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# MATHEMATICS

**Paper 0580/11**
**Paper 11 (Core)**

## Key Messages

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

## General comments

Candidates need to give answers in the form required, for example, in **Questions 10** and **18(b)**. Candidates must check their work for sense and accuracy as it was very noticeable that there were many calculation errors that lost candidates marks. Candidates must show all working to enable method marks to be awarded. This is vital in 2-step problems, in particular with algebra where each step should be shown separately to maximise the chance of gaining marks in, for example, **Questions 6**, **9**, **10**, **15** and **21(a)**.

The questions that presented least difficulty were **Questions 1**, **3**, and **16(a)(i)**. Those that proved to be the most challenging were **Questions 5, 8**, **13**, **17** and **22**.

## Comments on specific questions

### Question 1

Most candidates gave the correct answer to this question which was expected to be a straightforward start to the paper. Occasionally, candidates gave answers that were not fully simplified, for example, the expression, 10 – 6. A number of candidates gave the incorrect response of 14 from (10 – 3) × 2 showing that the order of operations was not well understood.

*Answer*: 4

### Question 2

The majority of candidates showed understanding of prime numbers. Some did not appear to have read the question carefully and gave examples that were outside the given range or included 21, 25 or 27. A small number wrote out the prime factors of 20 and or 30.

*Answer*: 23 29

### Question 3

In **part (a)**, the most common errors were arithmetic rather than misunderstanding that angles around a point add to 360. Occasionally, the answer to **part (b)** was given as 'acute'.

*Answers*: **(a)** 138 **(b)** obtuse

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**Question 4**

This question caused significant difficulty for many candidates. There were two sources of confusion. The first was the actual understanding of the number, which was commonly misunderstood to be 6500 or 5006000. There was even more confusion over the form it should take. In **part (a)**, a lot of candidates tried to use standard form or wrote 506 k or wrote their answer in words. For **part (b)**, forms other than standard form were seem. For those that did attempt standard form, common incorrect answers included $5.06 \times 10^3$, $5.06 \times 10^6$ and $506 \times 10^3$. It was possible for candidates to score a follow through mark in **part (b)** if their answer to **part (a)** was correctly written in standard form.

*Answers*: **(a)** 506 000 **(b)** $5.06 \times 10^5$

**Question 5**

Very few candidates were able to round all three of the numbers to one significant figure. Many attempts to round included numbers with 1 or more decimal places. Most candidates that did correctly round the numbers in the numerator, rounded the denominator to 17 instead of 20. The result of inappropriate rounding was that the majority of candidates were left with an extremely difficult calculation to do in **part (b)** but this did not cause them to reconsider their figures in **part (a)**.

*Answers*: **(a)** $\frac{5 \times 2}{20}$ **(b)** 0.5

**Question 6**

Whilst many candidates arrived at the correct solution, few showed a correct algebraic method. The first step proved problematic for many. A common error was to start by adding 8 to 11. Those candidates who did start with the division by 2 often resulted in inappropriate multiplication, with $2n - 16 = 11$ and $2n - 16 = 22$ being seen quite frequently. It was difficult to award a method mark to those who did not produce the correct answer as working was often illogical, missed out steps or included many re-starts.

*Answer*: 30

**Question 7**

This question proved to be challenging for many candidates with many giving one correct component or showing that they could evaluate 2**b** correctly but some had problems with the negative signs. A large number of candidates showed no understanding of this area of the syllabus, treating the given vectors as fractions, or writing calculations that combined all of the given numbers before arriving at a solution which contained a single component or even four. A larger number than in previous sessions used a horizontal line between the two components.

*Answer*: $\begin{pmatrix} 6 \\ -13 \end{pmatrix}$

**Question 8**

This bounds question was one of the more challenging ones as candidates had to produce decimal answers rather than figures to the nearest ten or thousand. Integer answers were very common. Candidates appeared to understand in which order to give the two bounds as fewer reversed answers were seen. Some appeared to confuse boundary values with a rounding algorithm, suggesting 455.4 as the upper value. Of those that only scored 1 mark, the lower bound was more likely to be correct.

*Answer*: 454.5 455.5

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**Question 9**

This question was a bit unusual and although most could substitute correctly, it was rare for further progress to be made. A very common error was to state that $\frac{2}{36}+\frac{36}{2}=\frac{38}{38}$. Only a minority of candidates gave a correct final answer as a mixed number. Some candidates were often unable to evaluate $6^2$ correctly and then had problems adding the two fractions with reciprocals and attempts at multiplying being seen.

*Answer*: $18\frac{1}{18}$

**Question 10**

Again this was an unfamiliar question, rather than a difficult one and that seemed to prevent candidates knowing where to start with their solution. Some errors were due to a misunderstanding of exactly what was to be square rooted, evaluating $2^{-1}$ as –2 and not using sufficient figures to give an accurate two decimal place answer. As many candidates did not show workings but only an answer, the marks for evaluating part of the calculation could not be awarded.

*Answer*: 1.37

**Question 11**

This was a twist on the standard volume question which many handled very well. However, many calculated 8 × 15 but then did not divide the volume by this value. Those who did not get to the answer usually used completely incorrect methods, for example, methods that involved subtraction or the use of Pythagoras' theorem. Many candidates used trial and error and these were generally unsuccessful.

*Answer*: 6

**Question 12**

Many candidates appeared to misinterpret the scatter graph as showing a time series. The answers 'decreasing' or 'temperature and rainfall' were seen frequently in **part (a)**. There were some very good answers to **part (b)**, but some candidates struggled to describe the relationship between the temperature and the rainfall. Answers that implied a change over time were very common. A few said 'the numbers were going up by 5' but this might be a comment on the scales used.

*Answers*: **(a)** negative **(b)** More rain suggests lower temperature

**Question 13**

The majority of candidates found this question challenging. The simplest approach was to read the graph at 24 miles and then multiply the number of kilometres by 3 to find the speed. The alternative approach was to find the number of miles travelled in one hour and then to use the graph to convert to the number of kilometres. The problem with this approach was that 72 miles does not appear on the graph so there is an extra layer of problem solving. Some candidates did read the graph to find 38 kilometres but then were unsure what to do next. A small number of candidates ignored the graph and used the approximation that 1 mile is 1.6 kilometres so 24 miles is 38.4 km and then multiplied by 3.

*Answer*: 114 to 117

**Question 14**

This was answered well by many candidates. However although some candidates showed calculations, most didn't associate their results with any of the angles on the diagram and consequently relatively few candidates gained the method mark for partially correct attempts at this question. Calculation errors were quite common. A follow through mark was available in **part (b)** if both answers totalled 127.

