MATHEMATICS

Paper 0980/11
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 key words and instructions. Candidates also need to check that their answers are in the correct form, are accurate and make sense in context.

General comments

This paper proved accessible to a large majority of candidates. Most candidates showed some working and it was usually set out clearly. Candidates should show all their working to enable method marks to be awarded with each step shown separately.

The questions that presented least difficulty were **Questions 11(a)**, **14**, **18**, **22(a)** and **24(a)**. Those that proved to be the most challenging were **Questions 2**, **5(b)**, **20(c)** and **21**.

Comments on specific questions

Question 1

This question was answered well by many candidates. Most answers included the figures 46, but with incorrect place values when candidates did not know how many centimetres there are in a metre or divided instead of multiplying.

Question 2

Some candidates did not seem familiar with order of rotational symmetry. Common incorrect answers included 1, 2, 4 or attempts at finding angles. The answer 1 would often be accompanied by a single vertical line of symmetry on the diagram.

Question 3

This was answered well by most candidates. A very small number omitted the decimal point from their answer. Sometimes 5% was given as 0.5 instead of 0.05. Occasionally, $\frac{5}{25} \times 100$ was seen. Some achieved the correct value but then went on to take that from $25.

Question 4

Candidates who identified p as the common factor usually went on to give the correct answer. Some attempted to use an incorrect common factor, often 5. Some seemed to have little understanding of what was required, giving answers that appeared to be attempts at simplifying the given expression, so $6pt$ or $5p^2t$ were seen.

Question 5

(a) This was well answered, with most indicating the correct position for the probability on the scale. Some calculated the probability as 0.5 but then did not draw an arrow on the scale as a few seemed not to realise that half a division corresponded to the probability of selecting one pen.

(b) This part was not answered very well as many seemed to be under the impression that the arrow had to point to one of the dividing lines on the diagram. Candidates sometimes showed a correct probability as a decimal or percentage but then did not go on to plot the value correctly. A very small number of candidates showed two arrows rather than attempting to indicate the combined probability of red or blue.

Question 6

(a) Some candidates appeared not to be confident of rounding to the nearest 10 as answers such as 847 and 8500 were seen.

(b) This part was also challenging for some with common incorrect answers of 16.1, 16.10 or 160.86

Question 7

In most cases, the candidates who showed the conversions to decimals went on to achieve both marks. Often the candidates that did not show any working were incorrect in their ordering, suggesting uncertainty of the required methods to convert to a common form. A recurring error was to place 37% as the largest value.

Question 8

Most candidates made a good attempt at this, with the majority showing correct construction arcs and drawing a triangle that was within the required tolerance. A number of candidates drew one arc or a side which was 1 cm too long or short. The most common error was a triangle with no arcs either because they had been erased or that compasses were not used.

Question 9

Most candidates were able to perform the correct calculation, but many had difficulty giving their answer to the correct accuracy. Instead of an answer correct to 2 significant figures, many answers were rounded or truncated to 2 decimal places. A small number of candidates who reached the value of 4.6 spoilt their answer by including superfluous zeros but many of these were awarded a partial mark for a correct interim value. Those that ignored the order of operations obtained an incorrect answer of 16 (from $16.379 - 0.879 \div 4.2 \times 1.241 = 16.119...$). A small number rounded each number in the calculation before inputting into their calculator.

Question 10

This was answered well. Occasionally, the first step of dividing 518 by 7 was replaced by dividing 518 by 2 and 5 for each answer in turn.

Question 11

(a) This was very well answered. Sometimes the thousands became hundreds and some muddled teens and tens so fifty and sixteen were seen.

(b) Many candidates did not appear to understand standard form so this was not well answered. Quite a number rounded 15 060 to 15 100, or other rounded forms, before attempting standard form so 1.5×10^4 was a common answer. In questions of this type, all the digits should be present.

Question 12

Many candidates recognised what was required here, although a significant number were unable to deal with the negative terms correctly. A large number of candidates adopted a factorising approach, for example showing $c(5-2)+d(-1-3)$. Many of these candidates didn't simplify further and there were also many sign errors seen. Often the final answer was $3c-2d$ which gained partial credit as one term was correct.

Question 13

Most candidates were able to complete this correctly. There were few candidates using inaccurate values for π. Candidates who did not gain the method mark were usually unable to substitute 12 into the correct formula, frequently either substituting 6, working with $2\pi r$, or squaring π instead of (or along with) squaring 12. A small number used $2\pi r^2$ or $\frac{1}{2}\pi r^2$. A few did not use π in their calculations at all.

Question 14

This was very well answered. The candidates who did not score usually had multiplied rather than divided and gave \$7 148 500. In this question, more than many others, it was clear that some had reversed digits (i.e. 24 560) when using their calculators – this is another area, particularly with numbers with many digits, where candidates must take care.

Question 15

This proved to be a challenging question for many candidates. Some found the rate over 10 years (15) rather than per year. Many did not seem to know the formula for simple interest and so used a method that was completely incorrect, including using the compound interest formula. Writing $P\times r\times T$ equal to 690 rather than just the interest, 90, was a commonly seen incorrect first step. Others also forgot to divide by 100.

Question 16

There were many good answers seen to this fractions question. Candidates who used a cancelling method usually reached the correct final answer. Some candidates started correctly, but then attempted to use a common denominator or inverted one or other of the fractions. Some made errors in arithmetic as they tried to cancel down to the simplest terms. According to their working, a few candidates seemed to think multiplying by $1\frac{1}{7}$ was the same as multiplying by 1 then by $\frac{1}{7}$.

Question 17

This was generally answered well, the common errors being to add the coefficients or multiply the powers. A number of candidates attempted to factorise the expression to $x(2x^2\times 3x)$.

Question 18

This was generally answered well; the most common errors were to give an incorrect answer for the missing fraction or give 0.8 for the decimal.

Question 19

(a) Most candidates knew that the median meant the middle but many didn't order the data first and some only counted one of the 14s. A very common approach was to cross numbers off at either end of an ordered list but this was often unsuccessful because many continued until they had a single value, either 32 or 38; they did not realise that, in this case, there was a middle pair. Some found the middle values from the unordered list. Others identified 32 and 38 correctly but calculated $32+38\div 2$ rather than $(32+38)\div 2$, suggesting that they had used their calculators without considering the order of operations. A significant number found the mean rather than the median.

(b) This was answered more successfully than **part (a)**. A significant number either made errors identifying the largest and smallest values, or didn't complete the subtraction, suggesting that the range was '8 to 93'. Others calculated the mean and very occasionally, 14, the mode, was seen in either **part (a)** or in this part.

Question 20

(a) Whilst most candidates gave the correct response, answers seen ranged from 0.009 to 21 000 km, suggesting that candidates were not considering whether their answers made sense within the context. A number of candidates made errors based on the misunderstanding of the vertical scale where one square represents 3 km.

(b) Most candidates clearly understood that Juan had arrived at the shop and that he stopped. Some candidates stated that Juan stayed in the shop for a period of time but the question required candidates to describe what was happening at a particular instant. Common misconceptions included ‘Juan is moving at a constant speed’.

