# 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 the question 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, for example in Question **17**, trigonometry, and Question **21(b)**, re-arrangement of equations. Candidates must take note of the form or the units that are required, for example in Question **3**, where decimals or percentages were seen and Question **18**, where the *n*th term is asked for, not the next term. Rounding incorrectly and not using the appropriate degree of accuracy let down many candidates particularly in Questions **4**, **6**, **9** and **17**. The questions that presented least difficulty were Questions **1**, **11**, **14**, **19(a)**, **20(a)** and **(b)** and **21(a)**. Those that proved to be the most challenging were Questions **4(a)**, **12(b)**, **16(b)** and **(c)**, **17** and **18**.

## Comments on specific questions

### Question 1

This question was answered well by the overwhelming majority of candidates. A small number of candidates confused billions with millions and others gave thirty hundred thousand. A minority included figures in their answer.

*Answer:* thirty million

### Question 2

Some candidates did not deal with the directed numbers correctly, subtracting 2 from 5, leading to a final answer of 3 or added 2 to 5 to give 7. Some candidates used a completely incorrect method and attempted division giving answers of –2.5 or –0.4.

*Answer:* –7

### Question 3

Some answers in the wrong form (0.125 or 12.5) were seen but most gave an answer as a fraction even if it was not simplified. Answers such as $\frac{7}{10}$ or $\frac{56}{10}$ showed that some candidates misunderstood what was required.

*Answer:* $\frac{1}{8}$

**Question 4**

In both parts, a significant number of candidates gave answers that suggested that they had no understanding of the basic concepts behind rounding. Answers that were many orders of magnitude greater than the given numbers were common; answers in which multiple digits had been changed were also seen in many cases. Candidates were more confident with part **(b)**, using decimal places, than answering part **(a)**, using significant figures. In part **(a)**, some gave 0.040 as the answer or 0.04. Some candidates gave an answer that was a truncation to 3 significant figures, 0.401. Others multiplied the given number by 1000, moving the decimal point 3 places to the right. In part **(b)**, candidates often omitted the final zero.

*Answers:* **(a)** 0.0402 **(b)** 0.040

**Question 5**

There were many good answers seen, with the majority producing carefully constructed diagrams. The most common error was to attempt to complete this question without drawing the arcs or drawing many meaningless arcs. A few candidates drew the first arc, but omitted the second. Some candidates were let down by drawing lines that were not sufficiently accurate in length as some triangles only had one of the two sides correct. It appeared that some candidates may not have had a pair of compasses as a lack of arcs was also noted in Question **16**.

**Question 6**

Whilst there were many completely correct answers, a significant proportion of candidates were unable to order the given numbers correctly. The majority of errors involved the incorrect positioning of 58% and more often than not, placing it as the largest number as if it was 58. This was one of several questions where working to an insufficient degree of accuracy proved problematic. Some candidates didn't use a sufficient number of decimal places to determine which order the numbers should be placed in. Others showed no working so were unable to gain the method mark.

*Answer:* $\sqrt{0.33} < 58\% < \frac{18}{31} < \frac{7}{12} < 0.59$

**Question 7**

There were some excellent and completely correct answers to this question. The majority of the errors were arithmetical or involved sign errors. Few candidates put a horizontal line between the entries although some candidates did treat vectors as if they were fractions and cancelled down entries to give answers such as $\begin{pmatrix} 3 \\ -4 \end{pmatrix}$.

*Answer:* $\begin{pmatrix} 12 \\ -16 \end{pmatrix}$

**Question 8**

This question was answered well by many candidates who showed complete and convincing working. A few candidates made arithmetical errors, which should have been picked up when checking, or added when they should have subtracted. A small number gave working such as $\frac{6}{12} - \frac{4}{12}$ where the numerators came from adding (2 + 4 and 1 + 3) instead of multiplication. A few candidates arrived at a correct answer, but showed spurious or no working.

*Answer:* $\frac{5}{12}$

**Question 9**

The most common misconception was for candidates to use the area formula to find the circumference. Of those who used the correct formula, some used 3.14 or $\frac{22}{7}$ for $\pi$ even though these approximations are insufficiently accurate and lead to answers which are outside the permitted range. Others lost marks for not rounding correctly.

*Answer:* 50.3

**Question 10**

There were many completely correct answers, often accompanied by clear working that showed good insight into the concept being assessed. However, there were also a large number of incorrect attempts. Most of these involved attempts to find $\frac{2}{9} \times 48$, suggesting that these candidates had not understood what was required. A small number of candidates chose to decimalise the fraction $\frac{2}{9}$ and therefore introduced an unnecessary rounding error as they went on to calculate $48 \div 0.22$.

*Answer:* 216

**Question 11**

Part **(a)** was answered well by many candidates but some gave the probability rather than the letter E, while others appeared to pick any letter from the word. In part **(b)**, most gave answers involving zero, but many seemed to find it difficult to express a probability of zero.

*Answers:* **(a)** E **(b)** zero

**Question 12**

This question caused significant difficulty for a large number of candidates. In part **(a)**, the most common incorrect answer was 'negative'. A few candidates wrote notes suggesting that they were considering how much fuel was left in the tank rather than how much had been used, which is a possible cause for this error. However, a number of candidates did not seem to be able to name any type of correlation, with answers referring to proportion, speed, units of measurement and even specific values being seen often. In part **(b)**, most felt that this should be positive or negative, although a similar range of incorrect answers was seen as in part **(a)**.
.
*Answers:* **(a)** positive **(b)** zero

**Question 13**

Most candidates could identify the mode correctly in part **(a)**, but finding the median in part **(b)** caused difficulties for a considerable number. The most common errors were to give the middle value in the list without ordering, to only use one of each value or to calculate the mean instead.

*Answers:* **(a)** 8 **(b)** 6

**Question 14**

There were many good answers seen. In part **(a)**, a few candidates divided by $\frac{4}{5}$ instead of multiplying. In part **(b)**, the most common error suggested that candidates had keyed in $7.1 \times 4.8 \div 15.3 - 9.62$, without the necessary brackets. In part **(c)**, the cube root caused problems for some, with answers seen that had been found using square rooting, squaring or cubing.

*Answers*: **(a)** 72 **(b)** 6 **(c)** 17

**Question 15**

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 second equation by 2 and then subtract. An alternative approach is to double the first equation and multiply the second by three but this method involves more multiplications and more chance of error. There were a number of candidates who re-arranged both equations into $x =$ form (or $y = ...$), equate them and solve for *x* (or *y*). Very 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.

*Answer*: [$x =$ ] –1, [$y =$ ] 5

**Question 16**

There were some excellent answers to this question, but in some cases, the answers presented consisted of a collection of arcs and lines that seemed to show no understanding of what was being asked. In part **(a)**, those who realised the need to draw an arc were usually able to do so to the required accuracy. However, a considerable number of candidates did not draw the complete arc across the triangle and others may not have had a pair of compasses. In part **(b)**, a large number of candidates drew the perpendicular bisector of *AC* (as the wrong pairs of arcs were seen on many answers) rather than the angle bisector of *ABC*. Very few were able to identify the correct region in part **(c)**. 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. This was one of the questions that was most likely to be left blank by candidates.

**Question 17**

The vast majority of candidates recognised that this could be solved by using sin 37° and a majority stated $\sin 37° = 15 \div x$. After that, many candidates were unable to rearrange the equation correctly and so gave $15 \times \sin 37° = x$. Another common error was that many candidates rounded their answer to the nearest cm rather than to three significant figures as stated in the rubric. A few candidates used cos 37° to find the base of the triangle and then Pythagoras' theorem to find *x*. This only scored method marks once the full method was given and early rounding often caused the answer to be inaccurate.

*Answer:* 24.9

**Question 18**

This proved to be a highly challenging question. Most identified the patterns in the sequences correctly and many stated the next terms. However, finding the *n*th term proved to be highly problematic. In part **(a)**, attempts to use $a + (n - 1)\ d$ were often unsuccessful because candidates were not able to remember or use the formula correctly. Common incorrect answers were $6 + n$ and $6n - 1$. In part **(b)**, most attempted to find a linear expression in $n$, so gave $2 + 7n$ (from using $a + (n - 1)\ d$ with $a = 9$ and $d = 16 - 9$) but only a tiny minority realised that a quadratic expression was required. A few candidates recognised that the sequence was of square numbers but starting at $3^2$ rather than $1^2$. The most frequent mark awarded in part **(b)** was for reaching a common second difference of 2.

*Answers:* **(a)** $6n + 1$ **(b)** $(n + 2)^2$

**Question 19**

Part **(a)** was very well answered with most candidates getting this correct. In part **(b)** many candidates got the size of the angle correct but were not sufficiently clear in their explanation or only gave the calculation. Some candidates incorrectly gave 35° as the missing angle with the explanation that the triangle was isosceles. Also seen was the incorrect answer 145° with the explanation that angles on a straight line add to 180°. Part **(c)** used the properties that a tangent to a circle meets the radius at 90° and angle at the circumference in a semicircle is 90°. In part **(c)(i)**, some candidates recognised the tangent and gave 90° as the answer. Others assumed that the diameter bisected the remaining angle on the tangent and gave the answer 69° while others appeared to ignore the diameter and subtracted 42° from 180°. A follow through mark was available in part **(c)(ii)** if the two answers in part **(c)** added to 90° as this recognises the second property mentioned above.

*Answers:* **(a)** 54 **(b)** 61 **(c)(i)** 48 **(ii)** 42

**Question 20**

Most candidates were able to identify the co-ordinates of point *A* and plot point *C* correctly in parts **(a)** and **(b)**. There were some good answers seen for part **(c)**, although the spelling of isosceles proved to be problematic for some. A large number of candidates mistakenly described the triangle as being equilateral. If candidates plotted *C* incorrectly but correctly named the type of triangle their *C* made with *A* and *B*, they could gain a follow through mark, so those who marked *C* at (–2, 5) and then followed this with ‘scalene’, got a mark. The final parts involving vectors caused real difficulties. Candidates often didn’t interpret the positive and negative directions correctly. A number also muddled up the horizontal and vertical components and some gave a 2 by 2 matrix as their answer for part **(d)**. In part **(e)**, candidates should be aware that an answer of ($x = -5$, $y = 3$) scores zero when co-ordinates are asked for, as all that is required is (–5, 3).

*Answers:* **(a)** (1, 4) **(c)** Isosceles **(d)** $\begin{pmatrix} -4 \\ -6 \end{pmatrix}$ **(e)** (–5, 3)

**Question 21**

Part **(a)** was answered correctly by the majority of candidates. However a number reached the stage $x = 8 \div 4$, but then gave the final answer as $x = 4$. Part **(b)** caused more difficulty. The most common errors were to subtract 2 from $y$ rather than adding it and to only enclose the numerator of the expression $\frac{y+2}{4}$ in the square root sign. A number attempted to take the square root as their second step, but most of these candidates omitted to find the square root of 4. Some candidates seemed to be unable to access this question at all, with operations being applied in an arbitrary order and using incorrect symbolic notation. A number of candidates appeared to be attempting to solve an equation, rather than rearrange a formula. These candidates produced working in which one or both of the variables disappeared, often at an early stage.

*Answers:* **(a)** 2 **(b)** $\sqrt{\frac{y+2}{4}}$

# MATHEMATICS

**Paper 0580/12**
**Paper 12 Core**

## Key Messages

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

## General Comments

There were many scripts which showed good, clear working of solutions and a good number of candidates showed thorough knowledge of most of the topics. However, working was often absent, in the working space or on diagrams, where it would have helped and candidates may well have scored method marks if shown.

Often answers to questions were given which were impossible for the situation, outside a requested range or not sensible for the context.

Answers were often not given to sufficient accuracy. The rubric asks for inexact answers to be given to 3 significant figures and while more than 3 is not penalised, an answer to 2 figures will lose an accuracy mark. Rounding during a calculation too can produce inaccuracies. Occasionally an answer in the answer space is different from a correct answer in the working. This might just be a transcription error, a deliberate change, or from further continued working. Candidates should make their required answer absolutely clear.

## Comments on Specific Questions

### Question 1

**(a)** This question was generally not answered well. Most common was the error of assuming it was the section of time for stopped, resulting in responses of 1 and 6 to 7, or 6 and 7. A number of candidates gave the response of 10.

**(b)** Most candidates gained this mark but a few misread the scale and gave 3.5 while 2 and 3 were seen occasionally.

*Answers*: **(a)** 6 **(b)** 2.5

### Question 2

**(a)** A number of candidates did not know that % meant out of 100 and gave the answer $\frac{9}{10}$. Some interpreted 'fraction' as 'decimal fraction', giving the response of 0.09 but the vast majority did give the correct answer.

**(b)** It was only a very small number of candidates who gave an incorrect answer to this part and it was usually 0.03.

*Answers*: **(a)** $\frac{9}{100}$ **(b)** 0.3

**Question 3**

The knowledge of inequality signs was clearly lacking for some candidates. It may also have been lack of knowledge of basic conversions, but few candidates wrote all three correctly.

*Answers*: $<$, $>$, $=$

**Question 4**

**(a)** Most candidates realised that the slightly longer middle line was required, although a few showed arrows at 0.4, 0.2 or 1. The reason many did not gain the mark was that they indicated a range with a horizontal arrow from 0 to 0.5.

**(b)** This question asked for a probability but many candidates just worked out that 2 counters were yellow and gave that as their answer, which appeared to be a case of not reading or interpreting the question correctly. Of those who did make progress, the common error was $\frac{2}{10}$.

*Answers*: **(b)** 0.1

**Question 5**

**(a)** Most candidates placed the brackets correctly but quite a few ignored the instruction 'one pair of brackets' and wrote brackets around 6 + 12 also. Quite a few candidates did not attempt the question.

**(b)** While this part was correctly answered by the vast majority of candidates, the error of inputting 1.17 + 1.28 ÷ 3.92 into the calculator was seen quite often, evidenced by answers of 1.496 or 1.5. Others, having worked out the computation, gave just an answer of 0.63 when the correct answer, which was exact, had 3 figures.

*Answers*: **(a)** $6 + 12 \div (2 \times 3) = 8$ **(b)** 0.625

**Question 6**

**(a)** As the vector operations were split into two parts, this question was correctly answered by the vast majority of candidates. A few responses indicated a lack of knowledge of the topic but a (fraction) line between the components was rarely seen.

**(b)** This slightly less successful part was due to weakness with operations on directed numbers rather than lack of knowledge of subtracting vectors.

*Answers*: **(a)** $\begin{pmatrix} 15 \\ -21 \end{pmatrix}$ **(b)** $\begin{pmatrix} 3 \\ -13 \end{pmatrix}$

**Question 7**

**(a)** This part was well answered with not many candidates writing an answer of –11 and even fewer multiplying to give 24.

**(b)** This was not so well answered as part **(a)**. While the common errors were 12 and –12, there were other results of operations on –3 and 9. Some candidates even used the 5 from the time 5 am in the calculation, presumably due to a lack of understanding of the wording.

*Answers*: **(a)** 5 **(b)** 6

**Question 8**

**(a)** Many candidates clearly did not know the difference between factors and multiples so 2 and 4 were very common incorrect responses.

**(b)** In both parts, but particularly in part **(b)**, many candidates gave more than the 1 response asked for. If the responses were all correct that was not penalised but very often an incorrect number was seen and so the mark was lost. 51 and 57 and even numbers were common incorrect responses, either alone or alongside other correct ones. Here too was evidence of not reading the question as it specified values within a small range so a few candidates, who understood prime numbers, lost the mark due to an answer outside the range.

*Answers*: **(a)** 24 or 48 etc **(b)** 53 or 59

**Question 9**

**(a)** This part was not well answered as many candidates did not seem to understand what 'correct to the nearest thousand' meant. 14 000 and even 14 800 were understandable errors but a great variety of values from 400 up to seven figures were seen.

**(b)** Some candidates ignored the instruction to put their answer to part **(a)** into standard form. However, some gained the mark for putting their incorrect answer to part **(a)** correctly into standard form.

*Answers*: **(a)** 15 000 **(b)** $1.5 \times 10^4$

**Question 10**

This was not answered well with many candidates assuming that the triangle was right-angled, ignoring the 67°, and giving an answer of 48°. Another common error was 42° from an assumed isosceles triangle. Most correct responses were from candidates who filled in angles on the diagram and then worked out the value of the required angle. For many, the 42° was ignored and parallel lines with an angle of 67° given meant that the required angle was alternate to and so equal to 67°.

*Answer*. 25

**Question 11**

While many candidates gained a mark for a correct expansion of the brackets, the second mark was lost by some for subtracting 48 to reach an incorrect answer of 5. There were quite a number of candidates who wrote $6k – 8$ for the expansion. However, there was a high percentage of fully correct answers.

*Answer*. 21

**Question 12**

The trapezium area was not answered well with many not knowing the formula or being able to split the shape into more basic shapes. The 5 cm length was taken as the height in many calculations but nearly all who used the correct formula gained full marks. There were many and varied incorrect responses; the most common was finding the perimeter with an answer of 38.

*Answer*. 58

**Question 13**

Although this was a basic trigonometry question, there were many candidates who clearly had a lack of understanding of this area of mathematics. Some tried to use Pythagoras' theorem even though an angle was involved, while cosine and to a lesser extent, tangent showed weakness in knowledge of which ratio was needed. For those who did use sine, most applied it correctly but a significant number lost a mark by giving only a 2 significant figure answer, or an incorrectly rounded one.

*Answer*. 7.42

**Question 14**

Many candidates were not able to interpret this question as a subtraction of two volumes, even with the diagram provided. Most realised that the volume of the cuboid was required but many left 270 as their answer. Others felt that the cube volume, whether worked out correctly or not, had to be added. Quite a lot of candidates did not read the question carefully and assumed that the part removed was a cuboid 2 by 2 by 5 and not a cube as the question stated. Surface area calculations were also seen quite a number of times.

*Answer*. 262

**Question 15**

**(a)** A significant number of candidates did not attempt one or both parts of this question. For those who knew a subtraction from 1 was required, many did not cope with a probability so small. Impossible probabilities of 2 and 99.98 were common as well as repeating the question probability as their answer.

**(b)** In this part, quite a number of candidates did not realise that 'number of these cups' had to be between 0 and 2500. Some gave a probability, usually $\frac{1}{50}$, values far greater than 2500 or even the result of 0.02 ÷ 2500.

*Answers*: **(a)** 0.98 **(b)** 50

**Question 16**

**(a)** Nearly all responses were correct with the only significant error being in the order of the co-ordinates. There were a few cases of the unacceptable ($x = 7$, $y = 1$) seen.

**(b)** Most candidates attempted a solution to the gradient by using the formula connecting co-ordinates of 2 points. However many used $\frac{\text{difference in } x}{\text{difference in } y}$ or mixed up the co-ordinates. Few attempted counting squares for $\frac{\text{vertical}}{\text{horizontal}}$ which may have been more successful as the scales were the same. One mark was gained by many who gave the positive value of the gradient.

*Answers*: **(a)** ( 7, 1) **(b)** –1.25

**Question 17**

**(a)** Many candidates had little idea of the condition for similar triangles. It would have helped if the missing angles had been worked out and written on the diagram in order to see which two did have the same angles.

**(b)** There were many correct responses to this question. However, an answer of 7.4 (from (12.8 − 9.6) + 4.2) was common.

*Answers*: **(a)** *B* and *D* **(b)** 5.6

**Question 18**

**(a)** Many candidates did not attempt this part of the question and some ignored 'one student', putting a ring around two or more points. Some circled all the points. Of those answering in the correct way, the point (18, 20) was the common error.

**(b)** Those who were familiar with the topic gained this mark but there were many candidates who were not. Some gave negative or no correlation.

**(c)** The line of best fit was not well drawn with many candidates putting their line through (0, 0) and towards, if not through (20, 20). Lines too short or freehand and some simple joining of points were seen.

**(d)** This was another part not attempted by a significant number of candidates, and only straight lines were allowed for use in this strict follow through of the candidate's line of best fit. The main error was misreading the scale, for example, an answer of 10.3 given for what should have been 11.5.

*Answers*: **(a)** (9,14) identified **(b)** positive

**Question 19**

**(a)** Many candidates did not know that an octagon has 8 sides so there were many different multiples of 4 offered for the perimeter. Some candidates did not attempt the part while some gave answers which were not multiples of 4 which may have meant they didn't understand the term 'perimeter'.

