$, but a method mark was available if using other points leading to an inaccurate answer. A common error seen was not recognising that the gradient should be negative.

Part (b) was the most successful part of the question for candidates where follow through of their gradient from **part (a)** was allowed, suggesting that the form $y = mx + c$ is well understood. The most common fault by a few candidates was to omit the *x* from their equation.

In **part (c)** not all appreciated that the gradient of the normal was the negative reciprocal of their gradient from **part (a)**. Sometimes a correct calculation was seen to produce the equation even when the gradient used was an incorrect follow through.

Question 17

This question was answered well by a good number of candidates. Correct answers were sometimes accompanied by a tree diagram but in other cases the candidates identified the appropriate probabilities to multiply and add without the use of a tree diagram. There was also a large number of candidates who only gained part marks for the question as they had some correct working but made errors in dealing with the fractions, or had one or both of the correct products but did not then correctly add them. Some candidates answered the question 'with replacement' and were awarded a mark for the special case if they did so accurately. A common error however was to see confused working with the numerator of the fraction changing (without replacement) but the denominator remaining unchanged (with replacement), which did not gain credit.

Question 18

This question on vectors was found to be one of the most challenging questions on the paper, with very few correct solutions seen. Candidates should be encouraged to show a correct route (e.g. $\vec{OP} + \vec{PS}$), as those who did gained a method mark. Often however they then were not successful in expressing it terms of $\underline{a}$ and $\underline{b}$. Many did not seem to appreciate that PS was $\frac{4}{9}$ of PQ or SQ was $\frac{5}{9}$ of PQ, although some labelled the diagram with 4 and 5 but were unable to use it as few were able to show that $\vec{PQ} = \underline{b} - \underline{a}$. Those that managed to reach a correct expression did not always put it in it's simplest form.

Question 19

In **part (a)** only minority of candidates were able to give a fully correct response for the sketch of $y = tanx$. Some others demonstrated awareness of the correct shape of the graph but with the incorrect period or with some sections correct and some incorrect. Common incorrect answers were attempts at sine or cosine graphs or a translation of one of these.

Part (b) was a little more successful for candidates where they were asked to solve the equation $5\tan x = 1$. A good proportion were able to use their calculators to obtain the answer $11.3°$, and this was sometimes correctly accompanied by $191.3°$, but was also seen with answers from the wrong quadrants $168.7°$ or $348.7°$. A small number of candidates gained credit with the special case for two answers with a difference of $180°$, showing some understanding of the cyclic nature of the tangent function.

Question 20

Only a minority of candidates got this question fully correct. Many thought that for the lower bound they had to find the lowest values for both distance and time, not realising that the division meant this was not correct. Hence the correct distance of 595 km was commonly found (and gained a method mark) but often then combined with an incorrect time bound. Some merely amended the distance and left the timing unchanged. Of those who were correctly looking for an upper bound of time, 8 h 45 min was sometimes found but not then correctly used as 8.75. Some chose to work in minutes which was fine if they remembered to multiply their answer by 60, but some also incorrectly added on 4 minutes rather than 5 for the upper bound of time.

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 many excellent scripts with a significant number of candidates demonstrating an extensive understanding of all topics. Few candidates were unable to cope with the demand of this paper. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Non-response was most common in **Questions 4**, **17**, **21b** and **23**. Candidates showed particular success in the fundamental skills assessed in **Questions 1**, **2**, **5b**, **7b**, **8** and **9**. The more challenging questions were **Questions 4**, **5a**, **12ai**, **12b**, **19a** and **21b**. Candidates were very good this year at showing their working. It was rare to see stages in the working omitted and so in the majority of cases it was possible to award method marks when answers were not correct or inaccurate. Some candidates lost marks due to rounding or truncating prematurely within their working, or giving answers to less than the required three significant figures: this was particularly evident in **Questions 10a**, **14** and **19**. Candidates are advised to learn how to store and retrieve answers to previous calculations on their calculator, to help with the issue of premature rounding.

Comments on specific questions

Question 1

Candidates got off to a good start with this probability question and there were very few who could not answer **part (a)**. There were a few more errors seen in **part (b)** where a fraction of $\frac{35}{50}$ was sometimes given along with an answer of 15 from those who did not read the question carefully.

Question 2

This question was almost always answered correctly with both 0.4 and $\frac{2}{5}$ frequently seen. The most common incorrect response was 0.64 which came from candidates misunderstanding the notation and calculating $4 \times \sqrt{0.0256}$ instead of $\sqrt[4]{0.0256}$. Some took the square root instead of the fourth root and 0.16 was another common incorrect answer.

Question 3

A large number of candidates calculated all three values correctly, interpreting the stem and leaf diagram appropriately and including the tens digit as well as the units in their answers. Of those who did not score well, a common error was to give the units digit only, so, for example, giving the mode as 6 rather than 16. Some candidates miscalculated the median and/or the range. A common error seen for the median was to give the 7.5^{th} value of 9.5, with incorrect values of 11.5 or 12 also seen. For the range, a common error was to give the answer as 3 – 20 without performing a subtraction. Some candidates calculated the mean, 10.7, and gave that as one of the values.

Question 4

Few candidates were able to offer a correct response to this question. Approximately a quarter of candidates offered no response. Some gave a numerical answer, or wrote ‘maximum value – minimum value’, illustrating a lack of understanding of the demand for an ‘expression’. A minority were more able to engage with the question, writing an expression in k, but a common wrong answer seen was $k + 1$. The most successful candidates first tried with numerical examples e.g. 1, 2, 3, 4, 5 followed by range of 4 then 1, 2, 3, 4, 5, 6, 7 followed by range of 6, to see that the range was always one less than the number of consecutive values. Misunderstanding was sometimes evident in offering an answer using inequalities.

Question 5

Part (a) was a challenging question for many, with very few candidates selecting “It is not possible to tell if there is correlation as there are not enough points”. The vast majority of candidates selected “It shows negative correlation”. Only an occasional candidate circled the other two options.

Part (b) was very well answered with the majority of candidates selecting the correct answer C. The next most popular answer was A, with some candidates believing that a line of best fit needs to go through the origin, and a few candidates chose D. It was very rare for a candidate to select option B.

Question 6

Most candidates were able to construct the rhombus correctly and show correct arcs. Some constructed a perpendicular bisector of the given line, showing arcs and then measured to find the position of the vertices so incorrect method of construction. A few just drew one triangle. Some used the dashed line as one of the sides of the rhombus and then often went on to accurately construct equilateral triangles either side of the dashed line. A few rectangles were seen with the dashed line as one of the sides, indicating a lack of understanding of what a rhombus is. Seeing a correctly drawn rhombus without arcs was rare. Very few candidates left this blank.

Question 7

Most candidates were able to score at least one mark for **part (a)**, usually for the prime number. The most common incorrect answer for the prime number was 91. Many candidates did not understand the meaning of the word reciprocal. Common incorrect answers included -5, $\frac{1}{5}$, $\frac{2}{10}$ and the unfinished answer $\frac{1}{0.2}$.

Most candidates answered **part (b)** correctly with the most common incorrect answers being $\sqrt{9}$ and $\frac{7}{5}$ and very rarely, but occasionally, 0.6 or 8 were chosen.

Question 8

Nearly all candidates gained both marks for this question. Of those making errors, many still gained one mark for the correct initial substitution. Mistakes following this included incorrect rearranging, usually dividing by 10 instead of multiplying, squaring 56.25 rather than square rooting or leaving the answer as 56.25. Those who did not score any marks often omitted the 2 or the 5 from the denominator or squared 5 instead of multiplying it by 2.

Question 9

Another question that was generally well answered with many gaining full marks. The most common and most successful method was to multiply $\frac{2}{3} \times \frac{7}{10}$. The common denominator method of $\frac{14}{21} \div \frac{30}{21}$ was often less successful with many not realising that the next step was to just divide the numerators. Consequently, this was sometimes followed by the incorrect working $\frac{14 \div 30}{21}$ rather than $\frac{14}{30}$ or $\frac{14}{21} \times \frac{21}{30}$. Of those who did not score full marks, most did not show all of the working, although this was rare. Very few scored no marks as even those with missing method tended to show the improper fraction $\frac{10}{7}$ at the start. There was also a small minority who did not simplify the final answer and scored just two marks. Use of decimals was rarely seen.

Question 10

Part (a) of this question was correctly answered by the majority of candidates. A small number of candidates gave the answer as 6.54×10^3 and a very small number only gave two significant figures in their answer.

Many correct answers were also seen in **part (b)**. The most common error was to see the answer given as 102.

Question 11

This question was often answered well, with the standard algebraic method for changing a recurring decimal into a fraction was well known by many, whilst others seemed either to simply remember standard results for 99ths, or used their calculator to write the correct answer only. The most common incorrect answer offered was $\frac{1}{25}$, suggesting the dots indicating recurring digits were not seen or not understood. A few answered for only the 4 recurring, reaching 4/90.

Question 12

This question proved to be a challenging question for many candidates, with many scoring zero in all three parts. Few candidates gained the mark in **part (a)(i)**, mostly because they only wrote part of the answer, namely 'square' or 'even' or 'not odd'. The most common incorrect answer was 'odd square numbers.' Fewer responses involved the descriptor 'prime numbers' as set A was not part of the question, although it was not uncommon to see the answer 'square prime numbers' with candidates not realising there are no square prime numbers. A few candidates gave examples or values as their answer rather than the description asked for in the question.

Part (a)(ii) was the best answered part of the question indicating an understanding of subsets. A commonly seen incorrect answer was ABC.

Part (b) was not well answered, with very few candidates correctly shading all but the central section.

There was a very wide variety of incorrect answers and there was not much of a pattern in the incorrect answers. Candidates often had more sections of set D left unshaded, often with both intersections of E and F left unshaded. Many did not shade outside the circles. The most successful responses were seen where the candidates labelled the ***sections 1 – 9*** and broke the question down into steps.

Question 13

Many candidates gained full marks here with solid understanding of the question and complete working shown. It was rare to see the alternate segment theorem used but some candidates did show *DAC* and *DCA* as 68, but then did not know where to go from there. Few clearly labelled the angles in their working, so it was not always clear what angle they were attempting to find. Common errors were: *AOC* as 136 correct but then finding the reflex angle at *O* and halving that for *x*, doubling *ADC* to get 88 and then halving to give 44, $x = 136$ from 180 – 44 or $x = 22$ from 44 ÷ 2.

Question 14

Many candidates were able to score four marks for this question. For candidates scoring three marks, the main error was using prematurely rounded values in their calculations, usually to two or three significant figures for the base of the triangle, leading to an inaccurate final answer. The majority of candidates used the tangent ratio to calculate the base of the triangle and then used area of triangle = $\frac{1}{2} \times$ base $\times$ perpendicular height, often leading to the correct final answer. A less efficient approach was to calculate the hypotenuse length for the triangle before using Pythagoras to calculate the base of the triangle. This was often done correctly, but usually lacked the required accuracy to gain full marks. A small number of candidates calculated the hypotenuse length of the triangle and used area of triangle = $\frac{1}{2}ab\sin C$ usually leading to a final correct answer provided interim values were not prematurely rounded. Many candidates did not work out triangle areas but instead worked out the area of the trapezium using area $=\frac{1}{2}(a+b)\times h$. A common error here, leading to two marks, was to only use one of the 15.4 cm lengths or only one of the bases of the triangle in their calculation. $\frac{1}{2}\left((9.68+15.4)+15.4\right)\times 18.2=368$ was the most common incorrect working and answer.

Question 15

The majority of candidates gained at least one mark in this question. Candidates were able to decide whether the triangles were congruent or not but many struggled with the criterion. For the first two congruent triangles, many copied the criteria from the example of ASA. In the first triangle, many had written the wrong order of SAS, either ASS or SSA so it must be emphasised that the order is essential for the criteria. For those saying that the bottom triangle was congruent, something to do with the right angle was often quoted, for example RHS or RA triangle. A few candidates tried to describe the congruency criterion in words but this was often too ambiguous, for example in the first triangle '2 sides and an angle' which is not sufficient.

Question 16

There were many correct answers to **part (a)**. Common errors included finding the gradient or finding the mid-point. Others made errors in the use of Pythagoras including adding the coordinates, $\sqrt{(9+5)^2+(-1+7)^2}$, subtracting the squares $\sqrt{(9-5)^2-(-1-7)^2}$ or not squaring the differences, $\sqrt{(9-5)+(-1-7)}$. Some candidates who had the correct surd form $\sqrt{80}$ or $4\sqrt{5}$, then lost a mark by writing their final answer to only two significant figures.

Part (b) was generally answered better than **part (a)** with many candidates gaining full marks. Common errors included finding the gradient as $-\frac{1}{2}$ instead of –2 or arithmetic errors in substitution, often leading to *c* = –3 instead of 17. Few candidates made both of these errors, so most were able to score at least one mark. A very small number of candidates gave the final answer without 'y ='. There was a large proportion of candidates who offered no response to this question.

Question 17

There was a mixed response to this question. There was a large proportion of candidates who offered no response to this question. While many candidates recognised the need to find the negative reciprocal of the gradient, not all were able to determine the gradient of the given line. Some candidates assumed that the gradient was the coefficient of x and consequently gave the answer as $-\frac{1}{4}$, while others recognised the need to divide throughout by 3 to make *y* the subject, but were then unsure how to proceed often giving $\frac{4}{3}$ or $-\frac{4}{3}$ as the answer. A few candidates assumed that the equation of a perpendicular line was needed or gave the answer as $-\frac{3}{4}x$. Some candidates used values from **Question 16** in this question.

Question 18

Many candidates understood the nature of the compound function notation, and applied it in the correct order, scoring at least one mark, often two, for a correct first step on each side of the equation. The gf(x) was most commonly correct with a common error in fg(x + 1) being to forget the +1. A good number then had confident algebra skills to work through to the correct answer. Algebraic errors hindered others, many were unable to correctly square a bracket as $(x + 5)^2$ was often followed by $x^2 + 25$. Others did not simplify (x + 1 + 4) before attempting to square and often each term was squared again, resulting in $x^2 + 1^2 + 4^2$. More basic slips were in evidence in collecting terms after correctly negotiating the squaring of brackets. It was also common to see $(x + 5)^2 – 25$ becoming $x^2 + 10x + 25$, i.e. forgetting the –25 part. For those not scoring on the question the issue was either applying the functions in the incorrect order, or a lack of familiarity with the function notation, instead attempting products. It was rare to award the special case because for those who used the incorrect order many also had slips in the algebra too.

Question 19

Part (a) was a demanding question but quite a few candidates gained full marks. If they could not do this question, they often managed to gain M1 for the angle, although a number of candidates seemed to be unable to recall the properties of an equilateral triangle. Occasionally the cosine rule was used on the triangle ABC to reach the 60 degrees. Writing $\frac{k}{360} \times \pi \times 12.4 \times 2$ to score M1 was less common as many did not substitute in any numerical r because they did not know the numerical value for *k*. Some tried to work from the full circumference of the circle and often added or subtracted the length of *BC*. Some correctly found 60 or 300 but used them with an area formula instead of a perimeter formula. Many found the correct arc length of 64.9 but added an incorrect value (multiples of 12.4 rather than just 12.4, often 3) or no value. Several just found the perimeter of the triangle, with 37.2 being a very common incorrect answer.

Candidates were slightly more successful in **part (b)** than **part (a)**, perhaps because the angle was given this time, however they did not often score all three marks. Many calculated using 41 degrees rather than 360 – 41 = 319. Using 41 led to √208 and an answer of 14.4, which were both common ways of scoring M1. Others gained M1 for writing the correct equation $74.5 = \frac{319}{360} \times \pi r^2$ and this was the most successful starting point. Those who started with $74.5 = \pi r^2 - \frac{41}{360} \times \pi r^2$ often struggled with the fact that r^2 appeared twice and it was not uncommon to see r^4 appearing. Of those scoring two marks, the lost mark was usually due to premature rounding part way through the calculation and obtaining an answer outside of the acceptable range of 5.172 to 5.173…Rounding also played a part when the calculation was completely correct, a mark being dropped for a 2sf answer of 5.2 without a more accurate answer being seen. Common errors included: thinking 74.5 was the area of the whole circle or the minor sector; using a formula for arc length instead of sector area; thinking the area of a circle is $2\pi r^2$ rather than πr^2 or re-arranging the formula incorrectly.

