MATHEMATICS

Paper 0580/11
Paper 11 (Core)

Key messages

To succeed in this paper, candidates need to have completed the full Core syllabus, be able to remember and apply formulae and to give answers in the form required. Candidates should be reminded of the need to read all questions carefully, focussing on key words.

General comments

The paper was accessible to most candidates, with the majority attempting all questions. Candidates must show all working to enable method marks to be awarded. This is vital in two or multi-step problems, in particular with algebra, where each step should be shown separately to maximise the chance of gaining marks. Rounding incorrectly and not using the appropriate degree of accuracy let down many candidates particularly in **Questions 5**, **8**, **9** and **16**. The questions that presented least difficulty were **Questions 1**, **2**, **10(a)**, **11**, **14**, and **19(a)(i)**. Those that proved to be the most challenging were **Questions 8**, limits, **15**, polygons, **20(b)**, surface area, and **21(b)**, identifying a region. Those questions that were occasionally left blank were **Questions 10(b)**, **15**, **19(b)** and **21**.

Comments on specific questions

Question 1

This first question was answered well by the overwhelming majority of candidates, with most giving the correct answer. A few added the given angles then subtracted 180. There were a small number of candidates that made arithmetical errors, despite being able to use calculators for this paper.

Answer: 101

Question 2

There were many completely correct answers. However, some candidates reached the correct value but then did further work in order to arrive at an answer with a decimal value, usually 9.944 or 99.44. Occasionally, candidates used an incorrect method such as division or addition rather than multiplication. This is a good example of where doing an approximate calculation would indicate the magnitude of the expected answer.

Answer: 9944

Question 3

The most efficient method was to add the powers and this was often seen, and frequently evidenced as 2^1, which was an acceptable answer. Others came to the correct answer by writing 0.0625 × 32 = 2, which was a long method but nevertheless correct. Incorrect answers included 4^1, 2^{-9} and other various powers of 2, either written as a power or evaluated, for example, 512.

Answer: 2

Question 4

This was the first problem solving question on the paper where there was no scaffolding to aid candidates. Many knew that the starting point was to find the total of Amber's marks and those candidates frequently went on to score full marks. Some got this correct with no working – showing no working in a two or more mark question is a risky strategy. Some wrote $(68 + 81 + 74 + 89 + x) / 5 = 80$ but were then unable to solve this, with $312x = 400$, or similar, being commonly seen. Totally incorrect methods generally came from finding the mean of the 4 given marks (78) or the marks being treated as a sequence. Thus, several times it was seen that candidates wrote out the marks in ascending order and showed the term-to-term rule starting with 68 + 6 = 74 and adding one more each time, finishing with 98 as her mark for the fifth test. This is an incorrect approach as it is based on a complete misunderstanding of the scenario.

Answer: 88

Question 5

In both parts, a significant number of candidates gave answers that suggested that they had no understanding of the basic concepts of rounding. Answers that were many orders of magnitude greater than the given numbers were common and answers in which multiple digits had been changed were also seen in many cases. Candidates were more confident with **part (a)**, using decimal places, than answering **part (b)**, using significant figures. Some candidates gave an answer to **part (a)** of 18.7, a truncation to 3 significant figures, or 18.77, rounding to 2 decimal places. In **part (b)**, candidates often put a zero in each column of the original number so gave 19.000.

Answers: **(a)** 18.8 **(b)** 19

Question 6

Many candidates did well with this question but the order of operations was a problem for some leading to incorrect working of $\sqrt{\frac{2+0.2}{0.8}}$. A few got as far as $\sqrt{2+0.25}$ but this was not sufficient for a method mark.

Answer: 1.5

Question 7

Most candidates were able to factorise the given expression correctly and many were able to gain 1 mark for either a partially correct or an incomplete factorisation. Some candidates did not recognise that there were common factors and often seemed to be trying to factorise the expression as if it was a quadratic. A small number of candidates identified a correct factor, but then divided every term rather than factorising and arriving at the answer $4x + 5y – 3$. A few candidates used an incorrect numerical factor leaving non-integer coefficients in the bracket.

Answer: $3x(4x + 5y – 3)$

Question 8

Candidates can find this area of the syllabus challenging and a number did not attempt this question. Very many candidates realised that they had to go half a unit either side of the given measurement but were not clear about the decimal places involved and what the half a unit was, so adding and subtracting 0.5 instead of 0.05 was frequently seen. However, there were many answers that showed no understanding at all, with numbers that were both greater than or both less than 14.3, or more than one unit from 14.3. A small number gave two numbers that would round to 14.3 rather than the upper and lower bounds. Some candidates earned 1 mark for one bound correct, often in the answer 14.25 and 14.34.

Answer: 14.25 14.35

Question 9

In this question, one misconception was for candidates to use the circumference formula. Occasionally $2\pi r^2$ was used as the formula. Of those who used the correct formula, some used 3.14 or $\frac{22}{7}$ for π even though these approximation are insufficiently accurate. Of those that used the correct formula, some used the incorrect value for the radius such as 3 cm or even the diameter, 9 cm.

Answer: 63.6

Question 10

Most candidates were able to identify the co-ordinates of point *A* but common incorrect answers included (3, –2) (reversed co-ordinates) and occasionally (3, –1). Very occasionally, some candidates wrote (x = –2, y = 3) which is not an acceptable form of the answer. In **part (b)**, some answers were so inaccurate that they implied that candidates did not have any understanding of the shape of a rhombus. In other cases, the candidates' plots were within half a unit of the correct position, suggesting that these candidates had some understanding of what was expected, but were struggling to use the co-ordinate grid correctly. Common errors included plotting *D* at (3, k) or (k, 3) or simply joining *A* to *C* to form a triangle.

Answers: **(a)** (–2, 3)

Question 11

Most candidates were able to identify the correct values in both parts. The common error in **part (a)** was not cancelling completely. For **part (b)**, the most common error was to give a decimal or percentage in which 9 did not have the correct place value.

Answers: **(a)** $\frac{5}{9}$ **(b)** 0.09 9%

Question 12

The biggest problem in this question proved to be in dealing with the mixed number, with a number of candidates either omitting this step or making errors. Some felt that both fractions needed to be converted to a common denominator, these often arrived at $\frac{25}{15}-\frac{33}{15}$. Only a tiny minority didn't show any method at all; a slightly larger number produced the correct answer, but showed calculations that were not completely correct, such as $\frac{10}{15}-\frac{11}{15}$, presumably having arrived at the answer using their calculator. Others misread $\frac{11}{15}$ as $\frac{11}{5}$ but were able to access a mark for the method of using common denominators. Candidates should be clear that in fraction questions, a decimal answer is not acceptable.

Answer: $\frac{14}{15}$

Question 13

Most candidates were able to gain some marks on this question, but there were few completely correct answers. Both –7 and $\frac{1}{3}$ were suggested as the smallest number and some candidates thought that –7 and –11 were natural numbers.

Answers: **(a)** 343 **(b)** –11 **(c)** 343

Question 14

There were many completely correct answers that showed good understanding. The most common error was to interpret the given vectors as fractions with some drawing a horizontal line in their answers. Inclusion of such a line is not acceptable.

Answers: **(a)** $\begin{pmatrix} 2 \\ 7 \end{pmatrix}$ **(b)** $\begin{pmatrix} 2 \\ 5 \end{pmatrix}$ **(c)** $\begin{pmatrix} 8 \\ 20 \end{pmatrix}$

Question 15

This was another problem solving question without the scaffolding to show candidates the first step. Also, this was the question that was most often left blank; that could be a response to either the content or the problem solving aspect. Many were able to perform a correct first step, either finding a value for the exterior angle or the total of the interior angles. However, many seemed to be unclear what they had calculated, with answers that implied that the interior angle of a regular pentagon is 72° being quite common. A minority attempted to use the known angle of 90° in the quadrilateral formed by the line of symmetry, *AB* and the fact that angle *d* added to 2 interior angles and 90° would total to 360°. However, these candidates were rarely able to go on to solve their equation, since most did not identify the correct relationship, i.e. that $d + 2(2d) + 90° = 360°$.

Answer: 54

Question 16

There were some excellent solutions but occasionally candidates gave the answer as 16 with no more accurate value being stated. Candidates should know to always give a more accurate answer before rounding. Those candidates who did not score often misapplied Pythagoras' theorem or only completed one step of a trigonometric argument.

Answer: 16.1

Question 17

For **part (a)**, many candidates answered correctly but the most common incorrect answers included m^3, m^7, m^{25} and $2m^5$ or only getting as far as $m^5 \times m^5$. Again, many candidates did well with **part (b)**, where the errors included a mistake in one or more of the three elements, usually involving 4 + 5 = 9 or $x^2 \times x^3 = x^6$ or $y \times y = y$. A common misconception was to treat the question as though it had an addition sign and try to factorise it, for example, $x^2y(4x + 5)$.

Answers: **(a)** m^{10} **(b)** $20x^5y^2$

Question 18

To achieve full marks, the correct method must be seen as well as the values for *x* and *y*. Candidates need to check for the most efficient way to tackle simultaneous equations so that they have as little opportunity as possible to make numerical slips. Here, the simplest method to eliminate one variable is to multiply the first equation by 2 so that there was a 6*x* term in each equation and then subtract the second from the first or to multiply the second equation by 4 and add the two equations. A number of candidates re-arranged both equations into *x* = ... (or *y* = ...), equated them and solved for *x* (or *y*). A few candidates used matrices but those who did proved to be more likely to make sign errors than those who opted to use an algebraic method. Many other methods, including substitution, will work but often have more opportunities for errors to be made. Some candidates gained the mark for 2 values satisfying one of the original equations.

Answer: [*x* =] –2, [*y* =] 3

Question 19

Part (a) was generally well answered with the overwhelming majority of candidates able to give the correct three angles and most of these went on to draw the pie chart accurately. Occasionally, a mark for three angles totalling 198 was awarded. It appeared that some candidates noticed that 180 – 18 (the number of English speakers) is 162, so then went on to subtract each frequency in turn from 180, so showing a complete misunderstanding of this area of the syllabus. With the pie chart, the most common errors were to not label sectors, or to misread protractor scales. **Part (b)** proved to be more challenging. Answers that were not fractions were common. Many gave the fraction that spoke Portuguese, rather than the fraction that did not speak it. 70% was not acceptable as the answer, as the question asked for the fraction.

Answers: **(a)(i)** 99° 63° 36° **(b)** $\frac{252}{360}$

Question 20

There were some excellent and completely correct answers to **part (a)**. Some candidates showed understanding but made errors in evaluating the area. In some cases candidates worked to an insufficient degree of accuracy by rounding prematurely. Another approach was to divide up the shaded part in to different rectangles and then combine them. This method had plenty of places where numerical errors could and were made. One misconception was for candidates to assume the small rectangle was in the centre top of the large rectangle which was not supported by the given information and it is not necessary to know where the small rectangle is placed, in order to answer the question. There were a significant number of candidates who did not know how to calculate the area of a rectangle; these found perimeter, or used formulae involving doubling, halving or squaring the lengths of the sides. Candidates found **part (b)** challenging. While some candidates did score full marks, a very common incorrect answer was 180 from $4 \times (8 \times 5) + 2 \times (2 \times 5)$ showing no logic to the understanding of the diagram. Examples of completely incorrect answers included finding the volume or finding the total of all the edges or even using π.

Answers: **(a)** 71.48 **(b)** 132

Question 21

There were some excellent answers to this question but also many who omitted some or all parts. In **part (a)**, those who realised the need to use arcs in their accurate construction were usually able to do so to the required degree of accuracy. The most common error was to draw the diagonal *AC* rather than the angle bisector. A considerable number of candidates did not extend the line from *C* to meet *AB* which made it impossible for them to answer **part (b)** correctly. Most were able to draw the correct bisector of *DC*, but not all did so using an efficient method. The most common error was to only draw one pair of arcs. Again, a large number of candidates didn't extend their bisector as far as *AB*. If candidates had read the whole question before starting **part (a)**, they may well have drawn the bisectors long enough to enable them to go on to identify the correct region in **part (b)**. Even of those whose bisectors were long enough, very few were able to identify the correct region. A small number of candidates produced shading for two or more regions, with an overlap, but then didn't give any indication as to which region they intended as their final answer.

MATHEMATICS

Paper 0580/12
Paper 12 (Core)

Key messages

Show working for all questions with more than one mark. Give answers to required or sufficient accuracy.

General comments

The standard of candidates' responses was generally very good. However, it was noticeable that a significant proportion of candidates either did not attempt some topics or their responses indicated lack of experience of studying parts of the syllabus. It was also very common to see totally unrealistic answers to questions. Triangle heights unrelated to given measurements and taxi fares in thousands of dollars were examples of this. Just a few candidates appeared not to have a calculator, an essential item of equipment for this paper.

Comments on specific questions

Question 1

Apart from the usual error of missing the zero or too many zeros, it was noticeable that some candidates started with 40 instead of 14. Otherwise this question was well done.

Answer. 14 027

Question 2

While finding the temperature was well understood, the common error was to see the answer 3. Also a small number of candidates added the data resulting in a response of 37.

Answer. −3

Question 3

Finding any number to the power 0 is quite often asked and most candidates knew the answer, or could use their calculator. However, there were quite a number who gave 12 or 0.

Answer. 1

Question 4

Writing a number in standard form as an ordinary number seemed to be more of a challenge than the other way round. Quite a variety of incorrect responses were seen, including 5170, 517, 51 700 and $\frac{517}{10000}$. Some gave what seemed to be the correct answer but had no decimal point. Others had an incorrectly positioned decimal point or even figures different to 517.

Answer. [0].00517

Question 5

The ordering of the items was well done with much evidence of converting to decimals seen. The main errors were $\frac{5}{8}$ before $\frac{31}{50}$ and $\frac{5}{8}$ last, presumably as it had 3 figures after the decimal point.

Answer. $\frac{31}{50} < \frac{5}{8} < 0.63 < 64\%$

Question 6

This taxi journey question was one of the most challenging for candidates on the paper, with many totally unrealistic responses given. Errors often resulted from reading the question incorrectly or ignoring the mixture of cents and dollars in the data. 560 cents added to \$4.50 (\$564.50) and 4.5 added to 0.8 before multiplication by 7 (\$37.10) were regularly seen.

Answer. \$10.10

Question 7

While there was quite a good response to this calculator question, poor use of the calculator and ignoring the rounding instruction caused many to lose 1 mark or both. Simply entering 6.32 + 2.06 ÷ 4.15 – 0.12 produced the answer 6.696... An answer of 2.07 alone gained no mark while the often seen 2.08 indicated a determination to give 3 significant figures regardless of the instruction of 1 decimal place.

Answer. 2.1

Question 8

While factors and multiples were generally well known, a considerable number of candidates did not gain the marks in this question.

(a) 2×6, 3×4 was not a list of factors so did not score the mark. Other errors were missing a factor, putting in incorrect factors and including multiples. Including 1 and 12 was not penalised.

(b) The question asked for multiples between 20 and 40, a fact ignored by quite a number of candidates. Just one multiple was another error seen from a few candidates.

Answers: **(a)** 2, 3, 4, 6 **(b)** 27, 36

Question 9

The angle properties of straight lines and triangles were generally well known. Angle x was more often correct than angle y while a few gained a mark for reversed answers or other cases of $x + y = 100°$. Negative values were also seen.

Answer. [x =] 60 [y =] 40

Question 10

This percentage question was found challenging by many candidates. Many did not understand the operation by multiplying 55 by 2.2 or dividing 2.2 by 55. Those who did understand how to tackle the question often lost a mark by not changing or incorrectly changing both numbers to grams or kilograms. One mark was quite common for figures 25 or 2200 or 0.055 seen.

Answer. 2.5

Question 11

Candidates found finding the height of a triangle from a given area very challenging. The most common error was to apply base $\times$ height = area rather than the correct formula. Some candidates did know the formula but not how to change the subject to the height. Half the base, 16.5 was often seen as the answer.

Answer. 32

Question 12

A considerable number of candidates appeared not to be familiar with the topic due to the number of blank responses and answers which were not correlation types.

(a) Those who were familiar with the topic nearly always gained this mark.

(b) In contrast, few candidates seemed able to cope with two unrelated properties so more blank responses were seen. Many seemed to think that the only answer could be positive or negative.

Answers: **(a)** Positive **(b)** None

Question 13

Many candidates coped with finding the missing probability in the table but there were many who completely misunderstood the method. Some added the probabilities and divided by 4 but also a significant number added the three and subtracted it from 4 instead of 1. Other errors seen were simply the addition of the given three, 0.65, as the answer, or an arithmetic error leading to 0.25. The latter would gain a mark if working was shown but not without.

Answer. [0].35

Question 14

Upper and lower bounds is a topic candidates usually find challenging as evidenced by quite a number of blank responses, but many gained the marks in this question. Some lost a mark by reversing the correct limits or giving 362.4 as the upper limit. While many realised the limits had to be balanced around 362 there was a great variety of responses for the limits.

Answer. 361.5 362.5

Question 15

Many candidates were successful in finding the angle in this right-angled trigonometry question. Pythagoras' theorem was seen, although rarely leading to a correct long method. Nearly all who understood the topic chose sine with only a few choosing cosine or tangent. Finding an angle seemed to pose more problems than finding a side with a number not getting further than a correct expression for sin x. Insufficient accuracy prevented some from gaining 2 marks with answers of 52 or 52.1 common.

Answer. 52.2

Question 16

(a) Nearly all candidates coped with writing down the co-ordinates of a point with both numbers positive. The only significant error was to reverse the co-ordinates.

(b) Again plotting was very well done with the same main error as in **part (a)**. There were also a number of careless mis-plots of the point *C*.

(c) Recognising the type of triangle was less well answered. Just the word ‘triangle’ was a common response and had more joined the sides they may have recognised the type of triangle. It was close to being ‘equilateral’ but again candidates would see, or realise from measuring, that only two sides were equal. Other occasional incorrect responses were right-angled triangle and even quadrilateral triangle.

Answers: **(a)** (2, 5) **(c)** Isosceles

Question 17

(a) Most candidates were able to give a correct response to the length of the line. The only noticeable error was to misread the ruler to give the response 10 cm.

(b) While the mid-point was clearly identified by the vast majority, a point was not shown by quite a number of candidates.

(c) Most candidates knew the term perpendicular but there were quite a number of parallel lines seen as well as both parallel and perpendicular. Some candidates just drew any line at odd angles, usually through the mid-point. Although the position of the perpendicular line could be anywhere on the line, most drew (or constructed) the perpendicular bisector.

Answers: **(a)** 9

Question 18

Only a minority of the candidates found the correct angle for the hexagon. Many did not know that the hexagon had 6 sides and 5, 7 and 8 sides were common. While 720 gained a mark, it was often seen as the answer meaning many could not visualise the polygon or realise just the size of one angle was the question. The step of finding the exterior angle, 60° gained a mark, but many did not take the final step.

Answer. 120°

Question 19

Many candidates found drawing a net of a cuboid with given dimensions rather challenging with a minority gaining all 3 marks. Most had an idea of a net although quite a number of candidates drew a 3-D drawing or showed disconnected rectangles. Common errors were to show 4 by 4 squares and adjacent edges not the same length. Many lost a mark by drawing another 5 by 4 rectangle directly below the given one.

Question 20

(a) Most candidates showed clear understanding of changing an improper fraction to a mixed number. However, a significant number gave the answer as a decimal, 3.666.... or 3.7. Also seen was $2\frac{8}{3}$.

(b) Basic fraction addition without the complication of mixed numbers was well done. Absence of working by a few candidates meant no marks were awarded and it was quite common to lose a mark by not reducing the answer to its lowest terms. This was quite common from those who chose a common denominator of 48. Simply adding the numerators and denominators to give $\frac{6}{16}$ or $\frac{3}{8}$ was seen from quite a significant number of candidates.

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

Question 21

Candidates found this question on finding the equation of a line challenging as they had to find both the gradient and the y-intercept in one question rather than finding the gradient first. Consequently, only a minority succeeded in gaining the 3 marks. Many attempted to find the gradient from the co-ordinates of two points, but many who did this correctly did not know how to complete the equation. Some gained a mark from realising that the constant was 2 but others lost that mark by just giving $y = 2$. Many candidates did not appear to understand the meanings of m, x and c in the formula.

Answer. [y =] $0.5x + 2$

Question 22

(a) (i) Most candidates worked out the common difference and were able to add it to 29 successfully.

(ii) This part was also answered well but quite a number of candidates did not interpret the question correctly, usually by giving the expression for the nth term or $n + 7$. Another common error was to write just 7 as the answer without any indication that it was added.