(c) The majority of candidates completed the travel graph correctly and drew an accurate ruled line. The errors seen included un-ruled lines or lines going to an incorrect time on the axis. Some candidates drew two straight lines from (15 15, 15) to (15 45, 6) and then to (16 15, 0) as they thought the return journey should replicate the outward journey.

Question 21

There were some excellent answers seen to this question. There were many candidates who identified the need to use cosine who were then unable to rearrange their equation to make x the subject. A common error was for candidates to round the final answer as well as intermediate values, for example giving cos 43 to only 2 decimal places, and then using the rounded values in the next step of their calculations, leading to inaccurate final answers which could not gain the accuracy mark. A large number of candidates opted to use tangent, which calculated the vertical side, and of these, only a minority went on to use Pythagoras’ theorem in a longer method.

Question 22

(a) Candidates answered this algebra question well. The most common error was to expand $8(w + 11)$ as $8w + 11$. Candidates should not leave their answer in an embedded form, i.e. as $8(4 + 11) = 120$ instead of just the required 4, on the answer line.

(b) This was not answered as well as the previous part and a variety of errors were seen. Some candidates were unable to complete a correct first step, sometimes either adding 2 or subtracting 2 from the right-hand side. Others were unable to deal with the division by 3, often multiplying $x – 2$ by 3. A number of candidates who reached $x – 2 = 9$ went on to state that $x = 7$. Other errors occurred when candidates tried to do two steps at once.

Question 23

There were many excellent responses seen as well as many who did not attempt the question. 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 and that also has the fewest places where errors (method or arithmetic) might be made. The simplest elimination method with these specific equations is to multiply the first equation by 1.5 then add; other than that, both equations need to be multiplied in order to eliminate one variable. Candidates using elimination methods frequently made sign errors or made an incorrect decision as to whether to add or subtract their equations as well as arithmetic errors. Candidates using substitution or equating methods were usually able to rearrange one or both equations, but many made errors when dealing with the resulting algebraic fractions. Candidates who substituted into the first equation reached the correct solutions more frequently than those who substituted into the second equation.

Question 24

(a) This was answered well by a large number of candidates. Some did not see the symmetry (apart from the sign changes) in the table so gave different absolute values for $x = \pm 5$.

(b) Whilst there were some excellent graphs, there were significant issues with accuracy of plotting the points that were not on the major grid lines and drawing the graph as it approached the asymptotes. A significant number of candidates plotted both parts of the graph either in quadrants 4 and 1 or 2 and 3. Many did not realise that there should be nothing between $x = –1$ and $x = 1$ and joined the two parts of the graph together. Some ruled lines between some or all of the points. A few candidates plotted the points but did not draw in the curve.

MATHEMATICS

Paper 0980/21
Paper 21 (Extended)

Key messages

To succeed in this paper candidates need to have completed full syllabus coverage, remember necessary formulae and definitions and show all working clearly. They should be encouraged to spend some time looking for the most efficient methods suitable in varying situations.

General comments

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

Working was generally well set out. Candidates should ensure that their numbers are distinguishable, particularly between 1, 7, 4 and 9 and always cross through errors and replace rather than try and write over answers.

Candidates need to be reminded that prematurely rounded intermediate answers bring about a lack of accuracy when the final answer is reached. They should also remember that, unless asked otherwise, inexact answers should be given to 3 significant figures and exact answers should not be rounded.

Candidates should also be reminded to check that their calculator is in the correct mode to use degrees in angles questions.

Comments on specific questions

Question 1

This was answered correctly by the vast majority of candidates. Some candidates subtracted the correct answer of 1.25 from the original amount giving 23.75 as their final answer.

Question 2

This factorisation was done correctly by almost all candidates. Of the few who did not score, errors seen were to omit the addition sign in the bracket or to multiply the terms.

Question 3

The vast majority of candidates demonstrated efficient use of the calculator by showing a correct unrounded value in their working. The majority of these then went on to gain the second mark for rounding correctly but some left their final answer as 4.57 or 4.58, truncated or rounded to 2 decimal places. Candidates should be aware that 4.60 is not an answer given to 2 significant figures.

Question 4

The overwhelming majority of candidates were able to write the number in words for **part (a)**. Unambiguous poor spelling was condoned. A few confused the words fifteen and fifty and sixty and sixteen. Most candidates understood how to write a number in standard form in **part (b)**. When asked for a number in standard form, unless instructed otherwise, it should be given exactly. The main reason for not gaining a mark here was due to candidates rounding the number to 1.5 or 1.51 when in standard form.

Question 5

Most candidates were able to gain full marks for this question. The most common error was to incorrectly combine the *d* terms and give an answer of $3c - 2d$. A significant number of candidates combined the like terms and wrote $(5-2)c+(-1-3)d$ but did not complete the simplification.

Question 6

The equation was solved correctly by the vast majority of candidates, with most multiplying both sides by 3 as the first step. Of those not scoring both marks, most were awarded the method mark for reaching $x-2=9$, which was then followed by the common error of subtracting 2 to give an answer of 7. A few less able candidates made an incorrect first step, such as $x-2=6$, $\frac{x}{3}=3+2$ and $3x-2=9$.

Question 7

Candidates have a good understanding of the rules of indices and a large majority gained both marks. Occasionally an answer of $6x^6$ was given where the powers were multiplied instead of added. Those who did not score were often seen taking x^2 as a factor from both terms to give $x^2(2x\times 3)$ as their answer.

Question 8

Candidates demonstrated a good knowledge of working with fractions. They understood the need to convert the mixed number into an improper fraction before multiplying, although some just multiplied by $\frac{1}{7}$ and either ignored, or forgot about, the whole number. Many then created unnecessary work for themselves by finding a common denominator before multiplying. A minority confused multiplying with the method for dividing and inverted one of the fractions. Candidates should be encouraged to cancel fractions before multiplying, hence reducing the need for unnecessary calculations and cancelling large values at the end.

Question 9

Most candidates quoted the correct formula for simple interest and were able to go on to solve for the value of *r*. A few made errors when solving, but since working was so clearly shown, were able to gain the method mark for substituting correctly into the correct formula. Those who did not score were generally either using an incorrect formula, often omitting the division by 100, or substituting incorrectly, often using 690 rather than 90 for the interest earned. Others had not read the question carefully or did not understand the terminology and attempted to find the rate for compound interest.

Question 10

This was a fairly complex simplification involving indices and there were many fully correct answers. It was more common to score 1 mark for dealing with one of the three issues correctly in both the numerator and the denominator and it was also common to see either the numerator or denominator simplified completely, with answers such as $\frac{x^{-4}}{0.0625}$ and $\frac{x^{-4}}{\frac{1}{16}}$ being the most common. Many only applied the power outside the bracket to the numerator and so an incorrect step such as $\left(\frac{x}{8}\right)^{-4}$ was often seen. Many made a correct sensible first step of inverting the fraction and making the power positive but a common error in doing this was to also invert the power. Many candidates clearly understood what the numbers in the power meant, as correct cube root signs were often seen, with the 4 remaining as a power outside the bracket. Candidates often stopped at this or went on incorrectly from that point.

Question 11

The vast majority of candidates gained at least 1 mark for a correct first step in this rearrangement, which was usually to multiply both sides by w^2. Most then went on to square correctly but there was also a significant proportion who did not deal with the square root correctly and gave an answer of $x = \sqrt{yw^2}$.