*Answers*: **(a)** 74 **(b)** 53

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**Question 15**

Most candidates were able to start this correctly by multiplying 1.5 and 800. The next step proved problematic for many, but those who were able to access this almost always went on to arrive at a correct solution.

*Answer*: 1.6(0)

**Question 16**

Although there were many good answers seen, the incorrect answers showed misunderstandings of the rules of indices. In **part (c)**, incorrect answers of 9 or $h^4$ were common.

*Answers*: **(a)(i)** $p^{10}$ **(ii)** $t^{-3}$ **(b)** 4

**Question 17**

Few candidates were able to offer a correct explanation in **part (a)** as they struggled with the correct vocabulary. Most simply stated that triangle *PQR* was right-angled, or that angle *PQR* was 90 degrees because it was a right angle. Candidates did well in **part (b)** but the most common error was to assume this was the more difficult application of Pythagoras' theorem as the two lengths were squared then subtracted.

*Answer*: **(b)** 19.2

**Question 18**

It is evident that some candidates have difficulty showing a given result. Candidates should handle this type of question by doing the calculation required then checking their answer against the given value and if it does not match, check their work thoroughly. In **part (a)**, some candidates had problems dealing with the whole number part of the mixed numbers. Other candidates seemed able to deal with the issue of a common denominator but there were calculation errors evident in the numerators. Candidates were more successful with **part (b)** as many candidates knew how to start by inverting the second fraction. Many then multiplied the fractions and then simplified their answer when it was more straightforward to cancel first.

*Answer*: **(b)** $\frac{7}{8} \times \frac{40}{23} = 1\frac{12}{23}$

**Question 19**

In **part (a)(i)** most candidates could identify the maximum and minimum temperatures but then either did not know how to handle the negative signs, producing an answer of 6.5, or made calculation errors. A wide variety of answers were seen in **part (a)(ii)**. Many attempted to order the temperatures, often numbering them in the table. There were many errors seen in the candidates' ordered lists, with numbers omitted. A significant number ordered the absolute values, taking no account of the fact that some of the given temperatures were clearly negative numbers. Many candidates crossed out numbers from both ends of their lists; this often resulted in a middle number rather than a middle pair being identified. Those who did obtain a correct middle pair of values often struggled to use these to find the median. Attempts to add the two numbers often resulted in an incorrect total. Others were able to add the given numbers, but did not divide their answer by 2, often giving an answer of –6.6. **Part (b)** proved to be the most accessible part of this question as many correct solutions were seen. The answers $\frac{1}{12}$ and $\frac{7}{5}$ were the most common incorrect attempts at writing the probability. It was unnecessary for candidates to try and convert the probability to a decimal or percentage as that was not asked for.

*Answers*: **(a)(i)** 40.3 **(ii)** −3.3 **(b)** $\frac{7}{12}$

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**Question 20**

Finding the number of hours for each day proved challenging for many as 19 and 12 were seen frequently. Those who reached the answers 18 and 11 usually went on to arrive at a correct answer for **part (a)**. A few candidates assumed the bus company was open for the same amount of time every day. In the next part, the most common error was to omit the pm.

*Answers*: **(a)** 119 **(b)** 1 pm

**Question 21**

In **part (a)**, many candidates used 15 as the radius. Many candidates did not seem to know the formula for the area of the circle. Consequently incorrect methods, such as the use of $2\pi r$ or $2\pi r^2$ were seen in many cases. It was evident here that a few candidates had not read the question carefully as they went on to find the area of the shaded part of the diagram. In **part (b)**, many found it difficult to position the lines accurately, although in most cases the candidates' intentions were clear. The most common error was to omit the diagonal lines.

*Answer*: **(a)** 177

**Question 22**

A wide variety of errors were seen in **part (a)**, for example, the wrong trigonometric ratio or attempts at Pythagoras' theorem. Those candidates who correctly chose the sine ratio often didn't work to a sufficient degree of accuracy in order to obtain a correct answer. A number appeared to have their calculators set to grades or radians. A large number of candidates seemed to be unclear as to what was expected for **part (b)**. Answers that showed an attempt to calculate a length, or that subtracted the answer to **part (a)** from 360 were both quite common. A number of candidates showed no calculations at all and gave compass directions, usually south east.

*Answers*: **(a)** 52.6 **(b)** 127

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# MATHEMATICS

**Paper 0580/12**
**Paper 12 (Core)**

## Key Messages

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

## General Comments

The paper was felt to be a test of basic skills with enough questions of a standard that would enable the least able candidates to gain a positive result, provided they were well prepared for the examination. Some questions did require more understanding and these did differentiate between candidates.

While the overall performance of candidates was quite good, many marks were lost by rounding too early in calculations. In particular, quite a few candidates did not show working and quoted an answer written to less than 3 significant figure accuracy. It is very important that candidates write down the expression that is to be entered into the calculator since errors do occur when working out answers and method marks can then be awarded even if an answer is given to insufficient accuracy. Exact answers should be quoted in full and the 3 significant figure accuracy applied to non-exact answers only.

Questions asking for lengths or angles on diagrams and those in a context have answers which are sensible in terms of the situation. If candidates consider the appropriateness of the answer to the situation or context, they should spot any obvious errors made.

There seemed to be more than sufficient time for candidates to complete the paper but it was of concern that some candidates did not attempt certain questions, even some straightforward tests of basic skills.

## Comments on Specific Questions

### Question 1

This very straightforward question was not answered well. Many candidates confused addition and multiplication for the algebraic expression resulting in the very common incorrect answer of $p^4$, and $p^3$ was also seen a number of times.

*Answer*: $4p$

### Question 2

The cube root notation was clearly not understood by some candidates who seemed to regard it as 3 multiplied by the square root of 16, leading to an answer of 7.10. Others gave 2.11 from the cube root of the whole expression. There were cases of over-rounding to 1.5 which, without a more accurate answer, could not gain the mark.

*Answer*: 1.49

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**Question 3**

Writing in figures is a straightforward question but the words have to be read and interpreted carefully. In part **(a)** some candidates interpreted the question as two separate numbers, 300 and 40 000. Other errors included 30 400, 34 000 or even 430 000. In part **(b)** an incorrect number of 9's, usually 5 or 7, was common and 100 000 was seen from some. It was very rare to see the question written as 1 000 000 – 1 which may well have produced more correct answers. However, there were many correct responses to both parts.