(b) Finding an expression for the nth term of a linear sequence wasn't well answered with common incorrect answers of $n + 4$, +4 or the next term, 18. Some candidates found the $4n$ part of the expression but gave +2 or no constant. Others mixed up the parts of the expression to give the response $2n – 4$.

Answers: **(a)(i)** 36 **(ii)** Add 7 **(b)** $4n – 2$

Question 23

(a) This question was one of the most demanding types of solving linear equations by having the variable on both sides as well as a negative term and a fraction answer. However, quite a number of candidates did find the correct solution, either as a fraction or decimal to a minimum of 3 decimal places. The error of $11n – 3n$ was very common as well as other incorrect rearrangements of the terms. Many who reached the stage of $5 = 14n$ believed that a fraction less than 1 could not be the correct answer and so divided 14 by 5 to reach 2.8.

(b) There was a better response to this linear equation question with many gaining at least 1 mark for multiplying 3 by 5 as the first step. Many candidates then either subtracted 3 from 15 or divided by 3. Dividing just p or just −3 by 5 as a first step, resulting in $\frac{p}{5} = 6$ or $p – 0.6 = 3$, was seen a number of times.

Answers: **(a)** $\frac{5}{14}$ **(b)** 18

Question 24

Many candidates were successful in this similar triangles question. The usual error of addition or subtraction of lengths immediately meant no marks in both parts. The majority who did use a ratio of corresponding sides were successful in gaining the marks.

(a) The most common error was to add 5 to (15 – 12.5). Some candidates gained a mark for a correct fraction from corresponding sides but could not finish off correctly to find *x*.

(b) 9.5 from 12 – (15 – 12.5) was the common incorrect answer in this part.

Answers: **(a)** 6 **(b)** 10

MATHEMATICS

Paper 0580/13
Paper 1 Core

Key messages

Ensure answers are given to the required accuracy and avoid premature rounding in working.
Show working for questions worth more than 1 mark.
Understand how to measure a bearing.

General comments

The standard of candidates' responses was generally very good. However checking answers would help to eliminate errors, especially with directed numbers. Candidates should ensure they read the questions carefully, for example when an estimated answer is required, marks will not be awarded for the exact answer. Some candidates appeared not to have access to a calculator.

Comments on specific questions

Question 1

Although several candidates were able to give the correct answer, many used column subtraction and as a result common incorrect answers were 2 hours 72 minutes and 3 hours 12 minutes.

Answer. 2 h 32 min

Question 2

Many correct answers were seen. A small number of candidates did not attempt the question.

Answer. 84

Question 3

This question was not well answered, with trapezium and parallelogram being the most common incorrect answers.

Answer. Kite

Question 4

Most candidates knew they had to add the indices, but some multiplied giving y^{20} as the most common incorrect answer.

Answer. y^9

Question 5

(a) A significant number of candidates were unable to read the scale correctly, with the most common error being 0.13.

(b) Although several correct answers were seen, there were many candidates who could not correctly order decimals. 0.42 and 0.5 were seen in the wrong order as were 0.078 and 0.06. A small number ordered them by the number of figures rather than the value.

Answers: **(a)** 0.16 **(b)** 0.06, 0.078, 0.42, 0.5

Question 6

(a) This part was almost always correct but the probability, rather than the colour, was also seen.

(b) Again nearly all candidates were able to give the correct answer. A small number of candidates simply wrote 3.

Answers: **(a)** Yellow **(b)** $\frac{3}{16}$

Question 7

Whilst this was fully correct for most candidates, several gained only 1 mark. The most common reason for this was writing 8 rather than 80 for the percentage.

Answers: 0.25, $\frac{8}{10}$, 80

Question 8

Many candidates were able to give the correct answer to this two-step question. Including both multiplication of a vector by a number and subtraction of vectors in one expression made this quite demanding. The rules of directed numbers was also tested which led to some errors.

Answer. $\begin{pmatrix} 11 \\ -7 \end{pmatrix}$

Question 9

The majority of candidates were able to give the correct answer to this question. The most common errors were adding, rather than subtracting $2x$ and 4.

Answer. 5

Question 10

Many candidates did not show rounding and just attempted the question as a straight calculation. Others did as instructed but often 59.2 was left or rounded to 59, resulting in maximum 1 mark. Many who rounded correctly gained the 2 marks.

Answer. 20

Question 11

Although some candidates were able to give the correct answer, this question caused problems for some. A small number appeared to have seen the word estimate, then not used the 40 and 6. Several others divided 6 by 40 but did not know what the next step was.

Answer. 120

Question 12

Many candidates did not earn any marks on this question. The main error was to use 0.26 rather than 0.026, or to calculate 2.6% simple interest.

Answer. 1263.21

Question 13

(a) Almost all candidates gave the correct answer.

(b) Again, the majority of answers were correct.

(c) There were many correct answers seen. The most common error was −13 from subtracting rather than adding 3 to −10.

Answers: **(a)** Moscow **(b)** 8 **(c)** –7

Question 14

(a) The majority of candidates had the frequencies correct, but a significant number lost a mark as they converted them into probabilities or wrote the cumulative frequency in the frequencies column.

(b) Whilst most answers were correct, 80 to 89 was seen at times. Some candidates did not understand ‘modal group’ and gave a single value.

Answers: **(a)** 4, 5, 6, 3, 2 **(b)** 100 to 109

Question 15

Although finding the interior angle of a polygon is tested regularly, the correct answer was rarely seen. A significant number of candidates gained 1 mark for dividing 360 by 12, but few knew what to do after this step.

Answer. 150

Question 16

Many candidates were able to change a mixed number to an improper fraction and find a common denominator. It was much more common to see the mixed numbers turned into improper fractions than dealing with the whole number part and fraction part separately. A small number of candidates did not show all working and so lost the method mark, and / or the accuracy mark for leaving their answer as an improper fraction or for converting their answer to a decimal.

Answer. $1\frac{25}{28}$

Question 17

The majority of candidates were unsuccessful on this question. Pythagoras’ theorem was seen, although rarely leading to a correct long method. Of those who used trigonometry many used cosine or tangent rather than sine. Many candidates who correctly identified sine were unable to rearrange the formula correctly. Insufficient accuracy prevented some from gaining full marks with an answer of 11 being common.

Answer. 10.9

Question 18

(a) Many correct answers were seen. The most common incorrect answers were 1800 and 180 000.

(b) The majority of candidates were able to perform the calculation but had problems with the standard form. Many gained 1 mark for figures 215. Others appeared not to understand that standard form has only 1 digit before the decimal point.

Answers: **(a)** 18 000 **(b)** 2.15×10^6

Question 19

(a) Several candidates plotted the point (100, 60) but did not draw the line and as a result only gained 1 mark. A smaller number of candidates drew an incorrect line.

(b) (i) This part was mainly answered correctly.

(ii) Many correct answers were seen. The most common error was to give the answer 16 from confusing the scales. The common answer of $33.33 implied calculations rather than use of the graph.

Answers: **(b)(i)** 82 to 86 **(ii)** 31 to 35

Question 20

(a) (i) This part was almost always correct.

(ii) Many correct answers were seen. The most common incorrect answers were 6 and $n + 6$.

(b) There was a lack of understanding shown of the *n*th term expression. Some simply wrote +3 and a small number of candidates gained 1 mark for $3n$.

Answers: **(a)(i)** 34 **(ii)** add 6 **(b)** $3n + 8$

Question 21

(a) Many correct answers were seen, with almost all candidates interpreting the scales correctly.

(b) This part was not well answered. The most common incorrect answer was 9.5 (the distance from *A* to *B* in centimetres). Many candidates appeared not to understand how to measure a bearing.

(c) Few fully correct answers were seen. Many candidates had drawn a line which did not reach *AB*. Many candidates drew arcs from all four corners, but few knew how to use them. Some simply drew a line from *A* to *C*.

Answers: **(a)** 168 **(b)** 74

Question 22

Although a small number of candidates gained all 5 marks on this question, the majority of candidates made the same error. The area of the square was calculated correctly but many then calculated the area of the circle but did not halve their answer to find the area of the semi-circle. Therefore the most common answer was 178.5. Many of those who did not know how to work out the area of the circle at all, generally gained a mark for either the area of the square or for knowing the radius was 5. Several candidates gained the mark for correct units.

Answer. 139 cm^2

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 efficient methods of calculation. They should be encouraged to spend some time looking for the most efficient methods suitable in varying situations and remember to check working and answers for avoidable mistakes such as arithmetic slips, copying previous working incorrectly and misreading numbers in the question. Rounding values within working should be avoided.

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. Appropriate, thorough working was seen throughout the paper.

Candidates demonstrated a very good understanding of indices in **Questions 2** and **13**, dealt with the fractions extremely well in **Question 10** and could solve the data handling problem in **Question 4**.

Candidates particularly struggled with the bounds in **Question 8**, the vector problems in **Question 14**, set notation in **Question 15** and the 3D trigonometry problem in **Question 21**.

Comments on specific questions

Question 1

Almost all candidates gave a correct response in this question. The most common incorrect answer was 97, using the rule for cyclic quadrilaterals.

Answer: 101

Question 2

The vast majority of candidates clearly understood indices or used their calculator efficiently to give the correct value. 2^1 was seen regularly but was condoned in this instance. Of the few who did not gain the mark, a common error was to multiply the powers and/or the 2s.

Answer: 2

Question 3

The majority of candidates demonstrated that they could use their calculator efficiently to obtain the correct answer in **part (a)**. Some lost the mark because they did not read the question and rounded prematurely. Others showed a lack of understanding in order of operations and there were two common incorrect answers as a result of this. The most common value of 1.305 came from (numerator ÷ 0.13) – 0.015 and the less common answer of 1.01915 from $5^{0.4-\sqrt{3}}$ in the numerator. Most candidates were able to round their answer to **part (a)** to 2 significant figures to gain the mark in **part (b)**. The main reasons for the mark not to be awarded were rounding to 2 decimal places rather than 2 significant figures and adding zeros after the 5.

Answers: **(a)** 1.49220… **(b)** 1.5

Question 4

The vast majority of candidates understood the problem and gained both marks. Good, concise answers included the full equation, then clear rearrangement to the answer. A common error was to divide by 2 instead of 5. Another error was to average the four given marks. Some gained the method mark but then simplified to $312x$ rather than $312 + x$. A few noticed that the four given numbers arranged in order gave an increasing sequence, and gave the 5th value as 89 + 9 = 98.

Answer: 88

Question 5

Most candidates understood what was required in this factorisation although many were trying to factorise into two sets of brackets and so did not score. Many candidates scored 1 mark for either a partial factorisation or for making a slip and getting 2 out of the 3 terms inside the bracket correct.

Answer: $3x(4x + 5y – 3)$

Question 6

Very few errors were made giving the co-ordinates in **part (a)**, with just a few candidates reversing the co-ordinates. Fewer marks were gained in **part (b)** for various reasons. Some candidates, who obviously knew the properties of a rhombus, lost this mark due to inaccuracy, perhaps trying to construct rather than use the co-ordinate grid. One of the most common incorrect answers was for candidates to simply draw a line to connect *A* and *C*. Points (3, 3), (1, 1) and (4, 4) were often seen as point *D*, perhaps confusing the shape with a kite. Others made *AD* horizontal or *CD* vertical.

Answer: **(a)** (–2, 3)

Question 7

Candidates understood the concept of acceleration and there were many completely correct graphs. There were also a large proportion of candidates who gained 1 mark, almost always for a horizontal line following an incorrect speed reached in the first 30 seconds. This speed was often 0.4, 4 or 6. Sometimes a horizontal line at a speed of 0.4 was drawn for the whole width of the graph.

Question 8

This question proved to be among the most challenging on the paper. A small number of candidates worked in millimetres and then converted back to centimetres; however some did not convert back and so lost the final mark. The B1 mark was awarded fairly regularly, as many candidates gave the upper and lower bounds in their working, but then continued their work incorrectly. While most candidates understood the need to multiply by 3, the majority of answers which did not score any marks originated from applying a limit of accuracy to the combined height of the stack of 3, rather than each individual cuboid. Working of $6.5 \times 3 = 19.5$ with answers of 20 or 19.55 were common. Those who did deal with individual cuboids often gave an answer of 21 from 6.5 + 0.5. Candidates should understand that due to the nature of a bounds question, it is incorrect to apply any rounding to the final answer, as many lost the final mark by rounding to 19.7 on the answer line.

Answer: 19.65

Question 9

The concept of decreasing exponentially caused problems for some. However, the majority scored at least 1 mark and there were many fully correct answers. Candidates need to be aware that exact answers should not be rounded as some lost the answer mark by rounding to 7615 or 7620. The most common misconception was to find 15% of the original price and to subtract three lots of this, leading to an answer of 6820. Others increased the value by 15% each year. Some candidates worked year by year which didn't cause too many problems in this instance as each value was exact. They should be encouraged to use the formula and perform one calculation rather than carry out several calculations which often lead to errors.

Answer: 7615.15

Question 10

Candidates had an excellent understanding of dealing with fractions, showing clear and concise working. Most candidates converted to $\frac{5}{3}$ correctly and then used 15 as the common denominator. There were two main issues for candidates losing marks. Firstly, $1\frac{2}{3}$ was converted incorrectly, but many did then get the follow through mark for correctly finding a common denominator. The second common error was multiplying the numerator in $\frac{11}{15}$ by 3, resulting in $\frac{25}{15}-\frac{33}{15}=-\frac{8}{15}$. If candidates used a larger common denominator, most cancelled down successfully for their final answer.

Answer: $\frac{14}{15}$

Question 11

There were many fully correct answers to this angle problem and the majority scored at least 1 mark, usually for showing a correct calculation to find either the sum of interior angles or an exterior angle. A large number of candidates then did not know how to proceed and many simply halved the exterior angle of 72 to give 36 as their answer.

Answer: 54

Question 12

The majority of candidates answered this question well. Almost all were awarded at least 1 mark, with many gaining all 3 marks. The vast majority were able to choose the cube number in **part (a)**, the most common incorrect choice being $\frac{1}{3}$, presumably because of the digit 3. Slightly fewer could identify the lowest number in **part (b)**. A number of candidates seemed unaware that negative numbers were smaller than positive fractions so $\frac{1}{3}$ was a common incorrect answer and some chose –7. **Part (c)** caused the most problems where some may have been distracted by the 343 having already been used. This was obviously an unfamiliar term to many who appeared to have a guess at this final part of the question. $\sqrt{5}$ was a common incorrect choice, perhaps confusing with irrational.

Answers: **(a)** 343 **(b)** –11 **(c)** 343

Question 13

Candidates demonstrated an excellent knowledge of the laws of indices in this question. In **part (a)** the only occasional error was to give the index as 7. There was a slightly lower success rate in **part (b)** where sometimes the numbers were not combined or *y* did not have a power. A few candidates thought they had to factorise, treating the multiplication sign as addition.

Answers: **(a)** m^{10} **(b)** $20x^5y^2$

Question 14

This was one of the most challenging questions on the paper and many candidates struggled with both parts of the question, demonstrating a need for more understanding in the application of vectors. Candidates should be encouraged to sketch diagrams in this type of question in order to understand the problem.
Part (a) was the better attempted part of the question. The main error here was to attempt to subtract the values, giving the answers (5, 6) and (–5, –6) or a combination of these. Some candidates seemed to be trying to find the midpoint of (2, –5) and (7, 1). A high proportion of candidates could not make an attempt at **part (b)**. The minority of candidates who answered correctly showed clear working and understood what was required. Some understood that Pythagoras' theorem was involved and made a correct start of $13 = \sqrt{t^2 + 12^2}$ or $13^2 = t^2 + 12^2$ but were then unable to successfully re-arrange the equation to find a solution, with many simply 'cancelling' all the squares and roots, resulting in 13 = t + 12. This is not usually the case in a more familiar Pythagoras' theorem setting, in which candidates are well-practised (indeed this was not the case in **Question 21**). Others attempting Pythagoras' theorem began with $t^2 - 12^2$ or $12^2 - t^2$. A mark was often awarded for an answer of 5 where candidates had forgotten that the value of t was negative. For the majority of candidates who did not understand the nature of the question, 25 and –1 were popular incorrect answers, both resulting from simply adding or subtracting the 12 and 13.

Answers: **(a)** (9, –4) **(b)** –5

Question 15

Set notation appears to be an area which still requires more understanding. One of the most common responses in **part (a)** was to include the whole of the original set and others added in negative values or added the values together. Many candidates were clearly not familiar with the notation and did not attempt to give an answer. **Part (b)** was more familiar to candidates. The right-hand diagram was better attempted than the left where it was common to see the whole of *N* unshaded or the area outside of *M* and *N* unshaded.

Answer: **(a)** Fewer than 6 elements from {1, 2, 3, 4, 5, 6} or $\varnothing$

Question 16

The majority of candidates recognised the transformation as enlargement and gained the first mark. Some didn't earn this mark by stating that it was negative enlargement. The centre of enlargement was also generally well done; most candidates who answered incorrectly here either gave the origin or (1, 2) although a variety of points were given, both in between the triangles and to the right of triangle *A*. The scale factor was the least well answered part of the question, with the most common answers of 3, –3 or sometimes $-\frac{1}{3}$ or $\frac{1}{2}$ being given. The answer 3 may have been due to the candidate not reading the question correctly and giving the enlargement of *B* to *A*. Combinations of transformations were only rarely seen; this was usually when the candidate thought that a translation was also involved.

Answer: Enlargement, $\frac{1}{3}$, (2, 1)

Question 17

The majority of candidates understood the relationship and there were many fully correct answers. Candidates should be aware that they may be asked to give an equation as a final answer as in **part (a)**, rather than a value of *y*, which they may be more familiar with. Many gained 1 mark for starting with a correct equation and obtaining $k = 72$ but then reverted to a final answer of $\frac{k}{(x+1)^2}$ or sometimes $\frac{1}{(x+1)^2}$. There were also those who found the correct equation and then substituted $x = 0.2$ back in to give a final answer of $y = 50$. Where candidates did not score any marks, the most common approaches were to work with y proportional to $(x + 1)^2$ or inversely proportional to $(x + 1)$. Virtually all candidates with the correct equation, or a correct relationship containing k in **part (a)**, gained the mark in **part (b)**. Sometimes the value of k was calculated in this part of the question. A follow through mark was awarded fairly frequently to those with an incorrect relationship in **part (a)**.

Answers: **(a)** $\frac{72}{(x+1)^2}$ **(b)** 32

Question 18

The majority of candidates were aware of the requirements to construct a bisector and an arc and attempted this well. Most drew the bisector first, as usually just a very small arc marking the correct position of *S* was seen. Good answers gave clear arcs and bisector, and clear indication of point *S*. A number of answers did not fulfil all the requirements. Candidates should be aware that a construction question requires all construction lines and arcs to be clearly shown; trial and error measurement with a ruler is not sufficient. A bisector must show arcs and not be drawn using an angle measurer and a ruler and the majority of candidates did this well. It was more common to either only go as far as drawing the bisector, or to give no constructions and give *S* as a (correct) point, sometimes with the bird bath arc seen as well but sometimes as a point with no other working on the diagram. Some candidates did give full constructions of the arc from the bird bath and bisector, but then did not recognise that their intersection was *S*. Sometimes *S* was not shown at all or it was placed in an incorrect position, usually somewhere on their bird bath arc, bisector construction arcs or at the mid-point of the trees.

Question 19

Candidates appeared very competent in dealing with the two algebraic fractions and often scored 2 marks for reaching $\frac{8x+26}{(x-3)(x+7)}$. Many then struggled to deal with adding $\frac{1}{2}$ and should understand that adding numerical and algebraic fractions involves exactly the same process. The 1 and 2 were often just added to the numerator and denominator. Many added $(x – 3)(x + 7)$ to the numerator but forgot to multiply $8x + 26$ by 2 or also multiplied $(x – 3)(x + 7)$ by 2. Candidates sometimes ‘cancelled’ out the $(x – 3)(x + 7)$ in the numerator with the brackets in the denominator. Many attempted to deal with all three fractions together and those who wrote clear, methodical working with the correct brackets were often successful in reaching the correct answer. Those who had working in different parts of the working space and were careless with signs and brackets almost always made errors while multiplying out and simplifying. Extra terms were often seen as a result of multiplying a bracket by two values e.g. $(2)(5)(x + 7)$ turned into $5x + 35 + 10$ or $10x + 70 + 10$.

Answer: $\frac{x^2+20x+31}{2(x-3)(x+7)}$

Question 20

The majority of candidates realised that a simple multiplication of the area of the cross section and height was required to find the volume in **part (a)**. Those who were unaware of this tried to use the formula for the volume of a cylinder and often got into difficulties. Those who did successfully work backwards to find the radius of the base circle to use the volume of a cylinder formula, usually ended up with a number slightly off the correct answer because of rounding. Candidates had much more understanding of the relationship between height and area scale factors than in previous sessions in **part (b)**. Where the correct answer was not given, it was usually 90, with the area scale factor used for height. Some gained a mark for using the correct ratio but the wrong way round, finding the height of *B* to be less than 10 cm. A few used the cube root rather than the square root.