Question 12

Few candidates employed the incorrect method of carrying out the calculation and then applying a bound at the end. However, it was very few candidates who scored 2 marks, with the vast majority gaining 1 mark for the use of 15.15. Candidates should understand that a bound is an exact value and so should not be rounded, even when many decimal places are involved. Area and perimeter were often confused in the question, with many multiplying 15.15 by 4. The other common error seen was to add 0.5 rather than 0.05 and so use 15.6.

Question 13

Candidates who were familiar with and well practised in using the area formula usually gained both marks for this question. There were some rounding issues with many candidates giving an answer of 44.9, so incorrect to 3 significant figures. Sometimes the formula was seen with cos rather than sin and occasionally the $\frac{1}{2}$ was omitted. Candidates who were unfamiliar with the formula often found a perpendicular height using right-angled trigonometry and then applied the $\frac{1}{2}b \times h$ formula correctly, so carrying out the same process but in two steps. This did sometimes lead to inaccurate answers due to premature rounding and sometimes the incorrect base was chosen for the perpendicular height found. Some assumed a right-angled triangle and used Pythagoras' theorem to find the missing length which they then used as the perpendicular height. Candidates should never assume a right angle on a diagram; unless there are other properties on the diagram which make it a right angle, it will always be defined.

Question 14

This proved to be one of the more challenging questions for candidates who tended to treat it as linear. Hence the most common response was to multiply 4.9 by the linear scale of 10 000 000 and then divide by the cm to km conversion of 100 000. Part marks were sometimes awarded for those who correctly carried out one step; this was more often for dividing by $100\,000^2$ as many candidates were familiar with dealing with conversions between cm^2 and km^2.

Question 15

Candidates should ensure that they read the information in proportion questions very carefully, as the majority of errors come from setting up the incorrect relationship at the beginning of the working. It was occasionally seen as a direct relationship, or without the square. Those that set up the correct relationship and worked step by step to find a multiplier first, usually went on to gain full marks. This methodical working should be encouraged as many method marks were awarded in this question where candidates made either arithmetic or rearranging errors.

Question 16

The most frequent answer was 70.7 which scored 2 out of 3 marks. The majority of candidates employed the most efficient method of using the sine rule to find the missing angle. This was usually carried out correctly to reach 70.7, although there was some confusion with less able candidates who were attempting to find the sine of the lengths 12 and 8, or who rearranged incorrectly after setting up a correct ratio. More able candidates had come across the ambiguous case triangle and understood the need to subtract the acute angle from 180 to find the obtuse angle with the same sine value. Others either did not worry about their angle being acute or did not understand how to find the obtuse angle. A minority of candidates decided that the triangle was isosceles and used $180 - (2 \times 39)$ to find x.

Question 17

The majority of candidates understood the required method of subtracting the smaller sector from the larger sector. One misconception commonly seen was that the area of the shaded sector would be $\frac{40}{360}\pi(11-7)^2$. Other method errors involved incorrect formulae for the area of a circle and some halved the radii given on the diagram. Some confused the area with the arc length. Some candidates, who had perhaps seen problems of this nature which involved a straight line, found the correct area of the larger sector but then used the sine rule for the area of a triangle to find the area to subtract. Despite being asked for a value $k\pi$, many candidates worked with decimal values and then divided by π at the end which sometimes led to an inaccurate value of k.

Question 18

A good number of completely correct simplifications were seen and the majority of candidates were equipped with a correct starting point, where they usually earned a mark for a correct denominator. It was also relatively common to award 2 marks when a correct common denominator and numerators for both fractions were shown. This was often followed with a sign error when dealing with the $-2(2x+4)$ part of the numerator, leading to the incorrect answer of $\frac{x^2-3x+8}{2(x+1)}$. Those who tried to deal with the subtraction as one fraction straight away often made this error and could not gain the mark for a correct numerator and so candidates should be encouraged to show this intermediate step in the working. Candidates should also take care with brackets in their working and be aware that $2\times2x+4$ is not the same as $2(2x+4)$; some show the multiplications they intend to do on the printed question but if an error is made, merit cannot be given for an incorrect mathematical statement, even if their intention is to multiply each term. Some candidates who correctly multiplied the numerators and denominators by the appropriate expressions to give fractions with a common denominator then cancelled these back again before expanding brackets, but these candidates were in the minority. Perhaps due to the nature of the terms in the fraction, it was far less common to see terms being cancelled incorrectly following a correct answer. Less able candidates sometimes resorted to merely adding or subtracting terms in the numerators and in the denominators.

Question 19

Candidates were well practised in multiplying matrices with the majority carrying out the process correctly in **part (a)**, coping well with the 1×2 matrix multiplied by a 2×2 matrix. Some gave their answer as a 2×1 matrix and gained 1 mark for this. Some thought that the calculation was impossible and others gave a 2×2 matrix as the answer from a variety of combinations of multiplying the elements. **Part (b)** was not so well attempted and it was clear that many candidates did not understand the notation for the determinant. A significant number of candidates worked out the inverse of the matrix **P**, whilst others gave $-\frac{1}{2}$ as the answer. Many confused the notation with absolute value, finding –2 correctly but then gave an answer of 2. Others appeared to be finding the length of a line with a calculation involving the square root of the sum of squares.

Question 20

The most successful candidates set up a correct tree diagram so that all options could be seen, along with the probabilities of each event. Those who did not draw a diagram often gained 1 mark for finding one of the two possibilities, usually $\frac{9}{10}\times\frac{15}{16}$. One of the probabilities used in the calculation for either of the possible outcomes was often 1 minus the correct value. The most common incorrect attempt was to multiply $\frac{15}{16}$ and $\frac{3}{4}$, the two probabilities given in the question referring to travelling on the bus. Less able candidates multiplied all three given probabilities or added probabilities together. Candidates should recognise that a probability greater than 1 is incorrect and re-think their strategy.

Question 21

The majority of candidates identified the transformation as a translation to gain at least one mark in **part (a)**. Care should be taken when giving the vector for a translation, in particular checking that it is given in the right direction for both the *x* and *y* values. Many candidates did not score the vector mark because of this. A few gave a co-ordinate rather than a vector but very few added in a fraction line between the numbers. **Part (b)** was less well attempted, with a significant proportion of candidates not making any attempt. The vast majority of attempts showed the correct line of $y = x$ drawn but then many were not able to use this correctly. Some drew a rotation of the shape and many drew a reflection of either shape *T* in the line $y = 6$ or shape *A* in the line $y = 1$ even after drawing the correct line of $y = x$ on the diagram.

Question 22

This was a multi-stage problem which even the most able candidates found challenging. However, the majority were able to gain at least one method mark by showing a correct multiplication of at least 2 values or by showing a correct conversion. Many made a correct first step of multiplying 6 by 1.2 and gained credit for this, even without the conversion of metres into centimetres. Others sensibly multiplied 1.2 by 3600 to find the speed in metres per hour. Many gained 2 method marks for reaching an answer containing the digits 2592 but had either ignored the conversions or dealt with them incorrectly. Those who gained full marks tended to multiply 1.2 by 100 before multiplying, giving a value in cm^3 which they then divided by 1000 at the end. Less common but equally valid was to convert $6\,cm^2$ into $0.0006\,m^2$ which was then multiplied by 1000 at the end. It was fairly common to see candidates finding the radius of the pipe from the area of the cross-section and either using this incorrectly or then going on to use it in the area of a circle formula, hence getting back to a value close to 6. A significant proportion of less able candidates decided not to attempt the question and some sketched a pipe and wrote some of the figures down but then could get no further with any calculations.