Question 20

There were a lot of candidates who gained full marks here for correctly expanding three brackets and simplifying correctly. Many candidates were also able to achieve at least one mark for one correct expansion with at least three terms correct. The most common error was where candidates expanded the first pair of brackets and then expanded the second pair of brackets and then added these terms leading to a quadratic expression. Slips in signs prevented many from scoring more than one mark. The most common of these was to expand the first two brackets correctly but then to simplify $-4x + 5x$ as $-x$ leading to two incorrect terms when multiplying by the 3rd bracket. The most common reason to score two marks was for one small slip in one of the terms often an incorrect power of x in one of the terms, or simply omitting the *x* in a term. Another common error was those who were attempted to multiply all three brackets in one go. For example, $(x - 2)(2x + 5 + x + 3)$ was seen a few times. Some candidates gave final answers with a term in x^4 indicating that they were unaware of the form of correct answer they should be expecting i.e. a cubic in *x.*

Question 21

Part (a) was well answered with many candidates scoring two marks. The main error was to not combine the two expressions, after finding $k = 108$ correctly candidates gave the answer $F = \frac{k}{d^2}$. Common errors included these starting points $F = \frac{k}{d}$, $F = \frac{k}{\sqrt{d}}$, $F = kd^2$.

Part (b) was a challenging question for many and many offered no response to this question. The most common incorrect answer was $\frac{1}{2}$. The candidates who achieved the correct answer often achieved it from using their formula in **(a)** with numerical values.

Question 22

There were many fully correct simplifications scoring all four marks and the majority of candidates scored at least one mark, usually for the correct factorisation of the denominator. The coefficient of 2 in the numerator caused problems for many, although various good strategies were seen to deal with this. Many resorted to using the quadratic formula or their calculators to solve the quadratic on the numerator equal to 0, resulting in solutions 4 and –1.5 which were then turned into the incorrect factorisation $(x-4)(x+1.5)$. There were various results close to $(x-4)(2x+3)$, such as $(x+4)(2x-3)$. Candidates should be encouraged to check their answers to factorisations by multiplying them back out to ensure that they get the correct terms; this would have highlighted errors for those who were close to the correct factorisation but had the positive and negative or had the 3 and 4 the wrong way round. Some were unable to factorise fully the denominator even if they were able to factorise the numerator. Weaker candidates were seen attempting to cancelling terms on the numerator with terms on the denominator by crossing them out and not factorising anything. A small minority equated the numerator and denominator and attempted to solve their resulting equation.

Question 23

Few candidates scored no marks in this question with most able to find the principal angle of 48.59 or 48.6. Obtaining the second angle caused a few more problems. Incorrect answers seen included 48.6 + 90 = 138.6, 360 – 48.6 = 311.4, 270 – 48.6 = 221.4 or 48.6 + 180 = 228.6. Those who used a sketch graph or a 'CAST' diagram to help them usually did better. In some cases, candidates found the principal value and then 131.4, but then went on to only write 131.4 in the answer space, thus only getting one of the two marks. Others went on to write more than two answers in the answer space.

Question 24

A variety of approaches were seen to this question: the most popular was that of establishing a common denominator for the left of the equation in the first instance, and then adding the two fractions to make a single fraction. Many candidates were able to do this successfully, although mistakes were seen in the expansion of 9(x + 1), which frequently became 9*x* + 1. The next stage in the working was found to be more problematic and here errors were seen in attempts made to simplify the fraction on the left (e.g. cancelling 10*x* seen in the numerator and denominator). Those who successfully managed to cross multiply were often able to follow through to establish that $x^2-9=0$ and then find the correct values of x. Many solved this equation by factorising x^2-9 initially, rather than solving $x^2=9$ directly by taking the square root of both sides. It was also not uncommon to see candidates using the quadratic formula to solve $x^2-9=0$. Having said this, some candidates demonstrated excellent skills in algebraic manipulation and confidently obtained the required solutions in a very efficient manner.

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key messages

Candidates are not always showing their working. Some are working answers out in pencil and then rubbing out their working, leaving just the answer. It is very important that candidates show all their working for each question. They should also write their answers as requested in the question and, if not specified, inaccurate answers should be written correct to three significant figures, or to one decimal place if it is an angle.

General comments

There was evidence of the candidates using a 'rough sheet' for method and calculations. This sheet was attached to some scripts, but rarely had any question numbers on it. Many questions on such scripts had answers on the answer line only, with no copying over of their method. It was apparent that some of these incorrect answers would have gained method marks had the method been shown. There were also a large number of scripts where the answers were given correct to just two significant figures and accuracy marks could not be awarded.

Comments on specific questions

Question 1

Some candidates struggled with this question. Common errors were to add the positive numbers to give 24.6 or to subtract the positive numbers to give 21.4. Some wrote the question out using symbols as $23 < -1.6$.

Question 2

(a) Most candidates gave the expected answer, some gave $\frac{72}{100}$ and others gave 0.72 or 7.2×10^{-1}.

(b) The most common incorrect answers included unsimplified fractions and incorrect forms such as 4×10^{-3}, $\frac{4}{1000}$, $\frac{1}{25000}$ and 0.4 percent.

Question 3

Very few candidates gave the correct term and interior angles, allied angles, alternate angles, parallel lines or same angle were often used many times.

Question 4

The main error made by candidates was attempting to do just 360° – 100° and giving an answer of 260° or 180° – 100° so giving an answer of 80°; others assumed that the three angles were each 100°.

Question 5

Many candidates gave the total of 663 as their answer, whilst a few used the method for compound interest.

Question 6

Some candidates did not change the $$y$ into $100y$ cents. Others either divided by 100 or they used 10 as the conversion factor instead. The final step was to subtract $n \times p$ from this, many added it instead.

Question 7

(a) The alternative to 125 was 49.

(b) The alternative to 29 was 91.

Question 8

The main error made by candidates was to multiply so that they attempted 190×1.1723. A few did not round their answer to two decimal places as requested.

Question 9

Some candidates found it difficult to change $7\frac{1}{2}$ to an improper fraction. Then they would often invert the first fraction instead of the second fraction. There were some candidates who do not clearly show the second fraction turned 'upside down'.

Question 10

(a) The word 'translation' was often omitted, misspelt or replaced with move or similar words such as transformation, translocation or transition. The vector was usually accurate with some candidates choosing to describe it instead.

(b) Only a minority of candidates constructed this accurately, some did a positive enlargement and others used a scale factor of 2. Many candidates drew line rays but they did not know how to use them.

Question 11

This question was answered well. Some candidates did multiply the indices to give x^{12}.

Question 12

Most responses gave the answer as $-1 \leqslant x < 2$ rather than list the values of x. Those who did list the values of x usually gave 2 as an additional answer, or they omitted 0.

Question 13

When candidates removed the brackets the final term was often written as $-6q$ rather than $+6q$. This made the term in q as $-12q$.

Question 14

This question was well answered. Several candidates were not familiar with the term 'magnitude' and often attempted a method involving division. Another common error in the method was to not realise that it was Pythagoras' Theorem that was needed and to attempt a simple subtraction such as 29 – 20 = 9.

Question 15

(a) A few candidates used the correct term and some used enlargement. Alternative responses included congruent and same.

(b) The most common error was to halve an incorrect side, 7, to give an answer of 3.5.

(c) (i) The most common error was to use the incorrect area scale factor of $\frac{1}{2}$ rather than $\frac{1}{2}^{2}$ so giving the answer as 13.453. A few decided to round their answer and incorrectly truncated it to 6.72.

(ii) Many candidates gave the same answer as **part (i)**, the area of triangle *ABX*.

Question 16

A common error was to use the wrong number of sides for the hexagon, often 4, 5 or 8. Some candidates would attempt $6 \times 80 - 0.5$. Some just stopped at 79.5 and gave that as their answer. Finally, some used the incorrect lower bound of 80, choosing either 75 or 79.95.

Question 17

Those candidates who divided 360° by the external angle, 5° usually found the correct answer. Those who used $\frac{(n-2)\times 180}{n} = 175$ either omitted the *n* in the denominator, so that they wrote down $180(n - 2) = 175$ which lead to 2.97 or, if written correctly, they often could not solve this equation for *n*.

Question 18

(a) Most candidates gave the correct answer, the alternatives were usually 0.75, 3 or occasionally 9.

(b) Most candidates preferred to use it as a composite shape rather than as a trapezium. The most common error was that they did not use the correct formula for the area of the triangle, omitting the $\frac{1}{2}$, or many simply calculated the entire area of 14×12.

Question 19

(a) Here many candidates assumed that angle *ATQ* was a right angle, so angle *PQT* would be 40° and they gave an answer of 100°. The other common incorrect answer was 50°.

(b) The primary error made by candidates was to work out *w* as 112°, likely because they used the incorrect fact about opposite angles in a cyclic quadrilateral being equal. Often then they would use the fact that the internal angles of a quadrilateral sum to 360°, so the value of *x* calculated was incorrect. It would have been easier to use the fact that opposite angles in a cyclic quadrilateral are supplementary hence $5x$ is equal to 180°.

Question 20

A common error was to add the two numbers and add the indices to give $4.2 \times 10^{2p-1}$. We did see some answers given as $23.1 \times 10^{p-1}$ but then failed to convert this into standard form.

Question 21

The main error was to use length *AB* as 12.8 and then to try to use either the cosine rule or the sine rule. Candidates needed to draw a perpendicular from *B* to line *AC* and mark that length as 12.8 and thus create a right-angled triangle. Some candidates with the correct right-angled triangle still tried to use the sine rule.

Question 22

Many candidates did not use all the information given in the question, namely that it was inverse proportionality and the term is squared. Therefore, the equation to be used must be $z = \frac{k}{(y-2)^2}$. Some did show fully correct working and even found *k* as 81 but they did not write the full correct answer on the answer line.

Question 23

Many candidates calculated all three angles to find the largest one, when they could have used the fact that the largest angle is opposite to the longest side. Then they needed to use the cosine rule once. Most errors at this stage were to substitute the wrong values into the cosine formula. The angle should have been given correct to one decimal place.

Question 24

(a) Many curves had the correct shape but some did not show the asymptotic behaviour accurately, often they had the ends curling back. The curve should not cross either axis. Some candidates drew the graph in quadrant one only.

(b) This was not answered as well as **part (b)**. Many candidates drew it as a straight line or as a curve in two distinct parts. Again, it should not cross the horizontal axis.

Question 25

Many candidates were able to write down the first derivative of $5x^4 – 20x^3$. However some then kept differentiating until the powers of x reduced to nothing and many found it difficult to solve the quartic equation in x when they put this expression equal to 0. They would often try to use the quadratic formula rather than factorise. It was common to see x^3 divided out and only one answer, 4, would be given.

Question 26

A good tree diagram often led to the correct answer and often avoided some errors. Most calculated 0.7 × 0.95 but then some added 0.7 × 0.6. A few would take these two results and multiply them together. Some attempted to calculate the probability of not having bread and subtracting that from 1, but most were not successful with this method.

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates were able to complete the paper in the allotted time. Few candidates omitted part or whole questions. Candidates generally showed their workings and gained method marks.

Candidates should be encouraged to process calculations fully and to read questions again once they have reached a solution so that they provide the answer in the format being asked for and answer the question set. For example, **Question 7(c)** where candidates were asked to give their answer in standard form.

The standard of presentation was generally good; however, candidates should be reminded to write their digits clearly. Many candidates overwrite their initial answer with a corrected answer. This is often very difficult to read and is not clear what the candidates' final answer is. Candidates should be reminded to re-write rather than overwrite.

This year there were three questions which asked candidates to give a reason for their answer, **2(b)(ii)**, **6(d)** and **9(b)**. Candidates found giving worded answers challenging and candidates should be reminded to give as much information as possible to explain their reasons.

Areas which proved to be important in gaining good marks on this paper were; calculating with money and time, calculating with fractions, ratios and percentages, including percentage profit, pie charts, probability, bearings, speed, distance and time, straight line graphs ($y = mx + c$), drawing a reciprocal graph, transformations, trigonometry, forming and solving equations, standard form, Pythagoras' theorem, area of squares and circles and completing and interpreting a Venn diagram.

Comments on specific questions

Question 1

(a) Many candidates correctly found the total cost. The common error was in converting 125 ml to litres. Many candidates used 1 litre = 100 ml instead of the correct 1000 ml and therefore found the cost of the cream to be $10.70 instead of $1.07, which led to the common incorrect answer of $15.74. Most candidates correctly found the cost of the strawberries and gained partial credit. The alternative method of using 1200 g and 125 ml was rarely seen but when seen was done correctly.

(b) The vast majority of candidates gained full credit in correctly working out that the largest number of pineapples Ravi could buy was 13 with $1.15 change. Candidates who did not gain full credit generally gained partial credit for correctly finding 13 as the largest number of pineapples through a correct division sum (20 ÷ 1.45 = 13.79) but often then gave the change as $0.79 or $6.21 (from 20 – 13.79). Many candidates chose to use a trial and improvement or repeated addition of $1.45 to find the largest number of pineapples to be 13 and then finding the change by 20 – 18.85.

(c) Many candidates were successful in finding the number of biscuits that Abraham was left with to be 32. Successful candidates completed the problem in steps rather than multiplication of fractions. Good solutions showed their full working by first finding $\frac{2}{9}$ of 72 and then subtracted to leave 56 biscuits and then finding $\frac{3}{7}$ of 56 and subtracting to be left with 32 biscuits. The most common misunderstanding led to the answer of 26 or 25 by finding $\frac{2}{9}$ of 72 as 16 and $\frac{3}{7}$ of 72 as 30 or 31 (truncating or rounding) and then subtracting these from 72. Many less able candidates simply subtracted $\frac{2}{9}$ and $\frac{3}{7}$ of a biscuit leading to the answers of 71 biscuits.

(d) Fewer candidates gained credit for calculating the percentage of cakes sold mainly due to errors in rounding or not giving an answer to the required degree of accuracy. Many candidates showed correct working of $35 \div 84 \times 100$ but truncated the resultant recurring decimal to 41.6% or 41%, or rounded to 42%, which are not to the required 3 significant figures. A large proportion of candidates correctly calculated 41.7% but then gave the final answer of 58.3%, confusing between cakes sold and cakes remaining.

(e) Sharing the total number of sweets into a ratio proved to be one of the most successfully answered questions on the whole paper. Most candidates showed good working out following the common approach of $132 \div 12 = 11$ and then multiplying 5×11 and 7×11. Very few incorrect answers were seen, the most common coming from $132 \div 5 = 26.4$ and $132 \div 7 = 18.8$ or 18.9.

(f) (i) Calculating the percentage profit proved to be challenging for many candidates. Very few fully correct solutions or part solutions were seen. This was because the majority of candidates divided by the selling price of \$24 instead of the cost of \$12.80. Dividing by \$24 led to the most common incorrect answers of 46.7% or 46.6…% or 53.3…%.

(ii) Finding the new selling price proved nearly as challenging as calculating the percentage profit. The common incorrect answer was \$24.80. This was found by adding the increase in the cost to the selling price, i.e. $13.60 – 12.80 = 0.80$, selling price = $24 + 0.80$ = \$24.80.

Question 2

(a) (i) The majority of candidates correctly completed the table and gained full credit.

(ii) Fewer candidates gained full credit completing the pie chart although many candidates who attempted the pie chart did so successfully. It was clear from candidates attempts that the majority of candidates had access to a protractor or angle measurer, with again the majority of candidates using a ruler and pencil.

(b) (i) Finding the probability of picking a black marble from bag A was the most successfully answered part of this question with the vast majority of candidates giving the correct answer. The few incorrect answers seen were the ratios 2 : 3 or 2 : 5 (which are not an acceptable format for probability) or $\frac{2}{3}$.