**(b)** Without a diagram for this part, many candidates made little or no progress. Some gained a mark for dividing 360 by 12 but did not know how to progress. Others progressed to 180 × (12 – 2) but again omitted to complete the second stage.

*Answers*: **(a)** 32 **(b)** 150

**Question 20**

Many candidates tackled the question in two parts, usually a common denominator of 12 for the first two fractions. While this was quite well answered, a significant number found $\frac{5}{7}$ from adding the first two fractions. The question asked for a mixed number but many lost the fourth mark by not converting the improper fraction. Some candidates had little idea of the method.

*Answer*. $1\frac{7}{24}$

**Question 21**

**(a)** Most often this was correct but $8p$, $8p^3$ and $9p^3$ were common errors.

**(b)** This was very well answered but a significant number of candidates wrote $4q – 3$ while some made it into an equation leading to $x = 3$.

**(c)** The factorisation was quite well done but some combined the terms to a single $25t^3$. Only a few gained 1 mark for a correct partial factorisation while errors in factorising were evident in quite a number of responses. Some spoiled an otherwise correct factorisation by writing a minus sign between the terms in the bracket.

**(d)** The simultaneous equations question was quite well answered but many did not realise that the equations did not need to be multiplied for the elimination method. This often resulted in unnecessary errors. Those not arriving at fully correct answers often managed to score a mark for correctly substituting an incorrect value into an equation. Lack of basic algebra skills was evident for some candidates.

*Answers*: **(a)** $9p$ **(b)** $4q – 12$ **(c)** $5t(2 + 3t)$ **(d)** $x = 3$, $y = −2$

# MATHEMATICS

**Paper 0580/13**
**Paper 1 (Core)**

## 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 vast majority of candidates could attempt all questions. It is important, however that candidates read the questions carefully in order to understand what is required, especially when the question asks for the answer in a specific form, for example, a fraction. Careful checking would help to reduce errors. Candidates should ensure they do not round or truncate answers in the middle of calculations as this can lead to a loss of accuracy in the final answer.

Generally presentation was good. Many candidates showed method and were able to earn partial credit if they did not obtain the final answer, although a lack of working did cost some candidates marks. The majority of candidates used a ruler for the diagrams.

Candidates did not appear to have a problem completing the paper in the allotted time.

## Comments on specific questions

### Question 1

This question was generally well answered.

*Answer*: 5034

### Question 2

This was well answered with the majority of candidates giving the correct answer, apart from an occasional slip and partial solution i.e. −10 + 7.

*Answer*: −3

### Question 3

This was well answered with the majority of candidates giving the correct answer. 144 from $12^2$ was seen at times.

*Answer*: 36

### Question 4

Many candidates were able to give the correct answer. The obvious error of $n^{10}$ was not seen often.

*Answer*: $n^7$

**Question 5**

A good number of correct answers were seen; this was the easier case of a bounds question with no decimal in the value given. Some, who understood bounds, gave 948.4 or 948 as the upper bound. A significant number didn't reach the correct answer but not as many as usual on bounds questions.

*Answer*: 947.5, 948.5

**Question 6**

**(a)** Most answers were correct but some candidates did not know that standard form required the first part to be between 1 and 10 so that 24.7 and 247 were often seen. Several candidates missed out the question.

**(b)** Again answers were mostly correct but an index of 3 was seen at times. Otherwise the errors were similar to those in part **(a)**.

*Answer*: **(a)** $2.47 \times 10^6$ **(b)** $7.9 \times 10^{-3}$

**Question 7**

This was very well answered with few errors seen. A small number of candidates gained only 1 mark from the decimal conversion followed by an error in the order.

*Answer*: $0.4^2$, $0.6^3$, 0.22, $\sqrt{0.09}$

**Question 8**

Friday was the most common answer (from $2 \times 2$). However, some candidates did understand the question and gave the correct answer, sometimes with working shown. Others scored 1 mark for correctly identifying 5.4 or two of the other correct values.

*Answer*: Thursday

**Question 9**

**(a)** The part of the journey was mainly identified correctly.

**(b)** This was generally not well answered with most lines missing the final point. Usually the error was in the distance plotted. The majority of lines were ruled.

*Answer*: **(a)** *A*

**Question 10**

This was generally well answered with the majority of candidates scoring both marks. A few did not show the working and a smaller number attempted to use decimals. Other errors were rare. It should be emphasised to candidates that full marks are not awarded for answers without working when the question clearly states "write down all the steps of your working".

*Answer*: $\frac{23}{30}$

**Question 11**

The common error of 34 from 30 – 12 = 18, 16 + 18 = 34 was seen often. Many candidates however performed a correct division / multiplication.

*Answer*: 40

**Question 12**

**(a)** Many correct answers were seen, with the few errors tending to be dividing by 100 or 1000 rather than multiplying by an incorrect power of 10.

**(b)** Few candidates were able to give the correct answer. A variety of incorrect answers were seen with 1280 and 12.8 being common.

*Answer*: **(a)** 18.3 **(b)** 128

**Question 13**

**(a)** This part was well answered but a few answers of the highest value, 175, were seen.

**(b)** This part was less well answered. Many candidates confused the median and mean. Some showed working, which usually resulted in success; others correctly identified 164 and 168 as the middle pair but then did not know how to find the answer.

*Answer*: **(a)** 172 **(b)** 166

**Question 14**

**(a)** This was very well answered with almost all candidates giving the correct answer.

**(b)** The majority of candidates scored both marks with just a small number gaining 1 mark for a correct fraction, but not in its simplest form. A small number of candidates had not read the question carefully and gave answers as a decimal, 0.48.

*Answer*: **(a)** 0.6 **(b)** $\frac{12}{25}$

**Question 15**

**(a)** Many correct answers were seen as nearly all the candidates realised that multiplication was needed. Rounded answers were rare.

**(b)** This part was generally well answered, with the majority of candidates realising the need to divide. The main loss of a mark was for 133.41 as a result of incorrect rounding.

*Answer*: **(a)** 2644.32 **(b)** 133.42

**Question 16**

**(a) (i)** The majority of candidates gave the correct answer.

**(ii)** Again the majority gave the correct answer. Candidates should be encouraged to give a numerical answer rather than words, e.g. impossible.

**(b)** In general this part was less well answered than part **(a)**. Some candidates didn't know the method and a variety of incorrect responses were seen. However, several were able to give the correct answer.

*Answer*: **(a)(i)** $\frac{5}{12}$ **(ii)** 0 **(b)** 0.65

**Question 17**

This was correctly answered by the majority of candidates. Errors in writing times, for example, writing 7 and a half hours as 7.3, led to errors in the addition of times, giving an answer of 35.60. Although several did score 1 mark for (usually) 5 and 4, some candidates were not able to work out the time intervals correctly.

*Answer*: 36

**Question 18**

**(a)** Some candidates did not understand vector operations, producing unreasonable answers. It was rare to see an error from those who did know how to add vectors. Few candidates wrote vectors with a fraction line.

**(b)** This part was less well answered with several adding or even multiplying the co-ordinates in various combinations.

**(c)** This part was also not well answered. Many candidates subtracted the components while other variations of processes on them were evident.

*Answer*: **(a)** $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$ **(b)** $\begin{pmatrix} 2 \\ 4 \end{pmatrix}$ **(c)** (6, 10)

**Question 19**

**(a)** Correct answers were rare in this part. The majority of candidates appeared to understand the concept of perimeter, but almost all thought 4.5 was involved in the perimeter and others were confused by the number of sides the shape had.

**(b)** Some correct responses were seen but many confused attempts were seen. Several scored 1 mark for $4.5 \times 5$. Some responses included $\pi$.

*Answer*: **(a)** 30 **(b)** 47.5

**Question 20**

**(a)** Almost all answers were correct. The only noticeable error was taking 90 as the total of the angles of a triangle.

**(b)** This was less well answered than part **(a)**. Little working was seen and quite a lot of candidates did not attempt to answer this part. Most did not use 360° in any way.

*Answer*: **(a)** 68 **(b)** 9

**Question 21**

**(a)** Most candidates gained the 2 marks for drawing the lines of symmetry. The main error was to just draw the one line, the vertical from the top vertex.

**(b)(i)** There were quite a lot of drawings of a rectangle and a rhombus but squares were also common. Some hadn't appreciated that the shape had to be a quadrilateral and triangles and cuboids were often seen.

**(ii)** The majority of candidates with acceptable drawings were usually able to correctly name their shape.

**Question 22**

**(a)** The majority of candidates were unable to give the correct answer. The most common errors were not doubling the radius or working out the area**.**

**(b)** It was common to see the previous answer of circumference multiplied by 12. There were a number of correct solutions but a lot of responses were blank or showed little understanding of how to calculate the volume of a cylinder.

*Answer*: **(a)** 40.2 **(b)** 1544

**Question 23**

A high number of correct answers to this question were seen. Candidates showed a good understanding of simultaneous equations, and a large number showed working. Less able candidates often attempted a method, but showed very little understanding of what they were doing; some added or subtracted the equations without finding a common co-efficient. There was a large variation in the working seen. Some candidates just multiplied one or both equations but were unable to make further progress. Others made errors in deciding or executing the addition or subtraction of their equations with the signs causing a problem for some. Some candidates who had reached $x = 5$ or $y = -2$ often did not correctly substitute to find the other value. A small number of candidates used the substitution method; the rearrangement was often correct but then errors often occurred involving signs when substituting in.

*Answer*: $x = 5$, $y = -2$

# MATHEMATICS

**Paper 0580/21**
**Paper 2 (Extended)**

## Key message

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

It is important to keep the accuracy of figures to at least 4 figures in working unless the values are exact. There are many candidates truncating to 2 figures early in their working and this usually leads to an inaccurate answer. Algebra remains strong yet there are many candidates who do not understand that to cancel in a fraction you need to cancel a factor of the whole numerator with a factor of the whole denominator. Number work is also good except in proportionality where it is essential to include the constant as well. In shape and space many candidates used the sine and cosine rules in right-angled triangles even though they are unnecessary. In particular the cosine rule is very unwieldy and yet many candidates use it abundantly. In probability it is good practice to write probabilities as unsimplified fractions first before attempting to change or simplify them.

## Comments on Specific Questions

### Question 1

In most cases the correct answer was seen. However 3 was also seen from the subtraction of 2 from 5.

*Answer:* –7

### Question 2

Part **(a)** was found to be more challenging than part **(b)**. Incorrect answers seen included 0.04, 0.0401 and 0.0402000. The most common incorrect answer seen in part **(b)** was 0.04.

*Answer:* **(a)** 0.0402 **(b)** 0.040

### Question 3

There were some inaccuracies seen using 12.7 and hence 0.7 given as the answer. Some subtracted 12.67 from 14 instead of subtracting 12. Those who worked in euros were more successful than those who worked in Swiss francs, who generally did not then convert their answer to euros.

*Answer:* 0.67

### Question 4

This was well answered with the occasional multiplication error seen in the numerator.

*Answer:* $\frac{5}{12}$

**Question 5**

In part **(a)** some answers were left as a power rather than multiplying it out and in part **(b)** some answers had the power of 3 rather than –3. There were also quite a lot of answers such as $456 \times 10^{-5}$ which were not in standard form.

*Answer:* **(a)** $\frac{1}{125}$ **(b)** $4.56 \times 10^{-3}$

**Question 6**

A common incorrect answer was 48. Many candidates had indicated this as angle *WPQ* either in the working or on the diagram or they had indicated angle *WQP* as 90°. It is likely that many candidates did not know from the definition which angle to give as the answer.

*Answer:* 42

**Question 7**

Candidates had two challenges with this question. The first was to correctly factorise the numerator to $xy(x^2 + 2y^2)$. Those who achieved this successfully then had problems cancelling a factor in the numerator with the same one in the denominator. A few tried to cancel before factorising but this method usually didn't lead to the correct answer.

*Answer:* $\frac{x^2+2y^2}{xy}$

**Question 8**

A large number of candidates scored well on this question. The misconception arose when combining the integer value with the algebraic fractions. Many did not appreciate the significance of the common denominator, *pt*. Therefore $1-\frac{2t-3p}{pt}$ and $\frac{1-2t-3p}{pt}$ were common incorrect answers or given as incorrect working.

*Answer:* $\frac{pt-2t-3p}{pt}$

**Question 9**

The answer 55 for *x* was given from almost all candidates, but many gave an incorrect value for *y*. The most common incorrect values seen were 110, 70 (treating *OABC* as a cyclic quadrilateral), and 55 (using the rule, angle at circumference is half the angle at centre incorrectly).

*Answer:* [$x$ = ] 55 [$y$ = ] 125

**Question 10**

This was generally answered well. The common errors were square rooting the power 16 leading to $x^4$ in the term or halving the 36 giving 18 as part of the final answer.

*Answer:* $6x^8$

**Question 11**

Generally this question was answered correctly and with appropriate working. Those who didn't score full marks usually had a correct method but made a minor arithmetic error usually gaining credit. There were very few attempts seen with a totally incorrect method.

*Answers:* [$x$ = ] –1 [$y$ = ] 5

**Question 12**

In part **(a)** most candidates gave the correct answer although some did not fully cancel the fraction. In part **(b)** there were a number of methods seen. The most common method was to multiply by 100 and subtract. However many did not appreciate that the recurring decimal repeated forever. Hence those who attempted the subtraction should have reached an answer of 18 not 17.9992, for example. Some attempted to subtract 100$n$ and 10$n$ and because the digits do not align this method didn't lead to the correct answer.

*Answers:* **(a)** $\frac{1}{8}$ **(b)** $\frac{2}{11}$

**Question 13**

This question was generally answered well. In part **(a)** the common errors that were seen included $(2p-3)^2$ or $(2p+3)^2$, or attempting to take 4 out as a factor. Some candidates equated to zero and then solved to give values for $p$. There were a few attempts to factorise using fractions and candidates need to be reminded that these are not acceptable. In part **(b)** the main challenge was the signs and some were unable to deal with the negative signs correctly.

*Answer:* **(a)** $(2p-3)(2p+3)$ **(b)** $(a-2b)(2x-y)$

**Question 14**

There were many good methods seen but spoilt by inaccurate calculations. The value of the constant and the final answer were both recurring decimals which some candidates truncated to 0.6 or 0.66. Some candidates gave an incorrect formula, often using the square rather than the square root.

*Answer :* $6\frac{2}{3}$

**Question 15**

Part **(a)** was generally answered well and if errors were made, it was in the subtraction rather than the multiplication. There was little evidence of candidates checking the order of the matrices to see what the final answer should look like in both question parts. In part **(b)** the order was often incorrect or the answer was correct but omitting the matrix brackets.

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

**Question 16**

The most common misconception was that most candidates thought that the height of the smaller cup was half of the larger one and gave the answer as 4.

*Answers:* 6.35

**Question 17**

In part **(a)** the arc was usually correct although some of them did not reach one or both of the two sides. In part **(b)** the lines were usually correct, although some were too short. In part **(c)** most candidates who had a correct line and arc, also shaded the correct region.

**Question 18**

Part **(a)** was answered well except by those who squared –5 to give –25 leading to an answer of –46. In part **(b)** the common error was to divide $y$ by $qr$, although again this part was well answered.

*Answers:* **(a)** 4 **(b)** $\sqrt{y - qr}$

**Question 19**

In part **(a)** many found the term $6n$ although some gave an answer of $6n - 1$. The other error was to give 37 or $n + 6$ as the answer. In part **(b)** many candidates identified the constant second difference but were then unable to find the correct expression.

*Answers:* **(a)** $6n + 1$ **(b)** $(n + 2)^2$

**Question 20**

Part **(a)** was found to be very challenging with the common incorrect answer of $mx$ being given. In part **(b)** the common approach was to divide 10.5 by 5 to give 2.1.

*Answers:* **(a)** $0.06mx$ **(b)** 35

**Question 21**

Many candidates identified the correct lines but used incorrect inequality signs. Others confused $x$ and $y$ thus giving $x \geqslant 0$ and $y \geqslant 1$. For the diagonal line many thought it had the equation $y = x + 4$.

*Answers:* **(a)** $y \geqslant 0$ , $x \geqslant 1$, $x + y \leqslant 4$

**Question 22**

In part **(a)(i)** many candidates did not know how to find the number in the intersection. Some used a variable such as $n$ or $x$ but they did not know how to find its value. In part **(a)(ii)** there were a few who did not know which region the definition referred to. The most common error was to give the total incorrectly. In part **(b)** most gave the answer correctly but some included the intersection or set $C$ as well.

*Answers:* **(a)(ii)** $\frac{2}{10}$

**Question 23**

A few candidates tried to factorise the expression but the vast majority used the quadratic formula. The division line was short in many solutions and clearly some divided the incorrect number by the denominator. Some did not round their answers correctly and there were some errors with the minus signs.

*Answers:* –2.19, 0.69

**Question 24**

This question was answered well, spoilt only by the inaccuracy of intermediate values. In part **(a)** many used Pythagoras' theorem twice but carried an inaccurate value from one to the other. In part **(b)** the best attempts used either sin, cos or tan from a drawn triangle. There were some candidates who tried to use the sine or cosine rule in both parts when they were unnecessary.

*Answers:* **(a)** 13.9 **(b)** 35.3

# MATHEMATICS

**Paper 0580/22**
**Paper 2 (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 were generally very good at showing their working with very few just writing the answer only. Candidates showed evidence of good number and algebra work with particular success in questions **1**, **3**, **5**, **8**, **12**, **13c** and **14**. Candidates struggled in some of the shape and handling data questions, in particular finding questions **10, 11b, 15, 16** and **19b** more challenging.

## Comments on Specific Questions

### Question 1

This was generally well answered with the majority of candidates scoring full marks. In part **(a)** there was evidence of rounding to the nearest 100 or 10. Common incorrect answers that were seen included 14 800, 14 840, 14 000, 1500 and 15. In part **(b)** some candidates gave the original number 14 835 correctly in standard form or had a correct follow through, with many having the correct answer. Where the candidate did not gain the mark, this was generally due to an incorrect power of 10; $1.5 \times 10^{-4}$ was seen a number of times. Another common error was to truncate or round the original value to a different accuracy thus reaching answers such as $1.48 \times 10^4$. Also $15 \times 10^3$ was quite common.

*Answer*: **(a)** 15 000 **(b)** $1.5 \times 10^4$

### Question 2

A large number of candidates obtained the correct answer. Commonly, but not always, they marked known angles on the diagram. A common error was 180 – 67 – 42 = 71. Some marked *a* as 67 thinking it was alternate to the 67 given. A small minority assumed that the small triangle at the bottom was isosceles and 42 was occasionally given as the value of *a*.

*Answer*: 25

### Question 3

This question was one of the best answered questions in the paper and nearly all the candidates had the correct solution. Of those candidates who did not score 2 marks, a significant number scored 1 mark from $6k - 48 = 78$ followed by $6k = 78 - 48$ with the most common incorrect answer being 5. A small number of less able candidates ignored the brackets or multiplied them out incorrectly and consequently another incorrect answer occasionally seen was 14.3.

*Answer*: 21

**Question 4**

This was generally well answered with most candidates gaining 2 marks. Errors in the use of the trapezium formula that were seen included $\frac{1}{2}(13 \times 16) \times 5$, $\frac{1}{2}(13 + 16 + 5)$ or occasionally $(13 + 16) \times 5$. Others broke the shape down into a rectangle and a triangle, often successfully. Where this went wrong, the most common error was to use $\frac{1}{2} \times 3 \times 5$ for the triangle, leading to the fairly common incorrect answer of 59.5. A small minority worked out the perimeter instead of the area.

*Answer*: 58

**Question 5**

This was answered well with many candidates scoring full marks. Some candidates made progress with the coefficient but made an error with the *y* index, e.g. $9y^7$ was a common incorrect answer. Occasionally candidates did not completely simplify the numbers, leading to answers such as e.g. $\frac{18y^3}{2}$. Marks of 0 were rare and were usually the result of a misread of the question and candidates attempting to factorise.

*Answer*: $9y^3$

**Question 6**

1 or 2 marks were quite common for this question. A very common error was to round the answer to 72.3 which did not score both marks; candidates are advised that bounds should not be rounded. Other errors seen quite frequently were $8 \times 8 = 64$ then taking an “upper bound” of 64.5; using 8.05 instead of 8.5; using perimeter instead of area or very occasionally using the lower bound 7.5 instead of 8.5.