*Answer*: **(a)** 340 000 **(b)** 999 999

**Question 4**

There was more evidence of changing the numbers to decimal form than previously but many candidates did not give enough figures where needed to determine the order correctly. Four figures were needed for $\frac{5}{11}$ and at least three for $\sqrt{0.2}$. Many candidates showed no working and usually this meant no marks or just 1 mark from three items that were in the correct order. $\sqrt{0.2}$ was often written as the largest value.

*Answer*: $\sqrt{0.2}$ $\frac{9}{20}$ 45.4% $\frac{5}{11}$

**Question 5**

Both parts were answered well with just a few candidates giving −3 for part **(a)** and some giving 6 for part **(b)**.

*Answers*: **(a)** −9 **(b)** 10 or −10

**Question 6**

A common error in part **(a)** was to write the figures 57 but not add zeros or give the wrong number of them. 5.69 and 56 000 were also quite often seen. In part **(b)** quite a number of candidates did not seem familiar with standard form and a single number was often seen. For those who gave answers in the form $a \times 10^n$ common errors were $569 \times 10^3$ and $5.69 \times 10^{-5}$.

*Answers*: **(a)** 570 000 **(b)** $5.69 \times 10^5$

**Question 7**

This question caused a lot of problems for many candidates. Few realised that the total had to be 18 for a mean of 6. Even when that was realised many did not understand that a clear single mode meant that more than one '4' was required. The question was a good test of understanding of statistical measures and those who did get it correct were clearly the more able candidates overall.

*Answer*. 4 4 10

**Question 8**

Part **(a)** of this question was quite well answered as it was simply reading off the co-ordinates of the point with reference to the '5' in the equation. Some candidates gave the co-ordinates reversed while (0, 4) and (5, 5) were often seen. A response containing the letter *P* as a component was also seen from a few candidates. Part **(b)** was less well answered with many having no clear idea of a gradient, even though it could be worked out from the line or from the coefficient of *x* in the equation. 5 was a very common incorrect answer as well as −5, 1 and –*x*.

*Answer*. **(a)** (0, 5) **(b)** −1

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**Question 9**

This was the most straightforward type of simultaneous equations with no requirement to multiply either or both equations by a constant. However, some were determined to eliminate *x* and errors usually resulted. Many did get both variables correct but there were quite a lot of cases of just one correct. Subtracting, rather than adding, the equations as they stood was seen in quite a lot of candidates' responses. Candidates should check that their answers fit both equations which would enable them to correct their errors.

*Answer*. $x = 2$, $y = -3$.

**Question 10**

Many candidates gained the marks for this trigonometry question. Errors from those who recognised trigonometry included sine or tangent applied instead of cosine. Also those dividing 8 by cosine 28 should have realised that an answer greater than 8 was not possible. In this question some used 0.88 for the cosine of 28 and so lost accuracy. Several candidates gave 7.1 without a more accurate answer and so lost a mark and it is worth pointing out that 7.1 with no working did not score any marks.

*Answer*. 7.06

**Question 11**

This was quite well answered, in some way due to not needing work on decimals. The main errors were 8799.5 to 8800.5 and 8795 to 8805 with some responses of 8700 to 8900. It was noticeable that quite a number of responses for the upper limit were 8849 or 8849.9, which given the < sign, indicates they are not correct. Just a few candidates gave correct but reversed responses.

*Answer*. 8750 8850

**Question 12**

The question was quite well answered with a large number of fully correct answers in both parts. The main error in part **(a)** was to calculate 1324 – 1238 = 86. In part **(b)** many candidates gained one mark for completing just one of the two stages correctly. Once again here there were cases of more than 60 minutes in an hour, resulting in, for example, an answer of 19 65. A mark was often lost by an incorrect form of the answer, 8 05, 8 5, 08 5, 08 05 or 20 5.

*Answers*: **(a)** 46 **(b)** 20 05 or 8 05 pm

**Question 13**

The topic of bearings seems to be challenging for a lot of candidates. While a measure of 30° and subtraction of it from 180° was often seen, few seemed to realise that subtraction from 360° was needed. A number were confused between the two parts and gave a length for part **(a)(i)**. In contrast the conversion to distance in part **(a)(ii)** was answered well with most candidates not simply measuring the length in centimetres.
Part **(b)** was quite challenging and consequently the majority did not gain the mark, which needed some evidence of calculation. Those who did understand how to change units of volume usually produced clear, correct solutions.

*Answers*: **(a)(i)** 326° to 330° **(a)(ii)** 1100 to 1140 **(b)** *B*

**Question 14**

Part **(a)** was very well answered although quite a number of candidates did not divide by 3 and so had the answer 105.
Some candidates thought that changing the subject of a formula in part **(b)** meant a numerical answer or one not containing *V* was required. Otherwise many gained 1 mark, usually from dividing by *A* but division by $\frac{1}{3}$ rather than multiplying by 3 was not considered a satisfactory form of the changed formula.

*Answers*: **(a)** 35 **(b)** $\frac{3V}{A}$

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**Question 15**

While many correct responses were seen, some candidates gave 3.2 without any working which could not get credit. With the working shown it would have gained 2 marks. Otherwise 61 was used by some as the original value and (63 – 61)/100 × 100 = 2% were errors often seen.

*Answer*. 3.17

**Question 16**

Most candidates gained the first mark for $\frac{3}{4}$ but many were not clear how to show the subtraction of fractions. A few attempted a full decimal solution but only the mark for 0.75 could then be gained. However, many gave a fully correct solution.

*Answer*. $\frac{1}{12}$

**Question 17**

Many candidates gained the full marks but most made some progress towards the solution. Many final answers were totally unrealistic for the number of minutes for a plane to travel 800 km. A number of candidates were confused about dividing 800 by 180 or the other way round. Some solutions ignored the factor of 60 for changing to minutes or 1000 to change between metres and kilometres. It was a question that required developing in stages and certainly the more able candidates did achieve well on it. Only a few who reached a correct solution didn't gain the last mark for the required rounding.

*Answer*. 74

**Question 18**

Part **(a)** of this straightforward question was not so well answered. Some regarded the given probability as a percentage and offered the answer 99.82. Others did not observe the '**not**' in the question.
The other parts were well answered, but some candidates did not observe the forms for probability of fraction, decimal or percentage. Some candidates used 15 as the denominator and in part **(b)(ii)** some gave two separate fractions instead of the sum of them.
While the vast majority gained the mark in part **(b)(iii)**, a value was required and answers of impossible, no and none were not acceptable.

*Answers*: **(a)** 0.82 **(b)(i)** $\frac{5}{14}$ **(ii)** $\frac{9}{14}$ **(iii)** 0

**Question 19**

The types of angles were quite well known but many candidates gave obtuse for part **(b)**. Almost all knew the term for the lines in part **(c)** but a lot were confused about part **(d)** with line and congruent seen quite often.