(ii) Candidates found giving reasons for their answers challenging throughout the paper. Most candidates were able to correctly identify that Toby was incorrect but without a correct reason. To gain full credit candidates needed to compare the probabilities of picking a black marble from both bags. Answers needed to include the probability of picking a black marble from bag *B* as $\frac{5}{13}$ and compare this to the probability of picking a black marble from bag *A* ($\frac{2}{5}$). Most incorrect answers compared the number of marbles in each bag rather than the probabilities.

(iii) Finding the smallest number of black and white marbles added to bag *B* was a very challenging question with only the most able candidates correctly identifying the answers as 1 and 1 (or gaining partial credit for 3 and 4 or 5 and 7 or 7 and 10, etc.). Some candidates showed understanding by finding that $\frac{6}{15} = \frac{2}{5}$ and realised that they needed to add one black marble. However most then went on to give the answer of 1 and 2 instead of 1 and 1.

Question 3

(a) Most candidates gained full credit by drawing a line (or giving a point) 7.2 cm from *R* at the correct angle of 163°. The most common error was in drawing the angle incorrectly rather than the incorrect length of line. Candidates should be reminded that it is important that the location of *M* should be indicated by a dot or line; some candidates just wrote the letter *M* which meant there was not a location to measure.

(b) (i) Most candidates gained full or partial credit by multiplying and therefore having an answer with figures 3852. However, the common incorrect answers were $38 520 and $3 852 000 by multiplying 36 × 1070 (not converting to metres) or 3600 × 1070 (using 1 km = 100 m instead of 1000 m).

(ii) Less able candidates found this proportion question particularly challenging. However more able candidates gained partial or full credit by calculating the correct number of days or how much track would be built by 45 people in one day (180 m). The same repeated error of 1 km = 100 m was often seen which led to the answer of 20 days instead of 200 days.

(c) Calculating the journey time proved equally challenging for less able candidates, often quoting the incorrect formula for calculating the journey time. More able candidates gained full credit by using the correct formula and then multiplying by 60 to convert their decimal answer to minutes. Partial credit was awarded for the common error of 0.48 seen in the working and 48 mins given as the final answer. Some candidates rounded their final answer to 29 mins without showing the exact answer of 28.8 in the working. Candidates should be reminded that answers should not be rounded to less than 3 significant figures, unless directed to do so in the question.

(d) Calculating the bearing of *R* from *K* was one of the most challenging questions on the whole paper. Very few correct answers were seen and when done correctly this was generally worked out using 312 – 180. The most common incorrect answer was 48°, from 360 – 312.

Question 4

(a) Nearly all candidates correctly wrote down the coordinates of point *A*.

(b) (i) In contrast very few candidates were able to find the correct gradient of line *L*. The most common incorrect answers were $\frac{1}{2}$ or 0.5 (giving a positive gradient rather than a negative) and 2 and –2 (finding the change in *x* / change in *y* instead of change in *y* / change in *x*).

(ii) Many candidates were able to gain full credit by giving the equation of line *L*, sometimes on a follow through basis. Many candidates gained partial credit for an equation of the form $mx + 3$ or (their gradient) $x + c$.

(c) (i) Few candidates demonstrated an understanding of the word ‘perpendicular’. The most common errors were horizontal and vertical lines through *A*. A large number of less able candidates did not attempt this question.

(ii) Candidates who attempted **part (c)(i)** were successful in giving the correct coordinates of where their line crossed the *x*-axis; this was more commonly (–2, 0), from vertical lines, than the actual correct answer of (–4, 0). Candidates who drew horizontal lines from *A* generally gave the answer of (0, 4) or did not attempt this question as their line did not cross the *x*-axis.

(iii) Several candidates did not attempt this part of the question. Most candidates who attempted the question were able to gain at least partial credit for a correctly measured side or full credit for a correct perimeter, often as a follow through from a vertical line from *A* in **part (c)(i)**.

Question 5

(a) Most candidates who attempted this question gave the correct answer. A significant number of candidates, however, did not attempt this part of the question despite attempting the rest of the question.

(b) (i) This 'show that' question was often not attempted. Candidates who did attempt it often did not gain credit as they generally used the answer of $k = 8$ as part of their working. Candidates should be reminded that in any 'show that' question candidates must not use what they are asked to show as part of their answer. Correct solutions were, for example, $4 = \frac{k}{2}$ and then showed $k = 4 \times 2 = 8$.

(ii) Again, a significant number of candidates did not attempt this part of the question. Of the candidates that did attempt it only the more able candidates gave the correct value of y with the most common incorrect answer of 31.25 given, from $\frac{250}{8}$.

(c) (i) Completing the table of values was the most successfully answered part of this question. The vast majority of candidates gained full credit with some partial credit given, often for missing negative signs on some of the values.

(ii) Most candidates who achieved full credit in **part (c)(i)** also achieved full credit in **part (c)(ii)**. Candidates who made errors in their table generally scored for a correct follow through of their points. The standard of drawing the curve was good with very few candidates joining their points with straight lines.

(d) Very few correct answers were seen in this part with several candidates not attempting it. Candidates who recognised that $y = x$ was a line of symmetry often then gave $x = y$ as their second line of symmetry, not realising that this was the same line. $y = -x$ was rarely seen.

Question 6

(a) (i) Good solutions in this part contained the correct transformation, enlargement, and the correct scale factor (4) and centre (–4, –5). The most common error was to omit the centre of enlargement or give the incorrect scale factor. Few double transformations were given although the most common was to describe an enlargement and a translation.

(ii) Good answers contained all three parts to describe a rotation, including degrees and direction and centre of rotation. The most common error was to omit the centre of rotation or give the correct angle but without a direction. Less able candidates correctly identified the transformation as rotation but often did not give the centre or angle or direction.

(b) (i) Most candidates were able to translate the shape correctly. Many less able candidates did not attempt this part or translated in the incorrect direction, often five right and four up. Some candidates reflected the shape before translating.

(ii) Most candidates were able to correctly reflect the shape in the line $x = -4.5$. Common errors were to reflect in the line $x = -4$ or $x = -5$. A significant number of candidates did not attempt this question.

(c) This trigonometry and 'show that' question was one of the most challenging questions of the whole paper with many candidates not making an attempt. Of those that made an attempt, only the most able candidates used the correct trigonometry ratio of $\tan b = \frac{8}{4}$. A number of candidates who gave the correct ratio and second step $\tan^{-1}\left(\frac{8}{4}\right)$ did not gain full credit as they then gave the answer of 63.4°. Candidates should be reminded that in 'show that' questions which include the phrase 'correct to 1 decimal place' that they must show the answer to more than 1 decimal place before showing the final answer to 1 decimal place.

(d) Candidates found giving a reason why the three triangles were similar extremely challenging. The majority of candidates who attempted this question correctly identified that the triangles were similar but did not gain credit without an acceptable reason. To gain full credit candidates needed to say that the three angles were 63.4°, 26.6° and 90° and that the triangles are similar because they all have the same three angles. Many candidates were able to gain partial credit for saying that the three triangles all had the same angles but did not say what they were, or vice versa that the angles were 63.4°, 26.6° and 90° but did not then say that by having the same three angles that this shows that the triangles are similar.

Question 7

(a) (i) Most candidates identified the need to add algebraic terms to write an expression for the total number of clocks. However many did not gain full credit as they did not write their solution in its simplest form or made errors with writing the number of clocks made by Pierre. Common errors for the expression for Pierre were $x - 3 \times 2$ (no brackets), $x + 3 \times 2$ (error in Suki and no brackets), $3 - x \times 2$ (error in Suki and no brackets), $2x - 3$ (incorrect multiplication of Suki). Partial credit was obtained by more able candidates for $x - 3$ written for Suki and/or $2(x - 3)$ for Pierre, but full credit were rarely given as these were not correctly added together and simplified.

(ii)(a) Some candidates gained full credit for calculating the value of x despite giving an incorrect or no expression in **part (a)(i)**. This was because it was possible to solve without an equation and using trial and improvement instead. Candidates who did have an expression in **part (a)(i)** often gained partial credit for equating their expression to 35 and then attempting to solve.

(ii)(b) A large proportion of candidates did not attempt this question despite attempting the two previous parts. Those that did attempt it were able to gain partial credit for calculating the number of clocks made by Pierre (16) but many did not then subtract to find how many more he makes than Martin. A large number of candidates were able to gain full credit by following through their value for x in **part (a)(ii)(a)**.

(b) (i) Many candidates were able to draw an accurate clock diagram to show the time 2.30 pm. The most common error was to draw the small hand pointing at the number 2 instead of being halfway between 2 and 3.

(ii) A similar number of candidates were able to calculate the obtuse angle between the hands on their clock diagram. Candidates who had hands pointing at 2 and 6 were able to get a follow through mark if they calculated their angle as 120°. Candidates who had a correct clock diagram rarely gave the correct answer of 105° and often it was clear through their answers that candidates had measured the angle rather than calculated as directed in the question.

(c) All candidates attempted to work out the number of seconds in 10 days, with many of the candidates giving the correct answer, although fewer were able to give this in standard form. The correct answer of 864 000 without changing to standard form (or incorrect standard form) gained partial credit.

(d) Very few candidates gained full credit in this application of using a clock question. The most common misunderstanding was that the 8 minutes lost each hour was taken off at the end of each hour rather than being continuously lost during the hour. This meant that many candidates gave the incorrect answer of 18 06, which came from adding 3.5 hours to 15 00 but then only subtracting 24 mins, from 8×3, rather than subtracting 28 mins, from 8×3.5. Candidates who worked in steps were more successful with those listing 15 00, 15 52, 16 44, 17 36 scoring partial credit for 17 36.

(e) Candidates found this multiples question extremely challenging with only the most able candidates gaining any credit. The correct answer of 16 was found rarely but when found this was from identifying 24 as the LCM, dividing 365 by 24 and then correctly remembering to include 1st Jan and add 1 to their truncated answer. Some candidates gained partial credit for all correct steps but did not include the check on 1st Jan and gave the final answer of 15. Partial credit was often awarded for 24 identified as the LCM or 25th Jan identified as the second time both clocks will be checked on the same day (often found by listing dates). A few candidates attempted to list all dates throughout the year when each clock was checked, although this list often went wrong. A common misunderstanding was to divide 365 by 6 and 8.

Question 8

(a) (i) Few candidates were able to give the correct wording in the statement to gain credit. The correct statement should be because ‘angle in a semicircle’. The most common response was that the triangle was a right-angled triangle, which is just repeating the information given in the question and not explaining why.

(ii) Most candidates correctly calculated the area of the triangle. Common errors were not dividing by 2 and using Pythagoras’ theorem to calculate the length *AC* rather than the area.

(iii) Fewer candidates were successful in calculating the length *AC*. Good solutions showed squaring, adding and square rooting. Common errors were adding the sides or attempting to use trigonometry.

(b) Making *r* the subject of the formula was a very challenging question for all but the most able candidates. Some candidates gained partial credit for a correct first step, generally $r^2 = \frac{A}{\pi}$. Some candidates didn’t make the square root symbol long enough to cover all of $\frac{A}{\pi}$ so it looked as though the answer was $\frac{\sqrt{A}}{\pi}$ rather than the correct answer of $\sqrt{\frac{A}{\pi}}$. Less able candidates subtracted instead of dividing by π.

(c) Successful answers showed each step in this complex area question. The best solutions started by finding the length of each side of the square by square rooting 81. The radius of the circle was then found by halving their answer and the area of the circle using the correct formula. Finally the shaded area was calculated by subtracting the area of the circle from 81 (the area of the square). Credit for 9 cm was the most commonly given part mark, followed by a correct attempt at finding the area of a circle, although often 9 cm was used instead of 4.5 cm.

Question 9

(a) (i) Completing the Venn diagram challenged many candidates. More able candidates placed all 12 values in the correct positions in the Venn diagram with the most common errors involving the 6 and 12 which were repeated in both circles and the intersection. Some candidates did not include the 1,5,7 and 11 outside of the circles.

(ii) Interpreting set notation challenged most candidates with few correct answers seen. Confusion about ‘n’ standing for ‘the number in the set’ and U standing for the ‘union’ were in equal proportions. Many candidates who understood that U stood for the union listed all numbers in the union and many who understood ‘n’ meaning the number in the set counted the number of values in the intersection rather than the union.

(iii) Candidates were more successful in finding the probability that the number was in the set $E \cap M$. Common errors included confusion over U and $\cap$ with $\frac{8}{12}$ a common incorrect answer (counting the number in the union rather than intersection). Some wrote their fraction with a denominator of 8 instead of 12, not including all values in the universal set.

(b) Candidates found giving the reason why Meg was incorrect challenging, although more successful than previous questions which required a reason for their answer. Most candidates correctly identified that Meg was incorrect. However a number of candidates thought she was correct because all even numbers are in the 2 times table and therefore not a prime number, forgetting that 2 is a prime number. The best answers were ‘*No because 2 is even and prime*’.

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key messages

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

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper, making an attempt at most questions. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required. 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. In 'show that' questions, such as **Questions 1(a)**, **1(b)** and **8(b)(v)**, candidates must show all their working to justify their calculations to arrive at the given answer, and should not use the given answer in a circular or reverse method. 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. When candidates change their minds and give a revised answer it is much better to rewrite their answer completely and not to attempt to overwrite their previous answer. Candidates should also be reminded to write digits clearly and distinctly.

Comments on specific questions

Question 1

(a) This proved to be a challenging question for many candidates. Few appreciated that the given information could be written as the ratio $1:1\frac{1}{2}:1\frac{1}{4}$, and then by multiplying by 4 gave the required ratio of $4:6:5$. As a 'show that' question all working needed to be shown and justified. A very common error was to perform a reverse method using the given ratio, or $\frac{4}{15}:\frac{6}{15}:\frac{5}{15}$, or the value of 142 500 from later in the question, or starting with an unjustified ratio such as $8:12:10$.

(b) This also proved to be a challenging question for many candidates. Again, in this 'show that' question many candidates used an unacceptable circular argument starting with the given value of 142 500. For example, $\frac{142500}{15} = 9500$ then $9500 \times (4 + 6 + 5) = 142500$ is an incorrect circular method and gains no credit. It should also be noted that sole working of 9500×15 and $47500 + 38000 + 57000$ are both insufficient as the values used have not been justified.

(c) (i) This part was more accessible and was generally answered well although common errors included $\frac{5}{4}\times 47500$, $\frac{47500}{0.25}$, 95 000, $\frac{15}{4}\times 142500$, $\frac{(142500-47500)}{2} = 47500$, or $\frac{142500}{3} = 47500$; the last two were also seen in the next part.

(ii) This part was generally answered well although it was noted that many candidates completed a second calculation rather than appreciating that their previous answer could be used on a follow through basis and a simple subtraction was all that was required. Common errors as in **part (i)** were seen.

(d) The compound interest formula was well remembered and used successfully by a good number of candidates. A small yet significant number spoilt an otherwise correct method by either adding or subtracting the principal amount. Some candidates did not give their answer correct to the nearest dollar as instructed in the question. A small minority made the error of using simple interest to calculate their answer.

(e) This part was generally answered well with the most successful method being to split the work into the two stages of $142\,500 \times 0.27$, followed by $142\,500 + 38\,475$.The more direct method of $142\,500 \times 1.27$ was rarely seen. Common errors included the use of + 1.27, + 27, 73% or 0.73, and answers of 38 475 or 104 025 (from subtracting rather than adding).

Question 2

(a) Many candidates could give the correct name of the pentagon. Incorrect answers given included hexagon, heptagon, quadrilateral, equilateral, rhombus, rotation and prism.

(b) This part was not generally well answered and few accurate and correct answers were seen. The majority of candidates did not appreciate that the easiest way of finding the area of the given polygon was to use the method of counting squares. Many tried to split the shape into squares, rectangles, triangles and/or trapezia but this was rarely successful either due to incorrect measurement or more usually incorrect formulas used. Other common errors included attempting to find the perimeter, or using the angles of a pentagon as evidenced by the use of 180, 360 or 540.

(c) Throughout this part the majority of candidates were able to identify the given transformation but not all were able to correctly state the required components for the full description. Candidates should understand that the correct mathematical terminology is required, and that terms such as turn, mirror and move are insufficient.