*Answer*: 72.25

**Question 7**

Most candidates achieved at least 1 mark with many scoring 2 for correctly finding $t < 4$. Sometimes they were then unable to find the integer values or wrongly included 0 as a positive integer. For those who didn't get 1 mark the biggest problem was making a sign error in the manipulation to reach $2 + 6 > 3t - t$. Many candidates took the more difficult route of $t - 3t > -6 - 2$; often they correctly reached $-2t > -8$ but then it was quite common for them to forget to reverse the inequality sign when dividing through by $-2$ or they lost one of the minus signs in this step resulting in $t > 4$ or $t > -4$. A significant number of candidates gained no marks because they set *t* on the left hand side to 0 and solved, followed by setting the *t* on the right hand side to 0 and solving that.

*Answer*: 1, 2, 3

**Question 8**

The majority of candidates scored full marks on this question. Of those who didn't score 3 marks, many scored 1 mark for a correct method with an arithmetic slip or for 2 values satisfying one of the equations. The most successful candidates solved this via the elimination method; occasionally the substitution method was seen and usually this was not as successful. Some chose to use matrices to solve with varying degrees of success, and arithmetic or sign errors were sometimes apparent when solving using this method.

*Answer*: $x = 9$, $y = 3.5$

**Question 9**

This was not particularly well answered, with many scoring 1 mark only. Most of these did correct work using a misplaced 52° (at the top of the triangle), effectively using an angle of depression of 38°. This led to the common incorrect answer of 384. The other common way of scoring 1 mark was to place 52° (or 38°) correctly on the diagram but to follow it with incorrect working. A sizeable number of candidates found the hypotenuse, giving a fairly common incorrect answer of 380.7. Most of the correct answers came from use of the straightforward $\frac{300}{\tan 52}$ or $300 \times \tan 38$. However quite a few used longer methods e.g. the sine rule or sine or cosine ratios followed by Pythagoras' theorem.

*Answer*: 234

**Question 10**

This question was one that proved to be a good discriminator with only the more able candidates achieving 3 marks. The correct answer is given by evaluating $53 \times \sqrt[3]{\frac{20}{30}}$ and the most successful candidates worked this out in one step on their calculators. Some candidates did this work in two or more stages. Frequently these candidates rounded their interim values and consequently lost the accuracy mark in this question due to this premature rounding. Candidates are advised to use the exact values in working and only round off the final answer to the required degree of accuracy. Many candidates did not realise that capacity is a cubic measure; instead they treated it as a linear measure and found their answer by $\frac{20}{30} \times 53$, using simple proportion. Consequently the most common answer was 35.3 and this was seen significantly more often than the correct answer. A few candidates realised that it wasn't a linear scale factor but incorrectly used the square root instead of the cube root.

*Answer*: 46.3

**Question 11**

Part **(a)** was generally well answered with most showing all correct construction arcs as well as the bisector. Some used the incorrect method of drawing arcs from points *B* and *C* which was seen fairly often. Candidates should be encouraged to use arcs with a sufficiently large radius for the drawing to be accurate. Sometimes the construction arcs were so close to point *A* that it caused the final line to be slightly inaccurate. Part **(b)** proved to be very challenging for the majority of candidates, many of whom could not answer with the appropriate language. It was also common to see no response to this question. The most common error was "equidistant from *B* and *C*." Others did not provide enough detail and simply wrote "equidistant" or "equal". Quite a few just described the meaning of angle bisector.

**Question 12**

Most candidates correctly answered part **(a)**. Occasionally $57 \times 2$ or $57 \times \frac{1}{2}$ were seen. In part **(b)** many candidates correctly found 36 and 21, often going on to gain 2 marks for correctly simplifying this. A small proportion of candidates gave the unsimplified ratio 36 : 21 as their answer or made occasional arithmetic errors cancelling the ratio. Some candidates were unclear how to give the simplified ratio, instead giving $n$ : 1, or less often 1 : $n$. A significant proportion of candidates found the 36 and 21 but then went on to divide both by 19 to get 1.9:1.1, sometimes with no working. It was also common to see the method:

| | | | |
|---|---|---|---|
| Ralf | $36 = \frac{x}{3} \times 57$ | Susie | $21 = \frac{x}{3} \times 57$ |
| | $x = \frac{108}{57} = 1.89$ | | $x = \frac{63}{57} = 1.11$ |

*Answer*: **(a)** 38 **(b)** 12 : 7

**Question 13**

Part **(a)** was answered well by the majority of the candidates. The remaining candidates were unsure how to answer this. Of the incorrect answers, the more common ones included $m(m^2 + m)$, $m(1^3 + 1)$ and $m^4$. Some candidates confused this with the difference of two squares and went on from the correct answer to $m(m + 1)(m – 1)$, or sometimes with $(m + 1)$ in the right hand bracket as well. In part **(b)**, again there were a good number of correct answers. There were a few who recognised the appropriate method but swapped the variables, so in effect gave the factors of $y^2 – 25$ and $(y – 5)(y + 5)$ was the most common incorrect answer quite often seen. Less able candidates struggled and offered a variety of incorrect responses including answers such as $25y^2$, $(y – 5)^2$ or $5^2 – y^2$. Part **(c)** was the best answered part of the question and many candidates who didn't score in one or both of the previous parts did score both marks here. The less able candidates did struggle but in the main, errors here were usually incorrect signs in the brackets. In some cases partial factorisation such as $x(x + 3) – 28$ was seen. A small number of candidates spoiled a correct answer by treating it as an equation equal to 0 and attempting to find solutions. This was more common in part **(c)** than the other parts.

*Answer*: **(a)** $m\left(m^2+1\right)$ **(b)** $(5-y)(5+y)$ **(c)** $(x-4)(x+7)$

**Question 14**

This was a well answered question with most candidates scoring 3 or 4 marks. Most cancelled down to the lowest terms but quite a few left the answer as an improper fraction, not a mixed number as asked. Consequently a final answer of $\frac{31}{24}$ was very common. Fewer candidates this year spoilt their answers by writing them as a decimal. The more able candidates used the method of re-writing the three fractions with a common denominator of 24; other candidates worked with equivalent denominators such as 48 and 96. Many worked in stages with $\frac{9}{12} + \frac{8}{12}$ commonly evaluated first. This was often followed by $\frac{136}{96} - \frac{12}{96}$ where candidates only knew how to find a common denominator by multiplying the two denominators together rather than finding the more efficient lowest common denominator.

*Answer*: $1\frac{7}{24}$

**Question 15**

This question proved to be challenging for candidates. In part **(a)(i)**, 4 was a common incorrect answer or values were listed i.e. 0, 2, 3, 4. Similarly in part **(a)(ii)**, 6 was a common incorrect answer along with 0, 1, 2, (2), 3, 4. In part **(b)** it was common to see either the numerator or denominator correct but less common for both to be correct e.g. $\frac{5}{22}$ and $\frac{8}{14}$ were common incorrect answers. In part **(c)** the candidates who struggled in parts **(a)** and **(b)** sometimes managed to score here. Common errors included shading $F \cup R$ or $F \cup R \cup M'$ or including the outside region with the correct region.

*Answer*: **(a)(i)** 9 **(a)(ii)** 12 **(b)** $\frac{5}{14}$

**Question 16**

This question was one of the least well answered questions on the paper. In part **(a)** common errors were to add the two given vectors or to subtract in the wrong order. A significant number of candidates multiplied corresponding elements to obtain $\begin{pmatrix}-10\\18\end{pmatrix}$. A small number gained a mark for writing $\overrightarrow{CB}+\overrightarrow{BA}$ but this stage was commonly missed out. Part **(b)** was less well answered than part **(a)** although there were still quite a few correct answers. The most common error was $-5^2$ instead of $(-5)^2$ leading to $\sqrt{11} = 3.32$, which was frequently seen. Also seen was $\sqrt{x^2-y^2}$ instead of $\sqrt{x^2+y^2}$ . It was also common to see an answer given to 2 significant figures (the instruction on the front of the question paper is to give answers to 3 significant figures). There were a number of candidates who seemed unaware of what the question was asking, with a significant proportion leaving the answer space completely blank. Some confused the notation with determinant of a matrix.

*Answer*: **(a)** $\begin{pmatrix}-7\\3\end{pmatrix}$ **(b)** 7.81

**Question 17**

This was answered correctly by a good proportion of candidates. Many scored 5 marks and a significant proportion achieved 4 marks because they missed the instruction in the question to round the answer to the nearest cm$^2$. The full range of marks were awarded in this question with a lot of opportunities for part marks to be awarded to those showing clear method. The most able candidates evaluated it all in one step using $\frac{125}{360}\pi\times48^2-\frac{125}{360}\pi\times40^2+32\times8$ . Some candidates used $\frac{125}{360}\pi\left[48^2-40^2\right]+32\times8$ (usually in stages) but a common error was to evaluate $48^2 - 40^2$ to be $8^2$ instead of 704. Another common error was adding i.e. $\frac{125}{360}\times\pi\times48^2+\frac{125}{360}\times\pi\times40^2+256$ . Some used $\frac{1}{2}$ or $\frac{1}{4}$ or $\frac{125}{180}$ instead of $\frac{125}{360}$ as their fractions in the formula. Some used the formula $\theta\frac{r^2}{2}$ to find the area of a sector. Common errors here were to take $\theta$ as 125, instead of using the radian equivalent or to use the rounded value $\theta = 2.18$ instead of the exact value leading to an inaccurate answer. The area of the rectangle was sometimes not included in the answer. Some candidates used formulas for arc length instead of area or omitted to square the radius in the area formula. Candidates should be encouraged to follow the instruction on the front of the question paper to use the value of $\pi$ on the calculator or 3.142 rather than other approximate values like $\frac{22}{7}$ and 3.14. Some less able candidates evaluated areas of triangles instead of sectors using e.g. ½ $ab\sin C$ or ½ base×height or found the answer to $\frac{125}{360}\pi\times48^2$ or $\frac{125}{360}\pi\times40^2$ then multiplied by 8. A few used the formula for the area of a circle instead of for a sector. It was also common to see $\frac{125}{360}\pi\times48^2-\frac{125}{360}\pi\times40^2+32\times8$ with the larger or smaller sector then added back on. A small minority of candidates were confused by the instruction in the question to give the answer correct to the nearest square centimetre and did the entire question as if it was a bounds question using 48.5 or 47.5 and 40.5 or 39.5 in place of 48 and 40.

*Answer*: 1024

**Question 18**

This question as a whole was found to be challenging by the less able candidates. Many were able to score at least 1 mark in part **(a)** for stating that it was an enlargement. There were a significant number of correct responses scoring 3 marks but the most common mark scored was 2, usually for enlargement and the correct centre of enlargement and an incorrect scale factor. The most common incorrect scale factors were 2, –2 and –½. Some incorrectly gave the co-ordinates of the centre of enlargement as a column vector. In part **(b)** there was again a mixed response, with more able candidates generally giving the correct image. Some of these showed supporting working but most didn't or didn't use the method of multiplying matrices. Where candidates attempted some working, they often had the matrices the wrong way round or thought that the matrix represented a reflection in the *y*-axis or a rotation 90 ° clockwise about the origin.

*Answer*: **(a)** Enlargement, scale factor ½, centre ( –1 , 3 )

**Question 19**

Part **(a)** was very well answered with many candidates who did not get 2 marks often scoring 1 for either correctly identifying the determinant or the adjoint matrix. The most common error in the calculation of the determinant was –8 – 15 = –23. With the adoint matrix the main errors were in the arrangement of the answer; those seen most often were $\begin{pmatrix} -2 & 3 \\ -5 & 4 \end{pmatrix}$ and $\begin{pmatrix} 4 & 5 \\ -3 & -2 \end{pmatrix}$. Candidates are advised that it is more sensible to leave the reciprocal of the determinant outside the matrix rather than taking it inside, particularly using the inexact decimal answers as these were often not correct to three significant figures. Part **(b)** was not as well answered as part **(a)** and led to a wide range of different responses. While most candidates seemed to realise that the determinant should equal 0, many candidates set theirs equal to 1 at the start and were then unable to obtain any method marks. For those correctly identifying the determinant should be equal to 0, a number made arithmetic or algebraic errors, such as not multiplying the –12 by *w* leading to $w^2 - 12 + 36 = 0$, or making an error with the signs, leading to $w^2 - 12w - 36 = 0$. Candidates who reached $w^2 - 12w + 36 = 0$ generally followed this through to the correct answer. However a number gained only 2 method marks because they incorrectly factorised to $(w - 6)(w + 6)$. A number of candidates also attempted trial and error, with varying degrees of success.

*Answer*: **(a)** $\frac{1}{7}\begin{pmatrix} -4 & 3 \\ -5 & 2 \end{pmatrix}$ **(b)** 6

**Question 20**

Part **(a)** was answered very well with hardly any incorrect answers seen; a very small number of candidates reversed the co-ordinates writing (1, 7). In part **(b)** many candidates gave a fully correct answer. Some correctly found rise / run but did not appreciate the gradient was negative, and $\frac{5}{4}$ or 1.25 were the most common incorrect answers. For those candidates who didn't score full marks, they were often aware of how to find the gradient but made an arithmetic error. A significant number of candidates found the difference in the *x*'s divided by the difference in the *y*'s. In a very few cases attempts were made to find the distance *AB* or the midpoint of *AB*. Part **(c)** was the most challenging part of this question. The main problem seemed to be to use the gradient of a line parallel to *AB* instead of perpendicular, with $y = -\frac{5}{4}x + 2$ being the most common incorrect answer. Some realised the gradient needed to change sign or that they needed the reciprocal of the gradient in part **(b)** but many did not do both. More able candidates realised that the line passing through the point (0, 2) meant the answer had to be in the form $y = mx + 2$. However some used substitution and a lot more working to reach the same point.

*Answer*: **(a)** (7 , 1) **(b)** –1.25 **(c)** $y = \frac{4}{5}x + 2$

# MATHEMATICS

**Paper 0580/23**
**Paper 2 (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 and variety 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 most parts of the last few questions.

Candidates showed some particularly good number work in questions **4**, **5**, **7**, **10** and **11**; a good understanding of algebraic expressions in questions **1** and **2** and a sound geometrical knowledge throughout the paper.

Candidates struggled with finding the perpendicular line in question **17**, drawing and finding the gradient from a tangent in question **19,** shading the Venn diagram in question **20,** calculating the heights in a histogram in question **22** and describing regions with inequalities in question **24**.

Candidates were generally good at showing workings and the algebraic fraction simplification in question **23** was well set out.

## Comments on Specific Questions

### Question 1

Almost all candidates gave the correct value of 36. A small number of candidates gave an answer of 144 from $(4 \times 3)^2$.

*Answer*: 36

### Question 2

Almost all candidates simplified the indices correctly. A few gave answers of $n^{10}$ or $2n^7$.

*Answer*: $n^7$

### Question 3

The majority of candidates chose the correct quadrilateral. The most popular incorrect choice was *D*, perhaps because the lengths of the sides looked similar.

*Answer*: *B*

**Question 4**

The vast majority of candidates were able to write both large and small numbers in standard form correctly. There were some responses of $247 \times 10^4$ and $24.7 \times 10^5$ in part **(a)**. In part **(b)** the negative was occasionally missing or $7.9 \div 10^3$ was given.

*Answer*: **(a)** $2.47 \times 10^6$ **(b)** $7.9 \times 10^{-3}$

**Question 5**

Candidates demonstrated a proficient understanding of dealing with fractions. The vast majority gained both marks by showing their working and giving the correct answer.

*Answer*: $\frac{23}{30}$

**Question 6**

This question proved challenging for a reasonable number of candidates. Whilst there were a good number of correct answers, it was also common to see the incorrect answer of Friday, as the candidate had identified that the total mass of cats on Friday was 4 kg. There were a small number of candidates who showed correct total masses for each of the days, but made an incorrect conclusion. Many gave their conclusion (whether correct or not) without showing any working which meant that they scored 0 marks for an incorrect answer.

*Answer*: Thursday

**Question 7**

The vast majority of candidates converted the values to decimals and placed them in the correct order. There were a very small number who converted correctly and then placed in the incorrect order.

*Answer*: $0.4^2$, $0.6^3$, 0.22, $\sqrt{0.09}$

**Question 8**

The majority of candidates were able to identify the correct bounds. There were some who had identified correct bounds, but reversed them in the answer space and so gained 1 of the 2 marks. Candidates should be reminded to read the question and the answer space carefully. Common incorrect answers were 4.3 and 4.1 or giving 4.24 or 4.249 as the upper bound. There was also a small minority who gave the bounds using inequality notation which was not correct given the way that this question was presented.

*Answer*: 4.25 and 4.15

**Question 9**

The vast majority of candidates identified the correct part of the line in part **(a)**. Part **(b)** presented more of a challenge for a significant number of candidates. Many drew a straight line with a positive gradient but were inaccurate by 1 square. A few had the correct gradient but continued to the edge of the grid. Many candidates confused speed with distance and drew a horizontal line to represent constant speed. Others started with a vertical line down to a distance of 20 and then continued horizontally.

*Answer*: **(a)** *A*

**Question 10**

Candidates demonstrated proficient calculator skills in this question. There were a high percentage of fully correct answers given to both parts of the question. Where candidates did not reach correct answers, it was generally possible to attribute this to incorrect inputting of the numbers into the calculator, for example in part **(a)**, $2^3 - \sqrt{10} + 4^2 =$ 20.8 and in part **(b)**, $\frac{2}{3}\sqrt{3\tan 70} = 1.91$. Candidates should check that their calculator is in the correct mode as answers were occasionally given in radians or gradians. There were a small number who rounded their answer to part **(b)** to 3.2 without showing a more accurate value and therefore could not be awarded the mark.

*Answer:* **(a)** 2.9 **(b)** 3.17

**Question 11**

The majority of candidates interpreted the question correctly and arrived at the correct answer. For those who were not successful, multiplication by 0.4 and/or 0.1 often explained an incorrect answer. Some candidates used division incorrectly, particularly after correctly calculating 20 400 which they then followed by dividing by 1.1. The use of multiplying by 0.5 was also seen, either for the whole amount or after correctly calculating 20 400. Candidates should be encouraged to use the most efficient methods of calculation, in this case multiplying by 0.6 and 0.9 rather than 0.4 and 0.1 and carrying out each subtraction.

*Answer*: 18 360

**Question 12**

There were a good number of fully correct responses to this question. Where full marks were not awarded it was common to award 1 mark for correct use of the formula for volume of the sphere. Incorrect answers that could not gain credit were predominantly those where the diameter was used in place of the radius in calculating either the volume of the whole sphere or of the hemisphere. A minority of candidates worked with radius squared rather than radius cubed, despite the formula being provided.

*Answer*: 32.7

**Question 13**

This conversion of a recurring decimal to a fraction was carried out correctly by the majority of candidates. Common incorrect answers were $\frac{2}{10}$ or $\frac{1}{5}$ and $\frac{222}{1000}$ or $\frac{111}{500}$.

*Answer*: $\frac{2}{9}$

**Question 14**

In part **(a)** of this question, candidates were required to find the perimeter of a compound shape made up of a square and a rhombus. The majority of candidates were able to correctly identify that all of the sides of the shape would be equal and therefore could find the perimeter. Where candidates did not recognise that the sides were the same length, it was common to see an answer of 29 cm where it was incorrectly assumed that two of the sides had length 4.5 cm (the perpendicular distance across the rhombus). In part **(b)**, candidates were required to find the area of the compound shape. There were a good number of fully correct answers. Common incorrect answers came from incorrectly finding the area of the rhombus ($4.5 \times 4.5$ rather than $4.5 \times 5$) or from finding the correct area for the square and doubling. Some candidates attempted to find the area of the rhombus by splitting it into a square and 2 triangles and this method often led to an incorrect length being used or an area being missed out.

*Answer:* **(a)** 30 **(b)** 47.5

**Question 15**

Part **(a)** caused very few problems to candidates. Part **(b)** was very well attempted with the most successful candidates employing the most efficient method of $360 \div 40$. Many candidates used the more inefficient method of finding the interior angle and setting up the formula $\frac{180(n-2)}{n} = 140$ which was often successfully solved but more time-consuming. This method resulted in a number of errors, most commonly confusing the interior and exterior angle (i.e. equating to 40 rather than 140) and omitting to divide by $n$ (i.e. 180 ($n$ – 2) = 140 leading to the impossible answer of 2.77…).