Question 23

Candidates completed each statement with varying degrees of success but a good knowledge of set notation terminology was evident. The majority understood the first statement and gave the number of elements rather than listing the numbers, which was the most common error. The number 8 was seen on numerous occasions, which presumably came from 5 elements in *A* and 3 in *B*. Those who drew a Venn diagram were the most successful in completing the second and third statements. The second statement proved more challenging to complete and there were 3 common incorrect answers; {0, 3, 4, 6}, omitting the intersection of *A* and *B*; {0, 2, 4, 5, 6}, omitting the 3; and {0, 4, 6}, where the intersection and union were confused. More candidates completed the third statement correctly although some used the universal set symbol on one side of the intersection. It should also be noted that B^{-1} is not acceptable notation for the complement of *B*. The final statement caused the most problems, with a minority understanding that the given set was a subset of *A*.

Question 24

A good grasp of functions was demonstrated in **part (a)** where a large majority gave the correct answer and clearly understood the terminology. The most common error was to multiply g(4) by f(4), resulting in an answer of 0 after the subtraction. Many found g(4) and f(4) and subtracted one from the other. **Part (b)** proved to be one of the most challenging questions on the paper. Successful candidates wrote out the inverse function $x = 2^y$ and understood that they were finding the value of *x* when $y = 5$. Many started correctly with the inverse function but then thought that the value of *x* was 5 and solved or attempted to solve with many giving an answer of 2.32. Answers of 5, –5 and $\frac{1}{5}$ were also common.

Question 25

Candidates should be encouraged to show clearer working in vectors questions, particularly showing a route, which would gain credit and focus the candidate on the direction of the vector. It was common to see the correct fractional lengths of the vectors on the diagram and in the working. However, without a clear route written down or arrows on the diagram, the direction of $\overrightarrow{BO}$ or $\overrightarrow{OA}$ was often incorrect in **part (a)**. A position vector was required in **part (b)** and it was clear that a large proportion of candidates did not understand this term. Many of those who did make an incorrect attempt were finding $\frac{1}{2}\overrightarrow{PQ}$ or $\frac{1}{2}\overrightarrow{QP}$. Errors in signs were sometimes made when simplifying brackets, but those who set out their working clearly were able to gain a mark for a correct route.

Question 26

Many fully correct answers were seen on the final question of the paper and a significant proportion of candidates gained method marks within it. The majority of candidates understood the need to calculate the area under the graph to find the distance travelled, and even if they struggled with the deceleration, were able to gain 1 or 2 marks for finding the area. Those gaining full marks understood that the time taken to come to rest is the initial speed divided by the rate of deceleration and this was the most efficient calculation to use. Some used –2.5 as the gradient to find the missing co-ordinate of (23, 0). Many candidates using this method used a positive gradient, resulting in an x value of 7. A common misconception was to think that the length of the sloping line was 2.5 and candidates then used Pythagoras' theorem to calculate the length of the base of the triangle. Some used the trapezium rule to calculate the area but the majority split the graph into the rectangle and triangle part. This meant that less able candidates who did not know how to deal with the deceleration were often able to gain a mark for finding the distance travelled at a constant speed.

MATHEMATICS

Paper 0980/31
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.

Attention should be paid to the degree of accuracy required in each question and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to 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. Candidates should also be encouraged to think whether their answer makes sense in relation to the question set.

The standard of presentation was generally good. However 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. There was evidence that most candidates were using the correct equipment.

Comments on specific questions

Question 1

(a) (i) The vast majority of candidates correctly completed the bar chart. A small number of candidates did not draw a bar.

(ii) Nearly all candidates correctly identified that December was the month with the most goals scored. A very rare error was to write the number of goals (26) instead of the month. Candidates who wrote both month and number of goals were given the benefit of the doubt and gained full credit.

(iii) The majority of candidates correctly added the number of goals for all five months and reached the correct total. Common errors were addition mistakes, not using a calculator to double check, or omitting the 10 goals from February and therefore reaching a total of 72.

(iv) Most candidates showed understanding of the term mean and divided their total from **part (a)(iii)** by 5 to reach the correct answer. Some candidates confused mean and median, with a few incorrect answers of 15 seen.

(b) (i) Candidates showed good understanding of working with money with the vast majority of candidates gaining full credit. Good answers showed all working out with very few errors seen in adding or multiplying.

(ii) Again in this part candidates showed good understanding of working with money with nearly all candidates correctly finding the change. The common error was calculating the change from only one programme.

(iii) Successful candidates showed full working for the percentage of tickets sold. Many candidates gave their answer as 86% rather than 85.7% per cent or more accurate. A few less able candidates made the question more difficult and found the percentage of tickets not sold by subtracting first.

(iv) Candidates found working out the time more challenging. Despite the correct answer given by more than half of the candidates, many attempted to add 14 55 and 1 50 as numbers rather than times and the incorrect answer of 16 05 was seen very often. Other common errors were incorrect format of the correct time, e.g. 16 45 pm, 4 45 without the pm or 16 h 45 mins (length of time given rather than time of day).

(v) Calculating the average speed proved to be the most challenging part of this question. Despite the vast majority of candidates able to correctly quote or use the Speed, Distance, Time formula, less than half of the candidates gained full credit as the time used was often given as 1.12 hours, 1 h 12 mins or 72 mins rather than the required value of 1.2 hours. Candidates were able to gain method marks for a division involving 66 km and a 'correct' time. However to gain full credit the speed had to be given in km/h. Therefore candidates who divided by 72 mins but did not then multiply by 60 only gained partial credit. Many less able candidates understood they had to work out distance divided by time but many used the time of day as 5 hours or 6.12 hours in their calculations.

Question 2

(a) (i) This question was very often not attempted. Incorrect responses included drawing a radius, arc and tangent, and some chords extended beyond the circumference. Segments were rarely seen but a shaded in region was not accepted as a correct chord as it was unclear if the candidate knew if the line was the chord or the shaded region.

(ii) Only a very few candidates gave the correct response. The most common incorrect reason given was that it was a right angle or in a right-angled triangle. Some stated 'the angle on the diameter is twice the angle at the circumference' or 'angle subtended by a diameter' which are not acceptable answers. Descriptions must be as given in the syllabus and in this case it is 'angle in a semicircle is 90°'. A frequent incorrect response was 'angles in a semi-circle add up to 90°.'

(b) Only the most able candidates correctly calculated the surface area of the cube. There was a variety of incorrect responses to this question; the answer seen most often was $8 \times 8 = 64$. Other incorrect responses included $8 \times 6 = 48$ or $8 \times 8 \times 8$, while others involved π in their calculations.