(i) A smaller number of candidates were able to identify the given transformation as a translation, with transition, translocation and transformation being common answers. The identification of the translation vector proved more challenging with the common errors being reversed or inverted vectors, incorrect signs, and the use of coordinates.

(ii) This part was generally answered well with the majority of candidates able to identify the given transformation as a rotation and more 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 (2, –2) and (3, –4) being common errors. The angle of rotation was sometimes omitted with 90 being the common error.

(iii) The majority of candidates were able to identify the given transformation as an enlargement, although disenlarge, minimise and shrinkage were common answers. However 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), (–2, –4) and (2, 4) being common errors. The scale factor also proved challenging with –2 and 2 being the common errors. A few candidates gave a double transformation, usually enlargement and translation, which results in no credit.

(d) This part was generally answered reasonably well with a good number of candidates able to correctly draw the required reflection. However, this part proved very challenging for less able candidates and a significant number were unable to attempt the drawing. A very common error was to draw a reflection in the line $x = 0$, with a small number of vertical translations also seen.

Question 3

(a) (i) This part was generally answered very well although common errors included 1330 am, 1330 pm and 13 hr 30 mins.

(ii) This part was generally answered very well although common errors included 4h 35 min, 7h 35 min.

(b) This part proved challenging for many candidates and proved to be a good discriminator with the full range of marks seen. Generally, a large proportion of candidates picked up partial credit for some correct working and methods were usually well set out. Some started by adding on 6 hours first and stated 2235, although sometimes this addition resulted in an answer of 0035. Errors after this often came from attempting to add on 13 hours 45 minutes, or candidates incorrectly subtracting 13:45 from 22:35. Others started by attempting to add 13 hours 45 minutes to 1635 – a common error was to arrive at a time of 0520 and give a final answer of Friday, 1120. Quite a few stated 1 for the day instead of Friday or gave the day as Saturday.

(c) The majority of candidates were able to apply the correct formula to find the average speed, with most knowing to divide 10736 by a time but many found it challenging to use the correct time. Errors included dividing by 13.45, 825 or 13 h 45 earning partial credit but there were also a wide variety of other times such as their arrival time from **(b)** or their answer to adding 13 hours 45 minutes to 1635.

(d) This part was generally answered very well. A few candidates rounded to the nearest euro. Common errors came from dividing by the exchange rate rather than multiplying, resulting in an answer of 607.9. Other errors came from incorrect answers after seeing the correct multiplication written in the workspace, e.g. $400 \times 0.658 = 26.32$.

(e) This part was generally answered very well, although a small number of candidates rounded to the nearest dollar. Common errors included adding £850 rather than subtracting, or subtracting the cost of one night and then dividing by 5.

Question 4

(a) Almost all candidates identified the equivalent fraction correctly.

(b) Many candidates gained full credit in this part. Others scored partial credit for having 4 of the 5 values in the correct order, and some for showing the correct decimal values, A common error included treating 58% as 58 rather than 0.58 and subsequently having this as the largest number. Other candidates did not include enough accuracy when converting all of the numbers to either decimals or percentages with, for example, $\frac{5}{12} = 0.58$, $\frac{8}{13} = 0.6$ or $\frac{2}{3} = 0.6$, making them impossible to order.

(c) The majority of candidates were able to write 0.724 as a fraction in its simplest form. Some left the fraction as $\frac{724}{1000}$ without simplifying. Other errors were to start from $\frac{724}{1000}$ leading to $\frac{181}{250}$, but then approximating as either $\frac{72}{100}$ or $\frac{7}{10}$, or simply rewriting the given number in standard form.

(d) Most candidates found this question challenging. Candidates recognised the need to work out the upper and lower bound, however, most could not do this correctly. Common errors were $410 \leqslant m < 420$, $414.5 \leqslant m < 415.5$, $414.95 \leqslant m < 415.05$, and $5 \leqslant m < 415$. A few candidates wrote the correct bounds in reverse.

(e) A good proportion of candidates were able to work out that 6 bags of flour were needed. The best approach was to work out $7\times\frac{3}{4}$ but other less efficient approaches, such as drawing out bags of flour or evaluating $\frac{3}{4}+\frac{3}{4}+\frac{3}{4}+\frac{3}{4}+\frac{3}{4}+\frac{3}{4}+\frac{3}{4}$ were seen. The majority of candidates scored partial credit either because they did not consider the context that whole bags needed to be bought and gave 5.25 bags as their answer or because they rounded down to 5 bags. This showed that they could not relate it to the functional problem they were asked. Less able candidates couldn't progress with this question because they could not set up $7\times\frac{3}{4}$ correctly.

(f) (i) Almost all candidates were able to show a good understanding of writing equations in this part and the next. Common errors were 15.50*tp*, 5*tp*, 15*tp* and 15.

(ii) Similarly, this part was also answered well. Common errors included omitting the 28.50 and giving only $5t + 4p$, $5t + 4p = 28.5tp$, $5t + 4p = 28$, or trying to collect the terms as $5t + 4p = 9tp$.

(iii) Candidates found this part quite challenging and it proved to be a good discriminator. A good number of candidates were able to show clear and correct working and gain full credit. The majority attempted to use the elimination method to solve their equations with equal attempts to equate the coefficients of *t* and *p*. However a number of numeric and algebraic errors were seen in the setting up of the equations. Candidates should be encouraged to substitute their answers back into both equations to check for this. The most common error in the method was to add rather than subtract the equations. Candidates who did not score the method mark were able to earn the SC mark for finding 2 values that satisfied one of their equations, provided the evaluation of the second value was given to enough accuracy.

Question 5

(a) The table was generally completed well with the vast majority of candidates giving six correct values. Common errors included missing negative signs and giving 2.3 instead of 2.25 in both the positive and negative versions.

(b) The reciprocal graph was generally plotted well and the majority were able to draw a correct smooth curve. Common errors were plotting (8, 2.25) and (–8, –2.25) outside of the tolerance, and sometimes (–4, –4.5) and (4, 4.5). Curves were generally smooth although sometimes rather thick. A small number of candidates incorrectly joined the points with ruled line segments and/or joined the two sections of the graph from (-2, –9) to (2, 9). Most had a good version of the correct shape so remaining parts of the question were accessible.

(c) This part was generally answered very well, particularly by those candidates who had drawn the graph correctly and knew the meaning of rotational symmetry. Common errors included a variety of incorrect answers often 1 or 4, and answers referring to transformations, angles or directions of turn.

(d) (i) Generally, a well answered question with many candidates gaining full credit. Less able candidates often scored partial credit for correctly plotting the point (6, 4). Common errors included (–3, –8) plotted instead of (–8, –3), (4, 6) plotted instead of (6, 4), not joining the points with a straight line, despite the instruction to do so.

(ii) This part showed mixed responses, with candidates who had accurately drawn the line in **part (i)** often able to read off the measurements, but a significant number not appreciating the readings to be taken. Common errors included missing off the negative sign for the negative intersection value, errors associated with reading the scale, and giving the coordinate where the line met the *y*-axis and the *x*-axis. A significant number were unable to attempt this part.

(iii) This was the most challenging part of this question. However, a good number of candidates understood how to calculate the gradient of the line, either from the coordinates given or from their line drawn, but there were a variety of numerical or algebraic errors made. A gradient of 2 was frequent. The calculation of the intercept proved more challenging. Whilst some tried to use the equation $y = mx + c$ by substituting values in to find a value of c, the more successful method was to use their line drawn. A significant number were unable to attempt this part.

Question 6

(a) (i) The majority of candidates were able to measure accurately at 7.3 cm and then use the given scale to correctly convert to give the actual distance required as 87.6 m, or measurements within the allowed tolerance. A small number gave answers of 7.3, or used incorrect conversions such as 0.73×12.

(ii) This part on the measurement of a bearing was not generally answered well with common errors of 67°, 113°, 157°, 293° and 7.3 cm frequently seen.

(iii) Candidates found this part quite challenging and it proved to be a good discriminator. Whilst many candidates correctly evaluated 102 ÷ 12 as 8.5 and scored partial credit for a point the correct distance from *B*, many were unable to place *C* on the required bearing from *B*. The most common error was to measure 157° anticlockwise from the north rather than clockwise. Some candidates measured the bearing correctly and appeared to just mark the point at the edge of their angle measurer, forgetting the distance criterion. It was also fairly common to see *C* somewhere along the line *AB*, or the line extended to a point *C*.

(b) By drawing a straight line on the diagram from *P* to *R*, many candidates realised that Pythagoras' theorem was the key to solving this problem. Clearly presented working was frequently seen and answers calculated accurately. Some using Pythagoras' theorem made the error of calculating $98^2 - 67^2$. Less able candidates either did not make the connection with the right-angled triangle or did not know Pythagoras' theorem and a variety of ideas were pursued. These included simply adding 98 and 67, finding the ratio of the given sides or attempting some trigonometry. Measuring the length and using the scale from **part (a)** was also seen despite the diagram stating 'not to scale'.

Question 7

(a) (i) This part was generally answered very well with most candidates able to give the three correct angles. If their angles were incorrect, they rarely totalled 360° meaning a full follow through was not possible in **part (ii)**. A small number appeared to draw the pie chart in **part (ii)** first and then to measure the angles drawn.

(ii) This part was also generally answered very well with most candidates able to draw the sector angles to the required degree of accuracy. Less able candidates often gained partial credit for one correct sector particularly with a follow through applied.

(iii) This part was generally answered very well with most candidates able to give the correct probability. There were many correct and fully simplified answers. Common errors included $\frac{1}{4}$, $\frac{1}{5}$, $\frac{54}{360}$ and $\frac{54}{144}$.

(b) (i) A significant number of candidates found this question very challenging and it proved to be a good discriminator although few fully correct answers were seen. Few candidates appreciated that the calculation to start with was 53 + 68 – 110 = 11 as this could then be placed onto the Venn diagram. Correct use of the three pieces of information would then complete the diagram. Many started with the figure of 53 (like soccer) but incorrectly positioned it usually in the (like soccer but not hockey) section, often followed by the figure of 68 (like hockey) positioned incorrectly in the (like hockey but not soccer) section.

(ii) This part was generally answered reasonably well particularly with a follow through applied. Common errors included 121 (from 53 + 68), or an incorrect value selected from their Venn diagram.

Question 8

(a)(i) This part was generally answered very well, although common errors included 'obtuse', 'isosceles' and 'right angle'.

(ii) This part was generally answered very well, although common errors included 'equilateral' or 'right-angled' and 'scalene'.

(iii) This part was generally answered well with many candidates showing full and correct working. Common errors included 180 – 36 = 144, 36, and assuming that angles *CAB* and *ABC* were equal arriving at an answer of 72°.

(iv) Candidates were generally able to state that the required angle was 36°, but only a minority were able to offer a correct reason. Common answers included comments about parallel lines, 'opposite' angles, 'Z' shapes or angles, and 'alternative' angles. A significant number did not offer a reason at all, but simply described their calculation process.

(b)(i) This part was generally answered well, although common errors included rhombus, trapezium and square.

(ii) This part was generally answered very well, although common errors included 14.5, 58, and attempts to find the area.

(iii) Candidates were again generally able to state that the required angle was 60°, but only a minority were able to offer a correct reason. Common errors included incomplete comments about straight lines, and reference to parallel lines or triangles. A significant number did not offer a reason at all, but simply described their calculation process.

(iv) This part was not generally answered well with the majority of candidates not appreciating that the interior angle of 120 or the external angle of 60 could be used to find the number of sides of the polygon. Whilst some attempted to use the formula for the angle sum of a polygon, many just wrote down a number with no justification or working.

(v) Candidates found this part very challenging and it proved to be a good discriminator. Few candidates appreciated that the use of trigonometry was the key to answering this show that question. Common errors included the use of reverse methods with the given value of 5.63 or attempting to use either the perimeter or the area. Of those who did use a correct method many did not show a more accurate value than the one given in the question. A significant number of candidates were unable to attempt this question.

(iv) This part was not generally answered well with the majority of candidates not appreciating that one of the required lengths had been given in the previous part. Common errors included 6.5 × 8, 0.5 × (8 + 6.5) × 6.5, 0.5 × (8 + 8) × 6.5, $6.5^2 + 8^2$, and a variety of other incorrect formulas.

Question 9

(a) This part was generally answered well with the majority of candidates able to draw the next diagram in the sequence, although common errors included a misalignment of the top line, and the incorrect number of blocks in the base line.

(b) This part was generally answered well with the vast majority of candidates able to correctly complete the table.

(c) This part was generally answered well, although the common errors included $n + 3$, $3n + 2$, $3n$ and a number of purely numeric answers.

(d) This part proved more challenging. Many candidates started with the premise that 84 ÷ 3 gave 28 as the pattern number. A significant number used the simpler but longer method of continuing the sequence from 10, 13 until either 82 or 85 was reached, although numerical errors often lead to incorrect answers. Common errors included 3 × 84 – 2 = 250, pattern number of 28 with 56 blocks remaining, and pattern number of 29 with 1 block remaining.

MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key messages

To do well in this paper, candidates need to demonstrate that they have a good understanding across the wide scope of the syllabus.

Where questions are worth more than one mark, it is generally expected that candidates will show some mathematical workings. This is particularly important if they make an error as without workings, they are usually unable to score any method marks. They need to use a suitable level of accuracy during the working out stages and for the final answer. Particular attention to learning mathematical terms and definitions would help all candidates to answer questions giving the relevant name or using the relevant process.

General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Candidates were able to complete the paper within the required time and most candidates made an attempt at most questions. Overall, there were some excellent responses with a good level of knowledge and skills evidenced by many candidates.

The standard of presentation and amount of working shown was generally good in most questions although in **Question 3(c)** which had several stages in the method, the working was often spread randomly across the workspace.

A lack of understanding of an overtime rate in **Question 1(d)**, median from a pie chart in **Question 2(b)** and unit conversion when finding an area in **Question 3(a)** was evident. Recognising Pythagoras' theorem in a context (**Question 3(b)**) caused problems for some candidates as was calculating probabilities in **Question 8(b)**.

Attention should also be given to the degree of accuracy required, and candidates should be encouraged to avoid premature rounding in workings. They need to ensure that when an answer works out to be an exact decimal, they do not round it to 3 significant figures. This applied to **Question 1(d)**, **Question 3(c)** and **Question 7(b)** which were all exact money answers and in **Question 5(a)(ii)** the answer was an exact decimal.

Candidates need to understand the importance of notation. For example, in **Question 10(b)** some candidates were writing coordinates as vectors. In **Question 1(a)** many candidates wrote intervals of time, for example 4 hours 30 mins as 4.3 or 0430 and multiplied them as these values.

When solving or rearranging equations candidates should perform one stage at a time to ensure clarity of method. Care also needs to be taken when negative signs are used in equations or expressions. This was evident in **Question 4(b)** and **4(e)(ii)**.

Comments on specific questions

Question 1

(a) Many fully correct answers were seen and many others scored partial credit. There were several common errors made by candidates. When calculating the number of opening hours some thought the morning and afternoon times were both $4\frac{1}{2}$ hours and others assumed the shop was open for the same time every day, whereas Saturday had different times. Some calculated the afternoon hours as 6 instead of 5. Many candidates used incorrect notation for their times such as writing $4\frac{1}{2}$ hours and $3\frac{1}{2}$ hours as 4.30 and 3.30 then adding and multiplying them as these decimals. It was also common to see calculations involving 4(0430 + 0330) + 0500 + 0500 = 4 × 0760 + 1000 = 3040 + 1000 = 4040 or 40.4.

(b) A large majority gained full credit in this part. A small number calculated the total cost of one of each item.

(c) Nearly all candidates found the correct answer in this part. A few subtracted the cost of one battery from $10.

(d) This question was found challenging by many candidates. Although many of the higher scoring candidates produced correct answers, most of the other candidates were only awarded partial credit. Many started by correctly multiplying the rate per hour by 32 or 37, although some did both, but then many struggled knowing how to proceed. Some candidates went on to work out the rate for the 5 hours overtime, but were not sure of what to do next. Others did understand that they needed to multiply the overtime rate by 5. Those who had difficulty understanding the concept of the overtime rate sometimes made errors such as adding 1.25 instead of multiplying by 1.25, whilst some multiplied 32 or 37 by 1.25. Some candidates were confused with daily rates and weekly rates as multiplication or division by 7 was seen regularly. A few candidates rounded their answer but it was an exact amount.