Answers: **(a)** 1480 **(b)** 30

Question 21

The main challenge in this question was to work out which angle was required and numerous incorrect angles were suggested and calculated. If incorrect working followed, it was often difficult to award a mark as candidates did not make it clear which angle they were attempting to find. Candidates should always be encouraged to draw diagrams and label points, as this helps both the candidate in their further working and the possibility of earning method marks. If the correct angle was identified, the main error was to give *MC* a length of 6. Many candidates did use Pythagoras' theorem, usually to find the length of *AC* which was then halved for *MC*. There were a large number of candidates who lost the final answer mark because they prematurely rounded $\sqrt{288}$ to 17 before halving to 8.5 which lead to an inaccurate answer. Candidates should be encouraged to leave values in the calculator or to work to at least 4 decimal places in working. This question was an example where inefficient methods were sometimes used; for example, finding *MC* and then *EC* unnecessarily and using this length with sine or cosine rather than the given length of 9 and the tangent ratio.

Answer: 46.7

Question 22

Candidates clearly understood how to interpret the graph and the majority gave the correct answer in **part (a)**. If full marks were not awarded, a method mark was frequently given for showing 120 with the candidate then not completing the question by subtracting that value from 200. The graph was also drawn well in **part (b)**, with clear points plotted and clean curves drawn. There were very few candidates who lost marks through drawing inaccurate curves through the points. The majority of marks lost were due to errors in plotting, due to misreading the scale of the *y*-axis. **Part (c)** was less well answered. Many candidates did earn full marks, and a method mark was awarded frequently for 130, perhaps retrieved from the table rather than the graph. A very common incorrect answer was 25 which appeared to come from 3 different incorrect methods. The most common appeared to be candidates using the mid-point between zero and the highest value of each set of data i.e. 110 and 85. The second was using the mid-point of the range for each set of data i.e. 160 and 135. The third was using 120 as the middle of the population rather than 100, perhaps confusing with the line in **part (a)**, resulting in values of 160 and 135.

Answer: **(a)** 80 to 84 **(c)** 26

Question 23

There were many correct inequalities given in **part (a)**, although candidates often lost a mark for using strict inequalities. There were a significant proportion of inequality signs which were reversed. Some candidates did not understand what was being asked of them in **part (a)** but clearly understood the concept, as they would often draw one, or even both lines correctly with correct shading in **part (b)**, following no response, or incorrect inequalities in **part (a)**. It was common for candidates to score 2 marks for drawing and shading $x \geqslant 4$ correctly in **part (b)**. Lines were often drawn at $y = 16$, $y = 12$ and $x = 8$ rather than $x + y = 16$. In **part (c)** the majority of candidates understood the need to choose a point within the region, and so even if they did not comprehend where the optimal point would be, often scored 1 mark for showing correct working for a point in the correct, or their, region.

Answers: **(a)** $x + y \leqslant 16$, $x \geqslant 4$ **(c)** 144

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key messages

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

General comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates showed evidence of good basic skills with the most success in **Questions 1**, **5**, **13(b)**, **16(a)** and **24(b)**. Most candidates were very good at showing their working although a few candidates showed just the answers and missed the opportunity to gain method marks when answers were incorrect. Some candidates did not work to an appropriate accuracy, losing marks due to not giving answers correct to three significant figures; this was evident mostly in **Question 24(a)**. Rounding or truncating part way through the working, with inaccurate final answers as a consequence, was also evident, particularly in **Questions 8** and **26**. Candidates found the locus question, the vectors question and the factional negative indices question particularly challenging.

Comments on specific questions

Question 1

This question was well answered with nearly all candidates reaching the correct answer. Common errors were finding 20 – 17 or 20 + 17 instead of 17 – 20.

Answer: –3

Question 2

This question was generally well answered. Occasionally candidates had the right idea but made an error with the power, leading to answers such as 0.0517 or 0.000 517. Another error occasionally seen was to express the answer as the fraction $\frac{517}{100000}$.

Answer: 0.005 17

Question 3

This question proved to be a good discriminator and was one of the most challenging questions on the paper. A significant number of candidates thought two points were required rather than two lines, with the most common incorrect answers being *N* and *M* or *C* and *A*. A small number stated *BC* with *AC* instead of *AB*. It was also common to see the incorrect answer *BN* and *BM*.

Answer: *BC* *AB*

Question 4

In **part (a)** most candidates gave the correct answers. A small number of candidates also listed 1 and 12, which still gained the mark. Occasionally candidates listed their factors as product pairs; 2×6, 3×4 which is not an acceptable answer. **Part (b)** was also answered successfully by many candidates, with most giving the correct answers of 27 and 36. On a few occasions candidates also added an extra number, often 18. As the question states the multiples should be between 20 and 40, including extra multiples meant the mark could not be awarded. A common incorrect answer was 3, 4, where candidates were presumably indicating that the third and fourth multiples were between 20 and 40.

Answers: **(a)** 2, 3, 4, 6 **(b)** 27, 36

Question 5

Nearly all candidates achieved full marks on this question. This was the best answered question on the paper. Very rarely only 1 of the 2 marks was awarded which was usually for the answers reversed.

Answer: $x = 60$ $y = 40$

Question 6

This question was well answered with many candidates obtaining the correct answer of 2.5%. The most common cause of error was incorrect conversion of 2.2 kg to grams or of 55 g to kilograms; in most cases candidates had the misconception that there were 100 g in 1 kg rather than 1000 g. This usually led to an answer with the correct digits so these candidates scored 1 mark as did those who forgot to multiply by 100 when expressing as a percentage, i.e. giving the answer 0.025.

Answer: 2.5

Question 7

This question was well answered by the majority of candidates. The most common error was to use base × height to give the area of a triangle, instead of using $\frac{1}{2}$ × base × height, so a common incorrect answer was 16.

Answer: 32

Question 8

Many candidates made a good attempt at this question and gained both marks. The more able candidates who worked with fractions, i.e. $18 \times \frac{55}{60}$ usually earned full marks whereas for those who switched to decimals, premature rounding or truncation sometimes meant that only 1 or no marks were earned. It was common to see, e.g. $18 \times 0.92 = 16.56$ with no other working. There were occasional instances of division of speed and time, rather than multiplication.

Answer: 16.5

Question 9

Many candidates successfully answered this question often with no working shown as calculators were usually used. There was evidence of some working without a calculator, usually inefficiently re-writing as normal numbers with lots of zeros rather than the method, e.g. $0.12 \times 10^{41} + 1.2 \times 10^{41}$. The most common error was to work out 1.2 + 1.2 and then incorrectly deal with the powers of 10 in some way and the incorrect answer 2.4×10^{81} was often seen. Occasionally candidates multiplied rather than added the two numbers together.

Answer: 1.32×10^{41}

Question 10

This proved to be one of the more challenging questions on the paper although many candidates still scored at least 1 mark. Some candidates lost a mark due to rounding their answer to three significant figures and writing 20.8 as their final answer; candidates are advised that bounds should not be rounded. Common errors were: subtracting 0.5 cm instead of 0.5 mm, i.e. 5.2 – 0.5 leading to a very common incorrect answer of 19.4; finding the perimeter of the triangle then subtracting 0.05 leading to an answer of 20.85 or finding the perimeter of the triangle then subtracting 0.5, giving 20.4 as the answer. A small number of candidates converted the original numbers given to millimetres and used this to find the lower bound. Of these candidates the majority scored 1 mark instead of 2 as it was rare for the answer to be converted back into centimetres. Very occasionally, candidates found the correct lower bounds, 5.15, 6.25 and 9.35, but then used them incorrectly, for example by trying to find the area.

Answer: 20.75

Question 11

The response to this question was mixed. Many candidates obtained a correct fraction, usually $\frac{16}{33}$, but were unable to show the required working. Some candidates incorrectly thought the decimal was 0.488888… and obtained a common incorrect answer of $\frac{22}{45}$. The less able candidates ignored the recurring decimal altogether and wrote down $\frac{48}{100}$ or $\frac{12}{25}$. The more able candidates showed accurate working usually by using x = 0.484848… and 100x = 48.484848… and subtracting these two equations to reach 99x = 48. On some occasions candidates wrote out many different powers of 10x but were unable to correctly identify which ones to subtract to cancel out the recurring decimals, e.g. it was common to see 100x–10x used. Another common incorrect answer was $\frac{0.48}{100} = \frac{3}{625}$.

Answer: $\frac{48}{99}$

Question 12

This question was generally well answered with most candidates correctly expanding the brackets. A common error here was writing the final term as $-n$ instead of $-n^2$ or leaving that term out completely. The most common errors on this question came from further working after successfully expanding the brackets, either multiplying through by –1 to give $n^2 - 2n - 15$ or re-factorising the expression. Most of these scored 1 mark for the original multiplication.

Answer: $15 + 2n - n^2$

Question 13

Nearly all candidates answered this question correctly, particularly **part (b)**. A few did not understand the meaning of mixed number. Sometimes an integer was followed by an improper fraction or a decimal answer was given, usually 3.67. Most candidates handled **part (b)** very well. Most candidates tended to use the most efficient 12 as the common denominator, although 48 and less commonly 24 were also seen. A small number of candidates didn't cancel enough and left their answer as $\frac{8}{12}$. Very rarely, with the less able candidates, it was evident that two numerators were added together and then the two denominators were added to reach $\frac{6}{16}$ instead of finding a common denominator.

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

Question 14

This question produced a variety of responses and proved to be one of the more challenging questions. More able candidates usually earned full marks. Of those who did not earn all 3 marks there were many who reached the correct statement, $-2 < n \leqslant 3$, and did not list the integers. Some lists were incomplete, often leaving out the 0, perhaps indicating the candidates were not sure whether 0 was an integer. Some lists offered only the positive integers 1, 2 and 3. Some candidates earned 1 mark for making the required correct progressive step in the solution of either the left or right hand side of the inequality, or both sides. The double inequality proved too much for some; the less able candidates added 5 to the right hand side, leading to $2n - 1 \leqslant 10$.

Answer: –1, 0, 1, 2, 3

Question 15

The majority of candidates recognised the need for a common denominator to gain at least 1 mark with many showing sufficient working to gain a second for a correct first step with the numerators. There was a significant number who were unable to deal correctly with the subtraction of the negative when simplifying the numerator, leading to the common incorrect answer of $\frac{y-x}{xy}$ which was almost as common as the correct answer. Some candidates showed poor understanding of efficient algebraic notation with unnecessary brackets or missing brackets, e.g. a denominator of $(x)(y)$ or having a numerator of $y \times x + 1 - x \times y - 1$. A minority cancelled inappropriately i.e. not common factors, sometimes after a correct first stage.

Answer: $\frac{y+x}{xy}$

Question 16

Part (a) was answered very well with most candidates giving the correct answer of –1. A very small number of candidates made an arithmetic error and some tried to work to the left rather than the right and found the preceding value, 29. **Part (b)** was more challenging for candidates. Many gave the correct answer of $-6n + 29$. Some candidates gave their answer in an unsimplified form, for example $23 - 6(n - 1)$ or $23 + (n - 1)(-6)$ after using the general formula for the nth term of an arithmetic series. A small number of candidates left this in the form $23 + (n - 1) - 6$ without the essential brackets which could not score any marks. Another, fairly common, error was to give a final answer of $6n + 17$, coming from use of a common difference of +6 instead of –6, giving $23 + 6(n - 1)$.

Answers: **(a)** –1 **(b)** $-6n + 29$

Question 17

There were many good responses seen to this question, but some candidates struggled to make any progress here. Those who identified that $x + 29x = 180$ were typically able to solve and find the correct value of x. It was also quite common to see $x + 29x = 360$ leading to x = 12 and then often a final answer of 30. Some candidates correctly wrote down $x + 29x = 180$ but then followed this by, e.g. $2x = 180 - 29$ or $2x = 180 \div 29$. A significant number of candidates quoted many formulae but were unable to solve them as they involved both n and x. Some calculated that $x = 6$ but then divided a number other than 360 by this e.g. 540.

Answer: 60

Question 18

This question was generally well answered with the most common, and most successful, method being the substitution of $y = \frac{x}{2}$ or $x = 2y$ into $2x - y = 1$. The main error here came from mistakes when multiplying through by 2. Other candidates re-arranged the equations in order to eliminate a variable by subtraction or addition. Those who used this approach were more likely to make errors with algebraic manipulation, particularly with negatives. However, when an incorrect value for x or y was found, candidates usually evaluated the other value correctly, leading to a pair of numbers that satisfied one equation and therefore had the opportunity to gain a mark. A further reason for losing marks was when candidates switched to decimal answers rather than giving fractional answers. Often these were not correctly rounded to three significant figures, for example $x = 0.666$ or 0.67 were quite common and then this often led to inaccuracies in the y value also.

Answer: $x = \frac{2}{3}$, $y = \frac{1}{3}$

Question 19

Many candidates scored 2 or more marks on this question. Some made the error of simply transferring the square root to the other side instead of using inverse operations. Some candidates got their operations in the wrong order; it was common to see the 1 subtracted first then followed by square root. Some candidates believed that $\sqrt{a+b} = \sqrt{a} + \sqrt{b}$ so a common incorrect first step was to write $y = x + 1$. A small number of candidates did not have a long enough square root sign. A few candidates wrote some incorrect subsequent work following the correct answer, e.g. attempting to cancel the square of y with the square root. A few candidates made an error in the second step obtaining $x^2 = 1 - y^2$ but often they still scored 2 marks.

Answer: $\sqrt{y^2 - 1}$

Question 20

This question was usually answered correctly with a roughly equal split between those using the formula for the area of a trapezium and those using the area of two triangles and a rectangle added together. Usually those who used the area of the trapezium formula were more successful as the most common error was omitting the division by 2 when finding the area of one or both of the triangles.

Answer: 132

Question 21

This question proved to be one of the most challenging on the paper. Many candidates scored 0 or 1 mark only. Correct notation is an area candidates need to work on, e.g. candidates are writing K or OK rather than $\overrightarrow{OK}$. There was evidence that many candidates did not appreciate the significance of the direction of the vector and who thought that $\overrightarrow{AB}$ was the same as $\overrightarrow{BA}$. Some candidates gained a mark for writing $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$ or for writing $\overrightarrow{OK}$ without further correct working. Many attempted $\overrightarrow{AK}$ having found $\overrightarrow{AB}$ without realising they needed to go further to find $\overrightarrow{OK}$. Some who did go further attempted, e.g. $\overrightarrow{OB} + \overrightarrow{BK}$ but had a sign error, instead using a vector equivalent to $\overrightarrow{KB}$. There were a number who worked through to a correct unsimplified answer gaining 2 marks then made errors in their attempts to simplify.

Answer: $\frac{1}{3}\boldsymbol{a} + \frac{2}{3}\boldsymbol{b}$

Question 22

This question was not answered as well as many, with quite a few partly incorrect answers seen, although few candidates scored 0. Many realised that w and x were opposite angles in a cyclic quadrilateral and thus that $w + x = 180$ and many were also able to use the angles in quadrilateral *ABCD* giving $w + x + y = 240$. Common errors included $w = 108$, presumably thinking that it was in the same segment as the angle at *O*, which led to the fairly common response $w = 108$, $x = 72$ and $y = 60$, or writing $w = 60$, possibly thinking that *ADC* and *DCE* are alternate angles, which led to the response $w = 60$, $x = 120$ and $y = 60$.

Answer: $w = 54$, $x = 126$, $y = 60$

Question 23

Full marks were not scored very frequently on this question. Many candidates were able to identify at least one of the required formulae, usually $\frac{30}{360} \times \pi \times 6^2$, although this did not always result in a correct value for k as candidates were not always leaving their answers in terms of π and it was quite common to see this evaluated to 9.42. The more able candidates also knew the area of the triangle could be found by using $\frac{1}{2} \times 6^2 \times \sin 30$. However it was quite common to see some candidates use a much more cumbersome method. For example, by dividing the triangle in half with a line from *O* to the mid-point of the chord, then using right-angled trigonometry to calculate the base and height of each triangle, and then $0.5 \times b \times h$. It was quite common for those that employed this method to prematurely round during their working resulting in an inaccurate answer, such as $c = 8.99$. A few used the sine rule to calculate the base of the triangle and Pythagoras' theorem to find the perpendicular height of the triangle. Of those unable to find the area of the sector, the most common incorrect calculation seen was $\frac{30}{360} \times 2\pi \times 6$. A few candidates were familiar with radian measure and calculated the angle θ in radians then used the sector area formula $0.5\, r^2\theta$. However some used $\frac{1}{2} \times 6^2 \times \sin\theta$ with their calculator still in degree mode. It was quite common to see c given as –9. Many stopped at an answer of 0.425 and were unable to progress from this to relate it to $(k\pi - c)$, often equating it instead.

Answer: $k = 3$, $c = 9$

Question 24

Part (a) was generally well answered with many candidates obtaining the correct answer expressed as a fraction. Some candidates converted to decimals with some converting to a two significant figure version, 0.36, which, if they had not shown a correct version in the working, lost a mark. The other common error was incorrect division of $\frac{14}{5}$ leading to a common incorrect answer of 2.8. However most candidates usually obtained the method mark before this error as they generally showed their working. **Part (b)** was a very well answered question with most candidates obtaining the correct answer of 18. The main error seen in this question was, after they had secured a method mark by writing $p - 3 = 15$, they incorrectly subtracted 3 leading to an answer of 12. Sometimes this was a careless error made by some of the more able candidates. Candidates are advised during their checking to substitute an answer back in to the original equation to check that it works.

Answer: **(a)** $\frac{5}{14}$ **(b)** 18

Question 25

Part (a) was well answered by many candidates; the most common error was to give the answer $(x-11)(x+12)$ and occasionally $(x-66)(x+2)$, $(x+66)(x-2)$, $(x-132)(x+1)$ or $(x+132)(x-1)$. Other errors included having the correct answer and then deciding to equate the expression to 0 and then solve by giving answers of x = 12 and x = –11; some candidates didn't factorise and just used the quadratic formula. **Part (b)** was more challenging with a very common answer being $x(x^2-4)$ which scored one of the marks for the correct partial factorisation. The more able candidates were able to follow the hint in the question, which asked the candidates to 'factorise completely' which is usually an indicator that taking out just one factor and one bracket is not sufficient. Occasionally the incorrect answer $x(x^2-4x)$ was seen and some candidates used inefficient notation, e.g. $(x+0)(x+2)(x-2)$. Some reached $x(x^2-4)$ and realised it was the difference of two squares but incorrectly followed it with $x(x+4)(x-4)$.

Answers: **(a)** $(x-12)(x+11)$ **(b)** $x(x+2)(x-2)$

Question 26

There were many correct and efficient solutions to this question with candidates correctly finding *AC* and then finding $\tan^{-1}\left(\frac{2}{5}\right)$. Of those who did not succeed, many identified the wrong angle, often finding *QAB*, *QBC or AQC*. Some good work was spoilt after correctly finding *AC* and/or *AQ* by going on to use an incorrect trig ratio, e.g. $\sin^{-1}\left(\frac{2}{5}\right)$ etc. It was quite common to see candidates using inefficient methods, e.g. using sine or cosine ratios instead of tangent and therefore having to work out *AQ*, often having already found *AC*. Usually these candidates prematurely rounded part way through their working using *AQ* as 5.38 and lost the final accuracy mark as a consequence. Some candidates made it even harder by opting to use the cosine rule. It was less common for these to reach a successful outcome and again frequently, premature rounding caused the loss of the final accuracy mark.

Answer: 21.8

Question 27

Part (a) was often correct although some candidates did not fully process their answers and wrote, e.g. 3^3.
Part (b) proved a little more challenging, although it was also often correct. Some candidates applied a correct rule for the power but gave the answer as 2 rather than x^2, or unsimplified as $x^{\frac{6}{3}}$.
Part (c) was less successful and one of the more challenging questions on the paper with full marks not being scored that often. A number correctly managed some simplification for 1 mark but very few fully simplified their answer. Common was leaving it one stage away, often as $\frac{0.5}{y^{-2}}$, $\frac{\frac{1}{2}}{y^{-2}}$ or $\frac{2^{-1}}{y^{-2}}$.

Answers: **(a)** 27 **(b)** x^2 **(c)** $\frac{y^2}{2}$

MATHEMATICS

Paper 0580/23
Paper 23 (Extended)

Key messages

Generally answers should be given correct to three significant figures unless the answer is exact or if the question asks for a different degree of accuracy.