*Answer:* **(a)** 68 **(b)** 9

**Question 16**

There were many correct answers to this question and the majority of candidates gained at least 1 mark. The most successful candidates set up a correct proportionality equation and used the given values to find the constant. Some struggled with the substitution and rearrangement following a correct equation, and a common error following a correct equation was to substitute 7 rather than use $(7+1)^2$. Where candidates didn't score any marks, it was generally because they were using direct proportion and not squaring or direct proportion with squaring.

*Answer*: 1.25

**Question 17**

This proved to be one of the most challenging questions on the paper and only the most able candidates gained all 3 marks. Many candidates were able to gain a mark by finding the gradient of $-\frac{1}{2}$ from the given points although this posed many problems, with gradients seen inverted, or incorrect pairs of values used. Some drew a grid which is always a good starting point to understand a question like this, but candidates must remember that only calculations will give accurate values. The majority of candidates did not know how to continue from this point and many gave an answer of $y = -\frac{1}{2}x$ or worked out the equation of line $AB$, $y = -\frac{1}{2}x + 7$. Many candidates attempted to deal with the perpendicular gradient but more often than not this resulted in final answers involving $y = \frac{1}{2}x$ or $y = -2x$. Many candidates gave an answer of $y = kx$ to gain a mark for understanding that the line would have no intercept on the $y$-axis. The word perpendicular led many down the path of finding the midpoint of line $AB$, some progressing no further than this.

*Answer*: $y = 2x$

**Question 18**

The vast majority of candidates were able to correctly substitute –5 into f(x) in part **(a)**. There were a significant number of candidates who incorrectly gave the answer –25, having dealt incorrectly with squaring a negative number and a few gave f(25) or f(–25). There were a good number of fully correct answers given to part **(b)** of the question. Where incorrect answers were seen these included $\frac{x^3-3}{2}$, $\frac{x^3-3x}{2}$, $\frac{x^3-3x^2}{2}$ and many instances where fg(x) had been found rather than gf(x). There were also those who thought that the answer had to be numerical and so came up with a value, sometimes following a correct function. Part **(c)** of the question caused the most challenges for candidates and there were many blank answer spaces. Although there were many who gave a fully correct answer, it was common to award 1 or 0 marks. There were a good number of candidates who gained 1 mark for a correct first step, commonly $x=\frac{y-3}{2}$ or $2y=x-3$ (often leaving the answer as $2y+3$). Common incorrect answers were $2(x+3)$ and $\frac{2}{x-3}$.

*Answer*: **(a)** 25 **(b)** $\frac{x^2-3}{2}$ **(c)** $2x+3$

**Question 19**

This question proved a challenge for many and it was clear that a significant proportion of candidates did not understand the meaning of drawing a tangent. However, the majority of candidates did know how to draw a tangent and made a good attempt. It should be understood that any gap between the curve and the tangent is unacceptable. The most common incorrect line drawn was $x = 1$ and other lines through (1, 0) or (1, –1) were often seen. The majority of marks were lost because candidates did not pay attention to the scales on the graph and simply counted squares to calculate the gradient. The majority of candidates interpreted part **(b)** correctly and gave the correct point. There was a high rate of nil responses to this question indicating a significant number who could not interpret the question. Popular incorrect points given were (–3.25, 0), (–1, 0), (0, –1), (–2, 0) and (–3, 3).

*Answer:* **(a)** $2.1 \leqslant$ grad $\leqslant 3.9$ **(b)** $(-2, 8)$

**Question 20**

Part **(a)** of this question involved putting the elements of the given set into the correct place on the Venn diagram. There were a reasonable number of fully correct responses to this; however it was more common to award 1 mark for three of the elements in the correct place. 7, $\pi$ and $2\sqrt{8}$ were most frequently placed correctly, with $\frac{5}{9}$ and 9.3 commonly both placed in set *A* or 9.3 in *A* and $\frac{5}{9}$ in *B*. In part **(b)** candidates were required to shade the region of the Venn diagrams indicated by the notation. A common error in the first Venn diagram was to omit the intersection. The second diagram was more likely to be correct than the first.

**Question 21**

The majority of candidates appreciated the need to use the $\frac{1}{2}ab\sin C$ formula and applied it correctly in both parts of the question. In part **(a)** there were many candidates who treated the triangle as right-angled and simply calculated $\frac{1}{2} \times 6.2 \times 4.7$ or calculated the length $AC$ using right-angled triangle trigonometry or Pythagoras' theorem. Part **(b)** proved more of a challenge than part **(a)** but it was still the majority who gained at least 1 mark in this part. Some candidates substituted values into the formula correctly but then made errors in the rearrangement. There was evidence of some inefficient methods such as finding the height of the triangle and then splitting it into 2 right-angled triangles. This method was often incorrect due to the assumption of an isosceles triangle and halving the base of 107. The cosine rule was often quoted in this part. Part **(b)** showed a fairly high rate of nil responses.

*Answer*: **(a)** 14.4 **(b)** 30.7

**Question 22**

This was one of the least understood questions on the paper and only the most able candidates tended to gain any marks. The most common response by far was to give 4, 7 and 3 as answers, following the 60 and 6 given in the table, taking no account of the class widths. Some candidates calculated frequency densities but took no account of the proportionality involved.

*Answer*: 1, 3.5, 1

**Question 23**

This simplification was dealt with proficiently by the majority of candidates and was well set out so that method marks could be awarded. The factorisation of both, or one of $7n(6p - 1)$ and $2t(6p - 1) + 3m(6p - 1)$ was achieved by the majority of candidates, although not all were able to make any further progress from this point and so 2 marks was common. The major challenge stemmed from the cancellation of $6p - 1$. Quite often the $6p - 1$ in the numerator was cancelled with only one bracket in the denominator, leaving a final answer $\frac{7n}{2t(6p-1)+3m}$ or $\frac{7n}{2t+3m(6p-1)}$. Those who were able to fully factorise the denominator into $(2t + 3m)(6p - 1)$ usually went on to achieve full marks.

*Answer*: $\frac{7n}{2t+3m}$

**Question 24**

Many candidates struggled with all or parts of this question and a full range of marks was awarded. Where fully correct answers were not given then there were a reasonable number of candidates who could correctly identify the lines on the diagram, but struggled with identifying the appropriate inequalities signs. Less able candidates could not identify $y = -\frac{3}{5}x + 6$ (the gradient was often $\frac{3}{5}$ or $\frac{5}{3}$), but were able to recognise $y = x$ and/or $x = 2$ and so gained some credit. There was some incorrect use of 10 and 6 such as $6y > 10x$, $y > 6$ and $x < 10$. There were a minority of candidates who used completely incorrect notation, for example $R > y > x$ or $x > x = 2$ and did not gain credit. Some candidates did not appreciate the form that their answers should give and gave co-ordinates or vague descriptions.

*Answer*: $y \leqslant -\frac{3}{5}x + 6$, $x \geqslant 2$, $y > x$

**Question 25**

The majority of candidates selected the correct combination in part **(a)**. The most common incorrect answer was **AD**. A good understanding of the rules of matrices was demonstrated in parts **(b)** and **(c)** with the majority scoring at least 1 mark in each part. There were some arithmetic slips in both parts but 1 mark could still be gained in this case. In part **(b)** a common incorrect answer was formulated from multiplying corresponding numbers in the matrices. Another matrix commonly seen was $\begin{pmatrix} 44 & 4 \\ 22 & 2 \end{pmatrix}$ from $\begin{pmatrix} 28+16 & -6+10 \\ 14+8 & -3+5 \end{pmatrix}$. In part **(c)** it was more common to give credit for seeing $\begin{pmatrix} 5 & 3 \\ -4 & 7 \end{pmatrix}$ than for finding the determinant if full marks were not scored. There were some arithmetic errors made in finding the determinant, most commonly giving 23 (from $35 - 12$). The arithmetic slip of $7 \times 5 = 30$ was also common. Many candidates gained the mark in part **(d)** although there was a fairly high nil response rate. The most common explanation was that the determinant is zero although there were other acceptable answers such as $4 \times 1 - 2 \times 2 = 0$. Common incorrect responses contained statements such as ‘no negatives’, ‘there are 2 of the same number in the diagonals’ and ‘it doesn’t have a determinant’.

*Answer*: **(a) CB (b)** $\begin{pmatrix} 36 & -2 \\ 18 & -1 \end{pmatrix}$ **(c)** $\frac{1}{47}\begin{pmatrix} 5 & 3 \\ -4 & 7 \end{pmatrix}$ **(d)** the determinant is zero

# MATHEMATICS

**Paper 0580/31**
**Paper 31 (Core)**

## Key messages

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

## General comments

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. Most candidates were able to complete the paper in the allotted time. Few candidates omitted part or whole questions. Most candidates showed their workings and gained method marks. However many method marks were lost because some candidates did not write down their working.

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.

## Comments on specific questions

### Question 1

**(a) (i)** The majority of candidates found the correct time of arrival. Candidates however often lost a mark for not presenting their answer in a correct format. 1700 and 5pm were acceptable correct answers but many candidates wrote 05.00, 5.00, 17 00pm which all have errors and therefore scored only one of the two available marks. Less able candidates often gave answers such as 16 60 or 21 60 from adding times as decimal values.

**(ii)** This part was attempted by all candidates with the vast majority gaining full marks. Few candidates divided by the exchange rate instead of multiplying.

**(b) (i)** Candidates showed good understanding of calculating $\frac{2}{3}$ of 660 and the answer of 440 was seen widely. However a significant number of candidates gave this as their final answer indicating that they had not read the question fully and therefore not given the total cost of all the tickets.

**(ii)** Candidates found the upper and lower bounds of a value challenging. Successful candidates showed an understanding of adding and subtracting 0.5 m. However often the lower bound was found but the upper bound was given as 105.4. Few candidates gave the correct answers in the wrong order. This question was not attempted by many less able candidates.

**(c) (i)** Candidates were very successful at completing the table. Few errors were seen with the most being in the percentage of time column. The vast majority of candidates understood the need for angles to add to 360° and correctly found the missing angle.

**(ii)** Candidates showed good use of a protractor with most candidates correctly drawing an angle of 72° or 108°. Very few candidates did not use a ruler and most candidates used a pencil.

*Answers*: **(a)(i)** 1700 **(ii)** 15575 **(b)(i)** 2200 **(ii)** 104, 105.5 **(c)(i)** 30, 20, 72

**Question 2**

**(a) (i)** Few candidates found the median instead of the mean. Good solutions often contained the five values added and the total before dividing by 5. Many candidates however showed no working.

**(ii)** Candidates found finding the range of the values more challenging than the mean. Many answers of 35 were seen from subtracting the first and last figure instead of the largest and smallest.

**(b)** The majority of candidates correctly found the probability. Most candidates went on to simplify the fraction $\frac{1800}{5000}$ successfully but some made errors; they were not penalised for this if they had already given the correct fraction before simplifying. All varieties of possible answers were seen (0.36 and 36%).

**(c)** Finding the missing probability in the table proved to be the most challenging part of this question. Many less able candidates did not attempt it. Common incorrect answers were 0.85 (candidates did not subtract from 1), 4.15 (candidates subtracted from 5) and 0.17 (candidates divided 0.85 by 5).

**(d)** Candidates showed that they were confident with working with money in this question. Good solutions showed all parts of the working out. Errors occurred when candidates did not interpret the question correctly. The most common error was 42.5 ($8.50 \times 5$).

**(e)** The scale caused most difficulty when constructing the bar chart. Good solutions used a simple scale of 1 square equal to 10 drinks sold. Candidates who used this scale generally completed the bar chart correctly. A common error was not starting the scale at 0. This meant that the scale was not linear. Candidates generally drew bars of equal widths and gaps.

*Answers*: **(a)(i)** 94 **(ii)** 115 **(b)** $\frac{1800}{5000}$ **(c)** [0].15 **(d)** 39.5[0]

**Question 3**

**(a) (i)** All candidates attempted to give a multiple of 7 and this proved to be the most successful question of the whole paper. Very few incorrect answers were seen, with 144 the most common of these.

**(ii)** Most candidates showed they understood the term ‘cube’ and gave the correct answer. The most common incorrect answer was 6, from $2 \times 3$.

**(iii)** Candidates were equally successful at identifying 11 as the prime number from the list. Very few candidates did not attempt this part, with 63 the most common incorrect answer.

**(iv)** More candidates found finding the LCM challenging. Many candidates gave 288 as their answer from $16 \times 18$. The most successful solutions came from candidates listing the multiples of 16 and 18 and identifying 144 as being common in both lists. Other candidates used factor trees or product of prime factors to find the correct answer.

**(b)** Explaining why the square of 4.86 must be between 16 and 25 proved very challenging for all candidates. Good answers showed their understanding by stating that $4^2 = 16$ and $5^2 = 25$ and because 4.86 is between 4 and 5 then $4.86^2$ must be between 16 and 25. Often candidates gave one of these but did not give both. This question was not attempted by a large number of candidates.

**(c) (i)** All candidates made an attempt at all three parts of **(c)**. Candidates were most successful at finding $4^7$. It was evident that candidates had a good understanding of how to use their calculator and could enter indices correctly.

**(ii)** This question was also well answered with the vast majority of candidates gaining full marks. The common incorrect answers were 12 and 0.

**(iii)** Candidates continued to show good use of their calculators in this part. Most candidates gave the correct answer to at least 3 significant figures.

**(d)** A wide range of methods were used successfully to write 90 as the product of its prime factors. The most common and successful was using a table or tree to find the prime factors and then give the answer as a product of these factors. Often correct tables and trees were seen but then answers were not given as a product; the most common was lists, e.g. 2,3,3,5. Candidates who did not use a tree or table often did not gain full marks but scored one mark for a correct product that equalled 90. The inclusion of 1 was seen often, in either a list of factors, a product of factors or in a table or tree. Candidates should be reminded that 1 is not a prime number.

*Answers*: **(a)(i)** 63 **(ii)** 8 **(iii)** 11 **(iv)** 144 **(b)** $4^2 = 16$ and $5^2 = 25$ **(c)(i)** 16384 **(ii)** 1 **(iii)** 74.1
**(d)** $2 \times 3^2 \times 5$ or $2 \times 3 \times 3 \times 5$

**Question 4**

**(a)** Candidates who attempted this question using the formula for the area of a trapezium were less successful than those that simply counted the squares. Often the formula was quoted incorrectly or incorrectly used. The most common error was multiplying the parallel sides rather than adding. Candidates were more successful giving the correct units for their answer ($cm^2$). However many candidates did not give any units.

**(b) (i)** Good answers contained all three parts to describe a rotation, including angle and centre of rotation. The most common error was to omit the centre of rotation. Less able candidates correctly identified the transformation as rotation but did not include the centre or gave the correct direction without the required angle. Few candidates gave the other acceptable answer of 270° clockwise.

**(ii)** Most candidates successfully translated the trapezium. Diagrams were generally well drawn, although most were without a ruler. Candidates should be reminded to always draw diagrams with a pencil as mistakes made in pen are difficult to correct and often led to answers which were particularly difficult to assess as corners of the shape were difficult to see.

**(iii)** Enlarging the trapezium by a scale factor of 0.5 was challenging for all candidates with only the most able candidates completing the question correctly. Many candidates did not attempt this part of the question and those that did often used a scale factor of 2 instead of 0.5. Candidates showed some understanding of enlargement by drawing rays from (0, 0) to each corner of the shape; however most then were unable to draw the image in the correct position or went no further.

*Answers*: **(a)** 3 $cm^2$ **(b)(i)** Rotation, 90° [anticlockwise], [centre] (0,0)

**Question 5**

**(a) (i)** Successful candidates were able to find the value half way between 15 and 20. This caused some problems for many candidates however with common incorrect answers of 15.5, 17 and 18 seen often.

**(ii)** This 'explain' question was answered well. The majority of candidates used words that showed they understood that Gianna had stopped moving at this time. Some candidates confused a horizontal line with a straight line and indicated that she was travelling at a constant speed.

**(iii)** Most candidates were able to quote the correct formula for calculating speed. However, few candidates identified the journey time to be 2 hours. Many candidates removed the 20 minutes time she was stationary and divided by 1 hour 40 mins (1.666….). This was an incorrect method as the question asked for her average speed. The most common error was dividing by 09 00, the time of day she arrived at work.

**(b)** Candidates showed good understanding of ratio in this question. Good solutions showed all workings and a separate calculation for bills, leisure and other. Candidates scored highly on this question with few candidates only getting 1 or 2 values correct. The most common error saw candidates divide 1320 by the values in the ratio.

**(c)** Compound interest proved to be a challenging topic for many candidates. A number of fully correct solutions were seen where candidates had calculated the amount at the end of each of the three years. Many candidates quoted the formula and substituted correctly but made errors in using their calculator or adding 1 + 2.1/100. This led to incorrect answers which candidates then rounded to 2 decimal places. To gain a method mark for correctly rounding, candidates had to show their answer to more than 2 decimal places and then their final answer rounded correctly to 2 decimal places. Most candidates rounded their answer straight from the calculator without showing a more accurate answer. When their answer was correct this still gained full marks, but when incorrect it meant candidates missed out on a potential mark for correct rounding. Candidates should be encouraged to always show the full calculated answer and then show their rounded answer. Less able candidates often calculated simple interest instead of compound interest which gained no marks.

*Answers*: **(a)(i)** 17.5 **(ii)** she stopped **(iii)** 8.75 **(b)** 660, 275, 385 **(c)** 5321.66

**Question 6**

**(a) (i)** This was very well answered with the correct answer given by the vast majority of candidates. Some attempted the *n*th term and gave $7n + 11$ or $n + 7$. Although the former is the correct *n*th term it does not answer the question.

**(ii)** Candidates who clearly used the rule in part **(a)(i)** found explaining it more challenging. Many of the responses described what they did without using specific quantities, e.g. 'I subtracted the terms and found the difference' or 'I added on the difference'. Again many specified $7n + 11$ or $n + 7$ which gained no marks. The simplest correct answer was "+7" or its equivalent, which many candidates did successfully.

**(b)** More able candidates correctly calculated the first three terms of the sequence. However many candidates found this question challenging and a wide variety of incorrect responses were seen. Many candidates correctly identified the first term but then used this to find the second and then again used the second term to find the third, e.g. 4, 19 ($4^2 + 3$), 364 ($19^2 + 3$). The *n*th term was also used as the answer; $n^2 + 1$, $n^2 + 2$, $n^2 + 3$ was seen, as was 3, 6, 9.

**(c) (i)** The majority of candidates gained at least 1 mark, with many scoring full marks. Candidates were more successful simplifying the $a$ terms to $2a$. The $h$ term was often simplified to $13h$ or $+3h$.

**(ii)** Again, most candidates scored at least 1 mark. The majority correctly expanded the brackets, although collecting like terms proved more challenging. $13x$ was found more often than the $-9$ term. One mark was often gained from $5x + 15$. Common incorrect answers seen were $13x \pm 19$, $13x + 9$ and $13x - 39$.

**(d)** Many candidates correctly factorised but a large number did not know that factorising meant the need to use brackets. There was a wide variety of incorrect responses including $3(2g + 15)$, $6(g + 2.5)$, $(2g + 5)$ and $21g$.

**(e)** Many able candidates recognised the need to form a linear equation using the formula for the area of a rectangle and most then went on to solve successfully and obtain the correct answer.

Many less able candidates did not progress beyond $\frac{85}{5}$ or $85 - 30$ and scored 1 mark.

Many correct answers were given without the need of an equation and were often seen embedded: $(11 + 6) \times 5 = 85$, answer 11, which gained full marks. Common incorrect methods seen were $(x + 6) + 5$ $(= 85)$ with the answer of 74 and $x + 6 \times 5$ (i.e. no brackets) with $x = 55$.

*Answers*: **(a)(i)** 46 **(ii)** add 7 **(b)** 4, 7, 12 **(c)(i)** $2a - 3h$ **(ii)** $13x - 9$ **(d)** $3(2g + 5)$ **(e)** 11

**Question 7**

**(a)** The best solutions showed a correct calculation of the gradient using either two co-ordinates and the formula or forming a triangle on the diagram (this approach was rarely seen). Many candidates found the $y$-intercept correctly. However only the most able candidates identified that the gradient was –5. Common errors when calculating the gradient were to quote the formula inverted or to not take into account that the line sloped down and giving the gradient as 5 not –5. Often, 1.2 was given as the gradient from the $x$-axis intercept. Many incorrect attempts were seen including $1.2x + 6$, $5x + 6$, $1.2 + 6$, $1.4 + 6$ and 6.