(c) (i) Calculating the volume of the cuboid was well answered by the majority of candidates, this part being the most successful part of this question. However correct working was seen spoiled by dividing or multiplying by 2. Some candidates attempted the surface area again. The units mark was often obtained regardless of the numeric answer. Incorrect responses were usually cm or cm^2.

(ii) Many candidates correctly completed the net. Others were able to draw a net of a cuboid but of the wrong height. Correct nets but with the lid missing were quite common. A large proportion of candidates showed that they did not understand the term 'net' of a shape, as many responses showed an attempt at a 3D shape. Of those who understood the concept, many found drawing a completely correct net challenging. The faces next to the given rectangle were most often drawn correctly but very often only two of them. Many had the right number of faces but not the correct dimensions. 3×4 faces were seen often instead of the 2×4 faces.

Question 3

(a) (i) Candidates showed good use of a protractor to measure the angle accurately. However many less able candidates had difficulty in knowing which scale to read from the protractor with a common incorrect answer of 83° seen.

(ii) Candidates who gave the correct angle in **part (a)(i)** generally gave the correct type of angle as obtuse.

(b) This part was the most successfully answered of this question with the vast majority of candidates correctly subtracting 56 and 85 from 180. The most common incorrect answer was 56 as candidates thought that angle *y* was the same size as the angle marked 56 on the diagram. Candidates should be reminded that the words 'NOT TO SCALE' means they have to perform a calculation to find the missing angle rather than compare it to other angles on the diagram.

(c) Successful candidates used the angle properties of an isosceles triangle and angles on a straight line to correctly find the size of the angle marked *z*. Good solutions showed each step of their calculations, subtracting 18 from 180, dividing by 2 and then subtracting from 180 again. Many candidates gave partial solutions by subtracting and dividing by 2. Less able candidates however often started with subtracting from 90° or subtracting 18 from 180 but then not halving their answer. A common incorrect answer was 18° which was found by repeating $180 - 162$.

(d) Calculating the size of an interior angle of a regular octagon proved to be the most challenging part of this question. Good solutions came from one of two common methods. Method 1: find the total of the interior angles $(8 - 2) \times 180 = 1080$ and then divide by 8. Method 2: find the size of the exterior angle $360 \div 8 = 45$ and then find the interior angle $180 - 45 = 135$. Successful solutions showed each step of the calculations. There was a wide variety of errors made on this question. A common error was not knowing how many sides an octagon has (6 and 10 the common incorrect number of sides used). Equally common was $360 \div 8 = 45$ only. Less able candidates often worked out $180 \div$ number of sides.

Question 4

(a) Many candidates found it challenging to convert the worded number into figures. One very good method used (rarely): $400\,000 + 18\,000 + 72$ laid out in a column method to obtain the correct answer. Others wrote four hundred and eighteen as 40 018. The most common errors were a missing '0', or '80' for '18'. Common incorrect answers were 480 072, 40 018 072, 401 872, 41 872, 408 072.

(b) This question was well answered by most candidates with partially correct responses omitting 1 or 16. Some candidates wrote 2^4 or all the even numbers up to 16. A small minority gave 3 and/or 6 as a factor of 16. Very few candidates confused multiples and factors, with a list of multiples of 16 rarely seen.

(c) This question was correctly answered by the majority of candidates. Some gave more than one answer with credit not earned if any were incorrect but 31 and 37 gained full credit. 33 and 39 were the most common incorrect numbers given. Some listed all the odd or even numbers between 30 and 40 and some gave a prime number which was outside of the required range.

(d) (i) Nearly all candidates demonstrated good use of their calculators to reach the correct answer. Occasional errors tended to be caused by misreading the number to be square rooted.

(ii) Again nearly all candidates demonstrated they could use their calculator accurately to find the cube of 18. An occasional error seen was using the wrong power.

(iii) Again candidates demonstrated good use of their calculators. Common incorrect answers were 0 or 7.

(e) Most candidates were able to gain partial marks on this question with the best solutions gaining full credit showing all steps of their calculations. 1 mark was often awarded for 320 or 2 marks for $\frac{8}{15}$. Many candidates however stopped at one of these points and did not complete the question to find the fraction of money left. The majority of candidates were able to find 120 and 200 from a correct method but did not gain any credit until they added these values. Only the most able candidates used a method that did not involve the 600 and just added the fractions before subtracting from 1. A small number worked out $600 - 120 = 480$ then found $\frac{1}{3}$ of 480, often resulting in $\frac{8}{15}$ or $\frac{7}{15}$.

(f) The correct LCM was found from a variety of different methods. Most common was finding 15 and 27 as the product of their prime factors and then multiplying the common factors to reach 135. The method of listing factors was seen less often, but when seen it was done correctly. The majority of candidates were able to gain at least partial credit. One mark was often given for a multiple of 135, usually 405, or for 3×5 and $3 \times 3 \times 3$ and/or $3^3 \times 5$ as the answer. 3 was often seen as an incorrect answer, the HCF.

(g) This question was well attempted with the correct product of prime factors frequently seen. Partial credit was often awarded for the correctly completed division into primes (using table/ladder or tree) or for a correct product equal to 432, 3×144 being the most popular. A common error occurred when candidates attempted a prime factorisation in a table/ladder or factor tree and missed out the last factor.

(h) Calculating the value of this investment proved to be the most challenging part of this question. Many candidates correctly quoted the formula for compound interest with the most able candidates substituting and calculating the correct value of the investment. Many less able candidates calculated simple interest. A significant number of candidates used the year by year method and sometimes this led to inaccuracies due to rounding or arithmetic errors. Some candidates subtracted 4000, giving the interest as the answer. Others added 4000 and a small number of candidates misread the principal amount as 400.

Question 5

(a) (i) 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. Less able candidates could correctly identify the transformation as rotation but did not include the centre, or only gave the degrees without the correct clockwise direction. A common error was to describe two transformations, a rotation followed by a translation.

(ii) Candidates found describing the enlargement more challenging. Most candidates understood that it was an enlargement but many candidates did not know how to describe the reduction in size and therefore gave answers like, de-enlargement or reduction rather than just enlargement. Only the most able candidates correctly gave the scale factor as $\frac{1}{2}$ with -2 or $\div 2$ being common incorrect answers. The centre of enlargement was often not given although candidates who drew lines connecting vertices of the two shapes often were able to give the correct centre of enlargement.

(b) (i) Candidates were more successful at translating the triangle by the given vector than they were at describing the transformations in **part (a)**. The correct image was drawn by the majority of candidates. However many less able candidates translated the triangle in the wrong directions, often 6 down and 2 right.

(ii) Candidates were less successful at reflecting the triangle in the line $y = 1$. Good solutions often saw the line drawn and then the correct image. Some candidates drew the line $x = 1$ and reflected in that line to gain partial credit. Some candidates did not read the question carefully enough and reflected the wrong triangle, often their answer to **part (b)(i)** or triangle *B* or *C*.

Question 6

(a) This question required candidates to find the equation of a given straight line. Successful candidates were able to correctly calculate the gradient and then use the *y*-intercept to give the correct equation. However only the most able candidates could find the gradient. Most candidates attempted to find the gradient using two sets of co-ordinates. However many used incorrect (x, y) co-ordinates, e.g. (3.2,15). Others chose correct co-ordinates, sometimes with triangles drawn on the graph, but did not quote the correct formula, often using change in x / change in y. Most candidates, having found the wrong gradient, used their equation to find the *y*-intercept rather than reading it from the graph. Others used their incorrect gradient to form an equation in the form $y = mx + 2$ for partial credit. Many less able candidates omitted the x from their final answer.