General comments

Candidates should show all their working, particularly the calculations they do on their calculators. Candidates need to read questions carefully and note the form the answer should be displayed in. Many errors are made in converting between units; many candidates do not know how to convert between area units and between volume units.

Comments on specific questions

Question 1

This question was usually answered correctly. The main error was to find the difference between the numbers and give an answer of 3 (h) 28 (min).

Answer: 2h 32 min

Question 2

Most answers were correct; however some candidates added 9 to the cube root of 25 and then found the square root, giving an answer of 3.45. Many candidates truncated the correct answer to 3.05.

Answer: 3.06

Question 3

Most answers were correct; some candidates gave 66 as their final answer without any supporting working.

Answer: 66.2

Question 4

The most usual answer was trapezium whilst other answers included rhombus and square.

Answer: kite

Question 5

Most candidates gave a correct solution. The most common alternative answer was a partial factorisation such as $3(6x + 9y)$.

Answer: $9(2x+3y)$

Question 6

Most answers were derived using a calculator rather than using indices and therefore, although the exact answer is a fraction, many gave their answer as a decimal and some of them did not give enough accuracy in their answer.

Answer: $\frac{2}{3}$

Question 7

This question was answered well, although some used simple interest where $31.2 was often observed, resulting in a final answer of $1262.40. The compound interest, $63.21, was sometimes presented as a final answer.

Answer: 1263.21

Question 8

In many instances, $\frac{79}{90}$ appeared in the answer space with very little or no working. In the cases where calculations were shown, $100x - 10x(=87.77\ldots - 8.77\ldots) = 79$ and $10x - x(=8.77\ldots - 0.877\ldots) = 7.9$ were common, less so was the use of $100x - x$. It was reasonably common to see $0.8\dot{7}$ being interpreted as 0.878787.

Answer. $\frac{79}{90}$

Question 9

Most candidates gained credit for correctly collecting the *x*'s and numbers together. If this resulted in $-10x \geqslant 12$, in many cases $x \geqslant -1.2$ was observed in the answer space. Common errors usually occurred in the manipulation of the inequality and included $19 + 7(= 26)$ as well as $8x - 2x$. Some candidates left their answer as an unsimplified improper fraction.

Answer: $x \leqslant -1.2$

Question 10

The most common method was to not use volume scale factors and to multiply 2400 by 30 and divide by 100. Some attempts involved $2400 \div 30$ as a first stage.

Answer: 64.8

Question 11

The most common method was to calculate $\frac{360}{12} = 30$ before subtracting 30 from 180. A less common method was to calculate $(12 - 2) \times 180$ before dividing by 12. The most usual incorrect answer was 30 from a partial method.

Answer: 150

Question 12

This question was usually well answered with the most popular method being $0.88 \div 0.8 = 1.1$, although occasionally the inverse method of 0.88×1.25 was seen, the 1.25 being the reciprocal of 0.8. The most common incorrect answer was to add on 20% to 0.88 by calculating $0.88 \times 1.2 = 1.056$ or 1.06 which was sometimes given as 1.1.

Answer: 1.1[0]

Question 13

The most common correct method was $\frac{22}{7}-\frac{5}{4}=\frac{88}{28}-\frac{35}{28}=\frac{53}{28}=1\frac{25}{28}$. The most common error was not to write the answer as a mixed number, instead leaving it as the improper fraction $\frac{53}{28}$. The other main error was not to convert the fractions to a common denominator before attempting to subtract them. Some tried to deal with the fractions without involving the integers and occasionally this did lead to the correct answer. There were a few who attempted to convert the fractions to decimals.

Answer: $1\frac{25}{28}$

Question 14

A very common error seen was the incorrect factorisation of $(x + 4)(5x – 3)$. The answer of $-\frac{5}{3}$ was frequently inaccurate with versions seen including -1.66 and -1.7. Many candidates tried to use the quadratic formula suggesting that they were unable to factorise the expression or that they did not see the request to factorise in the question.

Answer: 4, $-\frac{5}{3}$

Question 15

The most common error was either calculating gf(x) as g(x) $\times$ f(x) or writing the first line of working as $(5x – 3)^2 + 6x + 1$. Those who started correctly sometimes expanded $(5x – 3)^2$ incorrectly as $25x^2 + 9$ or $25x^2 – 9$.

Answer: $25x^2 – 8$

Question 16

The vast majority of candidates gaining full marks wrote their first line as $12m+4xy=xp$. Those candidates who rearranged their first line to be $3m=\frac{xp}{4}-xy$ did not write their second line as $3m=x\left(\frac{p}{4}-xy\right)$. They usually attempted to multiply the equation by 4 and they usually did not multiply the *xy* term by 4.

The other common errors were making a sign error when attempting to rearrange their three term expression, leaving an *x* term on both sides of their equation and choosing one '*x*' term to make the subject of their equation.

Answer: $\frac{12m}{p-4y}$

Question 17

Part (a) was answered correctly by most candidates. In **part (b)** most candidates started to solve the equation $5n^2 + 3 = 848$ by subtracting 3 from 848. However instead of dividing by 5 and then taking the square root, some tried to square root 845 first. A significant number did not solve this equation but they would state 'yes' and then give an implicit form such as $5 \times 13^2 + 3[= 848]$.

Answers: **(a)** 1, –4 and –9 **(b)** yes because 13 is an integer

Question 18

Those reaching the correct answer used the sine rule to find angle *ACB* first then, using the property of the angles of the triangle, they calculated angle *ABC*. The most common error was the incorrect rearrangement of the correct implicit sine rule equation. Those who attempted to use the cosine rule usually found the length of *AC* incorrectly.

Answer: 73.6

Question 19

In **part (a)** most answers were either completely correct or completely incorrect. The most common incorrect answer was $\begin{pmatrix} 6 & 0 \\ 0 & 6 \end{pmatrix}$. In **part (b)** the most common errors were to either not calculate the determinant at all or to calculate 5×0 to be 5 in working out the determinant, thus reaching a determinant of 7 and not 12. Some gave the answer in decimals correct to one decimal place without any working to support their answer.

Answers: **(a)** $\begin{pmatrix} 11 & -6 \\ -5 & 6 \end{pmatrix}$ **(b)** $\frac{1}{12}\begin{pmatrix} -6 & 0 \\ -5 & -2 \end{pmatrix}$

Question 20

A large number of candidates were able to reach the correct answer. Almost all candidates correctly calculated the area of the square and gave the correct units (cm^2). Common errors were to work with 10 as the radius in the formula for the area of the semi-circle or to use 5 as the radius but to find the area of the whole circle. A few candidates wrote 10×10 for the area of the square but calculated it as 20. Some attempted to convert the answer to square metres and most of these were attempted incorrectly.

Answer: 139 cm^2

Question 21

In **part (a)** the majority of candidates were able to correctly calculate the mean number of hummingbirds seen in Ali's garden. A relatively common error was to misread the graph and calculate the mean number of hummingbirds in Hussein's garden. Some incorrectly multiplied the day number by the number of hummingbirds before adding them together. In **part (b)** some candidates calculated the mean number of hummingbirds seen in one of the two gardens rather than the median for Hussein's garden. Where attempts at listing numbers and finding the median were seen there was a variety of different errors observed, the two most common being working with the data for Ali rather than for Hussein and not ordering the data before choosing the middle one. **Part (c)** was well answered with sometimes 3 or 4 given as the answer.

Answers: **(a)** 3.4 **(b)** 5 **(c)** 10

Question 22

Part (a) was usually answered correctly. The most common incorrect answer was 23°. **Part (b)** was also answered well, the most common error being to assume that both angles *AEB* and *BEC* were 19°. In **part (c)** a good number of candidates gained credit for labelling angle *EAB* as 90°. Incorrect answers were often based on calculations using differing combinations of 19° and 23°, for example 180° – 19° – 23°.

Answers: **(a)** 19 **(b)** 138 **(c)** 90

Question 23

In **part (a)** the common error with the first set was to shade B' only. In the second set the common error was to shade A' or $(A \cup B)'$. In **part (b)(i)** the elements 60 and 70 were often included or some of the numbers were omitted. The element 67 was sometimes in the incorrect place. In **part (b)(ii)** the elements were often listed, rather than the number in the set. In **part (b)(iii)** 0, 'nothing' or an incorrect symbol was often written.

Answers: **(b)(ii)** 3 **(iii)** $\varnothing$ or { }

MATHEMATICS

Paper 0580/31
Paper 31 (Core)

Key messages

Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed and emphasise that in show questions candidates must not start with the value they are being asked to show. 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.

General Comments

The difficulty of the paper was appropriate for the candidates intended. The majority of candidates were able to access all questions and the presentation of their work was generally good. This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. The vast majority of candidates were able to complete the paper in the allotted time. Few candidates omitted part or whole questions. The standard of presentation was generally good and there was evidence that most candidates were using the correct equipment. Candidates should be encouraged to not write over previous wrong answers when correcting their work, instead cross out wrong work and replace, as often answers are very difficult to read.

Areas which proved to be important in gaining good marks on this paper were; using negative numbers in the context of temperature, using money, calculate percentage increase, price after a percentage change and calculating compound interest. Successful candidates were able to interpret a scatter diagram, calculate mean and median from a set of data, plot and interpret a quadratic curve, measure, draw and calculate bearings, use scale to draw an accurate diagram, use a calculator accurately, use and give times in 24 hour format, understand probability, write a value as the product of its prime factors, draw and describe transformations, simplify algebraic expressions, form and solving linear equations, calculate the area of a triangle and continue sequences and describe the *n*th term of a sequence. Although this does not cover all areas examined on this paper, these are the areas that successful candidates gained marks on.

Comments on specific questions

Question 1

(a) (i) Candidates were successful in interpreting the scale and showed that they understood each division was equivalent to 2. Few candidates made errors on this question; the most common was an answer of 10.6 from interpreting each division as 0.2.

(ii) Again candidates successfully interpreted this scale using each division as 5. Few errors were seen; the most common was –18 or –19, using each division as 2 or 1 respectively.

(b) (i) The vast majority of candidates successfully identified the coldest day. Many candidates also gave the temperature (–6) which was not penalised if they also gave the day.

(ii) Most candidates correctly calculated the difference, with a 50–50 split between those that gave the answer of 6 and –6. Both answers however were acceptable.

(c) (i) Candidates found this time question more challenging. Most successful answers were given in 24-hour time format but 4 05 pm was also accepted. However a large number of candidates lost the mark because their time was given in the incorrect format, even though they clearly had found the correct time, e.g. 16 05 pm and 4 05.

(ii) The vast majority of candidates successfully added 7 to –3. Some less able candidates gave answers of 10 or –10 from subtracting 7 from –3 or adding 7 to 3.

Answers: **(a)(i)** 16 **(ii)** **–**15 **(b)(i)** Friday **(ii)** 6 **(c)(i)** 16 05 or 4 05 pm **(ii)** 4

Question 2

(a) This money question was successfully answered by nearly all candidates. It was the best answered question of the whole paper. Very few candidates only gave the answer and lots of good quality working was shown by most candidates. The few errors seen came when adding the cost of all the items together. Most errors seen were due to candidates not using their calculators to do the final addition.

(b) Most candidates attempted this question by finding the 8% first and then added it to $64. More able candidates used the multiplication method, 64×1.08. Both methods were seen often and well presented by successful candidates. The most common error seen was finding the 8% but not adding it to find the new price.

(c) Calculating the percentage increase proved to be more challenging, with only the most able candidates generally being successful on this question. The best answers calculated the increase in price first and then expressed this as a percentage of the original price. The most common errors were: expressing the increase in price as a percentage of the new price rather than the original price, or dividing the original price by the new price. The most common incorrect answer seen was 10.7% from $\frac{30}{280} \times 100$ or from $\left(1 - \frac{250}{280}\right) \times 100$.

(d) This question was well answered by more able candidates who showed clear working out. Very good answers showed a clear calculation of area followed by a multiplication by 12 to give the cost. Errors occurred generally because candidates did not calculate the area but found the perimeter instead. Another common error was to multiply the length and width by 12 first and then to add these together. Some candidates who used the correct method did not score full marks due to premature rounding. Often candidates calculated the area as 46.75 but then rounded this figure to 47 or 46.8 before multiplying by 12. Candidates should be encouraged to use the full calculator answer during the calculations and only round the final answer, if required.

(e) Calculating compound interest was a challenge for many candidates. However many correct answers were given by correctly quoting and substituting into the formula for compound interest. There were a number of errors seen; the most common was the calculation of simple interest. Other common errors were down to poor rounding or truncation of the final answer. Another way in which candidates lost a mark was rounding $(1.06)^3$ to 1.19 or 1.2 and then multiplying by 3600 to give an answer of 4284 or 4320.

Answers: **(a)** 180.5[0] **(b)** 69.12 **(c)** 12 **(d)** 561 **(e)** 4287.66

Question 3

(a) (i) This was a very challenging question with only a minority of candidates giving a reason that was acceptable. The majority of candidates gave the correct test but did not score the mark because their reason wasn't satisfactory. Correct answers compared the two test results for each candidate, so an answer of 'written test had higher scores' gained the mark but an answer of 'written test because most of the class had high scores in the written test' did not gain the mark as it does not compare with the speaking test. Most candidates did not gain the mark for a variety of reasons; any mention of the line of best fit did not gain the mark as it does not compare the two marks, mentioning the highest mark for each test only compares one student's results rather than all the candidates. A number of candidates attempted to count how many scored more than, for example, 40 for each test. If they counted correctly this answer was accepted but many candidates miscounted and therefore did not gain the mark. A small number of candidates put a lot of effort to calculate the mean for each test, however if inaccurate they also did not gain the mark.

(ii) Most candidates correctly identified that the correlation shown was positive. Extra comments like 'weak' or 'strong' were ignored. Some less able candidates did not use the correct terminology and 'direct proportion' was a common incorrect answer as well as 'negative'.

(iii) The vast majority of candidates correctly identified the point. The most common incorrect points circled were (7, 45) and (58, 60).

(iv) Most candidates found the correct score. The most common error was 33 or 33.5 which was using 39 from the written test rather than the speaking test. Many less able candidates did not attempt this question.

(b) (i) Few candidates found the mode or mean instead of the median. Good answers showed the whole list of data in order before identifying 29 as the middle value. Common errors involved writing a list of only 10 numbers and therefore finding the wrong middle value or finding the range instead of the median.

(ii) Few candidates found the mode or median instead of the mean. Good answers clearly showed all their working including an addition sum of all 11 values and a clear division by 11. Again some errors in rounding caused candidates to lose marks. A significant number of candidates showed no working and gave the answer of 27.4 which gained no marks as it is inaccurate and no working given.

Answers: **(a)(i)** Written test and a valid reason **(ii)** Positive **(iii)** (45,10) indicated **(iv)** 42
(b)(i) 29 **(ii)** 27.5

Question 4

(a) (i) This was one of the best answered questions on the whole paper. The vast majority of candidates correctly plotted the point (–4, 2) with only a few candidates plotting (2, –4) instead.

(ii) Giving the mathematical name of the triangle was much more challenging. Right angle(d) triangle was the most common correct answer however scalene was seen. The most common incorrect answers were 'rectangle triangle', 'right triangle' and 'isosceles triangle'.

(iii) The correct vector was only given by more able candidates with many less able candidates not answering or reversing the values or giving negative values instead of positive values.

(iv) (a) Calculating the gradient of the line was a very challenging question for many candidates. Few correct answers were seen with a variety of incorrect answers given. These included calculations involving run/rise, giving the common incorrect answer of 2. Many candidates attempted to use co-ordinates on the line but few were successful in finding the change in *y* co-ordinates/change in *x* co-ordinates.

(iv) (b) Candidates were able to gain a follow through mark if they used their gradient correctly but most did not gain this mark as they did not use the *y* intercept as 0. Only the most able candidates gave the correct equation with many candidates giving answers without the *x* variable. Candidates often showed they needed to have an equation of the form $y = mx + c$, however did not put a value for *c*. So common incorrect answers were $y = \frac{1}{2}x + c$ or $y = mx + c$.

(b) (i) Most candidates gained at least 2 marks for correctly finding the y values for $x = 0$, 2 and 4. The most common errors were for $y = –3$ and –1 with *x* values of –17 and –7 respectively. This is because candidates found $(–3)^2 = –9$ instead of 9 and $(–1)^2 = –1$ instead of 1.

(ii) There was good plotting of points and the follow through from **part (b)(i)** was seen often. Very few straight lines joining points was seen and even fewer thick or feathered curves drawn. Some candidates did not gain full marks as they drew a 'flat bottomed curve'. It is important that candidates draw a curved line between the points at $x = 0$ and $x = –1$ which goes below their co-ordinates.

(iii) Candidates found this question extremely challenging. It was the question which most candidates did not attempt in the whole of the paper. Those that did attempt it often did not use their graph to find where their curve crossed the *x*-axis despite being told to use their graph in the question. Many candidates attempted the quadratic formula but very few were successful. Candidates found the scale difficult to use and often were not accurate enough in reading the *x* value from the graph.

Answers: **(a)(ii)** Right-angled or scalene **(iii)** $\begin{pmatrix} 8 \\ 4 \end{pmatrix}$ **(iv)(a)** 0.5 **(iv)(b)** [y =] 0.5 **(b)(i)** 1 –5 –5 1 15 **(iii)** –2.8 1.8

Question 5

(a) Candidates generally measured the distance accurately and multiplied by 12 correctly. Some less able candidates measured to the nearest centimetre and therefore gave the answer of 48 km.

(b) The majority of candidates showed little understanding of bearings with the most common answer being a measurement of length rather than an angle or 227° which was the bearing of *A* from *B*. Very few candidates showed the ability to use a protractor accurately when measuring a bearing.

(c) Candidates found measuring a reflex angle even more challenging than the acute angle in **part (b)**. This part proved to be the most difficult in this question with candidates often not answering, measuring in an anticlockwise direction from North or measuring *C* from *B*. Candidates should be encouraged to draw a South line from town *C* and then measure, to split the reflex angle into 180 and 112, especially if not using a 360° protractor.

(d) (i) Good answers saw accurate arcs drawn using compasses from towns *A* and *C* and the town *D* clearly marked where the arcs intersected. A significant number of candidates found the correct position of town *D* but did not show any arcs, as instructed in the question.

(ii) Candidates generally showed they understood how to calculate speed by writing the correct formula or attempting to divide the distance by the time. However only the most able candidates were successful in gaining full marks. Most candidates lost marks because of premature rounding or dividing by time in minutes instead of hours. The most common incorrect answer was 8.4, from $\frac{84}{10}$. Candidates who attempted to convert the time to hours usually lost a mark by prematurely rounding their answer before dividing the distance by this time, e.g. $\frac{10}{60} = 0.16$ or 0.17.

(e) Finding the bearing of town *A* from town *E* proved to be the most challenging question of the whole paper. Those that attempted it often gave the incorrect answer of 242, from 360 – 118, or 62, from 180 – 118. The question asked for candidates to work out the bearing rather than drawing and measuring, so candidates who did attempt this question using a diagram did not gain the marks unless their answer was exactly 298.

Answers: **(a)** 51.6 **(b)** [0]47 **(c)** 292 **(d)(ii)** 504 **(e)** 298

Question 6

(a) (i) This was well answered with most candidates achieving at least 1 mark. The most common omissions were 1 and/or 18. The most common incorrect inclusions were 4 or 8. A small minority attempted prime factors.

(ii) Around half of the candidates correctly gave a multiple of 30, most commonly 60, although 30, 90, 150 and 900 were often seen. An equal number of candidates confused factors with multiples, so 2, 3, 5, 6, 10 or 15 were seen often.

(iii) Candidates showed good use of their calculators to find the square root.

(iv) This part was answered very well although many candidates gave a truncated or rounded answer, usually 15.6.

(v) Again candidates showed good use of their calculators with very few errors seen. The most common incorrect answer was –0.2.

(b) Many candidates showed a lack of understanding of the term ‘product of prime factors’ and only factorised it into, e.g. 9×8. Most candidates chose to use a ladder or tree method but some left a non-prime factor, e.g. 9 or 4. Many correct answers were seen, however a number of candidates added the prime factors or listed the factors and did not write the answer as a product.

(c) Lists or ladders of prime factors were seen in many responses and more able candidates generally went on to obtain the correct answer from this method. A significant number did not select the correct factors, often missing a factor of 2 from their answer or giving 120. It was also common to see the answer 2 following ladders of prime factors meaning candidates had identified the HCF instead of the LCM. Many candidates gained 1 mark with this method by showing either $2 \times 3 \times 5$ or 2^4, or multiplying all the prime factors to obtain 480. Others started lists of multiples; some stopped well before 240 or made a slight error, while others led to the correct answer.