**(b) (i)** Identifying the missing values in the table was well answered by the majority of candidates. Most candidates correctly identified the $y$ co-ordinate when $x = 2$. However a common incorrect answer was $y = 1$ when $x = -1$.

**(ii)** There was good plotting of points. Very few straight lines joining points were seen and even fewer thick or feathered curves drawn.

**(c)** Candidates found identifying the $x$ co-ordinate of the point of intersection challenging. Many candidates misinterpreted the question and gave the full co-ordinates. Less able candidates often gave the $y$ co-ordinate only or misread the scale and gave a value of 0.5. This question was not answered by a large proportion of the candidates.

*Answers*: **(a)** $-5x + 6$ **(b)(i)** 3, 12 **(c)** 0.2 to 0.35

**Question 8**

**(a) (i)** More able candidates drew clear and accurate nets, usually with a ruler and pencil. However the most common response seen was to draw the 2 by 3 faces as 3 by 3 and/or the 2 by 6 faces as 3 by 6. A common omission was the 3 by 4 ‘top’ thereby giving the net for an open-top box and not the full cuboid. There were also many 3D drawings and a significant number of blank responses.

**(ii)** The majority of candidates correctly calculated the volume of the cuboid, with the best solutions quoting the formula for the volume of a cuboid or providing evidence of their calculations. Several attempts at the surface area were seen.

**(b)** Identifying the name of the shape was attempted by nearly all candidates with the majority identifying it correctly. Some common incorrect answers were pentagon, octagon, polygon and heptagon.

**(c)** Many candidates did not identify an obtuse angle but most commonly marked an acute angle instead. The majority of candidates made an attempt at this question although only about half of all candidates got it correct. Other common errors were to mark an external angle or to draw an internal line and split the shape into an obtuse and acute-angled triangle. A small number of candidates extended one of the sides and then correctly marked an obtuse angle. This gained no marks as the question asked candidates to mark an obtuse angle on the diagram given.

**(d)** Only the most able candidates gained full marks and the best solutions were found using the method of $\frac{360}{22.5}$. The most common error was to use 180 instead of 360 in this method.

**(e) (i)** This was well answered by the more able candidates with those who recognised the need to use Pythagoras' theorem generally scoring 2 marks. The most common omission was the subtraction, and some used 6 instead of 12. $\pi$ was seen sometimes because of the semicircle. Trigonometry was used by a few candidates, of which only a small number were able to give a complete and correct solution. Few candidates used 16 to obtain the side of length 12 and then go on to show $x = 16$ (circular argument).

**(ii)** Most candidates who attempted the question showed evidence that they understood the method of finding two separate areas and then needed to add. However candidates often made errors in calculating each separate area. The most common error was in calculating the area of the semi-circle; candidates often omitted to halve. However most candidates quoted and used the correct formula for the area of a circle, and the vast majority of candidates used the correct value for $\pi$. Less able candidates often showed the correct method but calculated the area of the triangle incorrectly, often using the sides 20 and 16 instead of 16 and 12.

*Answers*: **(a)(ii)** 36 **(b)** Hexagon **(d)** 16 **(e)(ii)** 153

**Question 9**

**(a)** This was well answered, although many struggled with where to put the zeros. Some candidates' answers contained large gaps in the middle of the number and it was not clear if they were giving one answer or two separate figures. Most candidates showed consistent use of commas and points but a sizeable minority used them haphazardly throughout the paper. When this occurs, answers become ambiguous and examiners are asked to look through the paper to see previous answers to assess consistent use and identify which convention the candidate has chosen to use. Candidates need to be encouraged to use one convention only, consistently, throughout the paper.

**(b)** Many candidates showed evidence of understanding standard form. Common incorrect answers were $10.3 \times 10^4$ and $103 \times 10^3$. Some less able candidates wrote the value in words.

**(c) (i)** Candidates were more successful at converting values from standard form to ordinary numbers. Again some inconsistent use of commas and points were seen in this question which led to ambiguous answers, e.g. 46.100 given in this part when $1.03 \times 10^5$ was given in part **(b)**.

**(ii)** This part proved the least successful for candidates in this question. Many answers of 2 were seen from the difference in the index number of each population which showed misunderstanding of standard form. The answer of 98 and 100 both gained full marks and both were seen in equal proportions.

**(iii)** Good solutions to this question saw candidates give full workings out. Candidates who did not convert their correct answer back to standard form only gained one of the two marks. Candidates should be reminded to check that their answer has been given in the form asked for in the question. Most errors seen were due to errors in the subtraction.

**(d)** Some very good solutions were seen from more able candidates who showed correct working throughout. Candidates who showed no or little working often lost all marks due to incorrect rounding of their final answer. Candidates should be reminded to show explicitly their method. Many candidates used a ‘grid method’ similar to below:

30 405 ……………….100%
30 851 ……………….1.46%.

This presentation does not show how the candidate arrived at their answer of 1.46. As it is incorrect (due to rounding) and the working doesn’t explicitly show the method, it gains no marks. Many candidates showed the need to find the difference between the values but quite a few did not know how to progress further. A common misconception was to divide by 30 851 instead of 30 405. Candidates should also be reminded to write out formulae fully and correctly and to leave any rounding until the end and write down a longer version of their final answer before rounding it.

*Answers*: **(a)** 105 806 **(b)** $1.03 \times 10^5$ **(c)(i)** 46 100 **(ii)** 100 **(iii)** $6.82 \times 10^6$ **(d)** 1.47

**Question 10**

**(a)** The vast majority of candidates successfully used the scale and found the distance between the two towns. It was evident that all candidates had access to rulers and used them correctly with very few incorrect measurements seen.

**(b)** The majority of candidates showed little understanding of bearings. Some gave an angle of 55° which was the angle from the North line measured in an anti-clockwise direction. An angle of 125° was also seen, which was the bearing of town *Y* from town *X*. Very few candidates showed the ability to use a protractor accurately when measuring a bearing.

**(c)** Candidates showed a better understanding of bearings and scale drawing in part **(c)** than in part **(b)**. The majority of candidates scored at least 1 mark. The length was more successful than the angle with many placing *A* near or on the line joining *X* and *Y*. The common error for lengths was measuring 5 cm not 4.5 cm. The incorrect angle of 40° was seen often. Some candidates did not mark the point with a cross or dot. These candidates often just wrote the letter *A*. This is unacceptable as an answer as it is not clear where to measure to. It is important for candidates to make the position clear by using a dot, cross or a line joining their position of *A* to *Y*.

*Answers*: **(a)** 35 **(b)** 305

# MATHEMATICS

**Paper 0580/32**
**Paper 32 (Core)**

## Key messages

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

## General comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper, making an attempt at most questions. 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 paid to the degree of accuracy required, and candidates should be encouraged to avoid premature rounding in workings. Candidates should be particularly reminded that in questions where the answer is exact, this answer should not be rounded. 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 3 which came from not appreciating the given scale.

**(ii)** The pictogram was generally completed correctly with the majority of candidates able to show a clear intention to draw two circles and one quarter circle. The common errors were to draw two and a half circles or nine circles.

**(iii)** This part was generally answered well with Fantasy identified as the most popular type of book.

**(iv)** The majority of candidates gave the probability in the preferred fractional form although decimal and percentage forms were accepted. The question was generally answered well although common errors of 4, $\frac{4}{100}$, $\frac{9}{50}$ and $\frac{1}{5}$ were seen.

**(b) (i)** Many candidates found the concept of finding the median from a frequency table challenging and did not appreciate that the 25/26th value was to be found. A number were not able to differentiate between the value row and the frequency row. Common errors included $\frac{(3+4)}{2} = 3.5$, $\frac{(12+5)}{2} = 8.5$ and $\frac{(7+8)}{2} = 7.5$.

**(ii)** This part on finding the mean from the frequency table was better answered but still proved challenging for a number of candidates. Common errors included answers from $\frac{155}{6}$, $\frac{50}{6}$, $\frac{155}{21}$ and $\frac{50}{21}$.

**(c) (i)** A small but significant misconception in parts **(i)** and **(ii)** was to use the ages given in calculations rather than the angles of the pie chart. This part was generally well answered with correct use of the 90° shown in the pie chart. Common errors included 90, $\frac{90}{300}$, $\frac{60}{360}$ and $\frac{60}{300}$.

**(ii)** This part was generally well answered with correct measurement and use of 150°. Common errors included answers of 150, 41, incomplete methods of $\frac{150}{360}$ or $\frac{41}{360}$, and incorrect methods of $\frac{150}{300} \times 360$ or $\frac{41}{300} \times 360$.

*Answers*: **(a)(i)** 12 **(iii)** Fantasy **(iv)** $\frac{4}{50}$ **(b)(i)** 3 **(ii)** 3.1 **(c)(i)** $\frac{90}{360}$ **(ii)** 125

**Question 2**

**(a) (i)** This part was generally well answered with the majority of candidates able to identify the given polygon. However a full range of alternative mathematical names was seen with the most common error being hexagon.

**(ii)** This part was generally well answered with the majority of candidates able to state the order of rotational symmetry of the given polygon. Common errors were 1, 4 and 8.

**(iii)** The required enlargement proved challenging for many candidates with a significant number of nil responses. A number did not appreciate that the enlargement could be drawn anywhere on the grid. A number were able to attain a part mark for the correct enlargement of the horizontal and vertical sides.

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**(b) (i)** This part was generally answered well with the majority of candidates able to identify the required transformation as a rotation although not all were able to give a full description. Common errors included omission of the centre of rotation, omission or incomplete angle of rotation with a small yet significant number stating a double transformation, commonly rotation and translation.

**(ii)** This part was generally answered well with the majority of candidates able to draw the required reflection. Common errors included a reflection in the *y*-axis, and a triangle with co-ordinates at (–5, –1),(–2, –1) and (–2, –2).

**(iii)** This part was generally answered well with the majority of candidates able to draw the required translation. Common errors included triangles with only one part of the translation correct or drawing a triangle with a vertex at the point (3, –4).

*Answers*: **(a)(i)** octagon **(ii)** 2 **(b)(i)** rotation, 90° clockwise, centre (0, 0)

**Question 3**

**(a)** This part on calculating the lowest amount to pay, or best offer, proved demanding for many candidates. Many treated it as a 'best value' question and didn't appreciate that a number of combinations of the three given offers were possible and that these needed to be calculated to find the lowest amount that could be paid. A number omitted to 'show how you decide' as stated in the question. Other methods were possible but again needed justification. The possible combinations were 5 × 1-litre = \$3.25, 2 × 2-litre + 1 × 1-litre = \$3.15, 1 × 2-litre + 3 × 1-litre = \$3.20, 1 × 4-litre + 1 × 1-litre = \$3.21.

**(b)** This part was generally answered well although very common errors of 0.5, 1.8, 1.833 and 4.5 were seen.

**(c) (i)** The majority of candidates showed good understanding of ratio although the answer was not always given in the required simplest form. The most common error was 5 : 2 : 1 from the incorrect conversion of 1 litre to 100 millilitres. A small but significant number attempted to divide the three numbers by 1700 or 800 or 701.

**(ii)** Many candidates found this part very challenging with most not appreciating that each component of the fruit drink was to be increased in the same proportion. Common errors included 3.2 litres (2 + 0.2 + 1) and 3.7 litres (1.7 + 2).

**(d)** A significant number of candidates did not know the correct formula to calculate the volume of the cylinder whilst others did not realise the fact that the actual volume was given as 300 cm³. Those candidates who were able to apply the formula correctly to obtain $300 = \pi \times 3.5^2 \times h$ were usually able to then calculate the value of *h.* Common errors included $h = \pi \times 3.5^2$, $h = \frac{300}{3.5}$, $h = \frac{300}{3.5^2}$, $h = \frac{300}{\pi} \times 3.5$ and the use of 7 in place of 3.5.

**(e)** This part on bounds was generally well answered. Common errors included 760 with 740, and 750.5 with 749.5.

*Answers*: **(a)** 2 × 2-litre + 1 × 1-litre = \$3.15 **(b)** 2 **(c)(i)** 5 : 2 : 10 **(ii)** 6.8 **(d)** 7.79 **(e)** 755, 745

**Question 4**

**(a)** The table was generally completed very well with the majority of candidates giving 3 correct values although a common error was calculating $y = 7$ when $x = -1$.

**(b)** The graph was generally plotted very well with candidates able to plot correct or follow through points and join them with a smooth curve.

**(c)** Many candidates found the writing down of the equation of the line of symmetry challenging and often attempted calculations using $y = mx + c$ or the given quadratic. Candidates would be advised to draw in the line of symmetry onto the graph and then appreciate the fact that the vertical line would be in the form $x = k$, in this case 2.5.

**(d) (i)** Few candidates appreciated the fact that the given line crosses the *x*-axis when $y = 0$ and so $x = 4$ from substitution into the given $y = 4 - x$. A common error was (0.7, 0) or (4.3, 0) by using the curve.

**(ii)** Few candidates appreciated the fact that the given line crosses the *y*-axis when $x = 0$ and so $y = 4$ from substitution into the given $y = 4 - x$. A common error was (0, 3) by using the curve.

**(e)** The help given in part **(d)** was not always appreciated and few correct lines were plotted. Candidates who were unable to answer part **(d)** did not realise that a simple table of values would enable them to draw the required line. Common errors were drawing $y = 4$ and/or $x = 4$.

**(f)** This part was generally better answered with the majority of candidates able to read off the co-ordinates from the intersections particularly on a follow through basis. However common errors included misreading the vertical scale and omitting the negative signs.

*Answers*: **(a)** 9, –3, –3 **(c)** $x = 2.5$ **(d)(i)** (4, 0) **(ii)** (0, 4) **(f)** (4.1 to 4.3,–0.1 to –0.5), (–0.1 to –0.3, 4.1 to 4.5)

**Question 5**

**(a) (i)** This part was generally well answered although common errors of 40 and 45 were seen.

**(ii)** This part on measuring the bearing was generally well answered but still caused problems for less able candidates. Common errors included 100°, 100.5°, 75°, and 8.4 cm.

**(iii)** This part was generally well answered although the common error was to draw a line of the correct length but at an incorrect bearing.

**(iv)** This part proved challenging for a number of candidates with many not appreciating that the two constructions required were an arc, centre *C,* radius 5 cm, and the perpendicular bisector of the line *AB*. Those candidates who were able to draw the correct constructions usually did so accurately.

**(b)(i)** This part on completing a timetable proved challenging for a significant number of candidates. Common errors included the incorrect use of 100 minutes in an hour, misinterpretation of the rows and columns in the timetable, and the incorrect choice of operation needed.

**(ii)** The majority of candidates attempted to use the correct formula to find the average speed. Those candidates who treated it as one calculation of $\frac{25}{36} \times 60$ tended to be more successful. If working in stages, candidates should ensure that they show each step of their working and avoid premature approximation as this often leads to an answer outside of the required range and thus loses the available accuracy mark.

*Answers*: **(a)(i)** 40 to 42 **(ii)** 104 to 108 **(b)(i)** 06 20, 06 15, 07 30 **(ii)** 42.9

**Question 6**

**(a)** The majority of candidates showed an understanding of the concept of factors but not all were able to identify a square number. Common incorrect answers included 2, 576 and 4.9.

**(b)** This part was less successfully answered with a significant number not understanding what a cube number was. Common incorrect answers included 5, 4.6, 5.8, 144, and 150.

**(c) (i)** This part was generally well answered.

**(ii)** This part was generally well answered although common incorrect answers of 4.913, 51 and 2.57 were seen.

**(iii)** This part was generally well answered although common incorrect answers of 0.063, –8 and –16 were seen.

**(d)** This part was generally well answered although a significant number of candidates were unable to substitute the given values into the given formula correctly. Common errors included the use of $\frac{1}{2}(0.7 \times 4.2)^2$ or $\frac{1}{2}(0.7 + 4.2)^2$. The exact answer of 6.174 should not have been rounded.

**(e) (i)** This part was generally well answered although common errors of $a$, $a^1$, and 0 were seen.

**(ii)** This part was generally well answered although common errors of $b^6$, and $b \times b \times b \times b \times b$ were seen.

**(iii)** This part was reasonably well answered although common errors of $c^4$, $c^{0.5}$, $c^2$, and $\frac{c^1}{c^2}$ were seen.

*Answers*: **(a)** 4 or 1 **(b)** 125 **(c)(i)** 3.5 **(ii)** 4913 **(iii)** 0.0625 or $\frac{1}{16}$ **(d)** 6.174 **(e)(i)** 1 **(ii)** $b^5$ **(iii)** $c^{-4}$ or $\frac{1}{c^4}$

**Question 7**

**(a)(i)** This part was generally well answered with the majority of candidates able to calculate the correct answer.

**(ii)** Relatively few candidates scored full marks here with many being unable to cope with the multi-step process required. The full method of $15.25 \times 1.08 \times 38$ was rarely seen either as a complete method or done in stages. Candidates working in stages should be wary of premature approximation as this often loses the accuracy mark. As the answer in this part was the exact value of \$625.86 this is the value that should be given as the answer and should not be rounded to \$626 or \$625.9. Common errors included the use of 122 rather than 15.25, $15.25 \times 0.08$, $15.25 + 0.08$ and the use of an incomplete method.

**(b)** This part was another multi-step method and proved challenging for a significant number of candidates. Whilst most candidates were successful in converting 425 euros into dollars, many then omitted the required subtraction, or incorrectly converted their answer to part **(a)(ii)** before the subtraction. Again the exact monetary values of 616.25 and 9.61 should not have been rounded.

**(c)** Many good answers were seen with candidates using $500 \times 1.035^3$ leading to an accurate answer of \$554.36. Whilst many of those who did the calculation in stages had the right method, they frequently lost the final accuracy mark due to premature rounding or slips in their calculations. Common errors in method included using simple interest, using $1.35^3$, and giving the interest only as the final answer.

*Answers*: **(a)(i)** 122 **(ii)** 625.86 **(b)** Mei, 9.61 **(c)** 554.36

**Question 8**

**(a) (i)** This part was generally well answered although common errors of diameter, straight line, vertical line, diagonal, parallel and radius were seen.

**(ii)** This part was reasonably well answered although common errors of horizontal line, radius, straight line and diameter were seen.

**(b) (i)** Few candidates could correctly describe the circle theorem required in this part. Common errors included the triangle is right-angled; the angle is right-angled; the triangle is in a circle; *AB* is a straight line; it goes through the centre; the triangle is in a semi-circle.

**(ii)** This part on finding the area of the triangle was reasonably well answered although a very common error was to omit the halving and give an answer of 40. A small yet significant number used Pythagoras' theorem to find the diameter but then left this as their final answer.

**(iii)** Although some good answers were seen this part proved to be challenging for a number of candidates with many not appreciating that Pythagoras' theorem was needed to find the length of the diameter. Those who did apply Pythagoras' theorem usually did so correctly but many lost the final mark as they did not appreciate that, as this was a show that question, the value of 9.433 or better was required to be shown in the working. Common method errors included halving 9.43 to find the radius, sometimes doubling it back to give the diameter, and the use of 9.43 in area or circumference formulas. There were also a significant number of nil responses to this part.

**(iv)** This part on finding the area of the circle was better answered although a significant number lost the final accuracy mark due to rounding errors or premature approximation. Common method errors included use of $2\pi r$, $2\pi r^2$, $\pi d$ and $\pi d^2$.

**(v)** This part involved another multi-step method and again proved challenging for a significantly large number of candidates. Few candidates appreciated that the subtraction of part **(b)(iv)** and part **(b)(ii)** was the required first step, followed by writing this value ÷ part **(b)(iv)** as a fraction and then converting to a percentage. Other common errors included just subtracting the two areas, adding the two areas, using a division by 100, and the attempted use of 360.

*Answers*: **(a)(i)** tangent **(ii)** chord **(b)(i)** angle in a semicircle **(ii)** 20 **(iv)** 69.8 **(v)** 71.3 to 71.4

### Question 9

**(a)** The vast majority of candidates were able to recognise the pattern from the given diagrams and were then able to draw the fourth pattern in the sequence.

**(b)** This part was generally well answered with the majority of candidates able to complete the table correctly. Common errors were seen in Pattern 10 of 9 and 28, 9 and 34, 6 and 16.

**(c) (i)** This part was generally well answered with a good number of candidates able to give the more straightforward generalised rule of $n + 1$. Common errors included $n$, $n - 1$, $n = 1$ and +1.