(e) Many candidates were able to increase $36 by 40%. A common error was to calculate 40% correctly and give this value as the final answer, and a few subtracted it from $36. An incorrect common answer was 90 from working out $36 as a percentage of 40.

Question 2

(a) (i) Many correct answers were given in this part. Some gave the answer as 4, possibly choosing this because it was the highest number on the dice. It was common for candidates to give the answer as 2.5 often accompanied by working that showed they had found the median of the numbers on the dice or the mean.

(ii) The majority gave the correct answer in this part. Incorrect answers sometimes involved 360 ÷ 76 or 76 ÷ 90 but there were many varied incorrect values offered.

(b) Only a minority were able to give the correct median value from the pie chart. Common incorrect answers were 4 and 2.5, often with working showing they had found the median of the numbers on the dice. Some calculated the frequencies for each sector and found the median of these.

(c) Few candidates gained full credit in this part but many were able to score partial credit for either comparing the two correct modes or for comparing two sectors. Most commented on the largest and smallest sectors in the pie charts. Some calculated the frequencies for each sector which was not needed.

Question 3

(a) Many correct answers were found in this part. Most candidates measured the correct dimensions of the rectangle in centimetres. Those who converted these lengths to metres first, using the scale 1 cm represents 8 m, usually found the correct area in square metres. Many who multiplied the measurements in centimetres first to find the area, often only multiplied their area by 8 rather than 8^2.

(b) Those candidates who recognised they needed to apply Pythagoras' theorem nearly always calculated the correct length of the rectangle. Many did not and simply added, multiplied or divided the given dimensions. Others used Pythagoras' theorem but did not realise they needed to subtract the squared terms rather than add them. A few candidates didn't score the accuracy mark by only showing their answer to 1 decimal place although the two method marks for showing correct working were usually scored. Premature rounding of 3.6875 to 3.69 was seen and truncating it to 3.68 led to answers 1.9 to 1.91.

(c) A small number of candidates were able to show clear and correct working, usually done in stages, leading to the correct and accurate answer, and could be awarded full credit. Poor methodology, layout and lack of working were apparent. Many candidates successfully worked out the area of the rectangle but were less likely to obtain a correct answer for the quarter circle, with some using $2\pi r$. A significant number did work out the correct area and correctly found the amount of grass seed required in kilograms. The most common error was made by those who did not round their answer up to the next kilogram and hence didn't score the final method and accuracy marks. Quite a few candidates did not attempt to find the area of any shape and only $40 \times 6.8(0)$ was used, although some did include 1000 or 100. A large majority of candidates were awarded some method marks but the less able candidates struggled with this question and some did not attempt it.

Question 4

(a) Many candidates correctly collected the like terms in the expression. A few subtracted the terms in a but most errors occurred when candidates picked out the terms in b ($-5b$ and b) and simplified them incorrectly as $-6b$ or $+ 6b$.

(b) Many candidates gained full credit in this part. Some errors were made evaluating 3×5^2 as 15^2 or 3×10. When rearranging the terms candidates often made errors dealing with the negative term. This often resulted in the incorrect equation $90 - 75 = 5y$ or the negative equivalent $-5y = 75 - 90$. A few of those who correctly reached $90 = 75 - 5y$ ignored the negative sign and divided 15 by 5. Both errors led to the most common incorrect answer of 3. A few rearranged incorrectly leading to $90 + 75 = (\pm)5y$.

(c) (i) The majority of candidates were able to factorise the expression correctly. Some partial factorisations of $3(2x - 6)$ were given and a few wrote $2(3x - 9)$, neither of which could be awarded the mark.

(ii) This part was also answered well with a large majority able to give the correct complete factorisation of the expression. A few partial factorisations, most commonly $5(5x^2 + 2x)$ were seen. A small number did not understand the term 'factorise' and combined the terms to give the incorrect answer $35x^2$ or $35x^3$.

(d) Most candidates gave the correct rearrangement of the formula. A few made an error with the negative sign in the first step by writing $8d = T - 3$ instead of $8d = T + 3$.

(e) (i) This part was nearly always correct. A few divided 12 by 6 instead of multiplying.

(ii) More able candidates could solve the linear equation. Some of the less able candidates made errors rearranging the terms. Some candidates kept the same signs when moving the $3x$ and -4 to the other side of the equation and added $7x$ and $3x$ and/or collected the constant terms as $-4 + 2$. A few who did reach $4x = 6$ thought $x = 6 - 4 = 2$.

Question 5

(a) (i) Almost all candidates correctly evaluated the square root.

(ii) The majority of candidates evaluated the expression correctly but a few spoilt their answer by rounding it to 3 significant figures or occasionally to 4 significant figures when they should have given the exact value of the calculation. A few mis-read the indices as both squared.

(iii) Many candidates knew the reciprocal of 2 but incorrect answers were regularly seen; usually $\frac{2}{1}$ or 2 or occasionally –2. A few gave the answer 4 or found the square root of 2.

(iv) A very high majority of candidates evaluated 9^0 correctly as 1. A few gave the answer 0 or 9.

(v) A very high majority of candidates gave the correct answer. A few divided 42 by $\frac{3}{7}$.

(vi) A very high majority of candidates found the correct percentage of the amount.

(b) (i) In this part and the next a large majority were able to insert a single pair of brackets to give the correct order of operations within the calculation. A few included a second pair of brackets around the first three numbers.

(ii) Those who had not gained credit in the previous part often did not gain credit in this part either. Some did not attempt both parts. A few included a second pair of brackets or put a single pair in the wrong position.

(c) Many correct answers were seen in this part. In other cases, the inequality signs were reversed in one or both answers and some gave an inequality for the equals sign.

(d) (i) Many candidates were able to write 90 as a product of its prime factors. Some scored partial credit for a list of the correct prime factors or for a correct factor tree or table. In some cases, the list was incomplete, ignoring the repeated factor of 3, or the factor tree stopped at 9. Some listed the factors of 90.

(ii) Many found the correct lowest common multiple. A few wrote 630 as the product of its prime factors but the most common error was getting the answers for **(d)(ii)** and **(d)(iii)** reversed.

(iii) Many found the correct highest common factor.

Question 6

(a) Although more able candidates found this question straightforward, incorrect answers were seen just as often. Candidates did not recognise the angle in the semi-circle was 90°. The majority of incorrect answers were based on the assumption that the triangle was isosceles, hence 52° was very common. Other common incorrect answers were 180 – 52 = 128 or 128 ÷ 2 = 64 or 180 – 2 × 52 = 76.

(b) (i) Many candidates calculated the required angle by simple subtraction of the two given angles but many others were only able to write these angles in their positions on the diagram. They calculated extra angles making the question more difficult than it was. The answer 172 from angles around a point 360 – 42 – 146 was seen regularly as was 146 + 42 = 188. Other calculations involving 360, 180 and the given angles were very varied.

(ii) Many candidates found this part challenging and only a minority gave the correct answer. Incorrect calculations were seen and incorrect angles were marked on the diagram but it was also common for no working to be shown in this part. Many subtracted one of the numbers from their diagram from 180 or used 48 from 90 – 42 in their solution. Others added an incorrect number such as 180 + 47 to achieve an incorrect answer of 227. A common incorrect answer was 180 – 42 = 138 from co-interior angles between *A* and *B* although many candidates went on to use this correctly to find 222 from 360 – 138. Candidates should be encouraged to extend the 'North line' to create parallel lines in order to make the link to using either alternate, corresponding or co-interior angles in the correct places at *B* and hence make progress towards the correct answer.

(c) This part was answered correctly by a large majority of candidates. Those who did not gain full credit usually scored partial credit for the correct first step of finding 63° using angles on a straight line. Nearly all of these candidates gave 63° as the final answer as they assumed that angle *x* was one of the pair of equal angles in the isosceles triangle rather than the third angle. A few gave the answer as 126° or spoilt the correct answer by halving it.

Question 7

(a) A large majority of candidates found the correct value. A common error was to divide 2 400 000 by 3, the number of ratio parts for Rita rather than the total number of ratio parts.

(b) This question on compound interest required an exact money answer. Most candidates gave this value but a significant number of candidates rounded it. Some calculated simple interest. The question asked for the total value of the investment but a few gave the interest only and some who had the correct total added the principal amount to it again.

(c) A significant number of candidates used a correct method to produce the correct answer. Several common errors were seen in this question. Quite a number started with $12000\left(1+\frac{r}{100}\right)=12408$ but then made errors in the rearrangement, some subtracting 12000. Many missed out one or both of the final steps from 1.034 (subtracting the 1 then $\times$ 100). It was very common to see the final answer 1.034 from just $\frac{12408}{12000}$ or $12\,000r = 12408$, whilst many others did progress far enough to score a method mark with $\frac{12408}{12000}\times 100 = 103.4$. A common incorrect answer was 4.08 from $\frac{12408-12000}{100}$ and another was 96.7 following $\frac{12000}{12408}\times 100$ which a few truncated to 0.96 and subtracted from 1 giving 4% as their answer.

(d) Only the more able candidates did well in this question on providing the bounds for a value that was given correct to the nearest 100. Most of the other candidates struggled and many varied incorrect answers were seen. These included adding and subtracting 100, $\frac{1}{2}$, 0.01 and 10 as the most common errors. Some rounded the given value down to 10000 and up to 11000.

Question 8

(a) (i) Many candidates completed the frequency table correctly. A very common error was to include the frequency of 40 in the last interval hence giving the last two frequencies as 3 and 2 rather than 4 and 1. A few candidates wrote their frequencies as a fraction of the total number of frequencies.

(ii) Nearly all candidates gained full credit for drawing the correct bar chart for their frequency table. A small number drew a frequency polygon or just plotted points.

(b) (i) A significant number of candidates placed the value 0.8 correctly in the three positions on the tree diagram. However, there were many incorrect answers. Most values were less than 1 but three values of 1 were seen regularly. Other common values used were three 0.2's and three 0.1's especially by less able candidates. Different values on the three branches were another common error with 0.6 a common option for the bottom branch. A small yet significant number of candidates did not attempt this question.

(ii)(a) Very few candidates were familiar with the method to find the correct answer in this part and the next. Some knew that they should use 0.2 and 0.2 but it was very common to see these two probabilities added/doubled rather than multiplied together. In this part and the next, sometimes three probabilities were added (from picking all the 0.2's from the three 'late' branches in the tree diagram) and, in some cases, candidates then divided their answer by 2 or 3 as if finding an 'average'. Some worked in fractions rather than decimals and were given credit if successful. Most candidates who gained full credit in this part also gained full credit in the next part. A significant number omitted both of these parts.

(ii)(b) Very few candidates achieved the correct answer or an answer that followed their incorrect probabilities. Many knew which values to use but, as in the previous part, they added the probabilities rather than multiplied them. Some candidates gave answers which were greater than 1. Other incorrect methods included adding the 'not late' on Monday with both 'lates' on Tuesday, adding all three 'not lates' from the tree, just picking the 0.2 value for 'late' on Tuesday and some subtracted or divided probabilities.

Question 9

(a) Nearly all candidates completed the table correctly. A very small number of candidates calculated the y-coordinate for $x = –3$ as –17 from evaluating $(–3)^2$ as –9.

(b) A large majority of candidates gained full credit. Some joined the points with ruled line segments or were insufficiently accurate when trying to join their points with a curve. Nearly all realised the curve had a minimum value between $x = 0$ and $x = – 1$ and completed this part of the curve appropriately.

(c) Some of the more able candidates gave the correct equation for the line of symmetry but most others struggled with this part. Some came close with –0.5 while others thought it was x = 0.5. Some gave $y = mx + c$ as their answer or equations in this form. A significant number omitted this part.

(d) Many correct answers were given for the points of intersection of the curve with the x-axis. Only the least able candidates struggled with this part and a significant number made no attempt.

Question 10

(a) A large majority of candidates gained full credit for the correct translation. There were a few who scored partial credit for correctly translating the triangle in one direction and a significant minority who did not attempt this part.

(b) (i) Most candidates knew the triangle had been reflected but errors were often seen when describing the line of reflection as $y = 0$ rather than $x = 0$.

(ii) The majority of candidates knew the triangle had been rotated. Errors included not giving both properties of 180° and the centre (0, 0). Some thought the rotation was 90°.

(iii) More errors were made in this part although most recognised the transformation was an enlargement. However, only the term 'enlargement' is acceptable when describing this type of transformation and not descriptions such as 'smaller', 'reduced' etc. The scale factor was often described as 2 or –2 rather than $\frac{1}{2}$ and a few thought it was 1.5.

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key messages

Candidates sitting this paper need to ensure that they have a good understanding and knowledge of all of the topics on the extended syllabus.

Unless directed otherwise, candidates should give answers to an accuracy of at least 3 significant figures. This often requires candidates to retain numbers in their working that are more accurate than 3 significant figures otherwise premature approximation is likely.

General comments

There were some excellent scores on this paper and many candidates demonstrated that they had a clear understanding across the wide range of topics examined. The majority of candidates attempted most questions on the paper.

Candidates should make sure they read the questions carefully. For example, in **Question 3**, the question talked about the total surface area, not just the curved surface area. In **Question 8(a)(i)**, the stem said there were 50 children so the cumulative frequency table should end in 50. In **Question 9**, the diagram said NOT TO SCALE so the angles should not be measured. In **Question 10(d)**, candidates were asked to draw a suitable line to solve the equation, not just calculate the solutions.

The stronger candidates should try to use the most efficient method to solving a question. For example, in **Question 2(d)**, the area of a trapezium is more efficient than the area of two triangles and a rectangle. In **Question 3(a)**, the π can be cancelled out on both sides which avoids rounding errors. In **Question 5** candidates should select the cosine or sine method according to which leads more efficiently to the required information.

Questions that ask candidates to 'show' results require candidates to start with the given information and arrive at the value that is asked to be shown. Reverse methods do not usually score. For example, in **Question 1(a)(ii)**, candidates should not start with the 2 hours but start with the 100 km and \$98 and work towards the 2 hours. In **Question 2(b)** candidates should start from the 180 seconds and 1944 km/h^2 and work towards the 60 seconds.

In probability questions, if the question is given with fractions then it is usually best to stay working in fractions rather than working in decimals which will not necessarily be exact. For example, **Question 6(c)(v)** and **(vi)**.

For questions involving algebra, candidates are advised to complete each step on separate lines, rather than trying to do more than one step on the same line. For example, **Questions 7(a)**, **7(b)** and **12(e)**. Marks in algebra are generally awarded for individual steps clearly seen.

Comments on specific questions

Question 1

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

(ii) Many candidates made a good attempt at this and showed clear working. Marks were lost by candidates who did not show full working such as just writing 50 instead of 100×0.5. The reverse method, starting from 2 hours, was not accepted but one mark could have been earned for 100×0.5.

(b) Most candidates scored full marks in this question. The errors seen usually came from adding 5 + 2 + 7 incorrectly.

(c) The majority of candidates answered this question correctly. The most common error seen was to subtract 45 per cent of $84.1 from $84.1 rather than recognising that the $84.1 represented $1.45 \times$ the cost before midnight.

Question 2

(a) Most candidates knew that acceleration could be found from the gradient of the graph in the first 60 seconds and answered this part correctly.

(b) Good candidates were able to show clear detailed calculations to arrive at 60 seconds. Many candidates did not score as they were not able to convert 1944 km/h^2 into m/s^2, usually because they either used $\times 100$ rather than $\times 1000$ or they divided by 60^2 rather than 3600^2. Candidates were not rewarded if they used the reverse method, starting from the 60 seconds.

(c) Almost every candidate completed the speed-time graph correctly. Candidates who either did not draw a ruled line or whose lines did not meet the time axis exactly at 240 did not score. A few candidates drew their line to meet the time axis at 300 seconds.

(d) Many clear and accurate solutions were seen in this part. A few candidates used the most efficient method of using the formula for the area of trapezium but the majority of candidates preferred to work out the individual areas of the two triangles and a rectangle. Errors included not dividing by 2 in the formula for the area of a triangle, assuming both triangles had the same area and arithmetic slips.