(d) Most candidates counted in 6s and 9s until they arrived at a corresponding time and many correct answers resulted. Some incorrectly started their counting at 6 am and 9 am, instead of 2 am, or added 2 am, 6 and 9 to achieve 5 pm. Confusion was seen often with 24-hour clock times having am or pm added on, or 12-hour clock times not stating am or pm. The best answers followed lists 8, 14, 20 and 11, 20.

Answers: **(a)(i)** 1, 2, 3, 6, 9, 18 **(ii)** a multiple of 30 **(iii)** 46.2 **(iv)** 15.625 **(v)** 5 **(b)** $2^3 \times 3^2$ **(c)** 240
(d) 20 00 or 8 pm

Question 7

(a) (i) Candidates showed good understanding of probability in all three parts of **Question (a)**. The majority of candidates gave their answers correctly as fractions with few giving their answers as decimals or percentages. All correct equivalences were accepted for the marks.

(ii) Most candidates correctly identified the probability that the counter was white was $\frac{5}{20}$. This was seen in equal frequency as $\frac{1}{4}$ or 0.25.

(iii) The vast majority of candidates identified the probability that the counter was yellow was 0. This was equally seen as 0 or $\frac{0}{20}$. A common incorrect answer was $\frac{9}{20}$ from calculating the remaining fraction and therefore the probability that the counter was blue rather than yellow.

(b) This part was very well answered, although the method was rarely seen. 0.55 sometimes resulted by assuming 0.3 was 0.03. Candidates should be reminded to show all working out. A small number of candidates thought there was a pattern to the table as the values given decrease by 0.06 so the answer 0.36 was given.

(c) This part was very well answered. Many candidates showed that $\frac{8}{20}=\frac{6}{15}=\frac{2}{5}$ (or 40% or 0.4) to achieve full marks. The common incorrect answer was to express red as a fraction of blue for each bag, giving $\frac{8}{12}=\frac{6}{9}=\frac{2}{3}$. Another error was to add the two fractions together. Cancelling and conversion was generally of a high standard. A few candidates attempted to use a tree diagram, however this was rarely successful.

Answers: **(a)(i)** $\frac{6}{20}$ **(ii)** $\frac{5}{20}$ **(iii)** 0 **(b)(i)** [0].28 **(c)** $\frac{8}{20}=\frac{6}{15}=\frac{2}{5}$

Question 8

(a) This algebra question was well attempted by most candidates who generally scored at least 1 mark for multiplying out at least one bracket correctly. $-2x + 8$ was a common incorrect answer when multiplying out $-2(x + 4)$. A significant number of candidates were able to expand both brackets correctly but made an error when simplifying, e.g. $8x - 7$, $8x + 23$ or $8x - 23$, even though $+15 - 8$ was clearly in the working. Another error was to change the sign as terms were moved around the expression, e.g. $10x + 15 - 2x - 8$ became $10x - 2x - 15 - 8$.

(b) (i) This question was only answered successfully by the most able candidates. Many showed they understood the question but did not give their answer in its simplest form. $2x + 2x + 2x$, $3x2x$, $2x^3$ were common incorrect answers.

(ii) As in **part (b)(i)** many candidates achieved an unsimplified answer which did not score the mark.

Many candidates formed equations here instead of an expression. The most common incorrect answers were $20a \div 4$, $20a \div 4 = 5$, $a = 5$ and $20a \times 4 = 80a$.

(c) The best answers given in this part contained full working and correct simplification of algebraic expressions. Few candidates gave the initial expression containing brackets but most candidates did realise they needed to add 4 expressions together, although some candidates just added together the two given sides. Others correctly multiplied each side by 2 with a view to adding them but did not go on and gather like terms. Common errors were to confuse area with perimeter, $(3y + 1) \times (2y + 5)$. Some, having formed a correct expression, then went on to attempt to solve an equation, e.g. $3y + 1 = 2y + 5$ or $6y + 2 = 4y + 10$. Others achieved the correct answer $10y + 12$ and then changed the + to = or set it = 0 and solved for y, thus losing a mark.

(d) Most candidates appeared to understand the problem but many found the algebraic skills required to form a correct equation challenging and could only express a partial solution. Many candidates therefore scored 1 of the first 2 marks in the first part for either $m + 6$ or for $3m + 7t = 182$. Many chose to omit the equation and use a trial and improvement approach. A common incorrect equation was $3m + 7m = 182$, but those that were able to form the correct equation $3m + 7(m + 6) = 182$ generally then solved it correctly for full marks. Candidates who recognised that the problem could be solved using simultaneous equations were often successful. The usual approach was to substitute $t = m + 6$ into $3m + 7t = 182$. Other successful, but lengthy approaches were to find t first using $m = t – 6$ or sometimes $m = \frac{(182 - 7t)}{3}$, and then find m. There was some good use of elimination to solve for m (and t) as another alternative method, although this was rarely seen.

Answers: **(a)** $8x + 7$ **(b)(i)** $6x$ **(ii)** $5a$ **(c)** $10y + 12$ **(d)** 14

Question 9

(a) (i) Most candidates correctly used the formula for finding the area of a triangle. Some answers involved π, while others attempted to measure the height and base of the triangle instead of using the grid and measured incorrectly. Counting squares proved very difficult for those that attempted it with very few correct answers using this method.

(ii) This was well attempted with the correct triangle given in a variety of positions. This was the best answered part of this question. A significant number of candidates however only enlarged one side correctly while a few enlarged correctly but in the wrong orientation. The most common incorrect answer saw candidates adding two squares to the height and base rather than multiplying by 2.

(b) (i) The transformation was generally described well. Most achieved at least 2 marks with the centre of rotation being the usual omission. Some incorrectly called it reflection but very few gave more than one transformation in their answer. A few lost marks by giving extra information, usually a vector. Only a few used the full alternative transformation using enlargement.

(ii) Many candidates scored 2 marks for the correct reflection but the majority of responses were in an incorrect horizontal line, usually $y = 0$. Some reflected in $x = –1$. Candidates who drew the mirror line were more successful.

(iii) Many candidates achieved full marks by correctly translating the shape by the correct vector. Candidates found the translation easier than reflection. The horizontal move was more successful than the vertical, the common error being to move 1 down instead of up. A misconception was to translate the triangle point (–3, 1) to (5, 1) using the same numbers in the vector.

Answers: **(a)(i)** 7.5 **(b)(i)** Rotation, 180°, [centre] (0, 0)

Question 10

(a) (i) This part was very well done with the vast majority of candidates correctly continuing the sequence and giving the next term.

(ii) Several candidates tried to complicate this by attempting to give a formula for the nth term, when a worded description of the term-to-term rule was required. $n + 8$ was the most common incorrect answer. Others showed a sum to demonstrate how they answered **part (i)**.

(iii) Giving an expression for the nth term proved to be the most challenging part of this question with a large proportion of candidates not attempting this part. Many answers of $–2(n – 1)8$ and $–2(n + 1)8$ were seen which was an attempt to use $a + (n – 1)d$ but incorrectly quoting the formula. Many candidates gained 1 mark by spotting the difference is 8 and writing $8n$. Many correct answers were seen, both simplified or not. The usual incorrect answer was $n + 8$.

(b) Many of those scoring 0 made no attempt to substitute 2 for n and consequently had answers which included n. To be successful candidates needed to understand that 'second term of the sequence' means $n = 2$. A common incorrect response was to expand the bracket, $5n + 5 – 6$ was seen regularly as the first step, often followed by $5n – 1$ or just –1. The common incorrect answers were 4 and –1 using $n = 1$ or $n = 0$. Many less able candidates chose not to attempt this question.

(c) Candidates who successfully found the next term showed evidence of working out the differences between each term. Many responses were between 30 and 36 as a result of using incorrect differences. The answer of 32, from using 13 as the next difference, was common. 23 was seen frequently, being 19 plus the second difference of 4.

Answers: **(a)(i)** 30 **(ii)** add 8 **(iii)** 8n – 10 **(b)** 9 **(c)** 34

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. Candidates were able to complete the paper within the required time and most candidates made an attempt at most questions. Although a number of questions have a common theme, candidates should realise that a number of different mathematical concepts and topics may be tested within the question. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set.

Comments on Specific Questions

Question 1

(a) (i) This part was generally answered well although the common error was 85 minutes, coming from 8.20 – 7.35 = 0.85, i.e. using time as a decimal value or over reliance on a calculator.

(ii) This part was generally answered well although a common error was in giving the answer as a time period of 10 hours 10 minutes rather than the time of 10 10.

(iii) This part was generally answered reasonably well with the full method of $(1.66 \times 5) - 7.75$ used, resulting in the correct answer. Common errors included $7.75 \div 5 = 1.55$, $1.66 - 1.55 = 0.11$ and $7.75 - 1.66 = 6.09$.

(b) (i) This part was generally answered well although a significant number of candidates did not appreciate the definition of range and gave a variety of other statistical values.

(ii) This part on completing the frequency table was generally answered well although a small number of candidates misplaced one or more values.

(iii) This part on drawing the bar chart was generally answered well with correct heights and widths of the required bars. The common error was in not completing the scale used despite this requirement being stated in the question.

(iv) This part was generally answered well although a significant number incorrectly answered in a way that illustrated a lack of understanding of the term 'modal class interval'.

Answers: **(a)(i)** 45 **(ii)** 10 10 **(iii)** 0.55 **(b)(i)** 50 **(ii)** 2, 7, 4, 5, 6, 6 **(iv)** 10 to 19

Question 2

(a) (i) This part was generally answered correctly although a common error was writing 'eighty' instead of 'eight'.

(b) (i) This part was generally answered correctly.

(ii) This part was generally answered correctly.

(iii) This part was generally answered correctly.

(c) (i) This part was generally answered well particularly by those candidates who used a factor tree or factor table. However a significant number did not write their answer as a product of prime factors and gave answers of 2, 7, 7 or 2, 7 or 2, 7, 14. Another common error was in writing down a list of factors such as 2×49, 7×14 and 1×98.

(ii) This part was generally answered well again, particularly by those candidates who used a factor tree or factor table for both 98 and 182. Common errors included 2, 7 and 1274 (LCM).

(d) (i) This part was generally answered correctly although a common error was 24.

(ii) This part was generally answered correctly although common errors were 156.2 (the square root) and 468.5 (the square root $\times$ 3).

(iii) This part was generally answered correctly although common errors were 0 and 1.

(iv) This part was generally answered correctly. Common errors included –125, –15, $\frac{1}{5^3}$ and 0.005.

Answers: **(a)** eight thousand and forty-five **(b)(i)** 64 **(ii)** 61 or 67 **(iii)** 68 **(c)(i)** 2×7^2 **(ii)** 14 **(d)(i)** 1296 **(ii)** 29 **(iii)** 14 **(iv)** 0.008

Question 3

(a) Most candidates scored at least 1 of the 2 available marks with the order of rotational symmetry for the hexagon causing the most problems.

(b) (i) This part was generally answered well although common errors included reflecting in the y-axis, the x-axis or $y = -1$.

(ii) This part was generally answered well although common errors included enlargements drawn from a variety of incorrect centres.

(iii) The majority of candidates correctly identified the transformation as a translation although a number of errors were seen in the description of the required vector.

Answers: **(a)** 2, 6 **(b)(iii)** translation $\begin{pmatrix} -5 \\ 3 \end{pmatrix}$

Question 4

(a) (i) This part was generally answered well with the correct answer reached although the lack of working was noted for this part and a number of candidates may have lost method marks as a result. A significant number did not realise the complexity of this multi-stage question and the required stages of $10 \div 1.45 = 6.89$ giving 6 pens bought, $6 \times 1.45 = 8.70$, $10.00 - 8.70 = 1.30$ was often not seen or appreciated. A small number used the alternative valid method of repeated subtraction.

(ii) This part on percentage decrease was generally answered well although a very common error was simply finding 15% as 0.84 and giving this as the answer. Other common errors included $5.60 + 0.84 = 6.44$, $5.60 - 0.15 = 5.45$ and $5.60 \div 0.15 = 37.33$.

(b) This part on finding the median was generally answered well particularly by those candidates who re-wrote the values as an ordered list. Common errors included 18.5 (from unordered original list), 19 (mode), 27.6 (mean), 50 (range), $25 - 19 = 6$, omitting one value from the ordered list, and the calculator error of $19 + 25 \div 2 = 31.5$.

(c) This part on ratio was generally answered very well with the correct answer reached although the lack of working was noted and a number of candidates may have lost method marks as a result.

(d) This part on money conversion was generally answered well although the common error of 1400×1.54 was often seen.

(e) This part was generally answered well with the majority of candidates successfully applying the compound interest formula. Those candidates who did the work in stages often lost the accuracy mark or gave their final answer as 54.74. A small but significant number spoilt their method and lost accuracy marks by adding or subtracting 2000 from their calculated answer. The use of simple interest was rarely seen.

Answers: **(a)** 6 pens and 1.30 **(ii)** 4.76 **(b)** 22 **(c)** 3000, 1500, 2500 **(d)** 909.09 **(e)** 2160.09

Question 5

(a) Many candidates were able to show that 225 students chose Science by using $\frac{90}{360} \times 900$ or $\frac{1}{4} \times 900$. However, a significant number were unable to attempt this part while others used the given value of 225 in a circular argument which is not acceptable in a 'show that' question.

(b) This part was generally answered well with a good number of candidates correctly applying the method of $\frac{18}{360} \times 900$. Common errors included $\frac{18}{900} \times 360 = 7.2$, $900 \div 18 = 50$, $180 - 18 = 162$ and 18.

(c) This part on completing the pie chart was generally answered well with an accurate diagram drawn, although the lack of working was noted for this part.

(d) (i) The majority of candidates were able to state the required probability as 0 although $\frac{1}{900}$ was a very common error.

(ii) This part was generally answered well with a good number of candidates correctly giving their answer as a fraction in its lowest terms. Common errors included $\frac{18}{900} = \frac{1}{50}$, and $\frac{45}{360} = \frac{1}{8}$.

(e) This part was less successful and many candidates were unable to correctly calculate an estimate for the expected number of students. Many and varied incorrect calculations involving 125, 900, 20, 360 and 2520 were seen.

Answers: **(b)** 45 **(d)(i)** 0 **(ii)** $\frac{1}{20}$ **(e)** 350

Question 6

(a) (i) The majority of candidates were able to measure the required distance and convert to kilometres using the given scale although common errors of 9.5 and 100 were seen.

(ii) Although the measurement of the required bearing was performed quite well, many candidates were confused by this term with common errors of the distance 9.5 cm and angles of 45, 225, and 315 being often seen.

(b) (i) This part was generally answered well with a good number of candidates able to score both marks. One mark was often awarded for the correct distance and less often for the correct bearing.

(ii) The majority of candidates were able to use the correct formula to find the required speed but common errors included 78 ÷ 45, 78 ÷ 0.45 and 78 × 45.

(c) The required construction proved very challenging for many candidates and proved to be a good discriminator. Many candidates did not appear to appreciate that the two required constructions were the perpendicular bisector of the line *AB* and an arc of radius 7 cm from centre *A*. Although a number of candidates were able to draw one of these constructions they were often too short to be fit for purpose.

Answers: **(a)** 95 **(ii)** 135 **(b)(ii)** 104

Question 7

(a) (i) This part was generally answered well although common errors of octagon, heptagon, 5, hexagon were seen, together with a variety of other mathematical names.

(ii) This part was generally answered well although common errors of trapezium, parallel, rectangle, 4 were seen, together with a variety of other mathematical names.

(iii) This part was generally answered well although common errors of acute, reflex, 120, 60, isosceles were seen, together with a variety of other mathematical terms.

(b) (i) This part was generally answered well although the common errors included 25 + 12 + 8, 25 × 12 × 8 × 6, 0.5 × 25 × 12 × 8, and the incorrect use of squares or cubes.

(ii) The required conversion in this part was generally poorly done with few correct answers seen. Common errors included ÷10, ÷100, ÷1000, ×100, ×1000, and taking the square or cube root. Those few candidates who started again with 0.25 × 0.12 × 0.08 were usually successful.

(c) (i) This part was generally answered reasonably well with a good number of candidates able to identify the given line as the radius. Common errors included diameter, straight line, tangent, right-angled together with a variety of other mathematical terms.

(ii) The required explanation in this part was generally poorly done with few correct answers of 'angle in a semicircle' seen. Common incorrect statements included **'**triangle in a semicircle', 'because *BAD* is a right angle', 'triangle *ABD* is a right angle', 'the tangent touches the circle' and 'the angles are touching the circumference of the circle'.

(iii) This part on finding the circumference of the circle was generally answered well although a significant number lost the final accuracy mark due to rounding errors or premature approximation. Common errors included the use of $\pi \times 8^2$ and $0.5 \times \pi \times 8$ with other errors of $2 \times \pi \times 4$ and $0.5 \times 8 \times 14$ also seen.

(iv) This part on finding the length of *CD* was generally answered well by those candidates who recognised the need for Pythagoras' theorem, although again a small number lost the final accuracy mark due to rounding errors or premature approximation and some incorrectly used $14^2 + 8^2$. Very few fully correct answers were seen from those that chose to use a long method involving trigonometry. Less able candidates tended to use a variety of incorrect methods using the numbers given in the question such as 6 (from 14 – 8), 22 (from 14 + 8), 22 (from (8 × 14) – 90), 68 (from 90 – (14 + 8)) or 68 from (180 – (90 + 14 + 8)).

Answers: **(a)(i)** pentagon **(ii)** parallelogram **(iii)** obtuse **(b)(i)** 2400 **(ii)** 0.0024 **(c)(i)** radius **(ii)** angle in a semicircle **(iii)** 50.3 **(iv)** 11.5

Question 8

(a) (i) This part was generally answered well. Many of the incorrect answers involved a change of sign for some terms when re-ordering leading to answers such as $12p - 11r$, $4p - 11r$, $12p + 7r$ and $12p + -7r$. Other common errors included $5pr$ and $12p^2 + 7r^2$.

(ii) This part was generally answered well although common errors included 2304, $2304x$, $24x$, $24x^6$ and $10x^5$.

(b) This part was generally poorly answered with many candidates unable to write an acceptable algebraic expression. Common errors included $x + y = 165$, $xy = 165$, $x = 90$ and $y = 75$, $90x - 75y$, $90x \times 75y$, $165xy$, $15xy$, 165, 15 and 6750.

(c) The majority of candidates understood the method involved in this part and either gained full marks or 1 mark for a partial factorisation with $2p(6p - 4)$ being the most common. Common misconceptions seen included $12p^2 - 8p = 4p^2$, $p^2 - p = p$, $12p^2 = 144p$.

(d) This part was generally answered well with many candidates able to score full marks for solving the given equation or at least 1 method mark for a correct step. Common errors included $7r - 3 = 4r$, $28r - 12 = 16r$, $28r = 128 - 12$ after the correct $28r - 12 = 128$ and $r = 140 - 28$ after the correct $28r = 140$.

(e) A significant number of candidates scored full marks on this simultaneous equations question, showing a clear and succinct method. Most candidates used the elimination method and were able to demonstrate an understanding that they needed to multiply both equations to make the coefficients of one of the variables equal. There were many different types of errors seen and these included: sign errors, arithmetic errors, incorrect coefficients in one or both equations, subtracting the equations when they should have been added and vice-versa. Those who used the substitution method were less successful although many scored the method marks but were then unable to solve their resulting linear equation.

Answers: **(a)(i)** $12p - 7r$ **(ii)** $24x^5$ **(b)** $90x + 75y$ **(c)** $4p(3p - 2)$ **(d)** 5 **(e)** $x = 2.5$, $y = 11$

Question 9

(a) (i) The table was generally completed very well with the majority of candidates giving 3 correct values although a common error was calculating $y = –8$ when $x = –1$.

(ii) This was well answered by many candidates who scored full marks for accurate, smoothly drawn curves. Most others scored 3 marks, the fourth mark being most commonly lost for one point being plotted out of tolerance, or for just plotting the points without drawing the curve through them or for joining the points with ruled lines.

(b) (i) This part was generally answered well. Common errors included drawing the lines of $y = 4.8$, $y = 5.2$, $y = 6$ with $x = 5$, $x + y = 5$ and $y = x + 5$ also seen.

(ii) This part was generally answered well by candidates who had drawn the correct line in **part (b)(i)**. A significant number did not appreciate that the *y* co-ordinate of the intersection had to be 5. Other common errors included reversed co-ordinates, misreading of the scale, and attempting to solve the equation. Less able candidates were often unable to attempt **parts (b)(i)** and **(ii)**.