**(ii)** This part was reasonably well answered with a number of candidates able to give the more complex generalised rule of $3n + 1$. Common errors included $n + 3$, $3n$, $n = 3$, +3 and a range of numerical answers.

**(d)** This proved to be a more challenging part as few candidates appeared to appreciate that the generalised rules from part **(c)** could be used. A number of candidates were able to give a correct answer, and although there was not always evidence, they quite possibly simply extended the table. A significant number of candidates appeared to incorrectly use the proportion in the table in that 4 lines gives 2 dots and so 76 lines would give 38 dots. Other common errors included 25, 77 and the substitution of 76 into their answer to part **(c)(ii)**.

*Answers*: **(b)** 4 5 11 **(c)(i)** $n + 1$ **(ii)** $3n + 1$ **(d)** 26
10 13 31

# MATHEMATICS

**Paper 0580/33**
**Paper 33 (Core)**

## Key messages

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

## General comments

The paper gave the opportunity for candidates to demonstrate their knowledge and application of mathematics. The majority of candidates were able to use the allocated time to good effect and complete the paper. The majority of candidates attempted all of the questions with some part questions being omitted by individuals. The standard of presentation was generally good. Many candidates did show all necessary working. However, some candidates just provided answers or did not carry out calculations to sufficient accuracy and consequently lost marks. Centres should continue to encourage candidates to show all working clearly in the working space provided. The formulae being used, substitutions and calculations performed, are essential if partial credit is to be awarded.

Candidates should take the time to read the questions carefully and understand what can and cannot be assumed in each part of a question. In particular, they need to be aware of what is required in questions requiring reasons in the answer. For example, in geometry questions if asked for a reason, it would be necessary to state, for example, that the interior angles of a triangle add to 180° rather than just give the numerical calculation.

## Comments on specific questions

### Question 1

**(a)** Most candidates gave the correct answers. A few lost a mark for rounding \$25.56 to \$26.00.

**(b) (i)** Many candidates gave the correct answer. The most common error was to calculate the percentage that needed to be borrowed, 15%.

**(ii)** Fewer candidates gave the correct answer. Many candidates only found the amount borrowed, \$660, and then worked out the interest rather than the total amount owed. A few candidates used \$4400 or \$3740 instead of \$660.

**(c)** Many candidates gave the correct answer. The most common error was to misread the question and multiply \$321 by 12 instead of dividing by 12.

**(d)** Many candidates found this part challenging. Although many candidates correctly identified that the van would travel further they omitted to give a valid reason for their decision. In particular, some candidates made a calculation which, although correct, was evaluated to an insufficient degree of accuracy to be useful in making the final decision.

**(e)** Although most candidates showed an understanding of ratios, many only found one part, 1400, instead of two parts, 2800. Some candidates found the amount for repairs instead of fuel.

*Answers:* **(a)** 258(.00), 25.56, 758.56 **(b)(i)** 85 **(ii)** 739.2(0) **(c)** 26.75 **(d)** Van and 12.6 > 12.4 **(e)** 2800

**Question 2**

**(a) (i)** The majority of candidates gave the correct answer. The most common error was to give an answer of 24.30 – 23.85 rather than evaluating it. A few candidates gave a range for the distance rather than the time.

**(ii)** Candidates generally gave the correct answer. Again, some candidates used the wrong data, time instead of distance.

**(b) (i)** Most candidates showed an understanding of how to plot points with many correctly plotting the required points with good accuracy. The most common error was to misread the scale on the *x*-axis and plot all the points between 24.0 and 24.1.

**(ii)** The majority of candidates gave the correct answer. Some candidates embellished their answers with words such as weak or strong. A small number of candidates omitted to give an answer.

**(iii)** A large number of candidates thought that the given statement was correct. Many candidates who did say that the statement was not correct gave a good explanation.

**(iv)** Although many candidates drew a reasonable line of best fit a similar number of candidates did not. The most common errors were to join up every point or simply join the first point to the last point. A few candidates attempted to fit a positive line to the data.

**(v)** Most candidates showed that they understood how to read from a line of best fit. Occasionally the scale on the *y*-axis was misread.

*Answers:* **(a)(i)** [0].45 **(ii)** 6.115 or 6.12 **(b)(ii)** Negative

**Question 3**

**(a) (i)** Many correct answers were given by the candidates.

**(ii)** Many correct answers were given by the candidates. The most common error was to give an answer of 71.

**(b)** Few candidates scored 3 marks; many candidates scored 2 marks for 43. Many candidates did not give suitable reasons for their answer with most simply showing the calculation they performed rather than stating the geometrical properties behind the calculation. Where candidates did state the properties, some candidates lost the last mark as they only mentioned angles in a triangle and omitted angles on a straight line.

**(c)** About half the candidates calculated the correct answer. Some candidates tried using the cosine rule or Pythagoras' theorem but invariably didn't give a complete method.

**(d) (i)** This part was well answered by many candidates. The main error was to find $375^2$ and assume that this had proved the result.

**(ii)** Candidates found this part challenging. Most candidates divided 375 by 450 but many inverted these numbers. Some candidates added their answer directly to 14 45 not recognising that their number was in hours rather than minutes. Quite a few candidates used 100 minutes in an hour especially when their first part answer was 1.2. A few candidates did not use the 24-hour clock.

*Answers:* **(a)(i)** 35 **(ii)** 74 **(b)** 43 **(c)** 32.2 **(d)(ii)** 15 35

**Question 4**

**(a) (i)** Many candidates made good attempts at the construction. The most common errors were for either the line *AB* to not be vertical or to not show the construction arcs.

**(ii)** Some candidates gave the correct bearing. The most common error was to find the bearing of *A* from *C* rather than *C* from *A*.

**(iii)** Quite a few candidates did not answer this part. Many gave an answer of 360−23 rather than 180+23.

**(b)** Very few candidates gained full marks for this part. Most candidates understood they needed to construct a large arc of 6 cm around the point *W*. Very few candidates drew this arc inaccurately. Most candidates then drew arcs of similar length from *P* and *T* and marked their intersections with the original arc as the possible positions for the ship. Very few candidates attempted to construct a perpendicular bisector between *P* and *T* and those that did generally gained full marks.

*Answers:* **(a)(ii)** [0]37 to [0]41 **(iii)** 203

**Question 5**

**(a) (i)** Many candidates gave the correct answers. A few candidates misread the question and wrote $8^2$ and $9^2$ rather than 64 and 81. A few candidates just wrote 8 and 9.

**(ii)** Candidates tended to misunderstand this question. Although a large minority of candidates gave a correct answer of 90 and a few candidates gave an alternative correct answer of 1350, many candidates found a common factor, either 3 or 5. A substantial number of candidates did not give an answer to this part.

**(iii)** Many candidates showed an understanding of factors. Some candidates gave the correct answer. The most common errors were to either misread the question and include the even factors as well or only give three of the factors, with normally 1 or 27 being missed.

**(iv)** The majority of candidates gave the correct answer. The most common error was to give the common factors rather than the highest common factor.

**(b)** Candidates made a good attempt at this question with a small majority gaining full marks. The most common omission was to not show the division by $\frac{2}{5}$ as a multiplication by $\frac{5}{2}$. Another omission which was not so common was to misread the question and not turn their answer into a mixed number.

**(c) (i)** Nearly all candidates gave the correct answer. The majority of candidates stated the rule as “add 3” but some candidates wrote the *n*th term, $3n + 5$. Others gave the *n*th term as $n + 3$.

**(ii)** Slightly fewer candidates gave the correct answer here. Again the common error was in the rule with $n - 8$ being frequently stated although some candidates did give $33 - 8n$.

**(iii)** Many candidates gave the correct next term but did not give a satisfactory rule. The main issue was that their attempt at a rule did not identify that it was the difference that was increasing by one, with statements such as “the number increasing by one” being given or “the previous term increases by one”.

**(iv)** Most candidates found this part challenging. Many candidates tried to find a difference between terms. A few candidates did give a correct next term but could not give a rule.

*Answers:* **(a)(i)** 64, 81 **(ii)** $90k$ **(iii)** 1, 3, 9, 27 **(iv)** 16 **(b)** $4\frac{7}{12}$ **(c)(i)** 20, add 3 **(ii)** –7, subtract 8
**(iii)** 16, differences increase by 1 **(iv)** 125, cube numbers

**Question 6**

**(a)** Many candidates gave the correct answer. The most common error was to assume that a hexagon had a different number of sides with 8*h* being seen frequently. Another fairly common error was to multiply the sides together instead of adding them so $h^6$ was sometimes seen.

**(b) (i)** Slightly more candidates gave the correct answer. The most common error was to multiply the sides together instead of adding them, usually when the same error had been made in the previous part.

**(ii)** Many candidates gave the correct answer. However, a substantial number of candidates did not recognise that this part was related to the previous part with sides equal to *x* and just wrote down length x breadth.

**(c)** Some candidates found this part challenging with a substantial number not giving an answer. Of those candidates that attempted this part, many did not write down the correct expression for the perimeter but subsequently did equate this to 53 and solved their expression correctly and scored some part marks. Those candidates who only wrote down a final incorrect answer could not score any part marks.

**(d)** The clear majority of candidates gave the correct answer. The most frequent error was to mishandle the negative signs with answers such as $6a - b$ being seen frequently.

**(e) (i)** Nearly all candidates gave the correct answer. The few who gave an incorrect answer tended to omit multiplying the second term inside the bracket by 5 so $5x - 4$ was commonly seen here.

**(ii)** Slightly fewer candidates gave the correct answer. Those candidates who incorrectly multiplied out the expression in the previous part tended to make the same error here. A few candidates tried to simplify the expression further by giving the final answer as either 4x or $4x^3$.

**(f)** Only a minority of candidates gave the fully factorised answer. The majority of candidates gave partially factorised answers such as $2x(4x - 2)$ or $x(8x - 4)$. A few candidates mishandled the factorisation, giving answers such as $4x^2$ arising from incorrectly taking $x^2$ out of the expression to give $x^2(8 - 4)$.

*Answers:* **(a)** 6*h* **(b)(i)** 4*x* **(ii)** $x^2$ **(c)** 7.5 **(d)** $6a + b$ **(e)(i)** $5x - 20$ **(ii)** $x^3 + 3x$ **(f)** $4x(2x - 1)$

**Question 7**

**(a)** Many candidates drew the correct reflection. The common error was to reflect in the *y*-axis rather than the *x*-axis.

**(b)** Slightly more candidates gave the correct answer for the translation. The common errors were to incorrectly translate in either the *x* or *y* direction or to translate by $\begin{pmatrix} -3 \\ 1 \end{pmatrix}$ instead of $\begin{pmatrix} 1 \\ -3 \end{pmatrix}$.

**(c)** Many candidates recognised this as a rotation but omitted to state the other necessary requirements, usually missing out the centre of rotation. Some candidates stated 180° instead of 90°.

**(d)** Many candidates recognised this as an enlargement and slightly more gave the other two requirements to describe the transformation correctly. The common error was to miss out the scale factor.

*Answers:* **(c)** Rotation, (about) (0,0), 90° (anti-clockwise) **(d)** Enlargement, [centre] (0, 0), [sf] 2

**Question 8**

**(a)** The majority of candidates gave the correct answers. The main error was when evaluating the values for $x = -3$ and $x = -2$ where the negative sign was often not used correctly.

**(b)** Most candidates plotted their points correctly. There was little evidence of joining points with straight lines.

**(c)** Many candidates knew where to draw the line $y = 6$.

**(d)** Many candidates gave correct answers for their curve. The common error was to not recognise that each small square on the two axes had different values, 0.2 on the $x$-axis and 0.4 on the $y$-axis.

*Answers:* **(a)** 15, 8, 0, 0, 8 **(d)** −1.8 or –1.7 or –1.6, 3.6 or 3.7 or 3.8

**Question 9**

**(a)** Generally, candidates gave the correct answer. Some candidates did not recognise that they needed to obtain the factor $\frac{45}{18}$ in order to complete this part.

**(b)(i)** Candidates generally found this part challenging. Some candidates did not give an answer whilst others found $\frac{5}{8}$ rather than $\frac{8}{5}$ of 395.

**(ii)** Many candidates gave the correct follow through from their previous answer. However, common errors were to either multiply by 1000, or multiply or divide by 100.

*Answers:* **(a)** 325, 150, 450, 75 **(b)(i)** 632 **(ii)** 0.632

# 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 syllabus.

The recall and application of formulae and mathematical facts in varying situations is required as well as the application to problem solving and unstructured questions.

Work should be clearly and concisely expressed with answers written to at least 3 significant figures unless directed otherwise.

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

## General Comments

This paper provided opportunities for candidates to achieve across the range of topics. There were many excellent scripts with a large number of candidates demonstrating an expertise with the content and showing excellent skills in application to problem solving questions.

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 but there were a significant number of candidates losing unnecessary accuracy marks by either approximating values in the middle of a calculation or by not giving answers correct to at least 3 significant figures.

The questions on the topics of statistics, drawing graphs, drawing and describing transformations, Pythagoras' theorem, cosine rule and straightforward functions were very well answered by candidates. Areas which were found more challenging were interest and growth, mensuration and similarity with solids, algebraic manipulation in context, problem solving with sectors and general triangles.

## Comments on Specific Questions

### Question 1

**(a) (i)** Virtually all candidates reached 60 and 45 following division of the total by the number of parts. The only error seen was to regard the total of 105 as two separate totals and then divide by 4 and by 3.

**(ii)** The best solutions showed the correct multiplier of 1.12 to directly get to the answer. A minority of candidates calculated just 12%. Some candidates rounded their final answer which was inappropriate as this was an exact value.

**(iii)** Most candidates produced a concise solution using the multiplier approach to arrive at 105 ÷ 0.84. The common errors were to add or subtract 16% from 105. Some candidates made an initial statement that 105 is equivalent to 84%; this then gave them several approaches to reach the correct answer.

**(b)** The required methods to calculate simple and compound interest were understood by many candidates. The main error was to ignore the initial sum of money in the simple interest calculation and just find the simple interest only and then compare this with the total amount from the compound interest calculation. Some reversed the two rates showing some lack of knowledge of the two systems of financial growth and a minority of candidates used the same percentage for both calculations. On the issue of accuracy, candidates are advised to use full calculator values in working until the final stage. In this case, the degree of accuracy was specified in the question and some gave inaccurate answers of \$30.7 or even \$31 having shown a completely correct method.

**(c)** The most efficient solutions used the calculator once. Many candidates correctly interpreted the information in the question but could not do the rearrangement prior to calculation. Some candidates lost accuracy with the calculation of their $1.038^{30}$ and division by 3.06 instead of the full decimal value was a common error. Some did not understand the concept of an index in the growth calculation.

**(d)** This was found to be very challenging by almost all candidates. Many candidates just used 5 or 55 instead of $55 \div 5$ as the power in the calculation. A substantial number of candidates correctly used the compound interest formula with either 5 or 55 as the power. A few candidates used a simple interest method.

*Answers*: **(a)(i)** 60 and 45 **(ii)** 117.6 **(iii)** 125 **(b)** 30.68 **(c)** 480 **(d)** 6.5

**Question 2**

**(a)** The majority of candidates knew how to interpret the cumulative frequency diagram and they scored well in all parts. Some marks were lost due to misreading the vertical scale especially in part **(v)** where the intersection was often read as 178 rather than 176. A few candidates did not understand how to find the inter-quartile range in part **(iii)**. Some of the less able candidates were not familiar with this topic and did not score any marks.

**(b)(i)** This part on finding the mean value was also generally well attempted by candidates. Nearly all showed their method and this allowed them to demonstrate their understanding of calculating the mean value. Most candidates correctly identified the mid-points and then correctly found the required products before then dividing by 200. There were a few errors in processing in an otherwise correct method and only a small minority of candidates used the frequency width instead of the mid-point.

**(ii)** This was usually well answered. The majority of candidates had all four bars correct. The principle that the area of the bar is proportional to the frequency was well understood by many. A few candidates had all bars incorrect. The most common error was to have the 3rd required bar correct only as this was the same width as the given bar. Only a few did not attempt this part.

*Answers*: **(a)(i)** 15 to 15.2 **(ii)** 10.8 to 11 **(iii)** 9 to 9.2 **(iv)** 10 **(v)** 24 **(b)(i)** 16.75

**Question 3**

**(a)(i)** The main error in this part was to add two internal circles to the calculation or to make errors with the hemisphere calculation, typically by finding the volume of two spheres instead. The best solutions gave clear substitution and numerical values for the two components, then the total. They then clearly indicated the multiplication by 2.3 and the division by 1000 to convert from grams to kilograms. A few candidates ignored the rubric instructions and used $\frac{22}{7}$ for $\pi$ which produced an inaccurate answer.

**(ii)** Overall this was not answered as well as part **(a)(i)**. Some candidates were uncertain about the expressions in their calculation and many struggled to find the curved surface area of the cylinder as part of the required calculation. With the units, there were two main approaches, the first to work with centimetres and then convert to square metres, the second to change to metres first. When using the first approach, unit conversion was a source of many errors.

**(b)** Virtually all candidates made a correct first substitution to arrive at an equation just in terms of $x$ and equated to 500. Many candidates then struggled with steps beyond that first stage. Some candidates correctly processed as far as $2x^3 = 477$ but then took the cube root instead of dividing by 2.

**(c)** This question required a thorough understanding of the link between volume and area without reference to length. The best solutions worked out a volume scale factor or ratio, then an area scale factor or ratio but did not evaluate these calculations until the final stage to avoid any potential premature approximation. Many candidates could not make a meaningful start to the problem.

*Answers*: **(a)(i)** 51.7 **(ii)** 1.96 **(b)** 6.20 **(c)** 286

**Question 4**

**(a)** The table was usually completed accurately. The only common errors were to occasionally struggle with processing the negatives of $x = –5, –2$ and $–1$.

**(b)** The graph was usually accurately plotted and points joined with a smooth curve. The graph had two separate branches but a common error was to connect these branches. In addition some candidates need to ensure they use a sharp pencil, draw a single curve (with no feathering) and do not connect the segments with a ruler.

**(c) (i)** The line was drawn accurately by most candidates. It was very common for candidates to plot all 9 integer value co-ordinates from (–3, 2) to (5,–6) which is unnecessary and inefficient. This graph should be recognised as a straight line and so 8 or 9 plots are not necessary; some candidates got one or more plots incorrect and then joined them to make a disjointed line. A number of candidates did not give any response to this part.

**(ii)** Whilst many candidates recognised that the solution to the equation could be read from the intersection of their graphs, others attempted to solve the equation algebraically which was invariably incorrect.

**(iii)** This was a challenging part. A minority of candidates completed this successfully. Many candidates understood what they were trying to do but were not successful, with a very common error being to attempt to multiply both sides by $x^2$ to remove the fraction but incorrectly dealing with the left hand side, arriving at $1 – 2 = x^2(–x – 1)$.

**(d) (i)** Some candidates read off their intersection accurately and many gave correct co-ordinates as required. ($\sqrt{2}$ , 0) was accepted. The interpretation of ‘cuts the positive $x$-axis at’ was often incorrect, with some choosing the negative side. For others, this point was often (2, 0).

**(ii)** In this part, carefully ruled and accurately drawn lines were frequently seen and rewarded after a sensible point $A$ previously. Errors in the previous part were often carried through here.

**(iii)** Most candidates who had correctly completed the previous two parts understood that their line was indeed a tangent at their point $A$. The most common incorrect response was ‘perpendicular bisector’ and not to give a point but a value for the second response.

*Answers*: **(a)** 0.92, 0.5, –1, –1, 0.5, 0.92 **(c)(ii)** 0.7 to 0.95 **(iii)** $p = 2$, $q = –2$ **(d)(i)** (1.3 to 1.6, 0) **(iii)** tangent, $A$ or (1.3 to 1.6, 0)

**Question 5**

**(a) (i)** This was answered well by the majority of candidates who were able to draw the correct image after translation. Less able candidates occasionally misunderstood completely and reduced, enlarged or reflected the original as well as moving it. A few candidates lost marks by misinterpreting the vector and used the translation $\begin{pmatrix} -8 \\ -4 \end{pmatrix}$ instead.

**(ii)** A significant number of candidates did not understand what was required here and they generally gave answers still in vector form. Where candidates understood the modulus symbol this was generally answered well but some candidates lost marks by rounding their answer to 8.9 without showing a more accurate value. Some were unable to square the negative terms when using Pythagoras' theorem and omitted important brackets within their method.