*Answers*: **(a)** acute **(b)** reflex **(c)** parallel **(d)** perpendicular

**Question 20**

In both these parts the answers were exact and candidates should give the exact answers, even if a rounded answer appears more appropriate. However those giving the full answer before rounding gained both marks. Apart from the rounding issue, many confused volume and surface area and some who showed the method for volume did not do the correct calculation of $6.7^3$, often calculating 3 × 6.7.
Candidates were less successful with the surface area in part **(b)** where often the area of one side was given. Some multiplied their volume by 6.7 while others calculated $6.7^2$ but only multiplied it by 4. It was not uncommon to see cases of π used in both parts even though there was a clear diagram of a cube shown.

*Answers*: **(a)** 300.763 **(b)** 269.34

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**Question 21**

Part **(a)** on area of a circle was quite well answered but some candidates did not know the formula or omitted to halve the diameter. Most are using the calculator value of π or 3.142; the use of the approximations 3.14 and $\frac{22}{7}$ lose the required accuracy.

The majority of candidates gained the 2 marks in part **(b)(i)** but some clearly did not understand the 3-letter notation for an angle. 63° and 90° were given by some as well as 117, the latter suggesting that two angles added to 180°.

Many did not gain the mark for the last part of the question. Those who chose to justify the right angle usually referred to the tangent but not the radius or diameter as the other line bounding the 90°. Most who chose the other property gained the mark but many chose to write down the calculation performed to find the angle *ACO* and not put into words the geometrical reason.

*Answers*: **(a)** 177 **(b)(i)** 27°

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# MATHEMATICS

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

## Key Messages

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

## General comments

The vast majority of candidates could access most of the questions. It is important, however, that candidates need to understand the correct form for answers - probability should not be written as a ratio and vectors should not contain a fraction line.

The majority of candidates are showing working although several did not show enough working in **Question 23**. It appears a small number of candidates did not have access to, or were not able to use a pair of compasses correctly. Several candidates were unable to distinguish between perimeter and area.

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. A small number of candidates gave the answer −3.

*Answer*: −19

### Question 2

This was well answered with the majority of candidates giving the correct answer. A small number of candidates gave answers of 645 or 6.45.

*Answer*: 64.5

### Question 3

This was well answered with the majority of candidates giving the correct answer. If candidates had realised the angle was obtuse they may have avoided the common error of 52°.

*Answer*: 128

### Question 4

56.2 + 174 from 56 – (34.8 ÷ −0.2) was the common error. Practice using a calculator for this type of calculation would help candidates in the future.

*Answer*: −107

### Question 5

This was generally well answered. A small number of candidates gave answers of 0 or 7.

*Answer*: 1

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**Question 6**

Some candidates did not appear to know what standard form was. Those with some understanding often gave $45 \times 10^3$ or $4.5 \times 10^5$.

*Answer*: $4.5 \times 10^4$

**Question 7**

Most of those candidates who understood the concepts of nets were able to give the correct diagram. Common errors were 3-dimensional drawings or adding an extra square on a side.

**Question 8**

The majority of candidates were able to answer the question correctly, although 33 and /or 39 were often included or 31 given alone.

*Answer*: 31, 37

**Question 9**

**(a)** Those who understood vectors have 2 components usually got both correct. Others often wrote just one component. A small number of candidates made errors with signs.

**(b)** The majority of candidates gave the correct answer. In both parts several candidates added a fraction line.

*Answer*: **(a)** $\begin{pmatrix} -6 \\ 8 \end{pmatrix}$ **(b)** $\begin{pmatrix} -5 \\ -2 \end{pmatrix}$

**Question 10**

**(a)** Even though there were few numbers to choose from, quite a number of candidates found both a cube number and a factor of 4 difficult to comprehend. 4 was the most common incorrect response.

**(b)** Apart from some candidates confusing factors and multiples, this was well answered. Some had clearly not read the question carefully as they had simply repeated 1258.

*Answer*: **(a)** 8 **(b)** 1224 or 1292

**Question 11**

This was not well answered with many candidates repeating a number. Those who managed to give the correct numbers on the left side almost always scored both marks.

*Answer*: −3, −5, 0 (=) −8

**Question 12**

Very few candidates were able to answer this question correctly. It appeared some did not have a strategy to solve the problem. Some had worked out 6 but then did not know what to do for the second stage. Common errors were to divide 36 by 4 or $36^2 = 1296$.

*Answer*: 24

**Question 13**

This question was found challenging and many did not understand what was required. Several of those who did have the correct answer showed little idea of method with trial and improvement being frequently seen.

*Answer*: 8

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**Question 14**

This was well answered but again errors on directed number manipulation spoiled several solutions.

*Answer*: − 22

**Question 15**

**(a)** This was generally well answered. Common errors were 13 or giving the answer in an incorrect form or ratio.

**(b)** More correct answers were seen in this part, although 11 and an incorrect form were again seen. If candidates give the answer as a percentage they must ensure they include the percentage sign.

*Answer*: **(a)** $\frac{13}{24}$ **(b)** $\frac{11}{24}$

**Question 16**

Very few candidates were able to answer this correctly, although many did identify $\frac{3}{6}$ and $\frac{4}{6}$. Some then gave $\frac{3.5}{6}$ but did not do any further work.

*Answer*: $\frac{7}{12}$

**Question 17**

This question was generally well answered. The main errors were not bisecting the given line but drawing a line on one side only or not using two sets of arcs.

**Question 18**

Many candidates were able to give the correct answer but several used the total angle as 180° rather than 360°. A smaller number thought the angle was 100°.

*Answer*: 84

**Question 19**

The majority of candidates were able to give the correct answer. Only a small number of candidates used multiplication rather than division. Some who did use division divided by 1350 rather than 1.313.

*Answer*: 1030

**Question 20**

There was confusion between translation and other transformations. Many candidates were able to score 1 mark for a correct translation in one direction.

**Question 21**

The confusion between 180° and 360° spoilt the method for some but there were quite a lot of correct responses. The two marks only for the question should have made those who tackled long methods realise that only one method stage was needed.

*Answer*: 12

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**Question 22**

**(a)** Many candidates did not understand the term 'congruent'. Those who did understand the term generally got both parts correct. 46° was a common incorrect answer.

**(b)** Those who gave the correct answer in **(a)** generally gave the correct answer in this part. The common error was 9.65.