Answers: **(a)(i)** –6, 6, 14 **(b)(ii)** $1.8 \leqslant x < 2$, 5

MATHEMATICS

Paper 0580/33
Paper 33 (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 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. The standard of presentation and amount of working shown was generally good, but candidates need to be aware that if they show no working and give a wrong answer they cannot score any method marks. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should also be made to the degree of accuracy required, and candidates should be encouraged to avoid premature rounding in workings. A lack of understanding of BIDMAS, whether performing arithmetic without a calculator, with a calculator or manipulating algebra, was seen in **Questions 2(a)(i)**, **2(c)**, **5(a)(ii)**, **5(a)(iii)** and **6(a)(i)**. Marks were also frequently lost in **Questions 3(a)** and **4(a)** where candidates were not able to give correct mathematical names. However, the graph in **Question 7(a)(ii)** was particularly well drawn by most candidates.

Comments on specific questions

Question 1

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

(ii) This part was answered very well. The most common errors were either to find $\frac{160}{3}$ or to misread the question and calculate $\frac{800}{10} \times 3$.

(iii) The majority of candidates answered this part correctly. However, the most commonly seen error was to convert $\frac{3}{8}$ to an inaccurate decimal of 0.37 or 0.38 and these wrongly gave either 59.2 or 60.8 hats.

(b) (i) Almost every candidate was able to work out correctly the cost of the T-shirts bought. The few errors that were seen were generally from misreading the number of each type of T-shirt bought.

(ii) The majority of candidates were able to work out 20% of \$9.50 as \$1.90. However not all of these candidates recognised that they needed to subtract this from \$9.50 to find the reduced price rather than just finding the reduction in price.

(c) (i) Although most candidates attempted this question, it was rare to see any working or method to find the degrees per T-shirt. Whilst many scored full marks, a very common misconception was to incorrectly assume that because the sector angle for plain T-shirts was '20' more than the number sold, then the sector angle for striped T-shirts would be 85 + 20 = 105° and for logo T-shirts 115 + 20 = 135°.

(ii) This part was generally well answered with accurate and ruled sectors drawn. The pie chart was followed through from their table, provided their three sector angles had a total of 360°.

(d) Whilst most candidates attempted this part, it was clear that the phrase 'percentage profit' was not well understood . Whilst most candidates recognised that the profit was $9, common errors were either to give answers of 140%, 1.4 or 0.4 or to incorrectly divide the profit by the selling price.

Answers: **(a)(i)** 800 **(ii)** 48 **(iii)** 60 **(b)(i)** 43.5 **(ii)** 7.6 **(c)(i)** 102°, 138° **(d)** 40

Question 2

(a) (i) Almost equal numbers of candidates gave the incorrect answer of 3 as gave the correct answer showing that many candidates do not understand BIDMAS.

(ii) Most candidates successfully completed this question.

(b) (i) Most candidates successfully completed this question.

(ii) Most candidates successfully completed this question.

(c) This part was not answered well. The most common errors seen were with candidates who either evaluated the sum correctly but did not round it correctly to the required accuracy or who evaluated the numerator and denominator separately but got no further than, for example, $\frac{3.67}{86.1}$. Others attempted to calculate the sum in one go but did not understand the BIDMAS rules and the need to insert brackets. Others gave answers of 0.04 or 0.042 but showed no other working and so could not be awarded a method mark.

(d) This part was answered well. The most common errors came from either summing rather than multiplying the numbers, forgetting to square the 4.5, misreading the values or writing $\frac{1}{3}$ as 0.3.

(e) Relatively few candidates were able to correctly identify the irrational number.

(f) (i) Most candidates were able to evaluate T correctly.

(ii) Although some candidates scored full marks on this question, many did not even attempt to use a recognised method such as a factor tree or tree diagram. Frequently candidates who scored no marks had just written down a list of products of 80, that is 80×1, 40×2, 20×4, 16×5 and 10×8.

(iii) The candidates scoring full marks on this question were usually able to give the HCF as 20 with little or no working. Others were able to gain 1 mark for giving a smaller common factor such as 2, 4, 5 or 10.

Answers: **(a)(i)** 9 **(ii)** 4 **(b)(i)** 1.4 **(ii)** 4096 **(c)** 0.043 **(d)** 64.8 **(e)** $\sqrt{5}$ **(f)(i)** 300 **(ii)** $2^4 \times 5$ **(iii)** 20

Question 3

(a) (i) Relatively few candidates were able to give the mathematical name for *AB* as chord. Whilst some incorrect mathematical answers such as tangent, radius and perpendicular were seen, there were also a number of candidates who gave the non-mathematical words string and rope and a large number of candidates who did not give a response.

(ii) Only around a third of candidates correctly named *PQ* as a tangent. Again, there were a range of incorrect mathematical words given and a large number of blank responses.

(b) (i) This part was answered well. However it was clear that some candidates, in this and the next two parts, did not understand what, for example, 'angle *COQ*' meant and/or which angle it represented.

(ii) This part was answered reasonably well with most candidates recognising that triangle *ABO* was isosceles. Some candidates, who showed working, were awarded a method mark despite making arithmetic errors.

(iii) This part was answered well with many candidates recognising that angle *COQ* + angle *OQC* =90°. Candidates who could progress no further than indicating that angle *OCQ* = 90°, either on the diagram or otherwise, were awarded 1 mark.

Answers: **(a)(i)** chord **(ii)** tangent **(b)(i)** 48 **(ii)** 66 **(iii)** 42

Question 4

(a) The majority of candidates could not give the correct name of the triangle. Common errors of isosceles, normal, irregular, obtuse-angled, image, object and translation were seen.

(b) Candidates were frequently able to obtain at least 1 mark when describing the transformation. Common errors that were seen included not giving the correct word 'translation', miscounting the horizontal and vertical displacements, mapping *B* onto *A* (instead of *A* onto *B*), omitting one or more of the negative signs, inverting the vector or giving the vector as a co-ordinate.

(c) Candidates generally rotated the triangle 90° clockwise. Candidates were not so careful about using the correct centre of rotation and it was reasonably common to see (1, 2) or (1, 1) being used as the centre.

(d) (i) Candidates were reasonably successful in correctly working out the area of triangle *A*. Common errors seen were 2, 3 and 6.

(ii) Candidates generally understood the concept of enlarging triangle *A* with scale factor 2. However, candidates did not find it so easy to use *P*, the centre of enlargement, correctly and triangles were often drawn with a vertex at *P*.

(iii) Candidates found this part quite challenging. Those few candidates who calculated the area of the enlarged triangle tended to be successful, but generally candidates showed little evidence of working or any method. A common incorrect answer was 2.

Answers: **(a)** scalene **(b)** translation $\begin{pmatrix} -5 \\ -4 \end{pmatrix}$ **(d)(i)** 1.5 **(iii)** 4

Question 5

(a) (i) This part was generally well answered with most candidates giving the correct expression in terms of n.

(ii) Most candidates understood the concept but were not accurate in their response as was evidenced by their lack of understanding of the need for brackets and BIDMAS. The most common incorrect answer was $2n + 10$.

(iii) Most candidates who attempted this question were able to gain at least 1 mark. Marks were awarded for equating their linear expression from **part (a)(ii)** to 52 and/or starting to solve it. Some candidates gave the correct answer without writing down an equation.

(iv) Candidates were often able to obtain the correct answer, or if not, were rewarded for doubling their answer in **part (a)(iii)** and then adding 10 to it.

(b) (i) This part was answered well. Marks lost were usually for not giving the fraction in its simplest form or for giving the answer in the wrong form such as a decimal or a percentage.

(ii) Whilst some candidates answered this correctly, on the whole this was not well done. The most common errors were to show the probability at $\frac{1}{4}$ or to draw an arrow that was not clearly pointing to $\frac{3}{4}$.

(c) This question was answered well with many candidates showing evidence of their ability to convert accurately from grams to kilograms. The most common errors seen were to use a wrong conversion or to either forget to multiply by 6 or to forget to convert the units.

(d) This was a relatively easy bounds question but it was not well answered. The most common errors included 110 with 130 and 119.5 with 120.5.

Answers: **(a)(i)** $n + 10$ **(ii)** $2(n + 10)$ **(iii)** 16 **(iv)** 42 **(b)(i)** $\frac{1}{4}$ **(ii)** arrow at $\frac{3}{4}$ **(c)** 2.7 **(d)** 115, 125

Question 6

(a) (i) Many candidates were able to find the correct median of the list of values. The most common error made was not re-ordering the list and attempting to find the median from the wrong middle pair, 2.3 and 4.3. Some scored 1 mark for re-ordering the list and/or identifying the correct middle pair, 4.3 and 4.7. Again a lack of brackets and knowledge of BIDMAS saw errors such as $\frac{4.3+4.7}{2} = 6.65$.
Other errors included finding the 5th number or giving 5.5 as the answer or finding a different statistical value, usually the mean.

(ii) Many candidates found the range successfully. The error seen most commonly was the answer of 4.9, from 9.6 – 4.7, the end values of the original list.

(iii) This was well answered with the majority of candidates able to calculate the correct mean of the data.

(b) (i) The majority of candidates scored full marks. Many others scored the method mark for calculating the correct time of 1.5 hours taken to complete the walk. Some candidates did not then convert 1.5 hours to 1 hour 30 mins, but added 1.5 to the starting time of 14 20 leading to incorrect answers such as 15 70 or 16 10. Candidates scoring no marks had usually multiplied, rather than divided, the distance by the speed, thus $9 \times 6 = 54$ followed by a finishing time of 15 14 was reasonably common.

(ii) A minority of candidates scored full marks. Most were able to score the method mark for converting 6 km to 6000 m although a number of candidates thought there were 100 m in a kilometre. Others knew they needed to divide by 60 to convert the hours to minutes and this could also score the method mark. It was common to see various multiples of 6 and 10 used incorrectly.

(c) (i) This was generally well answered with the majority of candidates recognising positive correlation on the scatter graph. A small, yet significant number of candidates gave answers referring to distance, time, speed or acceleration.

(ii) This question tested interpretation of the points on a scatter graph recording distances and time and candidates found this quite challenging. Candidates usually knew that one of the extremities should be chosen but they chose the correct answer, one of the bottom pair (2.5, 35) or (3, 28) or the highest point (5.8, 69) in roughly equal quantities. It was fairly common to see 2 or more points circled.

Answers: **(a)(i)** 4.5 **(ii)** 8 **(iii)** 5.18 **(b)(i)** 15 50 **(ii)** 100 **(c)(i)** positive **(ii)** (4, 68) indicated

Question 7

(a) (i) Nearly all candidates completed the table of values correctly for $y = \frac{12}{x}$.

(ii) This was well answered by many candidates who scored full marks for accurate, smoothly drawn curves. Most others scored 3 marks, the fourth mark being most commonly lost for one point being plotted out of tolerance, or for just plotting the points without drawing the curve through them or for joining the points with ruled lines. However, only a few candidates joined the points across the *y*-axis, thus spoiling the shape of the graph of this reciprocal function.

(iii) Many candidates scored the mark for drawing the line $y = –5$ using a ruler. Some lines were vertical through $x = –5$ or slanting through the point (0, –5). Other candidates drew the lines $y = –5.2$ or $y = –4.6$ either by lack of accuracy or not interpreting the scale correctly.

(iv) Those who scored the mark in **part (a)(iii)** were usually able to read off the point of intersection of the curve and the line $y = –5$, although some attempts were spoilt by candidates who read the negative *y*-axis scale backwards; –2.6 being given as –3.4 for example. A few others scored the mark for reading off from their incorrect curve/line.

(b) (i) Candidates did not do very well on any of the **parts (b)(i)**,**(ii)** and **(iii)**. Although there were many good attempts at rise/run seen, this part proved to be a challenge for the majority of candidates.

Incorrect answers included $\frac{1}{2}$, +2, –2, vectors or just co-ordinates of point(s) taken from the grid.

Some correct answers were spoiled by including the *x*, that is, giving the gradient as $-\frac{1}{2}x$.

(ii) Only a minority of candidates were able to find the equation of the line drawn on the grid. Many had only a vague idea how to use $y = mx + c$. Answers often appeared as constants, contained *m* or were left blank.

(iii) This part required a good understanding of $y = mx + c$ and usually only those who had scored the previous mark were able to score marks in this question. Whilst some candidates correctly drew the line on the grid many candidates did not give any response.

Answers: **(a)(i)** –3, –6, 6, 3 **(iv)** –2.5 to –2.3 **(b)(i)** –0.5 **(ii)** $y = –0.5x + 2$ **(iii)** $y = –0.5x + 3$

Question 8

(a) (i) A large majority of candidates scored full marks for an accurate drawing of the trapezium. Many candidates assumed *DC* = 5 cm.

(ii) Only around half of the candidates were able to measure the obtuse angle in their trapezium correctly. The most common error was to measure the acute angle instead.

(iii) The majority of candidates scored the mark for measuring their *DC* correctly. Many had assumed it to be 5 cm and drawn it accordingly.

(iv) The majority of candidates made a good attempt to find the area of their trapezium either by using the trapezium formula or by splitting the shape into a rectangle and triangle. Errors were many and varied including incorrect formulae, finding the perimeter or multiplying values together.

(b) (i) Only a minority of candidates knew the formula for the volume of a cylinder and these candidates generally scored full marks. Many incorrect formulae were used and not all of these included π. Some candidates were able to earn a mark for recognising that the radius was 15 cm but most did not. Simply calculating 30×25 was a common error.

(ii) The majority of candidates struggled with this part because they could not connect the dimensions of the cylinder to the dimensions of the cuboid. Just getting as far as recognising that the three dimensions were 30, 30 and 25 would have earned a mark. Candidates often found the area of one face, usually $30 \times 25 = 750$ and either left this as their final answer or multiplied it by 6. A significant number of candidates left this question blank.

Answers: **(a)(ii)** 124 **(iii)** 4.7 **(iv)** 31.25 to 32.25 **(b)(i)** 17 700 **(ii)** 4800

Question 9

(a) The majority of candidates were able to factorise this expression correctly. Common incorrect answers were usually from trying to combine the two terms to give answers such as $8y^3$ or $9y^3$ or $8y^2$.

(b) Many candidates scored full marks. Most other candidates were able to score 1 mark usually for correctly expanding the first bracket $3(2x-1)$. The most common error arose from a sign error when expanding the second bracket $-4(x-5)$ as $-4x-20$. Other errors included, for example, expanding $3(2x-1)$ as $6x-1$ or sign errors such as $-3+20=-23$ or -17.

(c) Many candidates demonstrated a good understanding of how to rearrange a formula and the correct answer was often seen. The most common errors were usually sign errors, such as $k+5m=7p$ or $5m-k=7p$, or trying to subtract the 7.

(d) A significant number of candidates scored full marks on this final question. Most candidates used the elimination method and were able to demonstrate an understanding that they needed to multiply both equations to make the coefficients of one of the variables equal. There were many different types of errors seen and these included: arithmetic errors, incorrect coefficients in one or both equations, subtracting the equations when they should have been added and vice-versa. A mark was earned by less able candidates for finding two values that satisfied one of the equations.

Answers: **(a)** $y(y+8)$ **(b)** $2x+17$ **(c)** $\dfrac{k-5m}{7}$ **(d)** $x=4$, $y=-3$

MATHEMATICS

Paper 0580/41
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

Some questions allowed candidates to recall and demonstrate their skills and knowledge, others provided challenge where problem solving and reasoning skills were tested. Solutions were often well-structured with clear methods shown in the space provided on the question paper. A number of candidates were less systematic and often gave random working sometimes with a choice of methods.

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 acceptable answer range. There were a number of candidates losing unnecessary accuracy marks by either approximating values in the middle of a calculation or by not giving their answers correct to at least three significant figures.

The topics that proved to be accessible were simple ratio, reverse percentage, solving simple equations, factorising and solving quadratics, simplifying algebraic fractions, quadratic graph drawing, finding the mean from a grouped frequency table, interpreting histograms, linear and simple quadratic sequences, and matrix manipulation.

More challenging topics included working accurately with currency, problem solving with angles and circles, using graphs to solve related equations, problem solving with 3D shapes, harder probability, reasoning and problem solving with general triangles, vectors.

Comments on Specific Questions

Question 1

(a) This part was nearly always answered correctly. A few candidates divided the given total by 13 or 5, rather than 13 + 5. Occasionally the total for fiction books, rather than non-fiction books, was found.

(b) Most candidates were familiar with ratio questions in which they are given the value of one of the items but many were unsure how to deal with this question, in which they were given the difference in value of two terms. A minority were able to link 10 – 6 with 384 in the ratio to obtain the solution.

(c) (i) Most candidates were able to make an attempt to find the speed and there were many correct answers. The main source of error was with accuracy. For example the time of 23 minutes was often converted to either 0.38 or 0.383 hours and then this was used to find the average speed. In both these cases this gave an answer outside the accepted range. It is important for candidates to appreciate that they must use full decimal values in calculations where appropriate to ensure accuracy.

(ii) There were few candidates who scored full marks. Those who chose to find the journey time using the new speed of 32 km/h sometimes made an error, such as giving $\frac{32}{20}$ but most used the correct method. Those who worked in minutes often gave the exact answer of 37.5 minutes whereas those working in hours sometimes made the same error as described in the previous part, using a time such as 0.38 hours. Some did not then calculate the time difference and others divided by the new time rather than the original time.

(d) This was not well answered. Those that worked in dollars often overlooked that the final answer should be given to the nearest cent and \$0.1 was a common final answer. Some truncated their answer to \$12.92 when converting to dollars. Others chose to work in euros and multiplied \$12.99 by 0.9276 but then very few converted their difference in euros back into dollars. Candidates should note that the method steps in the conversions should be very clearly shown to ensure method marks when values are inaccurate.

(e) There were a large number of correct answers. There were a number of candidates who applied the correct method but used 88% instead of 78%, presumably from calculating 100–22 incorrectly although very few showed the subtraction. Many candidates did not realise that this was a reverse percentage situation so it was quite common to see 22% of 7605 or 122% of 7605.

Answers: **(a)** 2915 **(b)** 1056 **(c)(i)** 52.2 **(ii)** 63.0 **(d)** 0.06 **(e)** 9750

Question 2

(a) In general, candidates responded to this question well and although the work was often set out quite randomly, many candidates reached the correct answer. There were many possible methods, most involving the drawing of additional lines on the diagram. It was often difficult to identify the angles that candidates had used, although in a small number of cases these were written on the diagram. The most common method which did not involve drawing extra lines was to use the formula for the sum of the interior angles. Although some errors were seen involving substituting an incorrect value for the number of sides, most gave 1080° and often went on to find the correct answer.

(b) Candidates found this part challenging and few were able to give the correct answer. By far the most common error was to falsely assume that *PQRO* is a cyclic quadrilateral so $2y - 60 + y = 180$ was seen very frequently. Those who gave a correct first step such as $360 - (2y - 60)$ sometimes omitted the brackets and those who were able to give a completely correct method, such as $360 - (2y - 60) = 2y$ made a sign error either when removing the brackets or when solving their equation.

Answers: **(a)** 122 **(b)** 105

Question 3

(a) Candidates answered this part very well. Any errors were usually as the result of a sign error when rearranging the equation.

(b) (i) This was also answered well. Some candidates gave $x(x+9)-22$ and others made sign errors leading to $(x+2)(x-11)$.

(ii) Most candidates gave the correct answer but some did not appear to see the connection with the previous part and so it was common to see the quadratic formula being used. Although this method normally resulted in the correct answers being obtained, a few errors associated with this method were also seen.

(c) Although some candidates only scored 1 mark, most earned 2 marks by removing the brackets correctly and removing the fraction by multiplying both sides by x to reach $xy = 2x - 2a$. Candidates found the next step rather more challenging but some separated the terms containing x from the $-2a$ term. Those that did this usually went on to factorise and then divide by $y - 2$ or $2 - y$ to obtain the correct answer.

(d) This part was generally well answered, although a number of candidates did not attempt any factorisation but carried out some 'false' cancelling e.g. cancelling the x^2 in the numerator with the x^2 in the denominator. Those who attempted to factorise usually did both parts correctly although some made a sign error.

Answers: **(a)** –2.75 **(b)(i)** $(x + 11)(x - 2)$ **(ii)** –11 and 2 **(c)** $\frac{2a}{2-y}$ **(d)** $\frac{x}{x+6}$

Question 4

(a) Most candidates successfully found both required values but the occasional sign error led to a value of $y = 18$ for $x = -1$.

(b) The points were generally plotted well, with only a small number misinterpreting the scale and some plotting the first point at (–2, 9) instead of at (–2, –9). Most candidates drew the curve correctly although feathering, double lines and ruled sections were quite common.

(c) Most candidates read off the correct value from their graph. The most common incorrect answer was 15.

(d) Although the majority of candidates correctly drew the tangent at $x = 3.5$, some drew it elsewhere or not at all. The gradient of the tangent was correctly found by many. A common error was to count squares for the rise and the run instead of taking into account the different scales on the two axes.