**(b) (i)** Almost all candidates successfully identified the required transformation as 'enlargement'; most identified the centre of enlargement correctly but many lost marks on the scale factor, often quoting it as 2 or –2.

**(ii)** Candidates often worked the matrix out by using the co-ordinates of the vertices, rather than just quoting the required matrix from the scale factor. This did ensure that some candidates were successful here when they had not scored fully in part **(b)(i)**. A range of incorrect answers was also seen and a significant proportion left this answer blank.

**(iii)** This was answered similarly to part **(b)(ii)**. The majority of candidates who had given a matrix in the previous part were able to correctly calculate the determinant, although there were many who gave the reciprocal of the determinant, or even the inverse matrix.

*Answers*: **(a)(ii)** 8.94 **(b)(i)** enlargement, scale factor 0.5, centre (0, 0) **(ii)** $\begin{pmatrix} 0.5 & 0 \\ 0 & 0.5 \end{pmatrix}$ **(iii)** 0.25

**Question 6**

**(a)** This was usually attempted correctly using Pythagoras' theorem, although some candidates applied this incorrectly by adding the squares of the sides. Some used right-angled trigonometry to calculate either angle *BAC* or angle *ABC* and then further trigonometry to calculate *BC*. After a correct answer of 126.49 it was quite common to see this rounded to 126.5 and then to 127. Some candidates only wrote down their 3 figures answer; if they gave 126 this was accepted but 127 only seen lost the accuracy mark.

**(b)** This involved a straightforward use of the cosine rule and it was generally well done. Less able candidates often could not recall the correct formula or, having earned the method marks for correct substitution into the cosine rule, could not then process to the solution correctly. A very common processing error was to get as far as $CD^2 = 61300 - 61200\cos 33$ and then write $CD^2 = 100\cos 33$. Other errors made included using right-angled trigonometry assuming angle *ACD* was 90° or using a mixture of side lengths from 170, 180 and 220.

**(c)** Many candidates found this part challenging as they did not understand that the shortest distance from *D* to *AC* is the perpendicular distance from *D* to *AC*. Most candidates who understood the idea of dropping the perpendicular from *D* to *AC* found this part straightforward. However candidates who had assumed angle *ACD* was 90° in the previous part inevitably then gave their answer for part **(b)** here.

**(d)** Many candidates answered this correctly but some were unsure which angle was required for the bearing and so made little progress. Although some candidates found angle *BAC* using $\cos BAC = 180 \div 220$, many used the length of *BC* found in part **(a)** and used it with either sin or tan, frequently arriving at an inaccurate value as a result of using either 126 or 127, rather than a more accurate value for *BC*.

**(e)** There were many candidates who found the area of the two triangles correctly. There were some who used their calculated values from parts **(a)** and **(b)** in the wrong triangle and *CD* was quite often used as the height of *ACD*. The area formula $A = \frac{1}{2}ab\sin C$ was sometimes applied incorrectly with *C* not being the included angle. A few candidates treated *ABCD* as a triangle and attempted to find the area using $\frac{1}{2}\times220\times170\times\sin DAB$. Those who used $\frac{1}{2}\times170\times180\sin 33+\frac{1}{2}\times180\times\text{their } BC$ were most frequently within range for the total area. However the use of rounded values from previous calculations often meant that, although the method for individual areas was correct, the final answer reached was outside the acceptable range.

*Answers*: **(a)** 126 **(b)** 99.9 **(c)** 92.6 **(d)** 115.1 **(e)** 19700

**Question 7**

**(a)** On the whole, the tree diagram was correctly completed by the majority of candidates. A small number of candidates did not realise that the pairs of branches must have probabilities adding to 1.

**(b) (i)** Many candidates answered this part correctly giving the answer as either a decimal or a fraction. Very few used the most efficient method of subtracting $0.7 \times 0.8$ from 1. Most candidates attempted to write down the correct pairs of probabilities but some only gave two pairs with $0.3 \times 0.1$ usually being the one not included. Some candidates gave 0.3 on its own, but then also included $0.3 \times 0.9$ or $0.3 \times 0.1$.

**(ii)** This was usually answered well and a follow through was allowed from the previous part provided the probability given was between 0 and 1.

**(c)** Candidates found this part very challenging. A variety of incorrect comments were seen such as 'It's not very likely that the train is late at all three stations'. Some did say that the probability of the train being late at *C* was 1, or occasionally 0. However few realised that it was only if the train was already late at *A* and *B* was it then certain to be late at *C*.

*Answers:* **(a)** 0.7, 0.1, 0.2, 0.8 **(b)(i)** 0.44 **(ii)** 110

**Question 8**

**(a)** To show the given equation, candidates first of all needed to convert \$3.23 to 323 cents, as the cost of the fruit is given in cents, and the majority of candidates omitted to do this. A minority knew that 3.23 or 323 had to be divided by $x$ and $(x + 2)$ and almost all of these gained credit for this initial set up. Most then went on to remove the fractions correctly to score a further method mark but only a few were able to complete to the given equation correctly without errors. There were some very good, clear solutions where each step was easy to follow and candidates worked vertically down the page. Many however could not start the question and multiplied 323 by $x$ and $(x + 2)$ or just abandoned their work. There were some instances of incorrectly inverted fractions e.g. $\frac{x}{323}$ in the initial equation.

**(b) (i)** The majority of candidates found the prime factors of 323. A common error was 1 and 323 and a significant number made no attempt at this part.

**(ii)** Many candidates found this part challenging, with fewer than half having the correct factors. Many did not make the link between parts **(b)(i)** and (**b)(ii)**. Some had digits in the correct place but with incorrect or no signs. Some made no attempt at this part or had clearly used a calculator to obtain the solutions for the next part and then had tried to work back to the factors usually without success.

**(iii)** Most who had correct factors in part **(b)(ii)** correctly answered this part. However, a significant number did not link parts **(b)(ii)** and **(b)(iii)** together and restarted the question using the quadratic formula to find the solutions.

**(c)** Many candidates did not attempt this part, even after reasonable answers were given in part **(b)(iii)**. Some did not consider the context of the question and gave decimal answers.

*Answers*: **(b)(i)** 17, 19 **(ii)** +19, – 17 **(iii)** 17, $-\frac{19}{18}$ **(c)** 11

**Question 9**

**(a)** A large number of candidates obtained the correct solution to this part. Some wrote out the solution in a single step and many of these gave an answer of 238 as a result of writing 243 − 6 + 1 without brackets.

**(b)** Many candidates answered this correctly. Some wrote down $3(2x + 1) - 2 = 6x + 3 - 2$ and then gave a final answer of $6x - 1$. A small number of candidates gave an incorrect answer of $(3x - 2)(2x + 1)$.

**(c)** Some candidates made a sign error when separating the terms in $x$ from the constant terms but there were a large number of correct solutions. A number of candidates who obtained $-x > -3$ gave the answer $x > 3$.

**(d)** Most candidates answered this correctly. A few candidates started with $3^x = \frac{1}{9}$ but made no further progress.

**(e)** Most candidates answered this correctly. Some made a sign error when rearranging their equation at the first step.

**(f)** Almost all candidates gave $2x + 1$ as the common denominator. Many also went on to obtain the correct numerator but some omitted one set of brackets giving $3x - 2\ (2x + 1)$. Others who did include both sets of brackets did not expand them correctly, either giving $6x$ rather than $6x^2$ or making a sign error. A small number of candidates carried out some false cancelling as their last step.

**(g)** Many candidates attempted to find the inverse function, not realising that $f(4) = x$. Many did this correctly but some then substituted $x = 4$ into this rather than setting up an equation by equating the inverse to 4.

*Answers*: **(a)** 236 **(b)** $6x + 1$ **(c)** $x < 3$ **(d)** –2 **(e)** $\frac{x+2}{3}$ **(f)** $\frac{6x^2 - x + 3}{2x+1}$ **(g)** 9

**Question 10**

**(a)** Many candidates made a good attempt at this part and were able to write down a correct expression for the area of the sector. Some equated this to $r^2$ but many found the algebraic manipulation difficult and did not obtain a correct equation for *w*. In some cases the $r^2$ terms were eliminated, but $\pi$ then appeared in the numerator. Some gave a correct value for *w* but did not 'cancel' the $r^2$ in the numerator with that in the denominator.

**(b)** Candidates found this part challenging and it was often omitted. The most common error was to not write down the complete perimeter before equating it to the given expression. It was therefore very common to see the two straight edges of the sector omitted. Some candidates used $\pi r^2$ instead of $2\pi r$ and others used the general formula involving $\theta$ rather than the given *x* for the angle. Those who did reach $\frac{x}{360} \times 2\pi r = \frac{7\pi r}{10}$ often went on to get the correct value, but those who included the two straight edges '$+ 2r$' on both sides rarely did so.

**(c)** Candidates found this part very challenging with very many not attempting it. Some just tried using the area formula '$\frac{1}{2} q \times q \times \sin y$' but did not make any further progress. Better attempts were made by those who used the cosine formula for cos *y*. However many candidates did not write down $\left(q\sqrt{3}\right)^2$, omitting the brackets and so this was then given as $3q$ at the next step. Another error made with this method was to give $q^2 + q^2$ as $q^4$. A small number of candidates bisected the isosceles triangle and used $\sin \frac{y}{2} = \frac{q\sqrt{3}}{2q}$ but this was often not simplified further.

*Answers*: **(a)** 115 **(b)** 126 **(c)** 120

# MATHEMATICS

**Paper 0580/42**
**Paper 42 (Extended)**

## Key messages

Candidates need to be familiar with and practiced in all aspects of the syllabus and be able to apply their knowledge in unfamiliar situations. The accurate statement and application of formulae in varying situations is always required. Work should be clearly and concisely expressed with an appropriate level of accuracy. Candidates should be aware that if the required accuracy for an answer is three significant figures, then the working should be with at least four significant figures.

## General comments

This paper proved to be accessible to the majority of candidates. Most were able to attempt all the questions and solutions were usually well-structured with clear methods shown in the answer space provided on the question paper. There were a significant number of scripts with answers with no working so method marks could not be awarded if the answers were incorrect.

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.

Graphs were often well drawn and the readings taken from them were to the required accuracy.

Some candidates lost accuracy marks by rounding values in the working to two or three significant figures and used these in later work.

## Comments on specific questions

### Question 1

**(a)(i)** Many candidates found this question challenging. Of the successful attempts, most multiplied 18 000 by $0.85^3$ while the rest used a year by year approach. The most common incorrect approach was to find 45% of 18 000 and subtract this from 18 000.

**(ii)** Candidates had more success with this question as most knew that the given amount was 85% of the required answer. The error of finding the 15% increase of 14 025 was the common one.

**(b)** By far the most common error in this question was to use $P = 286.65$ in the formula for compound interest. Of those who used the correct method, a few spoiled the method by expanding $\left(1+\frac{5}{100}\right)^2$ as $1+\frac{25}{10000}$.

**(c)(i)** Many candidates used 224.72 instead of 24.72 as the total interest in their method. The other common error was to use the compound interest formula.

**(ii)** Many candidates were successful in using the compound interest formula correctly but a significant number incorrectly expanded $\left(1+\frac{r}{100}\right)^2$ instead of square rooting 224.72 ÷ 200. Again a significant number of candidates used the simple interest formula.

*Answers*: **(a)(i)** 11 054.25 **(ii)** 16 500 **(b)** 260 **(c)(i)** 6.18 **(ii)** 6

**Question 2**

**(a)** It was very rare to see any incorrect values in this question.

**(b)** The vast majority of candidates drew the correct cubic curve. The only occasional slip seen from the correct table was to plot (3, 1) at (3, 0.5).

**(c)(i)** The most able candidates knew that the final solution was larger than 2.5 and most were able to give some answers to the required accuracy.

**(ii)** Only the most able candidates knew to rearrange the given equation to obtain the equation of the line $y = -x$ as the one they needed to draw for the solution. Occasionally $y = x$ was drawn in error. The vast majority of candidates did not attempt this question.

**(d)(i)** Many candidates gave one or both correct equations but there were also many who did not and a significant number who omitted this question. A common error was to write two equations in the form $y = mx + c$ but without using $m = 0$.

**(ii)** Again there were many correct and incorrect responses. Common errors were to state the maximum value of 1; 0.33 or –0.04 from the table; or –2.38, the lowest point on the curve.

*Answers*: **(a)** 1 and 1 **(c)(i)** –1 < ans < –0.8, 1.25 < ans < 1.45, 2.5 < ans < 2.6 **(ii)** –0.7 < ans < –0.5
**(d)(i)** $y$ = 1 to 1.1 and $y$ = –0.4 to –0.33 **(ii)** –0.4 to –0.33

**Question 3**

**(a)** This question was generally well answered with many candidates correctly applying the sine rule and giving answers to the required accuracy. There were some instances of cosine being used instead of sine and also of 45° used instead of 85°.

**(b)** Most candidates knew what they were required to use but many did not earn full marks as they omitted to show a more accurate value than the given 33.75. The candidates who didn't score any marks did so because they merely substituted 33.75 into the area formula. A small number of candidates found the perpendicular height from $D$ to $AC$ using ½ × base × height followed by trigonometry to find the required angle.

**(c)** This question was not generally well answered as many candidates used $BD = BC + CD$ (presumably from vectors) or assumed that $BD$ was perpendicular to $AC$ and consequently used incorrect methods. Some candidates overcomplicated the question by finding $BC$, $CD$, angle $BCD$ and then correctly using the cosine rule in triangle $BCD$ but invariably accuracy was lost due to rounding values at intermediary stages.

**(d)(i)** By far the most common incorrect answer was 71.25 obtained by turning anticlockwise at $B$ instead of clockwise at $A$.

**(ii)** The follow through marks were awarded a reasonable number of times. The most common incorrect solutions were 360 – 50 = 310 and 180 – 108.75 = 71.25.

*Answers*: **(a)** 312 **(c)** 328 **(d)(i)** 108.75 **(ii)** 288.75

**Question 4**

**(a)** This was usually answered correctly. The most common incorrect answer was 14.9 after premature approximation of $\frac{2}{3}$ as 0.67. A few candidates stopped after dividing 10 by 40 and gave 0.25 as the answer. Very few candidates used the alternative method of 5 km in 20 minutes so 15 km/h.

**(b)** This question on finding an estimate of the mean time was often answered correctly with all the working being clearly shown. A minority of candidates used the interval widths instead of the mid-values. Some made errors with one of the mid-values within an otherwise correct method and gained partial credit. Candidates should be encouraged to check that their answer makes sense from the given distribution of times. Errors such as dividing by 6 instead of 200 led to answers that showed the candidate had no concept of average. A few candidates overlooked the information in the question that 200 people ran and then made an error when summing their frequencies leading to an incorrect answer.

**(c)** Frequency densities were understood by the vast majority of candidates as rarely were heights of 8 and 6 seen in the first and last blocks. The heights were often drawn correctly with just a few errors arising from incorrect interpretation of the scale on the frequency density axis. Achieving the correct accuracy for the last block was the most challenging part of the question. Candidates should use a sharp pencil and a ruler and carefully avoid the grid lines when the height of the bar should fall between them.

**(d)(i)** Almost all candidates answered this question correctly.

**(ii)** The majority of candidates were able to draw a fully correct cumulative frequency polygon or curve. Occasionally candidates who attempted to draw a curve missed their correctly plotted points. Very few candidates plotted the points anywhere other than the upper end of the interval. Heights were occasionally plotted incorrectly following misinterpretation of the frequency scale, using one small square as 2 units instead of 4.

**(iii)(a)** Most candidates successfully read the median value from their graph.

**(b)** The 90th percentile was usually correct. A few candidates stopped after finding 90% of 200 and gave the answer 180.

**(c)** Many correct answers were seen. Some candidates did not subtract their reading from 200 whilst others made an error when reading the scale on the cumulative frequency axis.

*Answers*: **(a)** 15 **(b)** 49.2 **(d)(i)** 125, 180 **(iii)(a)** 48 to 49 **(iii)(b)** 55 **(iii)(c)** 8 to 14

**Question 5**

**(a)(i)** Almost all candidates answered this correctly. A small number placed either $\frac{1}{8}$ or $\frac{1}{4}$ on both the lower branches.

**(ii)** Most candidates multiplied the two fractions $\frac{7}{8}$ and $\frac{3}{4}$ with nearly all giving their correct answer in fraction form. A few candidates unnecessarily converted their fraction to an approximate decimal. Very occasionally the error $\frac{7}{8} + \frac{3}{4}$ was seen.

**(iii)** This part was not so well answered. The relatively few candidates who realised that part **(a)(ii)** $\times$ part **(a)(ii)** was required nearly always gave the correct fractional answer. However many thought part **(a)(ii)** $\times$ 2 was required resulting in the answer $\frac{42}{32}$. In this case candidates should have realised that this answer, being a probability greater than 1, could not be correct but candidates' work revealed that very few considered this. Other incorrect answers were from $(\frac{7}{8}\times\frac{3}{4})\times(\frac{6}{7}\times\frac{2}{3})$ and from $(\frac{7}{8}\times\frac{3}{4})\times\frac{2}{3}$. In both of these cases candidates presumably thought that, as one flower had been considered, the numerator and denominator of the probabilities reduced by 1.

**(b)** This question was very well answered.

**(c)** Only the most able candidates answered this question correctly either by dividing 1575 by part **(a)(ii)** or by $\frac{3}{4}$ followed by $\frac{7}{8}$. However many performed just one of these 2 steps, dividing 1575 by $\frac{7}{8}$ to give 1800 or by $\frac{3}{4}$ to give 2100. The incorrect answer 2100 was also obtained in other equivalent ways, for example by $\frac{1575}{3}$ = 525 and then 1575 + 525. Other incorrect attempts at this question included finding either $\frac{1}{4}$ of, or $\frac{1}{8}$ of, 1575 and adding those to 1575. As these led to fractional answers candidates should have realised these could not be correct.

*Answers*: **(a)(ii)** $\frac{21}{32}$ **(iii)** $\frac{441}{1024}$ **(b)** 175 **(c)** 2400

**Question 6**

**(a)(i)** This question was very well answered.

**(ii)** The vast majority of candidates correctly used the equation $\pi r^2 \times 0.8 = 1.32$, manipulating the equation well to make *r* the subject. A large proportion of these candidates did not however maintain sufficient accuracy throughout their working. The two significant figure answer of 0.72 was very common and this lack of accuracy was penalised. Less able candidates used an incorrect formula for the volume such as $2\pi r^2 h$ or $\frac{\pi r^2 h}{3}$.

**(iii)** The vast majority of candidates correctly found the surface area of the cuboid. The most common error seen here was to treat the front, back, top and bottom faces as identical, usually with dimensions 0.8 by 1.5. Other candidates found the surface area of only three faces. A very few candidates mistakenly found the volume instead of the surface area. Finding the surface area of the cylinder proved to be more of a challenge. Combinations of the following errors were seen from many candidates: one or both of the circular faces were omitted; the width of the curved face was calculated as $\pi r$ or $4\pi r$ instead of $2\pi r$; the width of the curved face was not multiplied by 0.8 to find the area; the volume of the cylinder was used instead of the surface area. Although many candidates did show their working clearly, there was a significant number who just wrote down approximated decimals for some stages of their calculation. Candidates should be reminded that approximated values often do not inform the examiner that a correct method has been used. Even candidates who successfully applied a fully correct method for this question often did not achieve a sufficiently accurate answer. Working with at least four significant figures throughout a multi-step problem is necessary to obtain a final answer accurate to three significant figures.

**(b)(i)** Many candidates were able to write down the two correct inequalities. The most common errors were reversing one or both of the inequality signs or using > instead of $\geqslant$. Some candidates confused the orange and lemon sweets and wrote $x \geqslant 2$ instead of $y \geqslant 2$ whilst others used $2y$ instead of $y$ to give $x + 2y \geqslant 9$. Less able candidates omitted this question.

**(ii)** Candidates with correct or reversed inequalities in part **(i)** usually drew accurate ruled lines. Of these candidates, most shaded the correct side of each of their lines for their inequalities. A common error seen was to draw the line $x = 2$ instead of $y = 2$, even after a correct inequality in part **(i)**. Less able candidates were unable to draw the boundary line for the given inequality.