Question 3

(a) It was clear that most candidates were able to use the given formulae to correctly work out the curved surface area of the cone. However, the majority of candidates omitted the flat circular parts of the surface areas in either or both of the solids. Other errors included finding the curved surface area of a sphere rather than a hemisphere or making algebraic errors when combining $\dfrac{4\pi R^2}{2} + \pi R^2$.

(b) Most candidates were able to work out the correct volume of the larger cone. Finding the volume of the remaining solid proved more challenging with most candidates taking the approach of trying to find and subtract the volume of the small cone that had been removed. Of those finding the volume of the small cone, many did not use the correct radius or height with few candidates recognising that the radius of the small cone was $\dfrac{1}{4} \times 7.6$. Wrong calculations, such as $\dfrac{1}{3}\pi \times 7.6^2 \times 12$, were frequently seen.

Question 4

(a) (i) The majority of candidates correctly divided by 1.142 with only a minority of candidates incorrectly multiplying by 1.142. A common error was to overlook the requirement to give the answer correct to the nearest euro.

(ii) The majority correctly converted the euros to dollars and subtracted. A small number successfully used a longer method of converting to dollars to euros and then converting back to dollars. Some candidates did not use any conversions and merely subtracted 275 from 329.

(b) Few errors were seen. The most common error seen was to find $\frac{3}{8}$ of \$5.25 rather than recognising that the \$5.25 should be multiplied by $\frac{8}{3}$ to find the money saved during the month.

(c) The majority of candidates attempted compound interest and correctly set up the implicit equation, $6130 \times (1 + \frac{r}{100})^5 = 6669$. Errors included failing to take the 5th root, dealing incorrectly with $1 + \frac{r}{100}$ and premature rounding leading to inaccurate answers. A few candidates used trial and improvement to find the correct answer and a sizeable minority used simple interest.

Question 5

(a) The angle *AXC* = 102° was often seen. Those who knew to use the cosine rule usually reached the correct answer. Some candidates attempted longer methods such as first using the sine rule to find other sides or angles as part of their method, and whilst some were successful, most lost accuracy by premature rounding along the way. A common error when using the cosine rule was to evaluate $(6.4^2 + 10.6^2 - 2 \times 6.4 \times 10.6)\cos 102°$ rather than $6.4^2 + 10.6^2 - (2 \times 6.4 \times 10.6 \cos 102°)$.

(b) Those who correctly found angle *BAX* = 44° and used the sine rule, frequently reached the correct answer. Only a few candidates made errors in their rearranging of the sine rule. Again some candidates found other sides, such as *AB*, as part of their method and whilst some went on to find *BX* there were often errors in accuracy, usually from premature rounding,

(c) A small number of candidates correctly calculated the height of triangle *ABC* and used $\frac{1}{2}$ *x* base *x* height. The majority calculated the two triangles separately using the 78° and 102°. Those who attempted to use the whole triangle first calculated angle *ACB* or the side *AB*. This often led to premature rounding inaccuracy. The most common error was to use 10.6 as the perpendicular height rather than, for example, $10.6 \times \text{Sin}78°$.

Question 6

(a) This question was well done by most. Common errors were to show only *P*' or $P' \cap Q$

(b) The majority of candidates answered this correctly. The incorrect answers showed little evidence of the reasoning. Many were able to place the 5 correctly but this was not enough to score.

(c) (i) The majority of candidates interpreted the Venn diagram correctly and gave the correct answer.

(ii) Again the majority of candidates gave the correct answer, though a small number wrote 12.

(iii) A number of candidates answered this correctly. Those who failed to write the correct answer appeared to misunderstand the 'n' notation and gave answers that were set names.

(iv) Few candidates were able to describe the set accurately using set notation. Many candidates did not know the difference between intersection and union and wrote combinations of both. Others did not use the intersection symbol with the 'do not have brothers' and incorrect answers such as $(C \cap S)B'$ were frequently seen.

(v) A well answered question. Probabilities were written in acceptable form, the majority giving the answer as a fraction. Some candidates went on to give their answers as a rounded decimal number which is not necessary when the probability, as in this case, can be give accurately as a fraction.

(vi) This part answered correctly by only a minority of candidates. Most candidates were awarded one mark for $\frac{4}{19}$ but candidates either then calculated the probabilities with replacement, rather than not replacement, or they added, rather than multiplied, the fractions.

(vii) There were many clear correct explanations with candidates referring to the context of the question and explicitly including reference to $\frac{15}{30}$ or 15 candidates in their answer. Those that used the phrase 'equally likely' or probability of $\frac{1}{2}$ without reference to the context of the question and to '15' did not score.

Question 7

(a) Candidates who recognised that the numerator and denominator should be first factorised to create products were frequently successful. However, a common wrong approach was to merely cancel the x^2 in the first step with $\frac{x^2-25}{x^2-x-20}=\frac{-25}{-x-20}=\frac{5}{x+4}$, or similar, commonly seen.

(b) The majority obtained a common denominator and successfully expanded the brackets with only a few attempting to further simplify and introducing errors. A notable number of candidates did not know how to deal with the denominators when adding fractions with a common wrong approach to add the numerators and denominators separately as $\frac{x+5}{x}+\frac{x+8}{x-1}=\frac{2x+13}{2x-1}$.

(c) (i) Most candidates who attempted this question found the first derivative correctly. Not all candidates used the notation correctly with candidates using y when they meant $\frac{dy}{dx}$. Some candidates made the mistake of going on to find the second derivative.

(ii) Although there were correct answers given many found the value of y at $x = 4$ rather than from their $\frac{dy}{dx}$.

(iii) Most candidates who wrote $\frac{dy}{dx}=0$ went on to find the correct values for x though some made errors in the substitution of $x=\frac{4}{3}$ to find the y value. There were candidates who were unable to solve the quadratic other than writing $x = 0$. There was some misunderstanding of stationary points with candidates equated the original curve to 0 or only substituting $x = 0$ into y without any reasoning.

Question 8

(a) (i) Most candidates correctly completed the table, with only a few slips in arithmetic seen. Because the stem of the question said there were 50 children, candidates who had, for example, 3, 21, 42, 47, 49 could have expected to obtain 50 in the last box and been able to correct their error. Nevertheless, these candidates were awarded one mark. A significant number of candidates did not score because they had either merely copied the frequencies from the given table, gave the class widths or had multiplied or divided the class widths or mid-interval values by the frequencies.

(ii) The plotting of the numbers from their tables was well done and at the upper bounds. Some lost a mark because their curve did not go through their 5 plotted points. Some candidates drew blocks and a curve, which was not necessarily in the correct position in the intervals. A few candidates drew a line of best fit through the points.

(iii) If the curve was drawn correctly the answer was in range. Small errors in plotting usually led to an unacceptable value.

(b) The majority of candidates were drawing a box with whiskers. The common errors included misreading the Lower Quartile and Upper Quartile at 30 and 70 instead of at 25 and 75 or making mistakes with the scale on the box and whisker grid. Some candidates recognised that, in this question, the scales of the diagram and the grid were aligned and drew accurate vertical lines from the diagram to the grid to create an accurate box and whisker plot.

Question 9

(a) There were a lot of fully correct and well-presented answers with many candidates recognising that using Pythagoras' theorem in triangle *ABC* was the necessary starting point. With those finding BC correctly, common errors including omitting to include the area of one of the 3 rectangles or assuming that some or all of the rectangles had the same area. Common method errors included calculating $20^2 + 13^2$ to obtain *BC*, forgetting to divide by 2 when finding the area of a triangle, assuming the triangle *ABC* had angles of 45° or measuring the angles of the triangle and using trigonometry despite the diagram being labelled NOT TO SCALE.

(b) Whilst some candidates answered this correctly, there were a wide variety of incorrect methods seen including using the wrong triangle area or merely calculating $13 \times 20 \times 24$ or using methods involving π.

(c) Identifying the correct angle led to calculating *BF* or *AF* using Pythagoras and a correct use of trigonometry in the correct right-angled triangle. Premature approximation of side *BC* from **part (a)** or from the calculated length of *AF* or *BF* led to an inaccurate answer. A common error was not knowing which angle was to be found and many found angle *AFC* instead of *AFB*.

Question 10

(a) Most candidates completed the table correctly. Any errors seen were usually with the y values at $x = -0.5$ and $x = 4.5$ where the most common error was to give $y = 1.25$ at $x = -0.5$ from an error in the order of operations when evaluating $3 + 4 \times (-0.5) - (-0.5)^2$.

(b) The quality of the curve drawing was very high with curves seen passing through the correct points. Candidates read the scales carefully and plotted the non-integer values of *y* generally very accurately. The most common errors seen were the miss-plotting of either $(-0.5, 0.75)$ or $(4.5, 0.75)$. Candidates who used a ruler or whose curves had double lines or were not smooth were deducted one mark. Using a rubber to remove attempts that candidates wish to be disregarded would enable more candidates to score full marks.

(c) A number of candidates correctly gave 8 as a value of k for which the equation had no solutions. However a variety of other responses were seen indicating that many candidates had not understood the question.

(d) Although there were a small number of correct lines and answers given, this part proved difficult. Various strategies were seen for finding the solution, but only those who found the solutions after drawing the straight line graph, $y = 4 - 0.5x$, as required by the question, could score full marks.

Candidates who showed no method or who drew the graph $y = -1 + \frac{9}{2}x - x^2$ or who used the quadratic formula to obtain the correct solutions were only awarded one mark. Wrong methods included equating the original quadratic to the new quadratic or reading off the *y* values rather than the x values or reading off the x values where the original curve cut the x axis.

Question 11

(a) The most efficient method for finding the exterior angle is $\frac{360}{18}$ = 20 and those using this were frequently successful. Many candidates, however, used longer methods such as $180 - \frac{(18-2) \times 180}{18}$ and they too were often successful. It was common however for candidates to obtain 20 but spoil their method by adding to or subtracting from 180. The most common method errors included $\frac{180}{18}$, and $360-\frac{(18-2)\times 180}{18}$.

(b) Whilst some candidates clearly understood that multipliers were involved in this question, not all used $\frac{5.2}{5.2+2.6}$ with errors including $\frac{2.6}{5.2+2.6}$ and $\frac{2.6}{5.2}$ often used. Many other candidates used addition rather than multiplication with 6.75 – 2.6 = 4.15 being a very common wrong answer.

(c) A minority of candidates answered this part question correctly, recognising that $\frac{780}{32}$ gave the volume scale factor and that the cube root was required to find the linear scale factor of the heights. The majority of candidates did not cube root the volume scale factor but merely calculated $2\times\frac{780}{32} = 48.75$.

(d) It was rare for any candidate to adequately explain why the two triangles were congruent. Equal angles were often identified but acceptable reasons were not given. Candidates needed to use correct wording such as alternate angles or vertically opposite angles. Wording such as alt, z angles, alternative, alternate segment theorem were not accepted. In addition, angles needed to be named unambiguously, so, for example angle *N* was not accepted for angle *SNR*. Only a few candidates gave a final conclusion of congruency stating, for example, *ASA*.

Question 12

(a) Almost all candidates had no difficulty answering this part. The few errors seen usually came from errors in arithmetic.

(b) The most common error seen was to deal with the negative sign incorrectly and expand $3-2(3-2x)$ wrongly as $3-6-4x$. In addition many candidates did not use the correct order of operations and subtracted $3-2$ before expanding the bracket, to $3-2x$.

(c) This was answered well by a number of candidates. Others made errors when setting up and rearranging the equation into a 3 term quadratic. Those who factorised the quadratic usually gave the correct values with a small number making slips with the signs. Others used the quadratic formula and some completed the square.

(d) Again, this part was well answered with many scoring full marks and others scoring 1 mark for writing $x=3-2y$ by evidencing the correct changing of the x and y or for a correct first step in rearranging, usually to, $y-3=-2x$. The most common misconception was seen by those who did not understand inverse function notation and stated either $f^{-1}(x)=\frac{1}{f(x)}=\frac{1}{3-2x}$ or $f^{-1}(x)=-f(x)=-3+2x$.

(e) Whilst the first step was generally correct, problems arose when expanding $(3-2x)^3$. Many were able to expand $(3-2x)^2$ but then lost track of terms in x or x^2 or made errors with negative terms. Others expanded $(3-2x)^3$ with no middle terms as $27-8x^3$. Some forgot to add x^2+5 to their expression at the last step. There were very few fully correct answers.

MATHEMATICS

Paper 0580/42
Paper 42 (Extended)

Key messages

To achieve well in this paper, candidates need to be familiar with all aspects of the extended syllabus.

The recall and application of formulae and mathematical facts to apply in varying situations is required as well as the ability to interpret situations mathematically and problem solve with unstructured questions.

Candidates must learn to hold accurate values in their calculators when possible and not to approximate during the working of a question. If they need to approximate, then they should use at least four figures.

General comments

On the whole candidates were well prepared for this paper and demonstrated understanding of many areas of the syllabus. Some candidates were not sufficiently prepared for questions on new syllabus content such as graph sketching, application of differentiation to gradients and understanding asymptotes.

Candidates performed well on the more routine questions but had more difficulty when questions required interpretation of a topic or involved some element of problem solving.

Many candidates gave answers to the required accuracy, but some rounded intermediate values in multi-stage calculations which led to inaccurate final answers.

Most candidates showed full working with their answers and thus ensured that method marks were considered where answers were incorrect. This also included situations where candidates may show values on a diagram and where diagrams given are annotated, although care is needed to ensure for example when indicating an angle, the arc is clear and not covering more than the intended angle or if indicating a right angle then this is made clear.

If the variables in a question are given candidates should work with those variables or if not, clearly define the link between the variables given in the question and their own variables.

The areas that caused most difficulty were problem solving with bounds, asymptotes, reasoning with prime factors, solving equations involving indices, reasoning with median, problem solving with nets, sketching a cubic graph and harder sequence work.

The areas that candidates had the most success with were working with percentages and ratio, drawing algebraic graphs, rules of indices, drawing histograms, finding estimate of the mean, interpreting box-and-whisker plots, working with column vectors, using cosine and sine rule, rotating shapes, density and working with linear sequences.

Comments on specific questions

Question 1

(a) (i) Most candidates were able to work out the reduced price. As the answer of \$11.61 was exact, it was not acceptable to round this to 3 significant figures and give an answer of \$11.6 which was an error for some candidates. A small number found the reduction in price and gave the answer \$1.89. A small minority of candidates calculated a percentage increase or a reverse percentage.

(ii) Many candidates answered this correctly, although rounding the exact answer to 3 significant figures was again done by some. Some candidates worked with the original price rather than the sale price and some did not appreciate that the original tin contained 2.5 litres, so just multiplied by 42.5 rather than by 42.5 ÷ 2.5.

(b) (i) Most candidates calculated the percentage correctly, although a small number misread the question and found the percentage of red, rather than white, paint. Some gave the answer 53 rather than giving the required three significant figures.

(ii) Most candidates were able to divide in a ratio correctly. A small number found the number of red or white tins rather than green tins.

(c) Candidates found this question challenging. To find the smallest number of tins of paint to ensure that all the wall is painted requires finding the maximum possible area of the wall. Those who appreciated that bounds were required almost always found the lower bound of the area using 20.45 × 2.35 rather than the upper bound of the area using 20.55 × 2.45. Many candidates, however, did not use bounds at all in their area calculation and simply found the area using the given dimensions. Having found an area, most candidates were able to use this to find the number of tins of paint that would be needed. Some candidates misinterpreted this requirement and found the number of litres rather than the number of tins and some gave a decimal answer without understanding that a whole number of tins was required.

Question 2

(a) (i) Almost all candidates found the two missing values correctly.

(ii) Many candidates plotted points accurately and joined them with a neat, smooth curve. In cases where points were not on a gridline, some candidates plotted them in the incorrect small square, particularly at (0.5, 0.41). Having plotted points correctly, some candidates drew a curve that did not pass through these points. It is easier for candidates to draw an accurate graph if they draw small crosses for their points and use a sharp pencil for the curve. A small number of candidates joined their points with a ruler or did not join them at all.