(e) This part proved to be a challenge for most candidates. There were attempts at rearranging the given equation to compare it with the original function, and where candidates successfully reached $y = 2x + 10$, the correct line was usually drawn and usually all three values given correctly. Those who did not reach this equation often ruled a line through (0, 5) and a few attempted to draw the curve corresponding to the given equation.

Answers: **(a)** 10, 7 **(c)** –1.7 to –1.55 **(d)** 6.5 to 11 **(e)** –1.3 to –1.1, 1, 4.1 to 4.25

Question 5

(a) This was very well answered, with most candidates getting all three answers correct, although more errors appeared in the number of apples in the 140 g to 170 g interval than any other.

(b) This was answered successfully by many candidates. Even those who had incorrect values in **part (a)** were usually able to use their values correctly in this part. There was a common theme to errors in this part: a significant but small group of candidates used class widths rather than mid-interval values; a small number of candidates showed mid-interval values correctly but then found their sum and divided by 5; a small number of candidates found the sum of *fm* but divided by 5 or by an incorrect total obtained by adding their frequencies.

Answers: **(a)** 54, 76, 96 **(b)** 187

Question 6

(a) There were many correct answers in this part. The numerical answers were generally correct, with only the number of small squares in Diagram 5 causing some difficulty. Many candidates correctly gave $4n + 2$ for the number of crosses, sometimes in an unsimplified form. More candidates struggled to find the number of small squares in Diagram n.

(b) Many candidates were successful here, giving the correct answer even after an incorrect or missing algebraic answer in **part (a)**.

(c) Fewer candidates were successful here, although some misread the question and found the number of squares for Diagram 226 or solved $4n + 2 = 226$.

(d) Fewer candidates were successful in this part, which was not attempted by a number of candidates. Those who did attempt it often substituted $n = 1$ or $n = 2$ into the given formula. However, they then often put this equal to 0, so that answers of 4 or –4 or sometimes 12 were common.

Answers: **(a)** 18, 22, $4n + 2$, 17, 26, $n^2 + 1$ **(b)** 242 **(c)** 15 **(d)** 3

Question 7

(a) This part was answered very well.

(b) The majority of candidates were able to substitute h(3) into function g correctly. Those that made errors usually found a product of the two functions.

(c) Most candidates were successful in finding the inverse function. A few gave answers such as $\frac{3-y}{2}$ and did not 'interchange' the y with x. Others struggled with directed terms and from e.g. $x - 3 = -2y$, the negative was lost in the final division stage. Some less able candidates interpreted the notation as an index and gave $\frac{1}{3-2x}$.

(d) Although many made a correct start on this 'show that' question by giving 4^{3-2x}, most did not show the correct product or division step using the rules of indices that would have led to the answer.

(e) This was reasonably well answered. Those that did not obtain the correct answer often gained a method mark for showing $4^x = 8$ in the working.

Answers: **(a)** –7 **(b)** $\frac{4}{64}$ **(c)** $\frac{3-x}{2}$ **(e)** 1.5

Question 8

(a) Many candidates made a reasonable attempt at this part. Most attempted to write down the surface area of the cone and hemisphere although some used the volume of a sphere. As the value of the slant height of the cone is exact then, in order to score full marks, it is necessary to work with exact values and then correctly cancel or divide with these exact values. The majority of candidates, having written down algebraic forms for the surface areas, then used their calculators giving decimal forms for the surface areas. This did receive some credit for the method but not full marks. Candidates must also understand that when they are asked to show a result, they should not start by assuming that result in their method.

(b) Some candidates used an incorrect method by attempting to find the height using an area or volume but the majority identified Pythagoras' theorem as the appropriate method. Most applied this correctly and scored full marks with just a small number using $h^2 = 6.5^2 + 2.5^2$. Those candidates who had incorrectly used a radius of 5 in **parts (a)** and **(c)** were given credit in this part and in **part (c)** for a correct method. The answer to **part (a)** was given and all candidates should be aware that they must use 6.5 and not an incorrect value that they have calculated.

(c) This part was answered well with the majority identifying the correct volume formulas to use. The main source of error was for candidates to use the formula for a full sphere rather than a hemisphere. Those who used an incorrect value for the height of the cone from **part (b)** were given credit for a correct method in this part.

(d) Most candidates appreciated that they needed to use their answer from **part (c)** and that this needed to be converted from mm^3 to cubic centimetres. Some were also aware that $1\ cm^3 = 1000\ mm^3$ and so divided their volume by 1000. There were however many who divided by 10 or by 100 and in a small number of cases multiplied by their conversion factor. The majority then went on to complete the method multiplying their volume by 19.3 and 38.62. Some did not show their multiplications clearly and made it difficult to award method marks as a result.

Answers: **(b)** 6 **(c)** 72.0 **(d)** 53.7

Question 9

(a) (i) This part was well answered. The most common errors came from candidates either only getting as far as giving the probability of choosing a red bead as 0.65 or finding the number of green beads as 28 from 0.35×80.

(ii) This part was well answered. The most common errors were either just re-stating the probability of a green as 0.35 or by giving a final answer of $\frac{84}{240}$.

(b)(i) The majority of candidates recognised that the probability of choosing a yellow marble was $\frac{3}{9}$. Candidates often then went on to complete the question successfully. However, a number of candidates did not read the question carefully and did not replace the marble, finding $\frac{3}{9} \times \frac{2}{8} \times \frac{1}{7}$. Other candidates incorrectly attempted to add the fractions rather than to multiply them.

(ii) Only the candidates with a clear understanding of probability scored full marks on this question. Many candidates scored 1 mark for $\frac{2}{9} \times \frac{3}{9} \times \frac{4}{9}$ but most were unable to recognise that this should be multiplied by 6 for the six possible arrangements. A significant number of candidates incorrectly used 1 − [P(BBB) + P(YYY) + P(WWW)]. Other common errors included, as in **part (b)(i)**, not replacing the marbles or adding the probabilities.

(c) Candidates found this part most challenging. However, most candidates correctly used the idea of not replacing the counters and they were usually able to show either the product for P(PPP) or the product for P(PPG) or P(PGP) or P(GPP). A common error was not to recognise that 3×P(PPG) was required. Candidates who chose not to show any products to support their working frequently scored no method marks as it was often very difficult to know where their answers were coming from.

Answers: **(a)(i)** 52 **(ii)** 84 **(b)(i)** $\frac{27}{729}$ **(ii)** $\frac{144}{729}$ **(c)** $\frac{42}{60}$

Question 10

(a) Many candidates found this part challenging and rather than using the cosine rule to set up an equation involving x, tried to calculate x by first of all finding angle ABC and then used the cosine rule to find the value of x. Those that made a correct substitution into the cosine rule using $\cos 60$ were usually able to complete correctly to the given equation.

(b) This was quite well answered. Some used the quadratic formula correctly but did not round answers correctly to two decimal places. A few did not use essential brackets during substitution and made errors when, for example, squaring –17. Others gave correct answers from their calculators but were unable to show a correct method and scored only partial marks.

(c) For this part many candidates had two values of x, one from **part (b)** and one from **part (a)** and these were often different values. To score in this part they had to use their positive value from **part (b)**. Most candidates correctly used the sine rule.

(d) Some candidates used the area formula $\frac{1}{2}ab\sin C$ reasonably well and a number scored full marks for this part. Others used incorrect lengths or the wrong combination of lengths for the included angle.

Answers: **(b)** 14.35, –5.85 **(c)** 12.2 **(d)** 138

Question 11

(a) (i) Most candidates were successful and scored full marks. A few made sign or arithmetic slips but were able to score 1 mark for having two or three of the elements correct. A common error was to give the matrix $\begin{pmatrix} 4 & 9 \\ 1 & 16 \end{pmatrix}$, found from squaring the individual elements.

(ii) This part was completed correctly by the majority of candidates and they were able to demonstrate competency with the process to find the inverse of a matrix.

(b) There were mixed responses to this part. Some gave reflection, fewer gave the correct line of reflection. The most common incorrect answers involved rotations.

(c) Some candidates were able to work out, or recall, the correct matrix and scored full marks. Other candidates were aware the matrix should contain a combination of zeros and +1/–1 but it was evident they did not have a clear strategy as to how they could work out where to place them in the matrix.

(d) (i) There were some correct answers seen to this part. Answers were required to be correctly simplified for full marks. Some slips in signs or in the adding of fractions were often seen but many candidates were able to score at least 1 mark for giving either a correct route for $\overrightarrow{OP}$ or, for example, $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$.

(ii) Most candidates found this part challenging and many did not attempt it. To make progress, candidates had to recognise the need to use $\overrightarrow{OC} = \overrightarrow{OB} + \overrightarrow{BC}$. Only a few candidates were able to set up a vector equation and solve it correctly.

Answers: **(a)(i)** $\begin{pmatrix} 1 & -18 \\ 6 & 13 \end{pmatrix}$ **(ii)** $\frac{1}{11}\begin{pmatrix} 4 & 3 \\ -1 & 2 \end{pmatrix}$ **(b)** Reflection, y-axis **(c)** $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ **(d)(i)** $\frac{4}{7}\mathbf{a} + \frac{3}{7}\mathbf{b}$ **(ii)** $\frac{7}{3}, \frac{4}{3}$

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 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 need to be aware that in drawing graphs, linear functions should be ruled and curves should be drawn freehand with a sharp pencil.

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

Candidates should take sufficient care to ensure that their digits from 1 to 9 can be distinguished.

Candidates should ensure that their calculator is set in degrees.

General comments

Although a few question parts proved to be a challenge to many candidates, most were able to attempt almost all of the questions reasonably well. Solutions were usually well-structured with clear methods shown in the space provided on the question paper, but a number of candidates did not show full working on the questions that asked for this requirement and scored only partial marks as a consequence.

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, giving final answers outside the range required. Very few candidates lost accuracy marks by not giving their answers correct to at least three significant figures but there were a number of candidates losing unnecessary accuracy marks by approximating values in the middle of a calculation, particularly when their chosen method is not the most efficient available. This was apparent for example in **Question 3**. The requirement for accuracy to one decimal place in **Question 1(d)** and to two decimal places in **Question 8(b)** was sometimes ignored.

The topics that proved to be accessible were ratio, percentage decrease, simple interest and the recall of the compound interest formula, recall of and recognition of when it is appropriate to use the cosine rule, translation, rotation, matrix representation of enlargement, plotting points and drawing curves, drawing a tangent and finding its gradient, use of a cumulative frequency curve, finding the mean of grouped data, drawing histograms, probability, use of the quadratic formula to solve a quadratic equation and using functions including composite and inverse functions.

More challenging topics included manipulation of the formulae for volume of spheres and cones, total surface area of a cone, similar volumes, identifying the shortest distance from a point to a line, translation of a point by a vector and length of a vector, probability involving more than two events, creating and solving linear simultaneous equations, creating and manipulating equations with algebraic fractions and area of a composite shape.

Comments on specific questions

Question 1

(a) (i) Candidates cancelled the ratio to its simplest form with very few errors seen.

(ii) Nearly all candidates obtained the correct ratio. Some gave the unsimplified ratio 16 : 20. A minority thought that $\frac{1}{5}$ was an actual amount as opposed to a proportion and so subtracted 0.2 from the values giving an answer of 19.8 : 24.8.

(iii) Many correct answers were given. Some candidates ignored the bold **then** and subtracted the 4 from the original values leading to an answer of 16 : 21.

(b) (i) The majority of candidates were able to calculate the percentage decrease. Some found the new amount as a percentage of the original but then did not subtract this from 100. Others divided by the new amount instead of the original amount. A number of candidates in this part and in subsequent questions used arrows to link for example, 15600 to *x* and 100 to 11420. Candidates should be reminded of the importance of showing their method in calculations rather than symbolically.

(ii) Many candidates correctly obtained the answer 16000. There were two significant misconceptions that arose with this part. Candidates either reduced 15600 by 2.5% leading to an answer of 15210, or increased 15600 by 2.5%, leading to an answer of 15990. Those that recognised that 15600 was 97.5% of the new amount almost always went on to obtain the correct answer.

(c) The majority of candidates scored well on this simple interest calculation. The two common errors seen were either to make $\frac{200 \times x \times 15}{100}$ equal to 248 or to omit the division by 100.

(d) A large majority of candidates were able to begin correctly with the compound interest formula $256 = 200\left(1 + \frac{y}{100}\right)^{10}$. Errors were then seen when manipulating this equation to find *y*. A number of candidates took the 10th root first; some moved the 200 inside the bracket and others subtracted the 200 from 256 instead of dividing. Those that were able to rearrange usually went on to score full marks but some did forget that the question asked for 1 decimal place and gave answers to 3 significant figures.

Answers: **(a)(i)** 4 : 5 **(ii)** 4 : 5 **(iii)** 3 : 4 **(b)(i)** 26.8 **(ii)** 16000 **(c)** 1.6 **(d)** 2.5

Question 2

(a) (i) This was usually well answered. A few candidates did not use the correct formula for the volume of the cylinder, whilst a few others did not use 2*r* for the height of the cylinder. Most candidates subtracted the volumes correctly and only a few either added or only gave one volume.

(ii) This was a much more challenging part and proved to be a good discriminator. The difficulties were often in setting up a correct expression in terms of *r*. The volume of the sphere was often equated alone to the given 36; one of the volumes with $r = 8$ was occasionally used; the subtraction was occasionally in reverse order and an incorrect formula for the cylinder was sometimes seen. A significant number of candidates who reached a correct expression in terms of *r* had some difficulty in rearranging it to obtain the correct cube root. A few candidates used the alternative method of using similar volumes. These tended to be the more able candidates and usually they achieved full marks.

(b) (i) This was another challenging question requiring several steps and an understanding of the situation. Most candidates realised that an area was required although a few used volume. The perpendicular height of the cone was often used as the slant height and this caused the loss of most marks, as the Pythagoras' theorem calculation was not seen. The area of the base of the cone was often omitted. The candidates who used Pythagoras' theorem usually obtained the correct length for the slant height although $12^2 - 5^2$ was occasionally seen. A few candidates divided by 0.015, which gave a very expensive cost.

(ii) The most challenging aspect of this question part was to realise that volume was now required. Many candidates used areas and 16 was a very common answer. The successful candidates usually found the volumes of the two cones and divided. This usually gave an answer very close to 64 and most candidates realised that this would be the final integer answer. A few left the answer as a decimal and a few thought they should round down to 63. Some of the more able candidates realised that the cones were similar with the linear scale factor of 4 and then simply cubed it to give 64. This was the intention of the question.

Answers: **(a)(i)** 1070 **(ii)** 2.58 **(b)(i)** 4.24 **(ii)** 64

Question 3

(a) Many candidates gave fully correct answers and the vast majority were able to find the area of the right-angled triangle *ABC*. For triangle *ADC* some candidates misquoted the area formula using cos or tan instead of sin and others incorrectly assumed it must be right-angled and so calculated *AD* in order to work out $\frac{1}{2} \times 110 \times AD$, or $\frac{1}{2} \times 100 \times AD$.

(b) The majority of candidates showed their working clearly and were able to demonstrate partially correct methods towards finding the perimeter. Most used Pythagoras' theorem correctly to find *BC* and a few used trigonometry in a less efficient method. A large majority of candidates recognised that the cosine rule was required to find *AD* and recalled the rule correctly. Some errors seen with the formula included missing out the 2 or using sin instead of cos. After stating the rule correctly a significant minority gave the value 76.6 for AD^2 from treating the rule as $(110^2 + 100^2 - 2 \times 110 \times 100) \cos 40$. A few candidates included the internal measurement of 100 in their perimeter calculations.

(c) This question part proved to be a challenge for many candidates who did not know where the relevant distance was on the diagram. A common error was to assume *AD* was the shortest distance. Others recognised that they needed a perpendicular from *A* to *CD* but incorrectly assumed it would bisect *CD*, so performed Pythagoras' theorem and/or trigonometry using a length of 55 m. Some candidates who did identify the correct distance used inefficient methods such as the sine rule to calculate angle *CDA*, then basic trigonometry with that angle and length *AD*.

(d) Many candidates used a correct method to find either angle *ACB* or angle *ABC*. Their chosen method was not always the most efficient, for example some used the sine rule with their calculated length for *BC*, which inevitably led to rounding inaccuracies. Where possible, candidates should use given values for calculations rather than calculated ones. Many candidates found a correct relevant angle but did not understand the concept of bearing. This was clear from some of the arcs indicated on the diagram. Some working shown by candidates was ambiguous. It would be helpful to candidates if they either labelled an angle on the diagram or used the standard three letter angle convention.

Answers: **(a)** 7040 **(b)** 374 or 375 **(c)** 64.3 **(d)** 235

Question 4

In **part (a)** candidates needed to indicate the correct position of both the triangle and the pole.

(a) (i) The majority of candidates drew a correct translation of the flag.

(ii) Many completed this 180° rotation correctly but there were some candidates who used an incorrect centre or who only rotated through 90°.

(iii) This was the most challenging of the required transformations. Many correct reflections were seen but common errors included reflecting in the x- or y-axis. Other candidates correctly identified $y = x$ (or $y = -x$) but could not then visualise the effect on the flag.

(b) (i) The vast majority of candidates identified enlargement with centre (0, 0) and many of these also gave the correct scale factor. The most common errors seen were to give scale factor 2 or –2. A few candidates did not understand the concept of a centre and spoiled their answer by describing a translation as well as an enlargement.

(ii) Many candidates were able to recall the correct matrix form for an enlargement**.**

(c) Candidates found this to be one of the most challenging questions on the paper. A significant number did not know how to begin. A further significant number of candidates understood what was required but the omission of brackets within their application of Pythagoras' theorem spoiled their solution. It was very common to see $4u^2 + 3u^2 = 7u^2$. A few candidates applied Pythagoras' theorem incorrectly and wrote $(4u)^2 - (3u)^2$. Of the candidates who gave a correct answer some used their knowledge of Pythagorean triples for a very concise and efficient method.

Answers: **(b)(i)** Enlargement, centre (0,0), scale factor 0.5 **(ii)** $\begin{pmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{pmatrix}$ **(c)** ± 2.5

Question 5

(a) Invariably this part was correctly answered. A few candidates truncated their values to 3.1 and/or 5.1.

(b) Most candidates scored 3 or 4 marks in this part and only a few lost marks through incorrectly plotted points. The main difficulty seen was in dealing with the part of the curve between $x = 0.5$ and $x = 1$. Some candidates started with a vertical line which was too long and a few started the curve going to the left of $x = 0.5$. These candidates usually scored 3 marks for correctly plotted points.

(c) This part was very well answered. A few candidates gave for example, 0.7 instead of 1.7.

(d) These parts required an understanding of the number of times a horizontal line crossed the curve and was generally well answered. The most common error was to overlook the requirement of an integer answer. A few gave a list of integers in **part (ii)** and this was accepted if they were all correct. Some candidates gave their answer as an inequality which was not accepted as an inequality does not exclude non-integer values. A small number of candidates omitted both parts.

(e) Most candidates answered this tangent question extremely well. Accurate tangents were seen and the gradient was usually correctly calculated. A few candidates divided the change in x by the change in y; a few misread the scales when finding co-ordinates and some made errors in the calculation as a result of using negative co-ordinates. A very small number of candidates drew the tangent at an incorrect point and a small number of candidates omitted this part.

(f) (i) This part was generally well answered as most candidates drew the correct straight line. Almost all candidates who drew this line obtained an answer within the required range. A few candidates omitted this part and a small number of others drew a line from (0, 6) with an incorrect gradient.

(ii) This part was more demanding as it required considerable algebraic manipulation. It did appear that most candidates knew that rearranging and multiplication was necessary to end up with the equation in the correct form. Many candidates carried out these operations carefully and gained full marks. A few candidates omitted this part although the main challenges were in keeping correct signs as well as powers and multiples throughout all the steps.

Answers: **(a)** 3.2 or 3.15, 5.2 or 5.19 **(c)** 1.7 to 1.8 **(d)(i)** Any integer $k \geqslant -1$ **(ii)** Any integer $k < -1$
(e) 2.5 to 4 **(f)(i)** $2.85 \leqslant x \leqslant 3$ **(ii)** 8, –48, –16

Question 6

(a) (i) The median was usually correctly stated.

(ii) The upper quartile was usually correctly stated.

(iii) The inter-quartile range was usually found correctly.

(iv) The number of students who ran more than 350 m was usually found correctly. Occasionally candidates stated the number who had run less than 350 m.

(b) (i) This question was well answered with most candidates showing clear and accurate working leading to the correct answer. Only a small minority of candidates used the interval widths.