(b) (i) Finding the gradient from the equation of a line was the most successful part of this question. However, only around half of the candidates correctly identified the gradient of the line. Common incorrect answers were $3x$, $x = 3$, positive, negative, –4.

(ii) Finding the co-ordinates of the point where the line crosses the *y*-axis proved to be the most challenging part of this question. Many candidates used a co-ordinate on the line given in **part (a)** so (0, 2) was seen often. Those who found the gradient in the previous part usually went on to achieve this mark as well, although (0, 4) was seen frequently.

(c) Drawing the graph challenged all but the most able candidates. Candidates who constructed a table often went on to gain full credit. A common response was a straight line drawn going through (0, 1) but usually of positive gradient. Many less able candidates did not attempt this part.

Question 7

(a) (i) Most candidates were able to correctly draw the horizontal and vertical lines of symmetry. However a significant number of candidates then also drew the two diagonals of the rectangle.

(ii) Finding the area of the rectangle was successfully answered by the majority of candidates. Common errors were to find the perimeter instead of the area or to divide by two following multiplication.

(b) Calculating the percentage profit proved to be the most challenging part of this question. A variety of methods were used successfully with the most common being finding the profit for one flag and then dividing by the cost price and multiplying by 100. The most common error from this method was dividing by the selling price instead of the cost price. Another common error was to divide the values given in the question $\left(\frac{15}{21} \times 100\right)$.

(c) (i) Candidates demonstrated good understanding of probability in all three parts of **(c)**. Many candidates chose to give their answers as decimals or percentages but did not give them to the required degree of accuracy. Candidates who gave their answers as fractions generally were correct. Candidates who chose to give their probability as percentages must remember to include the percentage sign.

(ii) Again candidates showed similar understanding of probability. Some less able candidates found the probability that the flag was blue rather than not blue.

(iii) Finding the probability that the flag is red proved to be the most successful part of this question. Most candidates gave their answer as fractions $\frac{0}{30}$ although candidates did not have the difficulty of the previous two parts if they chose to write it as a decimal or percentage.

(d) Calculating the height of the larger rectangle proved challenging for many candidates who simply looked at the difference in the lengths of the two triangles (2.4 – 1.8 = 0.6) and added that to the height of the smaller rectangle (1.2 + 0.6 = 1.8). Candidates who showed some understanding that they were required to find a scale factor or proportional change were more successful. Most candidates found the scale factor by comparing the two rectangles ($\frac{2.4}{1.8}$ = 1.33…) and then multiplied the height of the small rectangle by their scale factor. However this method did lead to some errors due to premature rounding; candidates often rounded their scale factor to 1.3 instead of leaving it as a recurring decimal.

(e) Good solutions to this question required the correct application of Pythagoras' theorem. Candidates who recognised this generally did so correctly showing all steps in their calculation, including squaring, adding and square rooting. Few candidates subtracted instead of added after squaring. Some candidates gave an answer to only 2 significant figures. A significant proportion of the candidates did not recognise that Pythagoras' theorem was required and many less able candidates simply added or subtracted the two given lengths and some candidates calculated the area of the triangle or simply multiplied the lengths together.

Question 8

(a) (i) Most candidates were able to gain full credit in this part. The common error was to measure inaccurately.

(ii) Candidates found measuring a bearing challenging and only around half the candidates were able to give the correct bearing. There was a variety of incorrect answers but 280 was the most common from 360 – 80, i.e. anticlockwise from North. Another common error was answers around 260, misreading the question and measuring the bearing of *A* from *B*. Others had clearly worked from (a line drawn) South to reach 260 or 100. A few less able candidates gave a length for their answer, usually 11 cm.

(iii) Most candidates were able to gain one mark for *C* being placed the correct distance from *B*. However only the most able candidates could also measure the correct bearing and place *C* in the correct position.

(iv) Candidates who constructed correct arcs usually went on to draw a correct line gaining full credit. Most candidates realised that they needed to draw some arcs, but not all were sure where from. Some knew they needed to bisect something but bisected an angle. There were a number of responses which showed a set of arcs above the line *AB* with no attempt to draw a line.

(b) The correct answer was often seen but sometimes reversed. There were many varied incorrect responses, including [130 140], [134 136], [135 140], [134.5 135.4].

(c) This part was well answered. The common incorrect answer given was 0.59 by candidates who added the given probabilities but did not subtract from 1.

(d) All candidates attempted this question with nearly all successfully giving the temperature as –2°C. The most common incorrect answers were 2 or 12 from 7 – 5 and 7 + 5.

(e) This part was well answered with candidates successfully finding the new cost after a percentage increase. The best solutions used a multiplier and worked out 14 × 1.12. However an equal number of successful solutions were seen by calculating the 12% and then adding to the \$14. An incomplete method was seen often with 1.68 found but not added to 14.

(f) Most candidates were able to find the number of boats from the information given in the question. Most candidates showed full working to lead to the correct answer. Incorrect responses commonly seen involved 200 being multiplied by $\frac{25}{9}$. Others showed random calculations using the values in the question. For example $25 - 9 = 16$ then $200 - 16 = 184$ or $\frac{16}{25} \times 200$. It is important that candidates recognise the need to show full working out. This question highlights a common method of working which scores no marks unless the correct final answer is found.

$$\begin{array}{rcl} 25\text{ b} & \longrightarrow & 9\text{ m} \\ 200\text{ b} & \longrightarrow & x\text{ m} \end{array}$$

This method scores no credit in its current form. If the candidate is then able to give the correct answer then they score full credit but if they do not reach the correct answer then there is no indication of what they are dividing or multiplying by so is not an indication of method.

Question 9

(a) (i) Nearly all candidates were able to give the correct next term.

(ii) Fewer candidates were able to successfully give the rule for continuing the sequence. Candidates may have thought that this was more complex than simply writing down ‘add 3’ or ‘+3’ and many attempted to write the *n*th term or gave the answer as ‘$n + 3$’ or ‘$3n + 26$’.

(b) (i) The correct answers were seen most often with solutions showing the substitution into $n^2 + 5$ with $n = 1$, 2 and 3. The most common incorrect answers involved sequences going up by 5 each time, often 5, 10, 15 or 6, 11, 16.

(ii) This ‘show that’ question proved to be the most challenging part of this question. Candidates found it difficult to fully show why 261 was in the sequence with many candidates only gaining partial credit for a partial solution. To earn full credit candidates could show that 261 was the 16th term of the sequence by solving $n^2 + 5 = 261$ with all the required intermediate steps. Alternatively they could show that 261 was the 16th term of the sequence by substituting 16 into the *n*th term and showing all intermediate steps. Another method was to list all terms of the sequence up to 261. This was rarely seen and had to be totally correct to earn full credit.