(b) The rearrangement of the equation to find the equation of the straight line was found to be a challenge. Many candidates did not identify the connection between the equation given in this part and the graph they had already drawn. Those who did reach $y = 2.5 - 2x$ usually drew it correctly and read the solution from the graph correctly. A common error was to draw the line $y = 2.5 - 2x$ or to attempt to draw the graph of $y = 2 \times 0.5^x + 2x - 3.5$ on the axes rather than a straight line as required by the question.

(c) Very few candidates were able to identify the highest possible value of k and many were clearly unfamiliar with the term asymptote. Answers such as 3, the highest value on the y-axis, or ∞ were common. For the equation, candidates often repeated the given equation or gave a word such as linear or curved.

Question 3

(a) (i) This was very well answered. Some candidates dealt with the powers correctly but also multiplied the numbers leading to an answer 49^{11}.

(ii) This was also very well answered. Some candidates dealt with the powers correctly but also divided the numbers leading to an answer 1^{10}.

(iii) Most candidates answered this part correctly, although some left the answer as 49 rather than as a power of 7 as required.

(b) It was more common to cube each term separately and then attempt to combine the terms rather than simplify the bracket to $10x^3y^4$ and then cube the result. This led to the common answer of $125x^6 \times 8x^3y^{12}$ because candidates did not realise that this could be simplified further. Some candidates were unable to cube the numbers correctly and others made an error dealing with one or more of the indices, often failing to cube x in $2xy^4$.

(c) (i) Candidates who understood the term highest common factor usually gave the correct answer here. Many candidates showed correct prime factorisation of 540 and gained partial credit even if they did not know how to use it to find the HCF.

(ii) Those who had the correct HCF usually also found the correct lowest common multiple, and some found this correctly even without the correct HCF.

(iii) This part was found to be very challenging and incorrect answers of 1, 2 and 8 were common. Few candidates understood that in a cube number the prime factors will all have powers that are multiples of 3. Using this fact, they could identify that the smallest cube number would be $2^6 \times 3^3 \times 7^3$ leading to $R = 2 \times 7^2$.

(d) (i) Most candidates were able to factorise the expression correctly. The most common error was to reverse the signs to give $(x-4)(x+7)$.

(ii) Few candidates were familiar with how to factorise this expression and many started by expanding the given brackets and often went no further. Some identified that (a + 2*b*) was a common factor of both terms but were not able to reach a correctly factorised expression. A common error was to give an answer of $(7+4a)(a+2b)$ or $(7+4a)(a+2b)^2$.

(e) The first step required here was to convert 9^x to a power of 3, then rules of indices could be used to combine the terms and set up a linear equation in x and y. Those candidates who identified this first step often went on to reach the correct answer. Some converted 9^x incorrectly to 3^{3x} rather than 3^{2x}. Other candidates did not convert the base and their final answer still contained the 9^x term. It was also common to see an attempt at multiplication by 9^x leading to an equation with base 27 on the left-hand side. Some candidates used index laws incorrectly which led to a non-linear equation in x and y.

Question 4

(a) (i) Most candidates drew the histogram correctly, although a few inaccuracies in drawing occurred, for example height 7.5 drawn at 7.4 or 7.6. Most candidates did not show any working apart from the graph.

(ii) Many candidates were successful. A few, who knew the method, made occasional errors with one or two of the mid-interval values. By far the most common error was to use the width of the interval as the value of x instead of the mid-interval value. Just a few candidates added the frequencies and divided by 5. Some gave answers to 2 significant figures of 3.7 or 3.8 without a more accurate value seen first and often without sufficient working shown to be awarded full method marks.

(iii) The vast majority of candidates gave the correct probability although $\frac{7}{40}$ was a common wrong answer.

(iv) This question proved difficult for many candidates. Most did not recognise that they were selecting from the parcels that were greater than 2 kg and so their first probability was $\frac{4}{40}$ instead of $\frac{4}{29}$. Many also did not realise the need to change the denominator for the second probability, ignoring the 'without replacement' information. The candidates with the correct approach were usually successful and recognised the need to include reverse of the order of events although others did not consider both of the products required.

(b) (i) This part was very well done. A few misread the scale giving 4.3 instead of 4.6.

(ii) This was also well done. Again a few misread the scale leading to 3.1 instead of 3.2 and some gave the range instead of the interquartile range.

(iii) Only the strongest candidates recognised that the median was unchanged and most of those gave satisfactory reasons. Most candidates thought the median was reduced due to the reduced total mass or number of parcels or because 2.4 kg was further away from the median than 5.8 kg.

Question 5

(a) (i)(a) This was well answered. Any errors were associated with the directed numbers, a few did **a** – **b**.

(b) Again this was well answered. The only errors were associated with the directed numbers.

(c) Most candidates were successful here in using Pythagoras' correctly to find the magnitude of the vector.

Some appeared to not understand the modulus sign.

There were some errors in the application of Pythagoras including -5^2 rather than $(-5)^2$. A few gave an answer 5.4 without a more accurate value in working.

(ii) There were many fully correct answers seen. Some scored partial credit for obtaining the value of *k* correctly. Some candidates did not manage to translate the vector equation into a linear equation form and were unable to proceed further.

(b) (i)(a) Almost all candidates answered this correctly.

(b) Many candidates were successful. The common error was in not considering the direction of the vector **q** resulting in $\mathbf{q} + \frac{\mathbf{p}+\mathbf{q}}{2}$. Candidates should note that methods marks are awarded for stating a correct vector route e.g. $\overrightarrow{CO}+\overrightarrow{OM}$, this was also the case in the next part.

(c) This part was done less well than the previous part. The error was again with the direction of a vector and a+ $\frac{2}{5}\mathbf{q}$ was very common.

(ii) Only a very small number of candidates gave a fully correct answer. A number gained partial credit for stating that $\overrightarrow{ON} = \mathbf{p} + \frac{3}{5}\mathbf{q}$ and for giving a final answer of the form $k\mathbf{p} + \mathbf{q}$.

Question 6

(a) Most candidates were able to correctly recall the cosine rule and show substitution of the values correctly. Where a question asks for a value to be shown, candidates are required to show the result of their calculation to at least one more significant figure than is given in the question to demonstrate that they have performed the calculation correctly. In this question, many gave no more accuracy than the 16.9 given in the question so were not given full credit. A small number of candidates used the sine rule to calculate angle *BCD* using the given value of *BD* = 16.9 and then used this angle to work back to 16.9: this is not an acceptable way to show the required result.

(b) To find the required angle, the most direct method was to use the sine rule to find angle *BCD* and then use the sum of the angles in triangle *BCD* to find angle *CBD*. Many candidates identified this method and reached the correct answer. Some candidates rounded or truncated values too early in the calculation and reached an answer of 74.4 which was outside of the acceptable range. A longer method of using the cosine rule to find *CD* and then the sine rule to find angle *CBD* was sometimes used, but the complex rearrangement of the cosine rule often led to errors or inaccuracies. Some candidates incorrectly treated *BCD* as a right-angled triangle.

(c) Most candidates identified that the area could be found using the sum of two triangle areas calculated using $\frac{1}{2}ab\sin C$. Some used trigonometry to find the perpendicular heights of each triangle then used the $\frac{1}{2}$ base × height formula. Many correct answers were seen or correct methods using an incorrect angle found in **part (b)** although some candidates had rounded prematurely which led to an inaccurate final answer. A small number of candidates used 75° in the area formula in place of angle *CBD* and some used an incorrect area formula.

(d) Many candidates identified that the shortest distance is the length of the perpendicular from *B* to *AD* and this line was often indicated on the diagram, however not all candidates clearly marked the right angle at the base and showed no working to indicate this was the case. The correct calculation of 16 sin 57° was often used to calculate this length. A common error was to assume that the perpendicular bisected *AD* which led to an incorrect use of Pythagoras' Theorem with 16 and 9.5.

Question 7

(a) (i) The translation was correctly drawn by only a small number of candidates. The majority did not take the axis scales into account and completed a translation by 2 squares across and 1 square down so an actual translation of $\begin{pmatrix} 1 \\ -0.5 \end{pmatrix}$. Partial credit was awarded for this. A small number of candidates were unable to decode the given vector correctly and drew the translation by the vector $\begin{pmatrix} -1 \\ 2 \end{pmatrix}$.

(ii) The vast majority successfully completed the rotation by 90° clockwise about the origin. Of those who did not, the most common error seen was rotation by 90° clockwise about a different centre or by a rotation of 90° anticlockwise about the correct centre.

(iii) There were a number of correct enlargements. Those who did not score both marks often drew an enlargement of scale factor $\frac{1}{2}$ rather than $-\frac{1}{2}$. There was a tendency for some candidates to draw the ray lines and complete one vertex or two vertices correctly but then guess incorrectly at the position of the remainder. A few candidates drew ray lines but then did not attempt to draw a triangle at all. There were a few candidates who marked the position of the centre of rotation but did nothing further.

(b) Most candidates correctly identified the transformation as a reflection. Of these many also correctly identified the mirror line as $y = -x$ or $x + y = 0$. There were a number who thought the mirror line to be $y = x$, or named a point rather than a line. A small number of candidates gave a combination of two or even three transformations.

Question 8

(a) The majority of candidates found this part very challenging. Many however were able to gain partial credit for showing at least one of the required equations involving *L*, *W* and *H.* The strongest solutions started with two equations in the variables *L*, *W* and *H* and used the relationship $L = 2W$ to rewrite their equations as two simultaneous equations. Some candidates introduced new variables such as *X* without linking *X* to one of the variables in the question. The most common error was to write $2L + 2W = 37.8$ instead of $2L + 2H = 37.8$ A small number of candidates incorrectly worked with the surface areas.

(b) (i) This was generally well answered. Among the errors were candidates that decided to work with their own formula for the volume of a pyramid or used an incorrect height for the pyramid. A mark was available for the correct units and most who used g and cm in their calculation gained this mark. A few candidates tried to convert from one unit to a different one e.g. kg and m and this caused unnecessary difficulty and usually errors

(ii) Most candidates gained some marks for this part by starting with a correct expression for the diagonal *BD*. On the diagram, some indicated the wrong angle and could not visualise the right-angled triangle required. To find the correct angle required the use of two numerical values which in some cases due to premature rounding led to an answer which was out of range. When compared to previous sessions an increasing number of candidates are using the exact (surd) functions on their calculator which enabled better accuracy.

Question 9

(a) (i) This part proved challenging for many. Candidates that were successful generally used one of two methods, either showing that the expression factorised to $x(x-2)^2$ leading to the answer of 2 when comparing it to $x(x-a)^2$ or alternatively $x(x-a)^2$ expands to $x^3-2ax^2+a^2x$ also leading to the answer of 2 when comparing to x^3-4x^2+4x .

(ii) Curve sketching is new to the syllabus and the sketching of the curve for the equation in **part (a)(i)** proved to be very challenging.

Candidates are expected to have knowledge of cubic graphs and also when a curve passes through the origin. Sketching a correctly shaped positive cubic passing through the origin was awarded two of the available marks. A significant number of candidates did not draw a cubic curve.

The other two marks were for the curve touched the x-axis at $x = 2$ and this being the only turning point on the x-axis. These two marks proved to be more difficult to achieve by most candidates.

(b) A significant number of responses did not make any use of differentiation and so were limited to at most 1 mark for determining the correct y-coordinate at $x = 4$. These attempts tended to find the gradient of a straight line passing through (4, 16) and a second point, sometimes the origin and sometimes a second point on the curve. Those candidates familiar with calculus and its application to the tangent to a graph found this to be a very accessible question. Many candidates gained full marks by correct use of differentiation and the equation of a straight line.

Question 10

The majority of candidates obtained 125 and 29 for sequences A and B, but fewer were able to obtain 25 or 25.25 for sequence D. There were two possible answers that were both given full credit for sequence D.

Similarly, many obtained the correct nth terms for sequence A and B, n^3 and $6n - 1$ (or the equivalent $6(n - 1) + 5$).

The nth terms for sequence C and D proved more difficult to find.

Some recognised the exponential nature of sequence C but made errors in the base for the nth term, with n or 0.5 with an incorrect power being the most common. The correct expression $0.25 \times 2^{n-1}$ was sometimes seen in working but in the answer space this was incorrectly written as 0.5^{n-1}. Many candidates did not spot that sequence D was sequence B subtract sequence C and of those that did, not all of them had the confidence to use their nth terms for B and C to write the nth term for D. Candidates who used differences to find 25.25 were unable to find the appropriate nth term.

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 and only the final answer rounded to the appropriate level of accuracy.

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

General comments

The paper proved accessible for most candidates and the standard of performance was generally good, with most candidates attempting all questions. Some candidates showed working with stages that could be easily followed. In other cases, candidates omitted some stages or did not show calculations at all. For some candidates, improving their presentation would help, as there were several instances where candidates miscopied their own figures. Candidates appeared to have sufficient time to complete the paper and any omissions were due to lack of familiarity with the topic or difficulty with the question, rather than lack of time.

Most candidates followed the rubric instructions but there continue to be a significant number of candidates losing unnecessary accuracy marks by either making premature approximations in the middle of a calculation or by not giving answers correct to the required degree of accuracy.

The topics that proved to be more accessible were percentage change, reverse percentage, straightforward algebraic manipulation, simultaneous equations, use of a frequency table to find mode, median, range and mean, interpretation of a cumulative frequency diagram, Venn diagrams and simple probability, right-angled triangle trigonometry, Pythagoras' theorem, use of the sine rule, much of the early work on functions and the early sequence work. The more challenging topics were more complex exponential growth, combined percentage change, simplifying algebraic fractions, mean of grouped data from a histogram, algebraic manipulation of volume formulae, areas of sectors and segments and volumes of related solids, working in three dimensions, differentiation and harder inverse functions.

Comments on specific questions

Question 1

(a) (i) Candidates were well prepared and most obtained the correct total amount. Finding the value of one part of the ratio was the most common approach while some successfully set up an equation to find the amount. A few earned partial credit for correctly finding either Yasmin's or Zak's share of the money.

(ii)(a) Many correct responses were seen with most candidates opting to calculate 85 per cent of \$40. In a few cases, candidates mistakenly took the \$40 as the sale price or treated the 15 per cent as an increase in the price. For some candidates working consisted of just (1 – 15 per cent) × 40 or 85 per cent × 40. This was not a problem when the candidates gave a correct answer. If the final answer was incorrect then this working was insufficient to earn a method mark. Candidates needed to show the conversion of the percentage to a decimal or fraction, for example, $(1 - 0.15) \times 40$ or $\frac{85}{100} \times 40$. A similar comment applies to the remaining parts of the question.

(b) Many correct responses were seen, although not quite as many as the previous part. Some candidates mistakenly took the $29.75 to be the cost price but the most common error involved increasing the sale price by 15 per cent.

(b) (i) Most candidates were familiar with the method for repeated percentage increase and obtained the correct salary. Some lost the final mark by forgetting to round their final answer to the nearest dollar. A small number attempted year-on-year calculations and occasional premature rounding resulted in an incorrect final answer. A small number used an incorrect number of years, usually six, calculating an increase for all the years from 2010 to 2015 inclusive.

(ii) Calculating the required number of years was often carried out successfully, although some then gave 9 years as their answer instead of the year 2019. Some used trial and improvement either to calculate the salaries in different years or to calculate the number of number of years required for the multiplier to be greater than 1.1845. Although not required by the syllabus, some candidates successfully used logarithms to solve $1.02^n > 1.1845$.

(c) This proved challenging for candidates of all abilities and an answer of 3 per cent was more common than the correct answer of 2.9 per cent. Successful candidates often worked with correct multipliers of 1.05 and 0.98 in some form or another. Others preferred to use a starting value, calculate the populations in 2020 and 2021 and then successfully calculate the overall percentage change. Some candidates gave their final answer as 102.9 per cent.

Question 2

(a) (i) Almost all responses were correct with any errors usually due to numerical slips.

(ii) Most candidates had a good understanding of the order of operations and were able to rearrange the formula correctly. In a small number of cases, some candidates had a correct answer in the working but gave an incorrect version in the answer space, usually involving a square root covering the numerator only.