*Answer*: **(a)** 74 **(b)** 8.69

**Question 23**

Most candidates achieved full marks, but it should be stressed to candidates that marks will not be awarded for questions without working when the question clearly states "Write down all the steps in your working". Changing from $1\frac{1}{4}$ to $\frac{5}{4}$ was nearly always correct. Some candidates then missed out the next step of working and went straight to the answer, thus losing marks. The answer of $\frac{-2}{-5}$ was sometimes seen.

*Answer*: $\frac{17}{36}$

**Question 24**

This question was generally well answered. Some candidates had answers of more than 3 significant figures e.g. 6.47, which made working out the second value difficult. Candidates should be encouraged to go back and check their answers.

*Answer*: ($x$) = 4 ($y$) = 7

**Question 25**

**(a)** This part was generally correctly answered.

**(b)** This part was generally correct, with few incorrect statements seen.

**(c)** This part was generally correct.

**(d)** Fewer correct answers were seen in this part, with some rounding prematurely leading to inaccurate answers of 14.8 and 15.4.

*Answer*: **(a)** 6 **(c)** 16 **(d)** 15

**Question 26**

**(a)** This part was well answered with just a few candidates giving a partial factorisation. Some had $a^2$ as a factor and a few did not understand how to factorise. $10a^2b$ was a common error.

**(b)** Again this part was generally well answered with a few candidates giving $y^3$ in their answer.

**(c)** Many candidates gained 1 mark for $3x–6$ but few achieved a fully correct expression. A significant number made errors with signs.

**(d)** Although several candidates scored full marks there was some poor algebraic manipulation, even after $8x + 9 = 3x + 24$ was seen.

*Answer*: **(a)** $5a(3a^2 - b)$ **(b)** $3x^6y^4$ **(c)** $6 – 5x$ **(d)** 3

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**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**International General Certificate of Secondary Education**

# 0580 MATHEMATICS

**0580/17** **Paper 17 (Core)**

Due to a security breach we required all candidates in Kuwait who sat the paper for 0580/12 to attend a re-sit examination in June 2014. Candidates outside Kuwait sat only the original paper and were not involved in a re-sit.

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# MATHEMATICS

**Paper 0580/17**
**Paper 17 (Core)**

## Key Messages

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

## General comments

Often questions stipulate the form the answer must take, for example correct to 4 significant figures in **Question 12** or answers in dollars and cents in **Questions 11** and **15**. Questions in context require candidates to consider whether their answer make sense, for example in **Question 19** regarding time and distance travelled, and volumes in **Question 21**. Candidates must show all working to enable method marks to be awarded. This is vital in 2-step problems, in particular with algebra where each step should be shown separately to maximise the chance of gaining marks in, for example **Questions 11**, **13**, **16** and **19**. This will also help candidates check their own work.

The questions that presented least difficulty were **Questions 1**, **4**, **5**, **8**, **9a**, **22(a)(i)** and **23(a)**, Those that proved to be the most challenging were **Questions 10, 13**, **14**, and **21**. The question that showed the highest number of blank responses was **Question 21(b)**; a question in context. However, in general, the number of questions with no responses was low compared to past sessions.

## Comments on specific questions

### Question 1

Most candidates gave a correct answer to this question which was expected to be a straight forward start to the paper. However, a few showed only partial understanding of the question, giving the answer as 7×3 rather than a single factor or list of factors. A small number realised that they could answer with 1 or 21, therefore not having to find a different number that divided into 21.

*Answer*: 1 or 3 or 7 or 21

### Question 2

This question on place value, and writing a number in figures when given in words, was one that almost all candidates attempted but only about a third answered correctly. The problem for candidates here was where to place the zeros. The most common wrong answer was 4 002 906.

*Answer*: 402 906

### Question 3

Many names were correct but pentagon and octagon were seen occasionally. The spelling was not always accurate.

*Answer*: Hexagon

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**Question 4**

A large majority of candidates were correct with this directed numbers question. The only wrong answer of +5, was seen infrequently.

*Answer*: - 5

**Question 5**

Again, a large majority of candidates gave the correct answer to this question on angles. Those that were not correct either measured the angle, took 76 from 360 or 90 or added 76 to 180.

*Answer*: 104

**Question 6**

All candidates gave answers to this inequalities question. Given the three choices, there was no excuse to leave this question blank. Candidates were more successful with **part (b)**. Candidates could have worked out 8 ÷ 11 on their calculator to assist with part **(a)**. A few thought that $\frac{8}{11}$ equals 72%.

*Answers*: **(a)** > **(b)** <

**Question 7**

Some candidates named the shape rather than writing the order of rational symmetry. The common wrong answers involved all of the integers from zero up to six. The most common error for **part (b)** was for candidates to only draw the vertical line of symmetry. As the question uses the plural, lines, candidates should have realised that there were at least two lines to draw.

*Answers*: **(a)** 7

**Question 8**

Candidates did well with both parts of the question with only a small number working out the answers as the questions stood, i.e. 10 for **part (a)** and 59 for **part (b)**. Candidates generally did not use more than one bracket in each part as has been seen in previous sessions.

*Answers*: **(a)** **(6 + 14)** ÷ 2 −3 = 7 **(b)** 9 + $4^2$ × **(3 + 2)** = 89

**Question 9**

A few candidates gave $\frac{1}{7}$ for part **(a)** and others gave a decimal or percentage close to the correct answer but as these were not accurate they did not get the mark. Candidates had to use their probability from **part (a)** to work out the expected frequency of choosing an A for **part (b)**. This was not done so well with unrealistic answers such as fractions or an impossible answer of a number over 63.

*Answers*: **(a)** $\frac{2}{7}$ **(b)** 18

**Question 10**

This bounds question was one of the more challenging ones as candidates had to produce decimal answers, rather than figures to the nearest ten or a thousand. Integer answers were very common. Candidates appear to understand in which order to give the two bounds as fewer reversed answers were seen than in past sessions.

*Answer*: 7.75; 7.85

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**Question 11**

If candidates understood the compound interest formula and could substitute the relevant data, they did well. There are other ways to tackle this type question so knowledge of the formula is not necessary and in fact working out the interest year by year is easier to understand. Some candidates found the correct answer and, maybe because they did not understand the formula, then went on to add on another $600. Others subtracted $600 which may have been a misunderstanding of the question as sometimes candidates are asked for the interest only. Answers in money should be given to the nearest cent unless the question states otherwise.

*Answer*: 648.96

**Question 12**

Many candidates gave answers to more than 4 significant figures or 0.8664, a truncation of the decimal. It was also common to see 0.866, which is correct to 3 significant figures but maybe some of these candidates thought incorrectly that the zero is counted as a significant figure.