(c) The correct *n*th term was found by the most able candidates who often found it using the general formula of $a + (n - 1)d$, substituting $a = 27$ and $d = 6$. Some candidates used the correct formula and substitution but then expanded and simplified incorrectly. Most candidates showed that they could see that the sequence was increasing by 6 but few candidates were able to give the correct *n*th term; $n + 6$ and $+ 6$ were common incorrect answers. Some partially correct solutions of $6n$ and $6n + 27$ were seen.

MATHEMATICS

Paper 0980/41
Paper 41 (Extended)

Key messages

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

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

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

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

General comments

Many candidates seized the opportunity to demonstrate their understanding of a wide range of mathematical concepts as they were able to make an attempt at all of the questions.

The majority of candidates indicated their methods with clarity. In the ‘show that’ questions the best solutions had a step by step style with just one equals symbol per horizontal line.

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

Most candidates followed the rubric instructions with respect to the values for π although a few used $\frac{22}{7}$ or 3.14, which may give final answers outside the range required. Some candidates lost accuracy marks by not giving their answers correct to at least three significant figures, and there were a number of candidates losing accuracy marks by approximating values in the middle of a calculation.

The topics that proved to be accessible were: finding a percentage reduction, reverse percentage, straight forward compound interest, recall and use of the cosine rule, interpretation of a cumulative frequency diagram, use of a frequency table to find mean, median, mode and range, forming and solving a linear equation, forming and solving simultaneous equations, solving a quadratic equation, using correct notation for inequalities and spotting patterns to continue linear, quadratic and Fibonacci sequences.

More challenging topics included: selection and use of a relevant circle theorem, some ratio, more complex application of exponential growth, similar shapes, application of trigonometric ratios to 3 dimensional shapes, average speed, unstructured interpretation of a histogram to find an estimate for the mean, forming an equation connecting speeds, distances and time, finding probabilities of two events and recognising a cubic sequence.

Comments on specific questions

Question 1

(a) (i) This ratio question was answered very well by the vast majority of candidates. The most common error seen was to use the sum of the angles as 180 instead of 360.

(ii) There was a very mixed response to this question part. Many correct answers of trapezium were seen and less frequently cyclic quadrilateral. Many candidates simply named any special quadrilateral, often parallelogram, without understanding the necessary link with their angles from **part (i)**.

(b) The majority of candidates were able to set up the correct equation $x + \frac{x+1}{2} + x + 7 = 180$ and many also went on to solve this correctly. However a significant number of candidates attempted to multiply through by 2 but neglected to multiply one or more of the terms, or when multiplying $\frac{x+1}{2}$ by 2 produced $2x + 2$.

(c) Many candidates were able to make a correct first step of either $\frac{360}{72}$ or, more frequently, 180(72 – 2) and the majority were able to continue to a fully correct answer.

(d) This question differentiated well as only the most able candidates found all five angles correctly and many struggled to find more than two or three. Candidates who could apply some circle properties of angles were compensated by the follow through marks. A common error was to give angle *y* as 20° presumably from equating it to angle *BAC*.

(e) This question demanded very careful thought from candidates in order to state the correct relationship between the given angles. The most common error was to assume that the given quadrilateral was cyclic and as a consequence the given angles summed to 180. Other misconceptions were the given angles summed to 360, or were equal, or that the obtuse angle *AOC* = 2 × angle *ABC*. Some candidates who recognised the correct relationship went on to make a sign error when expanding 360 – (3*x* + 22).

Question 2

(a) The more able candidates immediately saw that 2 parts = 600 and easily reached the correct solutions. A significant number of candidates understood the ratios and attempted to form an equation involving $\frac{9}{16}$, $\frac{7}{16}$ and 600 but were often unable to complete the problem successfully. By far the most common incorrect solutions came from $\frac{9}{16} \times 600$ and $\frac{7}{16} \times 600$ as the two values.

(b) This question was usually correctly answered. Both methods of finding 11% directly from $\frac{24.2}{220}$ or finding 89% first were well used.

(c) There were many varied attempts to solve this problem. The incorrect methods were to treat 63 as 25% of the price, find 75% of 63 or increase 63 by 25%. However many candidates did understand that 63 represented 75% of the original price and then arrived at the correct solution.

Question 3

(a) Most candidates successfully answered this question. Some reached the correct solution by working year on year rather than using the compound interest formula. The two common errors were to use the simple interest formula or to find the interest earned instead of the value of the investment.

(b) (i) Many found this to be more challenging and only the most able candidates interpreted the question correctly to write down the correct formula and use it to reach the solution. Many merely added or subtracted percentages of 882. Another common error was to use $882(1 - 0.05)^2$.

(ii) This was another challenging question that was attempted by most candidates but not always with success. The most able candidates wrote down the correct equation and used trials to exceed 1100 or 1.247. Many did not read the question carefully and omitted to give the number of complete years.

Question 4

(a) (i) This question was generally well answered with many candidates using a correct formula for the curved surface area of a cylinder. A number of candidates calculated the volume, a few others added the area of a circle and a few found the area of the rectangle with the height and diameter as its dimensions.

(ii) Almost all candidates gained full marks by multiplying their area by the $0.85 per square metre.

(b) Many candidates produced well presented, complete correct solutions to this unstructured question. A further significant number of candidates found the perpendicular height of the cone correctly but then used this value in the formula $A = \pi rl$ instead of using Pythagoras' theorem to find the slant height. Candidates who did not understand that the volumes of the sphere and the cone were equal were unable to attempt the question. When incorrect methods were used it was still noticeable that the vast majority of candidates clearly showed the steps that led to their answer.

(c) Mathematically similar shapes are usually found to be challenging and this question was no exception. The fact that two areas were given did make this question a good discriminator with many candidates treating the area scale factor as the linear scale factor. Some of these candidates multiplied the given volume by this factor and others cubed this factor to find the larger volume. Credit was given for the candidates who found the square root of the area factor and many of these candidates did then correctly complete the question by cubing this square root and multiplying it by the given volume. A small number of candidates lost one mark by rounding values during the working, thus not reaching the exact answer.

(d) This part was also challenging as three-dimensional trigonometry is not a simple situation. The candidates who recognised the correct angle between an edge and the base usually went on to score full marks, using the tangent ratio. Some candidates used Pythagoras' theorem and then used the sine ratio and occasionally gave an answer out of range as a result of rounding during the working. A few other candidates used the sine rule or the cosine rule in a non-right-angled triangle, which was more work for only a maximum of three marks. A number of candidates omitted this part.

Question 5

(a) This was probably the most challenging question on the whole paper and yet the concept of average speed was not thought to be difficult. The most able candidates could show their ability here by setting up a correct calculation using total distance divided by total time. A few of these candidates gave an answer to only two significant figures. The most frequent error was to treat average speed as the average of the speeds and this was seen on many scripts.

(b) This question instructed candidates to use the cosine rule and was generally successfully answered especially by candidates who started with the explicit formula for an angle, although a few found one of the other angles in the triangle. Many who used the formula for a side were also successful but the challenge using this approach is to use order of operations and to collect terms correctly.

(c) (i) Bearings questions often prove to be quite challenging and this part showed that some candidates have a good knowledge of bearings whilst others appear to have little experience of this topic. The responses to the question were quite varied with a mix of correct answers and a range of incorrect ones with little evidence of how they were worked out. A number of candidates omitted this part.

(ii) The comments to **part (i)** also apply to this reverse bearing question.