(ii) Many accurately drawn histograms were seen. It was rare to see calculations for the frequency densities. Some candidates drew two of the blocks with incorrect widths but the more common error was to draw the height of 0.44 two squares above 0.4.

(c) Many candidates gave the expected answer of ‘further’ or ‘faster’ and a further significant number of candidates gave the answer ‘more’ which was accepted.

Answers: **(a)(i)** 280 **(ii)** 320 **(iii)** 90 **(iv)** 10 **(b)(i)** 250.2 **(c)** further

Question 7

(a) This question part was invariably correctly answered.

(b) Many correct answers were given. Some occurrences of $\frac{2}{6}+\frac{2}{6}$ were seen and some candidates got confused with the concept of replacement, leading to a response of $\frac{2}{6}\times\frac{1}{5}$. A very small number of candidates could not correctly process $\frac{2}{6}\times\frac{2}{6}$.

(c) The majority of candidates answered this in the correct format with very few giving a relative frequency as their answer. Some candidates felt this was a continuation of **part (b)** and found $\frac{1}{9}$ of 60.

(d) (i) Many fully correct diagrams were seen. There were a few instances of addition rather than multiplication. The most common error was five rows of 1113.

(ii)(a) The majority of candidates gave a correct answer or followed through correctly from their diagram. Some candidates stated the number of outcomes instead of giving the probability.

(ii)(b) Consistent with **part (d)(ii)(a)** the majority of candidates gave a correct answer or followed through correctly from their diagram. Some candidates stated the number of outcomes instead of giving the probability.

(e) This proved to be one of the most challenging questions on the paper. Many candidates did not know where to start. Of those that did, a number thought that they were still dealing with the grid from **part (d)** so used the probability of scoring a 1 from the grid which led to the response $\left(\frac{30}{36}\right)^4 \times \left(\frac{6}{36}\right)$. A number of candidates wrote the simplified fractions $\left(\frac{5}{6}\right)^4 \times \left(\frac{1}{6}\right)$ again using the grid or perhaps reverting to using an ordinary six sided dice. Others calculated $\left(\frac{2}{6}\right)^5$, $\left(\frac{2}{6}\right) \times 5$ or $4 \times \left(\frac{4}{6}\right) \times \frac{2}{6}$. Probabilities greater than 1 did not alert candidates to an error.

Answers: **(a)** $\frac{5}{6}$ **(b)** $\frac{4}{36}$ **(c)** 20 **(d)(ii)(a)** $\frac{9}{36}$ **(ii)(b)** $\frac{4}{36}$ **(e)** $\frac{512}{7776}$

Question 8

(a) (i) The correct equation was usually stated but a few candidates used inequalities.

(ii) Candidates who used $p = a + 2$ invariably successfully solved the problem. A significant number of candidates made the errors $p = 2a$ or $a = p + 2$.

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

(ii)(a) Those candidates who had the correct three term equation rarely made errors in reaching the required equation. Some initial equations included 5 or $\frac{5}{2}$ instead of 2 for the total time. Less able candidates omitted this question part.

(ii)(b) The correct formula was usually used with both fraction lines and square roots long enough to ensure that the calculation was accurately completed. Most candidates did select the correct value for the final answer but sometimes the addition of the two values was given as the final answer. Those who used completion of the square rarely reached the correct answer.

Answers: **(a)(i)** $7a + 9p = 354$ **(ii)** 21, 23 **(b)(i)** $\frac{2}{x}$ **(ii)(b)** 3.19

Question 9

(a) f(–1) was usually calculated correctly.

(b) Most candidates were able to set up a correct equation. A significant number of candidates made sign errors when rearranging the initial correct equation and answers of $-\frac{2}{3}$ and $-\frac{5}{2}$ were often seen.

(c) The composition of two functions was more challenging but many candidates answered this part well. A few took the composition to be a product of the functions. Errors with expansion of brackets, signs and combinations of terms were seen frequently. Some candidates completely ignored the negative signs in their working.

(d) hh(2) offered similar challenges to **part (c).** The question was well answered by the more able candidates either by finding h(2) followed by h(5) or by working out the algebraic expression for hh(x). Many of those who found h(2) = 5 went on to work out 5×5 instead of h(5).

(e) This inverse of a linear function was well answered. The most common answer was $\frac{x-1}{-2}$ and this was accepted for full marks. As in **parts (b)** and **(c)**, sign errors when rearranging terms were seen frequently. A number of candidates lost the final mark by leaving an otherwise correct answer in terms of y.

(f) This was the most searching part of this question, involving the composition of three functions. Compared to **part (c)**, more candidates took this part to be the product of the three functions, even though the form of the answer was given. The more able candidates realised that the safer way was to work out gf(x) first and then simplify it to the form ($ax+b$) and then substitute this into h(x). Those who worked out hg(x) first had more substitution to do and were generally less successful than those who worked out gf(x) first. Many candidates earned the first two marks by reaching $(1 - 2x + 4)^2 + 1$. If they then went on to $(5 - 2x)^2 + 1$, they usually scored full marks with a small number forgetting to complete by adding the 1. If, however, they tried to square $(1 - 2x + 4)$, they rarely obtained a correct nine term expansion.

Answers: **(a)** 3 **(b)** $-\frac{2}{5}$ **(c)** $-2x - 7$ **(d)** 26 **(e)** $\frac{1-x}{2}$ **(f)** –20, 26

Question 10

This was the most demanding question of the paper requiring strategy and application of several topics of the syllabus. It was clearly set to be a discriminating final question and this proved to be the case. There were some excellent answers with well organised working. Some candidates rounded off the three separate areas and gave a final answer out of range. Most candidates earned one or two marks, although quite a number did not attempt this question.

(a) Many candidates obtained a correct expression for the area of the sector. The area of the triangle was also often correctly found, sometimes by methods which were more complicated than necessary. The area of the rectangle proved to be challenging with many candidates taking the unknown side length to be x or $2x$. The more able candidates were able to use Pythagoras' theorem or trigonometry to find this unknown side length. The collection of the three areas was usually attempted although a subtraction was occasionally seen. A few candidates only found the sector and the rectangle, overlooking the first line of the question.

(b) This part was more straightforward but did depend on some success in **part (a)**.

Answers: **(a)** 5.68 **(b)** 4.40

MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key messages

Candidates need to use efficient methods of calculation, show their working and always check their final answers. They should always work with more figures than the final answer requires. In most cases this would need intermediate values written to at least four significant figures.

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 whole questions although some did not attempt several parts. A majority of candidates showed their working and gained method marks but in a significant number of scripts insufficient or no working was seen. In questions requiring candidates to show a result many were unable to gain marks as they used the value they had to show from the beginning. Presentation of work was often good with some scripts showing working that was clearly set out. For less able candidates, working tended to be more haphazard and difficult to follow making it difficult to award method marks. Candidates need to be encouraged to write their working clearly. There were many examples where candidates miscopied their own figures leading to a loss of marks. Similarly, 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.

Comments on specific questions

Question 1

(a) (i) There were many correct responses seen with a significant proportion calculating all three angles. The question required candidates to show a result and most incorrect answers involved incomplete methods, usually by not showing the division by 10.

(ii) Most candidates used an efficient method, either $12\sin 36$ or $12\cos 54$, although a significant number calculated the third side and then used Pythagoras' theorem. Some calculated the third side and went no further and a small minority could not get started as neither of the angles 36 and 54 had been found. A small number also took the sides to be in the same ratio as the angles.

(b) (i) Many correct answers were seen although some chose to calculate the perimeter and then calculate the longest side from that.

(ii) Many correct answers were seen. However, candidates were generally less successful in this part as a significant number took the ratio of the angles to be the same as the ratio of the sides leading to a common incorrect answer of 45°.

Answers: **(a)(ii)** 7.05 **(b)(i)** 13 **(ii)** 36.9

Question 2

(a) Almost all candidates gave the correct answer.

(b) (i) Apart from the common errors of 0 and x, the vast majority gave the correct answer.

(ii) Almost all candidates gave the correct answer. The common error was x^{21}.

(iii) This proved more challenging and far fewer correct answers were seen. Most of the incorrect answers involved errors in dealing with the negative index in the denominator and/or dealing with the coefficient of 3 in the bracket. Common errors involved x^8 in the final answer or coefficients of 3, forgetting to square the coefficient, 8 and 2 by reducing the coefficient by 1 when dividing by the denominator.

(c) (i) Incorrect answers were about as common as fully correct answers. Some candidates earned credit for a partial factorisation such as $(2x + 6)(x – 3)$ but answers such as $2(x^2 – 9)$ were very common. These candidates did not seem to pick up on the inclusion of the word 'completely' in the question.

(ii) Candidates were more successful in this part, with many earning at least 2 marks for a correct factorisation of the denominator. Some of those that only reached $2(x^2–9)$ in the previous part were able to complete the factorisation in this part. Many of the less able candidates simply cancelled like terms without any attempt at factorisation.

Answers: **(a)** 343 **(b)(i)** 1 **(ii)** x^{10} **(iii)** $9x^{16}$ **(c)(i)** $2(x – 3)(x + 3)$ **(ii)** $\dfrac{2(x+3)}{x+10}$

Question 3

(a) (i) A small majority of candidates coped well with the required change of unit for time that was needed and gave a correct answer. However, a large minority either changed the unit incorrectly or made no change at all. Attempting to apply Pythagoras' theorem to calculate the length of the sloping line was a common error.

(ii) Many candidates understood that calculating the area under the graph would give the distance between the two stations. Some of these were successful, usually by dividing the area into two triangles and a rectangle instead of using the efficient method for the area of a trapezium. Some lost marks because of their inaccurate conversion of times to decimal equivalents, such as 44 minutes equated to 0.73 hours. Some gained partial credit for a correct method for the area but without the conversion of minutes to hours.

(b) (i) A majority showed the correct conversion but many lost out by not showing a complete method.

(ii) Most candidates appreciated that they needed to divide a distance by the speed. Deciding which distance to use proved challenging for many of the candidates. Common errors included using 1400 + 2(200) or 1400 – 200 or simply 1400. Others were confused by the units and divided the distance by 126 km/h rather than 35 m/s.

(c) This part was not well answered and only a minority of candidates gave a fully correct answer. Many attempted to divide distance by time but a wide variety of incorrect values in the ranges 210 to 220 and 72 to 74 were used. It was common to see candidates attempting to divide their upper bound for the distance by their upper bound for their time, as well as forgetting to change the units of time. However, some did use the correct bounds and reached an answer of 3 km/min but then forgot to convert this to km/h.

Answers: **(a)(i)** 1890 **(ii)** 103.95 **(b)(ii)** 46.3 **(c)** 180

Question 4

(a) Many correct intervals were seen, the most common error being the middle interval $70 < t \leqslant 80$.

(b) Candidates have a good understanding of this topic and many fully correct answers were seen. Incorrect answers usually resulted from the use of one or more incorrect midpoints, the use of end points and in a few cases, the class widths were used. A few candidates set out the working correctly but did not reach the correct mean, almost certainly from keying the calculation incorrectly.

(c) (i) The most frequent incorrect response was to state that the intervals were unequal. Others stated that the individual times were unknown but did not specifically relate this to the highest and lowest times. Only a minority gave a complete explanation.

(ii) If a candidate knew what to do they usually went on to earn full credit. Many used the efficient method, $\frac{26}{150} \times 360$, but it was quite common to see candidates converting $\frac{26}{150}$ to a percentage, usually 17.3%, but this then lost the final mark as the answer was often inaccurate. Others lost marks by using the wrong intervals and 10 and 34 were sometimes used instead of 26.

(d) Almost all candidates gave the correct answer.

(e) (i) Fewer candidates were able to cope with two events but a reasonable proportion of them did manage to write down the correct product and follow it with the correct answer. The most common incorrect answers were $\frac{1}{225}$ from replacement and $2 \times \frac{10}{150}$. The probability for the second girl was often given as $\frac{10}{149}$ and a few candidates mistakenly added it to $\frac{10}{150}$.

(ii) Only a small minority were successful in this part of the question as the second possibility was frequently overlooked. Again, many calculated their probability 'with replacement'. Some attempted to work in decimals or percentages but sometimes lost marks by not giving answers to 3 significant figures.

(f) Candidates seemed unfamiliar with this style of question on the histogram and fully correct answers were rare. The one height that was given happened to be half of the frequency for that interval as well as being the width of the interval. Many of the incorrect responses followed one of these two patterns. Evidence of any working was rare but some candidates did list the frequency densities as their heights.

Answers: **(a)** $80 < t \leqslant 100$ **(b)** 86 **(c)(ii)** 62.4 **(d)** $\frac{22}{150}$ **(e)(i)** $\frac{90}{22350}$ **(ii)** $\frac{440}{22350}$ **(f)** 13, 8.5, 7.25, 1.1

Question 5

(a) (i) Many correct answers were seen. Reflection in the x-axis was the most common incorrect answer.

(ii) Candidates were slightly less successful with the enlargement. Many with an incorrect answer earned partial credit for an enlargement of the correct size and orientation but in the wrong position. Many of those with the wrong position had the apex of the triangle at (0, 4).

(iii) Again, many correct translations were seen with some candidates earning partial credit for a translation with a correct displacement in one direction. Several candidates treated the translation as $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$.

(b) Many fully correct or partially correct answers were seen. The centre of rotation caused the most difficulty.

(c) (i) This proved very challenging for many candidates who were unable to set out the working in the correct format to allow correct multiplication by not converting the co-ordinates (1, –4) into a column vector. Several candidates made no attempt.

(ii) As this part included a second matrix it proved more challenging than the previous part. Similar errors were seen and a significant number of candidates used their answer from the previous part instead of using (1, –4). A significant number of candidates made no attempt.

(iii) Candidates were more successful in this part. Some clearly recognised the matrix and gave a correct description of the transformation while others showed attempts to transform the unit square to find the correct description. Many of those that had struggled in the previous two parts made no attempt.

Answers: **(b)** Rotation, 90° clockwise,(4, –1) **(c)(i)** (4, 1) **(ii)** (8, –1) **(iii)** Rotation, 90° anticlockwise, (0, 0)

Question 6

(a) (i) This was well answered by many candidates. The two most common errors involved using 10 as the radius instead of 5 and using $2\pi r^2 h$ for the volume of a cylinder. Some candidates lost the final mark by giving an answer of 25.4, a truncated version of the correct answer.

(ii) Fully correct solutions were given by a minority of candidates only with many others using the formula for a whole sphere instead of a hemisphere. If the equation was set up correctly at the start, the radius was usually calculated correctly. Some lost the final mark by using square root instead of cube root, despite setting out their working correctly.

(iii) A majority of candidates showed the correct working and were able to give the correct answer. Quite a few candidates gave the area of one face only instead of the total surface area. Others lost the final mark by not maintaining sufficient accuracy, usually by giving the cube root of 2000 to only three figures. Other common errors involved multiplication by 2 when trying to square the length of a side and division by 3 when trying to find the cube root.

(b) (i) The majority of candidates made a successful attempt at this question. However, a number treated one angle as a right angle and $\frac{1}{2}\times 10\times 7$ was a common error. Some used cosine in the area formula instead of sine.

(ii) Many candidates demonstrated competency in identifying and using the cosine rule. Most were able to find the correct length for the third side and show a correct method for finding the perimeter. This was expected to be 23.46 or better but premature rounding of the third side resulted in a significant number of candidates only giving the perimeter as 23.5. Some candidates used less efficient methods, correctly drawing the perpendicular height and working their way through two right-angled triangles.

(c) This part proved more challenging and fewer fully correct answers were seen. Many candidates used the 28.2 as the arc length earning only partial credit; others used the formula for area instead of arc length. A few used 10.2 as the third side of the triangle and used the cosine rule to calculate the angle *c*.

Answers: **(a)(i)** 25.5 **(ii)** 9.85 **(iii)** 952 **(b)(i)** 22.5 **(c)** 64.9

Question 7

(a) Most candidates completed the table correctly with many of the errors arising from incorrect squaring of negative values of x.

(b) The plotting of the points was carried out accurately with many going on to draw a smooth curve. When points were plotted correctly any loss of marks was the result of the curve missing one or more points, the curve having straight line segments or occasionally excessive feathering.

(c) Most candidates understood what was required and were able to read off two values accurately. For some, reading the scale led to errors.

(d) This proved challenging for all but the most able candidates. Those that attempted to complete the square often started incorrectly with $(x + 2.5)^2$. Others attempted to expand $2(x + a)^2 + b$ with the intention of equating coefficients but few were successful. Common errors tended to lead to terms such as $2ax$, a^2 and $2b$.

Answers: **(a)** 9, –6, 9 **(c)** –3.4, 0.9 **(d)** $a = \frac{5}{4}$, $b = -\frac{49}{8}$

Question 8

(a) (i) Many correct answers were seen in this part.

(ii) A majority of candidates gave the correct gradient but many didn't appreciate that the equation should be written in the form $y = mx + c$. Apart from the incorrect answer of $\frac{3}{2}$, other common errors included 3, –3, $\frac{2}{3}$ and $-\frac{2}{3}$.

(b) A small majority gave a correct point on the x-axis. A wide variety of incorrect answers were given, frequently without any working. The most common errors included (0, 0.8) and the intercept with the y-axis.

(c) The process of finding the gradient of a perpendicular line was not understood by many of the candidates and only a minority gave a correct equation. Many of the incorrect equations resulted from an incorrect gradient, often given as 5, –5, $\frac{1}{5}$ and a variety of others. With or without the correct gradient, not all candidates appreciated that (10, 9) needed to be substituted to find the constant term. A significant number made no attempt.

(d) This proved quite challenging and a minority of candidates gave fully correct answers. Those that found the co-ordinates usually solved the simultaneous equations algebraically. Several attempted to sketch the two lines but this was rarely successful. Some attempted to find the point of intersection of line A and its perpendicular line. Many gave an incorrect pair of co-ordinates without showing any working and were unable to earn any method marks. A significant proportion of candidates made no attempt.

(e) In addition to a very high proportion of candidates that made no attempt, a majority of those that made an attempt struggled to make any progress. Many of those that were successful had drawn a diagram showing the triangle with intercepts clearly labelled.

Answers: **(a)(i)** 5 **(ii)** $-\frac{3}{2}$ **(b)** (0.8, 0) **(c)** $y = –0.2x + 11$ **(d)** (2, 6) **(e)** 13

Question 9

(a) Many correct expressions for the time were seen. Common errors included $\frac{10}{x} - 0.5$ and $\frac{10}{x+0.5}$.

(b) (i) Those candidates that had struggled in the previous part struggled again or made no attempt. Many attempted to set up an equation but it was common to see the times subtracted in the wrong order, and occasionally added. Algebraic fractions were often successfully combined but the expansion of brackets often led to errors with the signs. Some tried unsuccessfully to work backwards from the given equation, or use values found in the next part. Less able candidates often attempted to solve the quadratic equation.

(ii) A majority made a good attempt and usually obtained two correct solutions, although not always written to 2 decimal places as requested. When solving the equation some candidates made sign errors and the use of –1 instead of –(–1) for –*b* and squaring –1 to obtain –1 were common errors.

(iii) Many candidates made no attempt to find the time. Many of those attempting the question earned some credit but only a minority gave a fully correct solution. Some correctly calculated the time in hours but did not go on to give their answer in hours and minutes. Others that did convert their answers sometimes forgot to round their answer to the nearest minute. A significant number attempted to calculate Alfredo's time instead of Luigi's.

Answers: **(a)** $\frac{10}{x-0.5}$ **(b)(ii)** –4.23 and 4.73 **(iii)** 2 h 7 min

Question 10

(a) (i) Most candidates were successful in finding the prime factors, often by using a factor tree. Occasionally not all factors were reduced to primes but at least some credit was earned. Some gave an answer as the sum of prime factors rather than as a product.

(ii) The vast majority were able to give the correct LCM, the most common method being to list the multiples of both numbers. A few showed the prime factors of each number in a Venn diagram. Some gave 540 without any working. A common error was to think this was HCF giving an answer of 18 or to give a higher multiple of both which was usually 9720.

(b) This proved challenging for many candidates and a very high proportion made no attempt. Many of the candidates could not see the link between the given expressions for *X* and *Y* and the LCM and HCF values resulting in no progress being made. Forming an expression for the HCF and equating this to 1225 proved to be an efficient method. This led to $a = 5$ and enabled solutions for *X* and *Y* to be found. Others started by finding prime factor products for 1225 and 42 875, again leading them to deduce that $a = 5$. Some trialled values of prime numbers and if they reached $a = 5$ they were usually successful. A few divided 42 875 by 5 and 7 to give the required answers.

Answers: **(a)(i)** $2^2 \times 3^2 \times 5$ **(ii)** 540 **(b)** $X = 8575$, $Y = 6125$