*Answer*: 0.8665

**Question 13**

Many candidates used sine or cosine when they should have used tangent. Unfortunately, some gave their answer as 6.3 with no working. This 2 significant figure answer does not imply that the correct method has been used and so does not score any marks. Some candidates, who had the right method, wrote down and used a rounded figure for tan 36 and multiplied that by 8.7, which meant that the final answer was inaccurate. Candidates should prepare the calculation on paper for direct input into their calculators so there is no need or opportunity for this early rounding.

*Answer*: 6.32

**Question 14**

Many candidates were correct with their first step of 360 subtract 286 in this question on angles, but did not know what to do with the answer of 74. Some candidates made numerical mistakes after applying one or both of the geometrical properties.

*Answer*: 32

**Question 15**

Many candidates gave 87.6 as their answer to **part (a)**. As this is a money calculation, candidates must give the answer to the nearest cent, so many candidates did not score the mark. Some candidates instead worked out what percentage 19 was of 461. A few went further than the question asked by subtracting the correct answer from $461; if candidates continue their method after a correct answer found, they may lose marks they have already gained, so it is vital that candidates answer the question that was asked. Conversely, in **part (b)**, some did not go far enough, by only giving the discount rather than the new price. There were no marks available for only getting this far, the discount had to be seen subtracted from $485 in order to be awarded the method mark. In a very few cases, candidates used the $461 from **part (a)** rather than the $485 in the question.

*Answers*: **(a)** 87.59 **(b)** 368.60

**Question 16**

The most common errors involved failing to multiply all of the given terms correctly in this simultaneous equations question. Candidates who attempted substitution methods were rarely successful. Some candidates did not know how to start and made various attempts at manipulation of the equations. A few candidates tried guessing one value then used this to calculate the other. Candidates who attempted elimination methods were usually able to make some progress and often reached a solution, although there was very little evidence of checking their answers.

*Answer*: ($x$ = ) 3, ($y$ = ) – 1

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**Question 17**

In questions using Pythagoras' Theorem, candidates need to decide whether to add or subtract after finding the squares of the given two sides. The hypotenuse or longest side is given so candidates must subtract. It was clear that candidates did not check whether their answer made sense in the context of the question. A few tried to use trigonometry to find *BC*. This can be done but is a longer, less direct method which must be completed before any mark can be awarded. A few candidates gave a 2 significant figure answer with no working, which gained them no marks.

*Answer*: 7.14

**Question 18**

Many candidates showed working in this question on fractions, but unfortunately not enough to show the entire method. It was necessary to show the addition before $\frac{19}{24}$ is reached, and then carry out the division as the last step before arriving at the answer.

*Answer*: full method leading to $\frac{76}{120}$

**Question 19**

This question on speed, distance and time was a two-step problem. First, a time period had to be calculated, which then must be multiplied by the speed to give the number of kilometres Ilde drives. Candidates had problems working out the time period, with some treating times as decimals. Very few candidates were able to convert their time difference into a decimal hour. Some did not find the time period and went straight to multiplying the speed by one of the given times. Instead of multiplication, some candidates divided 96 by their time difference.

*Answer*: 360

**Question 20**

If candidates understood the topic of vectors, they did well in this question but there were many method errors besides the numerical ones which implied that this topic was not well understood. Some gave the answer to **part (b)** as 4. It was pleasing to see a reduction in the number of candidates who use a fraction line within the brackets. Whereas **part (a)** was worth only one mark so both entries had to be correct, it was possible for candidates to be awarded a mark if only one entry was correct in **part (b)**.

*Answers:* **(a)** $\begin{pmatrix} 6 \\ 12 \end{pmatrix}$ **(b)** $\begin{pmatrix} 4 \\ -11 \end{pmatrix}$

**Question 21**

This question on volumes caused the most challenge for candidates. Not many appeared to know the formula for the volume of a cylinder, with many simply working out the area of the base. Candidates must be aware that the use of π = 3.14 will not gain them the accuracy mark; the acceptable values for π are stated on the cover of the exam paper. **Part (b)** included a follow through from the previous part. Candidates had to convert to a common unit then subtract their answer from 2 litres. This caused problems as some candidates did not seem to know that one litre is 1000 $cm^3$. After the subtraction, there was the question of what unit was required. This needed to match their the value for the amount of water left in the jug so answers were most likely to be that shown below in ml or the equivalent in litres. The common answer of $cm^3$ is not an acceptable unit for the amount of a liquid - a concept that many candidates did not apply.

*Answers:* **(a)** 1700 **(b)** 300 ml

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**Question 22**

This question covered simple algebraic concepts through to the finding of the formula of the nth term of a sequence, a topic area that candidates often find difficult. Consequently, more blank answers were seen for **parts (b)** and **(c)**. The sequences given in **part (b)** often had a difference of 5, but not necessarily the correct numbers, or had the correct first term followed by incorrect. Some candidates started their sequence with $n = 0$, giving 4, 9, 14 as their answer. Few candidates got the formula correct in **part (c)**.

*Answers:* **(a)(i)** 16 **(ii)** 25 **(b)** 9, 14, 19 **(c)** $4n - 9$

**Question 23**

The plotting of the extra four sets of exam marks in this data handling question was generally accurate, with a very small number reversing the scores. For the line of best fit, a surprising number joined the 4 points they plotted in **part (a)** with a curve, ignoring the other 14 points. A line of best fit should be drawn with a ruler and not be too short but those candidates who joined the top left of the grid to the bottom right did not gain the mark. Some candidates drew a line from the origin to the top right, showing that they did not understand correlation. Many did well in using their line to estimate the mathematics score. Quite a high number of candidates did not attempt **part (c)** and many gave incorrect explanations or words - all that is needed for this type of question is 'negative' (as in this case), 'positive' or 'no correlation' so in effect, this is a multiple choice question.

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# MATHEMATICS

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

## Key messages

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

## General comments

The candidates' knowledge of mathematical processes was very good. In number work there is still a confusion of when to multiply and when to divide. In algebra many could not expand a single bracket by a single multiplier outside. In rearranging equations there is a tendency to expand brackets which is often unnecessary. In finding angles the higher rules for a circle are often known and correctly applied but the lower skills of identifying an isosceles triangle are not. There is still a tendency to round or truncate numbers to a low accuracy and often within a series of calculations. In trigonometry the candidates should learn which rule is appropriate for which situations and in particular they need to learn how to rearrange the cosine rule or learn the rule in a rearranged form. In multiple operations there is still a strong tendency for candidates to round their answers to only two significant figures. This is causing inaccuracies and is resulting in a loss of marks.

## Comments on particular questions

### Question 1

The common error was to read $2^{-1}$ as -2 and therefore a negative value was obtained.