(d) This part was testing knowledge about the shortest distance from a point onto a line. The question went a little further as it asked for the position of the nearest point on the line and not the shortest distance. The more able candidates answered the question well using either the cosine or the sine ratio. A number of candidates did find the shortest distance perhaps not quite understanding the situation. Marking the point on the diagram was a very helpful way to understand this question.

Question 6

(a) (i) Almost all candidates correctly gave the median from the given cumulative frequency diagram.

(ii) Most candidates found the interquartile range correctly. A few gave the answer of 25, from a half of 75 – 25.

(iii) Almost all candidates found the correct number of candidates by correctly reading the cumulative frequency graph and then subtracting from 200.

(b) (i) Most candidates gave the correct range from the frequency table of discrete values. A few gave an answer of 1 to 50, instead of 49.

(ii) The mode was almost always correctly stated.

(iii) Most candidates gave the correct median although a few overlooked the frequencies and found the median of a list of just six values.

(iv) The total of the products of the values and their corresponding frequencies was almost always correctly answered. A few candidates again ignored the frequencies and found the total of the six values in the list.

(v) Candidates who gave the correct answer to **part (iv)** generally calculated the mean correctly. Quite a few of these candidates lost the mark by giving the answer to 220 ÷ 15 as 14.6.

(c) Interpreting the given histogram to calculate an estimate of the mean was a challenging question. There were many fully correct answers and most candidates gained some marks by giving correct frequencies or by using mid-interval values. The errors seen were largely either treating the frequency densities as frequencies or by using half of the interval widths instead of the mid-values.

Question 7

(a) Candidates showed excellent understanding of how to interpret the information in this question to set up and solve a linear equation. Many fully correct answers were seen. Some candidates lost accuracy by using 1.7 instead of 1.75 for the mass of the apples even after writing the equation correctly. Another error seen was to begin by dividing the cost of the fruit by the mass to give $\frac{x}{2} + \frac{x - 0.6}{1.75} = 19.20$.

(b) Virtually all candidates correctly formed the initial equations and then efficiently solved to find the cost of a protractor. The main method correctly used to find the cost of one protractor typically involved equating the coefficients of p or r. A significant minority of candidates correctly made r or p the subject of one equation and substituted to correctly find the other value. The main error seen was to incorrectly convert cents to dollars. A small proportion of candidates formed the equations but then could not solve. A very small number of candidates attempted to solve the equations without algebra.

(c) (i) The features of the best solutions to this question were as follows:

- A clear initial statement of $\frac{12}{x}+\frac{6}{x-1}$.
- Careful manipulation of the fractions with one equals sign per horizontal line.
- Accurate rearrangement of their algebraic expressions.
- Clear symbols (powers, +, –).

Some candidates did not form the initial equation and appeared to be working backwards from the given result. A relatively common error was to work with more than one equals sign per line which often resulted in algebraic expressions that were not equal regarded as equal by the candidate. The best solutions were concise and clear from line to line. Some solutions were less clear due to mixing elements of correct working with an equation, for example by writing $x - 1$ next to some or all the terms.

(ii) It was evident that a significant number of candidates used their calculator function to solve $5x^2 - 23x + 12 = 0$ and then attempted to work backwards from their solutions, $(x - 0.6)(x - 4)$ being a common incorrect answer.

(iii) Candidates who had correctly factorised in **part (c)(ii)** were able to use this to give the correct solutions. Many other candidates answered correctly using the quadratic equation formula or the solve function on their calculator.

(iv) Many candidates found this part challenging. This required an interpretation of their numerical solutions in the context of the original question information.

Question 8

(a) Both of these simple probability questions were very well answered.

(i) Most candidates recognised the probability of an even number as $\frac{4}{5}$.

(ii) The most common incorrect answer was $\frac{1}{5}$ presumably because some candidates were not sure about the status of the number 2.

(b) (i) Some candidates scored full marks in this part after writing out a clear method for the probability of 3 and 2, and 2 and 3. Many correct solutions made use of tree diagrams to aid calculations. However there were many scripts that demonstrated a complete lack of understanding of this topic.

(ii) Candidates often struggled with this question and many less able candidates omitted it completely. Again only the most able candidates demonstrated their understanding with a clear method leading to the solution but many others were unable to make much progress. A few attempted to use a sample space, often incomplete, or a tree diagram to help in the solution but in many cases these did not lead to either correct working or the solution.

Question 9

(a) Many candidates correctly stated the three inequalities. The main error was to mix x with y in particular for $x \leqslant 8$. Instances of using strict inequalities did occasionally occur, as did using the inequality symbols the wrong way around.

(b) Many candidates stated the correct inequality showing that by division the correct result was reached. Some incorrectly worked with equality or strict inequality and there were many attempts at working with numerical values which gained no credit.

(c) The best solutions had clear ruled lines along with an indication of the required region. There were virtually no cases of unruled lines or lines that didn't cover a sufficient part of the grid. Some candidates misinterpreted the rectangular grid joining (0, 0) to (15, 10) in their attempt to draw $y = x$. A common error was to omit the line $2x + 3y = 30$ despite the instruction to use all four inequalities. A small proportion of candidates drew all four lines correctly but then shaded an incorrect region.

(d) (i) This proved challenging for many candidates. Some candidates were able to correctly answer this part by going back to the original question information. Common incorrect answers included 3, 8, 15, 10 and 4, 6.

(ii) The clearest solutions indicated the substitution of points from their region in $4x + 6y$. A common error was to ignore the region on their diagram and just work out the number of passengers in 7 large cars. Candidates had difficulty in relating the co-ordinates of a point on the graph to the number of large and small cars. Very few candidates checked more than one point with many just giving a numerical value with no supporting evidence. A significant number of candidates substituted into $2x + 3y$ rather than $4x + 6y$.

Question 10

(a) The majority of candidates were able to find both the 5th term and the nth term of the linear and quadratic sequences. Errors seen for the nth terms included $n + 4$, $4n - 4$ and other quadratic sequences such as n^2, $2n^2$ or $n^2 - 1$. The cubic sequence and the geometric progression proved to be more of a challenge with far fewer candidates able to find the 5th term for them both. If the 5th term for the cubic was found correctly then an attempt at a cubic for the nth term often followed although various quadratics were common errors. Candidates who found the 5th term for the final sequence were often still unable to express the nth term correctly, with a quadratic once again being a common error or simply $2n$. Occasionally candidates incorrectly wrote $\frac{1}{4} \times 2^{n-1} = \frac{1}{2}^{n-1}$.

(b) Most candidates were familiar with the Fibonacci sequence and often got the first and second sequences correct. In the final sequence a common error was to regard the initial term as –1 whilst other candidates could not decide if the sequence started at +2 or –2.

(c) (i) Very few candidates could find an expression involving p and q for the next term with many leaving this part blank. Most answers when given were numerical and when an algebraic expression was attempted this was usually incorrect (e.g. $\frac{p}{q}, \frac{q}{p}, \frac{11p}{18q}, \frac{18p}{29q}, \frac{(p+11)}{(q+18)}$).

(ii) This was often correct as a continuation of the original sequence. The main error was for candidates to try and work out the seventh term often after giving the sixth term as their answer in **part (c)(i).**