(b) (i) Most candidates factorised the quadratic expression correctly. In a few cases, candidates earned partial credit for reaching $(5x + 4)(3x - 2)$. A small number of candidates solved the quadratic equation as their first step but this usually led to an answer of $\left(x - \frac{4}{5}\right)\left(x + \frac{2}{3}\right)$ which earned no credit.

(ii) Most solutions to the quadratic equation were correct with many using their factors from the previous part. Some candidates did not see the connection and used the quadratic formula to find the solutions. A significant number of the solutions were not given correct to at least three significant figures.

(c) Many candidates displayed a good understanding of factorisation, spotting not only the common factor of x but also that the other factor was the difference of two squares. In general, the weaker candidates tended to go no further than $x(x^2 - 16y^2)$.

(d) This proved to be more challenging than the previous parts with only a small majority of candidates reaching the correct answer. Factorisation of the denominator proved to be the most accessible part for candidates of all abilities. The numerator presented more of a challenge with weaker candidates attempting only a partial factorisation. Even some stronger candidates struggled with this part. A small number of candidates factorised correctly but then did not simplify their answer by cancelling a common factor. After reaching $\frac{2x-1-2a(2x-1)}{x(2x-1)}$ a significant number of candidates cancelled the $(2x - 1)$ in the numerator with just one of the $(2x - 1)$ terms in the numerator, not realising that it resulted in 1 and not 0. Answers such as $\frac{2x-1-2a}{x}$ and $\frac{-2a(2x-1)}{x}$ were common incorrect answers.

Question 3

(a) (i) Many correct answers were seen. The most common incorrect answer was 6 to 10 without finding the actual range.

(ii) Candidates fared even better with the mode and incorrect answers were few and far between.

(iii) This proved to be the most accessible part with almost all candidates giving a correct value for the median.

(b) (i) The large majority of candidates obtained the correct median from the graph. Most incorrect answers usually involved reading from the wrong value of cumulative frequency.

(ii) Having to read off two quartiles provided more scope for errors and overall candidates were slightly less successful in this part. It is important that candidates clearly identify their two quartiles, especially when one of them is incorrect. Several candidates calculated $\frac{3}{4}$ of 100 = 150, $\frac{1}{4}$ of 100 = 50 followed by 150 – 50 = 100 while a small number gave either the LQ or UQ value as the interquartile range.

(c) Candidates displayed a good understanding of calculating the mean of a discrete distribution and many correct answers were seen. Most errors resulted from either division by a total frequency other than 200 or from occasional slips, usually when calculating the various products.

(d) This proved quite challenging and stronger candidates usually fared better. Calculating the frequencies was the first step but a significant proportion of candidates either could not or did not realise that this was required. Those that were successful usually went on to make a good attempt at the mean, sometimes losing out by the occasional numerical slip but some used interval boundaries or interval widths instead of the midpoints. A small number of candidates treated the five given intervals as eleven intervals of equal width and calculated the mean correctly.

Question 4

(a) (i) Nearly all candidates realised the midpoint was given by the average of the *x*– and *y*– coordinates of the points *A* and *B*. The most common error was subtracting the coordinates before dividing by 2.

(ii) Most candidates were able to find the gradient of *AB*, either by using $\frac{y_2 - y_1}{x_2 - x_1}$ or by forming two equations and solving them simultaneously to find the gradient and intercept. Weaker candidates often gave the equation of *AB* as their final answer. Some of those that continued found the gradient of the perpendicular correctly. Common errors at this stage usually involved giving the perpendicular gradient as $\frac{1}{2}$ or –2. A good proportion then correctly used their midpoint from the previous part to find the equation of the perpendicular. Common errors at this stage usually involved using the coordinates of either *A* or *B* instead of the midpoint.

(b) (i) It was evident that without a diagram some candidates were confused with direction and position, often adding the two given position vectors to give the common incorrect answer of $\begin{pmatrix} -4 \\ 8 \end{pmatrix}$. Only a small majority gave the correct vector $\overrightarrow{PQ}$.

(ii) Candidates were required to find the position vector of *R* and the correct use of $\overrightarrow{OP} + \overrightarrow{PR} = \overrightarrow{OP} + 3\overrightarrow{PQ}$ was seen in only a minority of responses. Most candidates correctly multiplied their $\overrightarrow{PQ}$ by 3 but a high proportion gave this as their final answer. Some of those that continued appeared confused with the directions and it was common to see $\overrightarrow{PR} - \overrightarrow{OP}$ rather than $\overrightarrow{PR} + \overrightarrow{OP}$. Candidates would be well advised to draw a sketch showing the relevant information given in the question which would help in determining the correct order for the vectors.

(c) (i) Most responses showed that candidates had a good understanding of the route required to find $\overrightarrow{OY}$ and the use of $\overrightarrow{OU}+\overrightarrow{UY}$ and $\overrightarrow{OT}+\overrightarrow{TY}$ were seen in roughly equal numbers. Many candidates stated expressions for $\overrightarrow{UY}$ and $\overrightarrow{TY}$ in terms of **u** and **t**, almost always relating this correctly to the given ratios $\frac{1}{3}$ and $\frac{2}{3}$. Most of the errors seen were directional, so that, for example, $\overrightarrow{UY}$ might be given as $\frac{2}{3}$(**u** – **t**) or $\overrightarrow{TU}$ as **t** – **u**.

(ii) Most candidates that recognised that triangles *OUT* and *ZYT* were similar and that the ratio of sides was given in the information usually gave a correct answer with little or no working. Candidates who did not recognise this similarity usually attempted to find a route, often leading to more complicated and unsimplified incorrect expressions. A significant proportion of candidates made no attempt.

Question 5

(a) Almost all candidates solved the simultaneous equations correctly. Subtracting the two equations was the most common method followed by the substitution method. A few candidates opted to multiply the equations in order to eliminate the y terms.

(b) Stronger candidates had no difficulty in solving the pair of equations with most opting to equate the two expressions for y. A significant number rearranged the linear equation to make x the subject and substituted this into the second equation. These candidates were usually less successful as the method provided more opportunities to make algebraic slips. Having reached a quadratic equation either in x or y most opted to factorise but a significant number did use the quadratic formula. Some candidates only gave one value of x while some divided the quadratic in x by x leading to just $x = –3$. As the question was of a higher demand many of the weaker candidates were prone to making algebraic slips in their working or were unsure of how to start.

Question 6

(a) Candidates displayed a good understanding of the Venn diagram and many completed the diagram correctly. Ignoring the 1 that was already given and assuming that all 24 liked homework or tests, leading to the answer 9 9 6, was the most common error. Some had the correct numbers but in the wrong positions on the diagram. Candidates who were unsure of how to proceed often gave answers of 18 0 15 or 18 blank 15.

(b) With the diagram completed, almost all candidates were able to give an answer that followed on correctly from their Venn diagram.

(c) Success in this part was dependent on the interpretation of $H' \cap T$. A majority did so correctly but the common incorrect interpretations usually involved either n(H') and n(T).

(d) Without the notation to interpret, candidates were more successful in this part. The most common error involved a candidate picked at random from those who liked tests and not from the class and in some cases candidates forgot to include the candidate who liked neither homework nor tests.

(e) A majority of correct responses were seen. However, the fact that only one candidate liked neither homework or tests caused problems for a significant number of candidates. Some gave the correct probability of $\frac{1}{24}$ for the first candidate and gave it as their final answer while others multiplied it by probabilities such as another $\frac{1}{24}$ or $\frac{1}{23}$. Some did use the correct probability of $\frac{0}{23}$ but then multiplied incorrectly. Other errors involved the addition of the probabilities.

(f) This was more challenging than previous parts and this was reflected by a minority of correct responses. The most common mistake was taking 24 and 23 as the denominators, i.e. picking from the whole class and not just those that liked homework.

Question 7

(a) A majority of correct responses were seen with misinterpretation of the shaded and unshaded circles the cause of most errors. A few gave the answer as $-2 < 1$.

(b) (i) Candidates seemed very familiar with completing the square and many correct answers were seen, often with little or no working. Some expanded $(x + p)^2 + q$ and compared coefficients and were equally successful. Common errors included $(x + 2x)^2$ and an incorrect constant, usually +1 or +3.

(ii) Fewer fully correct responses were seen as many candidates ignored the instruction to use their answer from the previous part. Instead, they solved $x^2 + 4x + 1 = 0$ using the quadratic formula. Answers were usually given as decimals, but not always to correct to three significant figures, and a significant number gave the answers in surd form.

(iii) Many candidates identified the correct coordinates of the turning point. However, some failed to recognise that they could read the coordinates from the completed square form. As a result, some chose to differentiate the equation of the curve instead of using their answer to **part (b)(i)**. A significant proportion of candidates made no attempt.

(iv) Candidates were expected to recognise the shape of the graph from its equation and use the answer from **part (b)(iii)** to fix its position on the grid. However, some candidates unnecessarily plotted extra points other than the key features. Errors were often due to graphs passing through the origin or not intercepting with the *y*-axis. Some candidates seemed to be unaware of the shape of a quadratic graph and a wide variety of incorrect curves and straight lines were seen.

Question 8

(a) (i) Almost all candidates obtained the correct volume and any errors usually resulted from slips with the arithmetic.

(ii)(a) Yet again, many correct answers were seen. The most common error usually involved candidates treating the cuboid as having two equal opposite faces and the remaining four faces as being equal. Occasionally, some candidates found the area of one face and multiplied by six.

(b) Only a small majority gave a correct cost per unit area with some candidates working in dollars and not cents. The most common errors usually involved $800 \div 152$ and 800×152. Candidates with an incorrect surface area could earn the mark in this part for a correct method and giving their answer correct to three significant figures. In such cases many candidates gave their answer to two significant figures.

(b) This part differentiated well across the ability range with only a minority of correct responses being seen. Stronger candidates had no difficulty in setting up a correct equation, rearranging it to find r^3 and then giving the correct expression for *r*. In other cases, partial credit was earned for setting up the correct equation but the rearrangement to r^3 often involved errors, usually when dealing with the $\frac{4}{3}$ and the $\frac{9}{2}$. Setting up a correct equation proved challenging for many candidates and incorrect expressions for the volume of the cylinder, quite often $2\pi x^2.\frac{9x}{2}$, $\frac{1}{3}\pi x^2.\frac{9x}{2}$ or $2\pi x.\frac{9x}{2}$ were often seen. In other cases, candidates used *r* for the radius of the cylinder.

(c) This part proved challenging for many candidates and few fully correct answers were seen. Most candidates appreciated the need to find the area of the cross-section of the water, multiply this by the length and convert their answer to litres. The difficulty arose in finding the area of the segment. Many treated the segment as a semicircle of radius 5 while others simply used the cross section of the cylinder and divided it by 4 and sometimes by 4^2. Stronger candidates realised that the segment could be found by using the area of a sector and a triangle. A variety of trigonometry methods was used to find the sector angle. Errors, such as finding only half of the sector angle or finding the wrong angle, were common and in a lot of cases candidates simply estimated its value, often as 120° or 90°. Some used their angle to find the area of the triangle while others preferred to use Pythagoras to find the height before finding the area. The conversion from cm^3 to litres was not always known, with some dividing by 10 or 100. Some stronger candidates converted the lengths to decimetres at the start, knowing that 1 dm^3 was the same as one litre.

Question 9

(a) This part of the question was accessible to most candidates and full marks were awarded for a majority of the responses seen. Working was usually clear and efficient in many cases with good manipulation of the sine and cosine rules to reach correct explicit forms. When working with triangle *BCD* some used the sine rule while some preferred splitting the triangle into two right-angled triangles with a perpendicular line from C to the side DB. Some candidates were confident in working with surd expressions generated by the angles of 60 and 45. However, a significant number of candidates rounded their lengths prematurely during the working out stages and lost the accuracy of the final answer. Calculating *AD* as 8.03 and rounding it to 8 before using the 8 to find *AB* was a typical example. Weaker candidates usually earned credit using standard trigonometry in triangle *ABD* but then failed to make any further progress with the application of the sine rule

(b) (i) This part of the question proved more challenging for candidates. Those using the efficient method of $x^2 + x^2 + x^2 = 8.5^2$ were usually successful. However, those who found the length of the base diagonal as $\sqrt{x^2 + x^2}$ often failed to square this expression when substituting it into their expression for *AB* as $\sqrt{\sqrt{x^2 + x^2} + x^2}$. A very common incorrect method was $x^2 + x^2 = 8.5^2$ leading to a length of 6.01. Several candidates assumed a value for the angle between *AB* and the base, usually 45, in order to calculate the edge of the cube. A significant number failed to give the required degree of accuracy with an answer of 4.9.

(ii) A majority of candidates identified the angle required find its correct value. Most used a sine calculation while some used a less efficient method by combining Pythagoras and cosine or tangent. Some were successful but those with an incorrect edge length in the previous part only gained the two method marks here. However, a small number of candidates gained full marks using $\tan = \frac{x}{\sqrt{2}x} = \frac{1}{\sqrt{2}}$. A significant proportion of candidates made no attempt.

Question 10

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

(ii) Again, this was almost always answered correctly.

(iii) Although fewer correct responses were seen, a large majority of candidates gave a correct answer. The composite function gf(2) was occasionally misinterpreted as either fg(2) or as g(2) × f(2).

(b) A majority of correct answers were seen. Some candidates started correctly but made errors in manipulating the algebra, usually involving an incorrect sign. Some left their final answers in terms of f(x) or y and a few answers of $\frac{1}{3x-2}$ were seen.

(c) Most candidates made a positive start in their attempt to find the composite function. Initial errors usually involved $(3x - 2)^2 + x$ and occasionally some used $(3x + 2)$ instead of $(3x - 2)$. Weaker candidates tended to make more errors when expanding the square term and incorrect expansions such as $9x^2 \pm 4$ and $3x^2 - 12x + 4$ were seen quite often. Although collecting like terms was usually done correctly it was common to see +4 – 2 simplified as –2.

(d) Many of the stronger candidates were able to find the correct derivative. Not all of them appreciated that the derivative of x is 1 and $2x$ was a common incorrect answer. Some candidates seemed unfamiliar with differentiation and in many cases simply factorised h(x) to give $x(x + 1)$. A significant proportion of candidates made no attempt.

(e) (i) This part proved challenging for many candidates and correct answers were in the minority. Some candidates were able to proceed from $j^{-1}(x) = 4$ to $x = j(4)$. Although not required by the syllabus, some successfully used logarithms. A wide variety of incorrect answers were seen, including 64, –81 and $\frac{1}{81}$.

(ii) This proved challenging and few candidates gave a correct answer. The idea that a function combined with its inverse has no effect on the operand seemed unfamiliar to many of them. A high proportion of candidates made no attempt at this question.

Question 11

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

(ii) A majority of candidates were able to describe the general term to term rule. Some had the right idea but had difficulty in describing it succinctly. All that was needed was to write ‘subtract 4 from the previous term’. There was some confusion between the term to term rule and the formula for the *n*th term, which was seen quite often.

(iii) Many correct answers were seen. Errors usually involved either an incorrect constant term, usually 11 instead of 15, and an incorrect coefficient of *n*, usually –5 instead of –4.

(b) (i) This part was answered well with nearly all correctly giving the correct values of the fractions for the 5th and 6th terms. Some did not evaluate the numerator or denominator, leaving these as $\frac{2\times5}{5+1}$ for example. These were insufficient to earn any credit if they were followed by an incorrect answer. A few converted their answers to decimals despite the question specifically asking for answers as fractions.

(ii) Those who equated the *n*th term to $\frac{3}{4}$ were often able to reach $n = \frac{3}{5}$. To complete the answer, candidates needed to recognise that *n* had to be an integer so that, as *n* was a fraction this meant $\frac{3}{4}$ could not be a term in the sequence. Some confused the terms of the sequence with the position of the term. The alternative method of considering terms of the sequence had to include the first term (calculated correctly) as that was the only term for which the value was equal to 1, whereas all the other terms had a value greater than 1. Candidates were rarely able to reach a valid conclusion using this method. A few candidates considered $2n$ and $n + 1$ for different values of *n* but did not consider the fraction formed so were unable to make much headway.