*Answer:* 1.37

### Question 2

Some candidates wrote out $\frac{2}{36}+\frac{36}{2}$ but then multiplied or cancelled and obtained the answer of 1.

*Answers:* $18\frac{1}{18}$

### Question 3

Some candidates added the 8 first and thus made an error in the order of the operations whilst others subtracted 8 after multiplying by 2.

*Answer:* 30

### Question 4

The demand for this question in **part (a)** asked that the three numbers be written to 1 significant figure and many did not do this. The numerator was often correct with 5 and 2 seen but the denominator was more often 17 or even 20.0 rather than the 20 required. Thus in **part (b)** many were unable to get the desired result of 0.5 which is the correct estimate.

*Answer:* **(a)** $\frac{5\times 2}{20}$ **(b)** 0.5

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**Question 5**

This question was answered well and the most common problem was to evaluate the $\sqrt[3]{0.5}$ incorrectly or if evaluated correctly to order them wrongly with the cube root in the first or second position. Few candidates showed the values of the numbers that they had used.

*Answer:* $0.5^3$ $0.5^2$ $0.5$ $\sqrt[3]{0.5}$

**Question 6**

Most candidates managed to change the euros into dollars by calculating 800 × 1.50. However it was common to see the 1200 multiplied by the 750 or 800 divided by the 750. There were some who clearly did not understand the term 'exchange rate'.

*Answer:* 1.6

**Question 7**

A common error was to try to multiply out the brackets as this creates two terms in x. Those who started correctly with $y - 6 = (x - 4)^2$ would then often take the square root correctly but then they would add 4 to the -6 and not to the root itself.

*Answers:* $4 \pm \sqrt{y-6}$

**Question 8**

Many knew to multiply the top and bottom of each fraction by the same expression and cross multiplying was a common method seen. However in the numerator, 2(x + 1) was often expanded as 2x + 1 and not 2x + 2. It was quite common to see the 2 in the numerator and the 2 in the denominator wrongly cancelled.

*Answer:* $\dfrac{2}{x(x+1)}$

**Question 9**

**Part (a)** was usually correctly answered; sometimes the time intervals were wrongly calculated by counting the ends as well so 19 and 12 were seen. Also 6 × 18 was sometimes calculated incorrectly. In **part (b)** most gave the answer of 1 00 but many omitted the pm.

*Answers:* **(a)** 119 **(b)** 1 pm

**Question 10**

**Part (a)** was answered quite well though many left their expressions only partly factorised and gave $a(x + y) + b(x + y)$ as their final answer. However in **part (b)** fewer candidates knew how to factorise this expression. It was usual to see a quadratic as the answer and often it was the correct one, $3x^2 - 5x + 2$. The question asks for this expression to be factorised which some did manage to achieve successfully.

*Answer:* **(a)** $(a + b)(x + y)$ **(b)** $(x - 1)(3x - 2)$

**Question 11**

Most candidates struggled to access this question. The initial problem was that many drew the triangle with a right-angle and used the normal trigonometry. A few used the sine rule which could not be applied to this problem as we do not know any of the angles. Those who used the cosine rule often did not evaluate it correctly and particularly in $8^2 + 2^2 - 2 \times 8 \times 2 \times \cos x$, they tended to get to 68 – 32 cos x then to 36 cos x instead of subtracting the 68 from the 81 on the other side of the equation. For the cosine rule candidates may benefit from learning the rearranged version of the rule.

*Answer:* 113.9 to 114.0

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**Question 12**

In **part (a)** $20 \times 10^9$ was seen but then this was written as the answer even though it was not in standard form. Other errors generally were from the multiplication of the indices to give $10^{20}$. In **part (b)** many wrote the fraction upside down and hence answers of 8 or equivalent were seen. Many others reached 0.125 or $\frac{1}{8}$ but could not write their answer in standard form. A common answer was $125 \times 10^{-3}$.

*Answers:* **(a)** $2 \times 10^{10}$ **(b)** $1.25 \times 10^{-1}$

**Question 13**

It was clear that some candidates did not understand the angle notation and gave the answer in **part (a)** of 116°, angle *AOC*. Some having correctly written 116 in the correct place in the diagram did not realise that the triangle *OAC* is isosceles and therefore they were unable to complete the solution. In **part (b)** fewer knew that the angles *CDA* and *CBA* added together to give 180°. Some thought that angle *CDA* was 116° and proceeded from there to 41°.

*Answer:* **(a)** 32 **(b)** 35

**Question 14**

Few candidates found the middle point of *AB* possibly because they did not know the meaning of the word 'bisector'. So those who knew the equation of the line was of the form $y = \frac{2}{3}x + k$ were therefore unable to find the correct value of *k*. They often used the co-ordinates of *A* or *B*. Other candidates assumed they had to use the rule $m_1 \times m_2 = -1$ to obtain the gradient of the line which they found to be $-1\frac{1}{2}$ - this was the gradient of line *AB* however.

*Answer:* $y = \frac{2}{3}x - 2$ oe

**Question 15**

An initial error seen was writing 5(x + 1) as 5x + 1. However, generally the rearrangement of their expressions was correct more often than not even though some had equal signs rather than inequalities. A common answer was x < 4 and then some included 4 in their solution set. However many left their answer as an inequality and did not answer the question asked.

*Answers:* 1, 2, 3

**Question 16**

In **part (a)** many found the square root of $2^{24}$ to be $2^{12}$ but then they tried to find the fourth root of $2^{12}$ and were unable to do so. In **part (b)** many reached the stage of showing $\frac{2q^2}{q^{\frac{1}{2}}}$ but were unable to combine the powers of q using a rule of indices.

*Answers:* **(a)** 8 **(b)** $2q^{\frac{3}{2}}$

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**Question 17**

In **part (a)** candidates often used 120 in their working and argument, despite the question asking that the angle of 120 needed to be shown. Generally in questions like this candidates need to find the value requested by using the other values in the problem. In **part (b)** they couldn't use the fact that the angle for Hong Kong is 180 – 150 because they are not told that these two angles form a straight line; they have to show this first. The correct method should have found the angle for Singapore and Hong Kong combined by using the other values and then applying the ratio given.

*Answer:* **(b)** 6

**Question 18**

In **part (a)** it was a common approach to work out both volumes using the values given and then to divide them and show that one is $\frac{1}{8}$ of the other one. This is not the correct method because they are using the values they are trying to demonstrate. The correct method which few were able to use, takes the volume scale factor of $\frac{1}{8}$ and finds the length scale factor which is the cube root of this and hence it is $\frac{1}{2}$. In **part (b)** much of this working had been done in **part (a)** but candidates are reminded that they should still show their working to **part (b)** in **part (b)**. This was answered better than **part (a)**; the main problem was the early truncating of numbers which lead to inaccuracies in their answers.