**(iii)** Many correct answers were seen in this question regardless of the quality of the region indicated in part **(ii)**. Candidates who did not find the correct value for the *lowest* cost nevertheless gave values of $x$ and $y$ that were then used correctly in the expression $2x + 3y$ to find a valid cost of a bag of sweets. Other candidates confused $x$ and $y$ and so evaluated $3x + 2y$. Less able candidates either omitted this question or did not use integer values for $x$ and $y$.

*Answers*: **(a)(i)** 1.32 **(ii)** 0.725 **(iii)** 0.513 to 0.518 **(b)(i)** $x + y \geqslant 9$ , $y \geqslant 2$ **(iii)** 20, 7, 2

**Question 7**

**(a)** This question was usually answered correctly, often without any working shown.

**(b)(i)** This question was generally answered correctly. Almost all candidates earned at least one method mark. Many candidates multiplied out the denominator, occasionally incorrectly.

**(ii)** The candidates who realised that this part followed from using part **(i)** found the required working very straightforward. The many candidates who did not see the connection found the task very challenging with errors of signs and incorrect expansions of brackets from an equation involving fractions. Some candidates seemed to be trying to work backwards from the given equation to one not involving fractions.

**(iii)** Almost all candidates scored well with the quadratic formula as correct substitutions were clearly shown. The fraction line in the formula was occasionally too short. The final answers to two decimal places were often seen but answers given to one decimal place (i.e. three significant figures) were seen quite frequently.

**(iv)** This question was more demanding than expected as few candidates realised that the solution was obtained by dividing 1000 by their positive answer from part **(iii)**. The two common errors seen were the addition of 4.50 to their positive answer from part **(iii)** and the substitution of their positive answer from part **(iii)** into the equation.

*Answers*: **(a)** 54.50 **(b)(i)** $\frac{1000}{x(x+1)}$ **(iii)** −15.42, 14.42 **(iv)** 69.34 to 69.37

**Question 8**

**(a)** This question proved to be challenging with many candidates earning no marks. The more able candidates used the exterior angle of the cyclic quadrilateral and then angle at the centre of the circle. The very common error was to think that quadrilateral *DOBA* was cyclic.

**(b)** This question also proved to be very demanding as most candidates did not appreciate that the perpendicular from *O* to the chord bisected the chord and consequently they did not draw an appropriate right-angled triangle in which to use Pythagoras' theorem.

**(c)** Many candidates did realise that there were two similar triangles and reached the correct solution. A few gave their answer to only two significant figures and a few did not use corresponding sides in their ratio statement. Some candidates wasted time by using the cosine rule and sine rule in triangle *KLX* to find two of its angles and then used the sine rule in triangle *NMX*, often reaching the correct answer. A significant number of candidates assumed the triangles were right-angled and used Pythagoras' theorem.

**(d)** This question was answered correctly by only the most able candidates as they were required to use the ratio of similar areas to set up and solve an algebraic equation. It was a challenging question, although a mark was available for recognising that the linear scale factor had to be squared. Few candidates scored any marks in this question because they used the linear scale factor or equated the areas of the two triangles. Of those who started with a correct equation, many did not cancel common factors and reached a cubic or quartic equation. Those who did simplify the equation usually gained full marks. This question was omitted by a large majority of candidates.

*Answers*: **(a)** 80, 160 **(b)** 6.24 **(c)** 5.05 **(d)** 4

**Question 9**

**(a)(i)** This question was almost always answered correctly.

**(ii)** This question proved to be challenging. Many candidates had the correct first step of $y - 2 = \frac{3}{x}$.
The most common error was initially to attempt to multiply by $x$ and reach $yx = 3 + 2$ and it was impossible to gain any marks after this fundamental error.

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

**(ii)** The candidates who answered this question in the steps hhh(2) = hh(4) = h(16) always reached the correct solution. A very common incorrect answer was 256 and the working leading to this was rarely clear. Less able candidates evaluated h(2) × h(2) × h(2).

**(iii)** This question was often answered correctly. Most candidates reached $2 - x = 2^3$ but a significant number went on to make sign errors which led to answers of 6 or –4.

**(iv)** Many candidates reached the correct solution but after far more work than was necessary. The efficient method of evaluating g(−1) was rarely seen.

*Answers*: **(a)(i)** 1.5 **(ii)** $\frac{3}{y-2}$ **(b)(i)** –3 **(ii)** 65 536 **(iii)** –6 **(iv)** 3

**Question 10**

**(a)** This question was usually answered correctly. The common error was to solve $3x + x = 60$. A few candidates confused perimeter with area.

**(b)** Most candidates recognised the need to use Pythagoras' theorem but many didn't correctly square the terms and reached a hypotenuse of $\sqrt{7}x$. Others omitted to square root and reached the quadratic equation $3x + 4x + 7x^2 = 60$. Other solutions did not involve Pythagoras' theorem and many assumed the hypotenuse to be $x$ and thus reached the answer of 7.5. Again some candidates used area instead of perimeter.

**(c)** Many candidates recognised that a quarter of the circumference was needed but of these a large number omitted to add the radii. Many did form the correct equation but some calculated $\frac{90 \times 2\pi x}{360}$ as $1.57x$ to reach $3.57x = 60$ which often led to an inaccurate answer due to the premature approximation. Again some candidates used area instead of perimeter.

*Answers*: **(a)** 7.5 **(b)** 5 **(c)** 16.8

# MATHEMATICS

**Paper 0580/43**
**Paper 43 (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 paper covered a wide range of topics from the syllabus and most candidates were able to make a positive attempt at some or all of the questions. More able candidates provided solutions that usually displayed clear methods. However some candidates provided solutions with little or no working and some didn't carry out calculations to sufficient accuracy and consequently lost marks. Candidates appeared to have sufficient time to complete the paper and any omissions were due to lack of familiarity with the topic or difficulty with the question rather than lack of time. For questions requiring several calculations, candidates are advised to write down the answer to each step using more than 3 significant figures and only correct to the required accuracy at the end of the calculation.

The topics that proved to be more accessible were ratio and percentages, drawing curves, manipulating simple algebraic expressions and equations and sequences. The more challenging topics were interpretation of graphs, determining the combination of outcomes to give a result in probability, interpreting statistical data, using algebraic methods to show a result and some aspects of the question on vectors.

## Comments on Specific Questions

### Question 1

**(a) (i)** This question was almost always correct. Errors usually involved division by 25 and occasionally finding the number of edge pieces rather than the total number of pieces.

**(ii)** This was another part that was frequently correct. Errors usually involved the percentage of the number of edge pieces as a percentage of the number of inside pieces.

**(iii)** Again, this was a part that was mostly correct. Most answers were given as decimals and any errors seen were usually due to finding Betty's time or incorrectly converting to hours and minutes.

**(b)** Many appeared to understand that the sale price was 65% and a majority of these went on to obtain the correct answer. However, some then went on to calculate 35% of $15.99 and add it on.

**(c)** Only a minority of candidates realised the correct relationship between the ratio of the areas and the ratio of the lengths. Those who did usually gained full marks. A few used the length, 35, and width, 25, of the photograph and trialled scaled up values until they reached $63 \times 45 = 2835$. However, many used the area scale factor of 3.24 as a length scale factor leading to the common incorrect response of 113.4. Others squared the ratio of areas rather than taking the square root.

**(d) (i)** A small majority of candidates were able to convert the area units correctly. Many however simply divided by 100 to obtain 66.1.

**(ii)** The majority of candidates appreciated that the percentage profit was based on the cost price and not the selling price and usually earned all three marks. A few reached 148% but then forgot to subtract 100. Almost all other errors involved those basing the profit on the selling price.

*Answers*: **(a)(i)** 1050 **(ii)** 12 **(iii)** 5.25 **(b)** 24.60 **(c)** 63 **(d)(i)** 0.661 **(ii)** 48

**Question 2**

**(a)** Most candidates were able to complete the table correctly. Errors in completing the table were few and far between and usually involved evaluating $\frac{2}{-2^2}$ instead of $\frac{2}{(-2)^2}$.

**(b)** The points were usually plotted correctly with occasional errors involving the misinterpretation of the scale on the *y*-axis. Curves were usually smooth but a number of candidates joined their points with line segments. A few joined the two branches of the curve. Some candidates used a pen to plot their points and draw their curve, making it difficult to make changes when slips were made. Some curves were drawn with thick lines which led to the loss of marks for the quality of the curve.

**(c)** This was frequently interpreted as 'the largest value of *y*' and 24.1 was a very common error. Those with some idea of what was required gave the incorrect answer of 6. Very few candidates were able to give the correct answer.

**(d) (i)** More able candidates could draw the correct line and use the points of intersection with the curve to find three solutions. Inaccuracies in drawing the curve, or line, usually meant that one or more of the solutions were outside the required tolerance. A significant number were unable to draw the correct line.

**(ii)** Yet again more able candidates performed well. Others struggled to make a correct start. Some opted to eliminate the fraction as their first step and often forgot to multiply the $3x + 1$ by $x^2$. Those that opted for collecting terms often made errors with the signs when rearranging.

*Answers*: **(a)** –4.5 and 10.5 **(c)** 5 **(d)(i)** –0.4 to –0.31, 0.35 to 0.45, 2.2 to 2.3

**(ii)** 6, –14, 0

**Question 3**

**(a)** Almost all candidates were able to solve the equation correctly. The few errors seen usually involved one or more sign errors when rearranging the equation or leaving the answer as an unsimplified improper fraction.

**(b)** Candidates were only slightly less successful in this part of the question. In addition to the type of error seen in part **(a)**, some candidates made errors with the inequality.

**(c)** Almost all candidates factorised the quadratic expression correctly. Errors usually involved the signs reversed or going further than needed and treating the question as a quadratic equation.

**(d)** Candidates were slightly less successful in this part. Errors usually involved the omission of one or both of the squares, most often with 6*y*, or incorrect signs when collecting the *xy* terms.

*Answers*: **(a)** 2.25 **(ii)** $x \geqslant 3.5$ **(iii)** $(x - 7)(x + 3)$ **(iv)** $12x^2 + xy - 6y^2$

**Question 4**

**(a)** Many correct answers were seen. Errors usually involved a refection in an incorrect vertical line or reflection in the line $y = 1$.

**(b)** Most candidates were able to draw the correct image with some earning one mark for a translation with either the correct horizontal displacement or the correct vertical displacement. A small number misinterpreted $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and translated the triangle using $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$.

**(c)** Candidates were less successful in this part of the question. Most understood how to enlarge the triangle with scale factor 2 but were less clear on how to use the centre of enlargement and so the image triangle was often in the incorrect position. The given centre of enlargement (4, 5) often became one of the vertices of the image triangle or was placed in the 'centre' of the image triangle. A small number enlarged the triangle with scale factor 3.

**(d)** Most candidates were able to correctly identify the rotation and also the angle of 90° although a significant number omitted the direction of rotation. Identifying the centre of rotation proved more challenging with many incorrectly giving (6, 4) and to a lesser degree (6, 3).

*Answers*: **(d)** Rotation, 90° clockwise, centre (7, 4)

**Question 5**

**(a)** Many answered this part well with a few candidates adding the probabilities rather than multiplying.

**(b)** Candidates were far less successful in this part. The most common incorrect answer came from $\frac{7}{8} \times \frac{7}{8}$.

**(c)** Candidates were generally more successful in this part than part **(b)** with a small majority reaching the correct probability. Less able candidates tended to work out the probability that the first spin is odd and the second spin is even, not appreciating that the result could be achieved in the reverse order also.

**(d)** This proved to be the most challenging part of the question. It was common to see candidates considering some of the possible combinations, but not all. Many considered (5, 8) and (6, 8) but forgot the possibility of (8, 8). When calculating probabilities, the fact that there were two 5's was often overlooked. The small number that drew up a complete possibility diagram usually obtained the correct answer. A significant number attempted a tree diagram, but with so many outcomes to consider these were often incorrect.

**(e)** This proved less of a challenge than the previous part. Successful candidates tended to list the possible combinations and a few drew a possibility diagram. Others attempted to list the individual outcomes such as (3, 4), (3, 4), (3, 4), (3, 5) etc., but all too often some outcomes were omitted or repeated numbers were not taken into account. Only the more able candidates used a more efficient approach such as (3, more than 3), (4, more than 4), etc. A significant number calculated the probability of (3, 4) + (4, 5) + (5, 6) + (6, 8).

*Answers*: **(a)** $\frac{1}{64}$ **(b)** $\frac{63}{64}$ **(c)** $\frac{30}{64}$ **(d)** $\frac{7}{64}$ **(e)** $\frac{24}{64}$

**Question 6**

**(a)** Many candidates were familiar with the cosine rule and made good attempts to find the required angle. Most started with the explicit version of the cosine rule but those starting with the implicit version were more prone to errors when rearranging. A very frequent error was omitting to show the required angle to more than one decimal place after otherwise correct working. Premature approximation with values in the working often led to inaccurate answers.

**(b)** More able candidates were successful in this part but less able candidates found this more challenging. The cosine rule and the sine rule were widely used to find angle *BLA* or angle *BAL*. Several of those who obtained a correct value for their angle were unable to continue and find the correct bearing angle. Premature approximation with values in the working often led to inaccurate answers.

**(c)** This proved more challenging for all candidates. Many candidates struggled to identify the required distance *BC* where the light was visible and many opted for *AB*, *AL*, *BL* or *AC*. Those that opted for *BC* used a wide variety of methods, some long-winded, that often resulted in a loss of accuracy along the way. Most candidates who had found a distance were able to then calculate a time correctly.

*Answers*: **(a)** 130.11 **(b)** 59.5 **(c)** 1h 50 min

**Question 7**

**(a) (i)** Most candidates were able to read off the value of the lower quartile without a problem but many appeared to struggle reading off the scale for the upper quartile. Almost all candidates that had values for the two quartiles were able to calculate the inter-quartile range from their values.

**(ii)(a)** Many responses were seen with candidates identifying that the median for Website *A* was lower than the median for Website *B* but then spoiling it by the inclusion of other statistics in their reasoning.

**(ii)(b)** Candidates were more successful in their comparison of the upper quartiles, rarely including other statistics in their reasoning.

**(b)** The correct method was frequently seen with few arithmetic errors. Common errors included the use of the upper bounds of the interval rather than the mid-values and in some cases using the interval widths instead of the mid-values. A small number simply added the mid-values and divided by 6.

**(c)** Many candidates were successful in calculating the cost of a monthly payment. For others, the calculation of the deposit was often correct but this was then subtracted from the cash price rather than the total cost leading to the common incorrect answer of $273.75.

*Answers*: **(a)(i)** 6000, 10200, 4200 **(ii)(a)** True, median price lower **(ii)(b)** False, A's UQ < 13600 **(b)** 11025 **(c)** 323.25

**Question 8**

**(a)** This proved to be the most challenging question on the paper. Although an algebraic method was asked for, many candidates attempted methods involving trigonometry. Others used the given value of $r$ to find the distance from $O$ to the chord $AB$ and then Pythagoras' theorem to show that half the length of $AB$ was 12. These methods earned no credit. Those that identified the perpendicular from $O$ to $AB$ as $18 - r$ usually went on to make a correct statement for Pythagoras' theorem. Not all went on to show that $r = 13$ as some struggled to expand $(18 - r)^2$ correctly.

**(b)** Most candidates were able to use simple trigonometry or the cosine rule to find angle *AOB*. Many, however, gave their answer as 134.8 and so omitted to show that the answer rounded to 134.8. In all such questions it is important that candidates obtain their answer to a greater degree of accuracy than given in the question. Some candidates assumed the value of 134.8 to find the angle *OAB* and then used their answer to find angle *AOB*. This circular argument earns no credit.

**(c) (i)** There was a lot of confusion over terminology such as sector and segment and this was reflected in some of the responses that were seen. More able candidates generally performed well, some finding the area of the minor sector and subtracting that from the area of the circle. Others opted to find the angle in the major sector and obtain their area directly. A significant number of candidates opted to calculate the area of half of the major sector but often omitted to multiply their answer by 2. As a result of the confusion, a significant number gave the area of the major segment as their answer. Loss of accuracy in the final answer resulted from premature approximation of some of the intermediate values.

**(ii)** Those that were successful in the previous part usually went on to find the area of triangle *OAB* and correctly find the area of the major segment. Some candidates restarted rather than use their previous answer, although not all were successful. A significant number with an incorrect answer in part **(i)** were able to earn marks for a correct method based on their previous answer.

**(iii)** Candidates of all abilities were more successful in this part, appreciating that the volume could be found by multiplying their previous answer by 40.

**(d)** A significant number of candidates were able to equate an expression for the volume to their previous answer. Most went on to obtain a correct answer based on their previous answer. Some, usually the less able candidates, used an incorrect formula for the volume of a cylinder.

*Answers*: **(b)** 134.76 **(c)(i)** 332 **(ii)** 392 **(iii)** 15700 **(d)** 29.5

**Question 9**

**(a)(i)** Many correct answers were seen. The most common error involved $2 \times 3 - 3 \times (-2)$, often evaluated as 0.

**(ii)** This question proved challenging, with only a minority obtaining the correct answer. Partial credit could be earned for a correct method but frequently the modulus was calculated as $\sqrt{12^2 - 5^2}$. Others simply interpreted the question by taking the absolute values of the two components and $\begin{pmatrix} 12 \\ 5 \end{pmatrix}$ was a common incorrect answer.

**(b) (i)(a)** Many correct answers were seen along with incorrect answers such as $\mathbf{a} + \mathbf{b}$.

**(i)(b)** Few of the less able candidates could obtain the correct answer with a common incorrect answer being $\frac{3}{5}\mathbf{b} - \mathbf{a}$. Others misinterpreted the ratio and fractions, so that $\frac{2}{3}$ often appeared in incorrect answers. More able candidates were frequently successful.

**(i)(c)** Many candidates found this part challenging. Some opted for the route $\overrightarrow{OB} + \overrightarrow{BM}$ but often used $\overrightarrow{MB}$ rather than $\overrightarrow{BM}$. Those that opted for the route $\overrightarrow{OA} + \overrightarrow{AM}$ were slightly more successful as they could use their answer to the previous part. Some more able candidates did not earn full credit as their answers were not always simplified.

**(ii)** Very few correct answers were seen in this part. There was little evidence that candidates connected this with the previous part and many answers were given without any working.

*Answers*: **(a)(i)** $\begin{pmatrix} 12 \\ -5 \end{pmatrix}$ **(ii)** 13 **(b)(i)(a)** $\mathbf{b} - \mathbf{a}$ **(i)(b)** $\frac{3}{5}(\mathbf{b} - \mathbf{a})$ **(i)(c)** $\frac{1}{5}(2\mathbf{a} + 3\mathbf{b})$ **(ii)** 1.5

**Question 10**

**(a)** Almost all candidates were able to complete the first column correctly. Less able candidates struggled to find the general terms but many of the others were successful. For the linear sequences, if the candidate obtained the $3n$ or the $-6n$ they were usually successful in finding the appropriate number term. Many spotted the general term for the third sequence but far less were successful with the final sequence, not recognising that the sequence was obtained by subtracting $n$.

**(b) (i)** Many candidates successfully equated the given expression to 155 and were able to show the required result. Most incorrect answers resulted from substituting $n = 155$ into the given expression.

**(ii)** Many correct solutions of the quadratic equation were seen; the majority of these were worked out using the quadratic formula. Errors with the signs and incorrect substitutions were seen. Only a very few candidates used the method of completing the square.

**(iii)** Not all candidates related this to the previous part and $n$ was a common incorrect answer. A few gave their answer as a fraction and occasionally as a negative number. However, many correct answers were seen.

*Answers*: **(a)** 14, $3n - 1$
$-4$, $26 - 6n$
25, $n^2$
20, $n^2 - n$
**(b)(ii)** 10 and $-\frac{31}{3}$ **(iii)** 10

**Question 11**

Credit was earned in three stages, eliminating the fractions from the equation, simplifying the result to the correct quadratic equation and solving the quadratic equation. Fully correct answers were in the minority but many earned partial credit for work at the various stages. The majority of candidates were able to earn some credit for elimination of the fractions, usually for collecting two of the given fractions as a single fraction. Errors at the first stage clearly led to an incorrect quadratic equation and many candidates earned credit for simplifying their equation to a quadratic. In most cases, solving the quadratic usually involved the use of the formula, either because of previous errors or difficulty with the correct coefficients. Making a correct attempt at solving their quadratic also earned the candidates some credit.

*Answers*: 5 and $-\frac{27}{2}$