*Answer:* **(b)** 147

**Question 19**

Most candidates did not realise that the triangle *AED* was a right-angled triangle and that they could use trigonometry to find the lengths *AE* and *ED*. Many truncated the values they obtained from their calculator and therefore obtained an inaccurate area. Some showed figures to an accuracy of only two figures despite the clear statement on the front page which suggests that an accuracy of at least three figures should be used. The area of the triangle was also found using the $\frac{1}{2}ab\sin C$ formula and this was fine provided that *AE* had been correctly found. The area of sector *ABD* was found more easily and was correct providing they used the appropriate formula and not the one for the length of the arc.

*Answers:* 1.38 or 1.39

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# MATHEMATICS

**Paper 0580/22**
**Paper 22 (Extended)**

## Key messages

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

## General comments

Candidates not giving answers to the correct degree of accuracy continue to be an issue. Marks are also being lost through premature rounding in the intermediate stages of calculations.

There was no evidence of candidates having insufficient time as almost all candidates were able to complete the question paper and to demonstrate their knowledge and understanding. The occasional omissions were due to difficulty with the questions rather than lack of time.

The two areas of the syllabus which stood out as being more challenging for candidates in general were sets and 2 dimensional vectors, whilst number work and trigonometry questions were attempted with greater confidence.

## Comments on specific questions

### Question 1

This was a very accessible first question on the paper and the majority of candidates earned the mark. Some candidates lost the mark by rounding to 1.5 without showing a more accurate answer. A small number of candidates made errors with the order of operations.

*Answer*: 1.49

### Question 2

Both parts of this question appeared to be straightforward for the majority of candidates.
The most common incorrect answers in **part (a)** were 57 and 57 000.
The most common incorrect answer in **part (b)** was $569 \times 10^3$.

*Answers*: **(a)** 570 000 **(b)** $5.69 \times 10^5$

### Question 3

The majority of candidates were able to successfully find the correct pair of values.
A large number of candidates, however, did not recognise that the most efficient method was to add the two equations to eliminate the '$y$' variable. Consequently some quite lengthy working was frequently seen.

*Answer*: $x = 2$, $y = -3$

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**Question 4**

The majority of candidates approached this problem using the cosine ratio as intended, although it was not uncommon to see the sine rule used as an alternative method. In most cases the correct answer was found, but some candidates didn't earn the accuracy mark by giving answers of 7 or 7.1.

*Answer*: 7.06

**Question 5**

Both parts of this question were generally well answered. Errors that were made tended to be in interchanging the *x* and *y* co-ordinates in **part (a)** or giving the answer (0, *P*). In **part (b)** some candidates didn't recognise the negative gradient or gave answers of 5 or 0.

*Answers*: **(a)** (0, 5) **(b)** −1

**Question 6**

This question proved to be the first real discriminator on the paper. Many candidates did not appreciate that they needed to find the upper and lower bounds for 8.5 at the outset and it was not uncommon to see the calculation of 8.5 × 12 = 102 followed by answers of 101.5 and 102.5. A few candidates obtained the correct values but then lost the final mark by rounding the values.

*Answer*: 101.4, 102.6

**Question 7**

Most candidates correctly answered this question. The one value which caused some misunderstanding was the 2½%, with a significant number of candidates unable to write 2½% correctly in decimal form, hence this value was the one most frequently misplaced.

*Answer*: 2½%, 0.2, $\frac{43}{201}$, $\sqrt{0.1}$

**Question 8**

This fraction question was generally answered well with many fully correct solutions seen. Most candidates were able to calculate $\frac{1}{2}\times 1\frac{1}{2}$ as $\frac{3}{4}$. Some candidates then didn't show the necessary working to justify their final answer. A few candidates worked in decimals throughout.

*Answer*: $\frac{1}{12}$

**Question 9**

The majority of candidates knew how to answer this question on percentages. A small number of candidates did, however, calculate the percentage loss on the new mass, finding 200/61, rather than the original mass.

There were some issues with candidates prematurely rounding $\frac{61}{63}\times 100$ to 96.8 before subtracting from 100, which resulted in an inaccurate final answer of 3.2 often being seen. It is important to note that rounding should only occur at the last step.

*Answer*: 3.17

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**Question 10**

The majority of candidates correctly substituted the values into the formula in **part (a)** and evaluated correctly.
The responses to rearranging the formula in **part (b)** were more variable. A significant number of candidates didn't give their answer in a simplified form with final answers of $\frac{V}{\frac{1}{3}A}$ often seen. Those candidates who multiplied by 3 first and then divided by *A* usually earned full marks.

*Answers*: **(a)** 35 **(b)** $\frac{3V}{A}$

**Question 11**

There was a mixed set of responses to this question on reverse percentages. Many candidates gave fully correct responses, with high scorers often simply writing 391 x 100/85 = 460, but there were many incorrect answers seen too. A significant number of less able candidates simply worked out 15% of $391 and added this on to $391, giving $449.65, whilst some subtracted 15% from $391, giving $332.35.

*Answer*: 460

**Question 12**

This question on solving algebraic equations was less well answered than other questions on the paper, although many fully correct solutions were seen. Most candidates earned the first mark for $3(x + 1) + 2x$ seen in their working, but many went wrong from here, with a significant number incorrectly expanding their numerator to $3x + 1 + 2x$. A significant number did not multiply through by $2x(x + 1)$ correctly to arrive at $5x + 3 = 0$, although any who reached $5x + 3 = 0$ usually also scored the final mark. The most common incorrect intermediate step seen was $5x + 3 = 2x(x + 1)$ which resulted from candidates thinking that $0 \times 2x(x + 1) = 2x(x + 1)$. They then proceeded to attempt to solve the resulting quadratic equation.
Some candidates rearranged the original equation to give $\frac{3}{2x} = -\frac{1}{x+1}$, but then couldn't deal with the negative sign correctly when cross multiplying.

*Answer*: $-\frac{3}{5}$

**Question 13**

This question on variation was well answered by the majority of candidates. Common errors seen were square, rather than square root and also direct rather than inverse variation.

*Answer*: 1.6

**Question 14**

In **part (a)**, many candidates didn't simplify their vector expressions, with **–p** + **r** + 2**p** often being presented as the final answer.
In **part (b)**, most candidates managed to score at least one mark for either stating a correct route or for **p** + ½ *their* **(a)**. Some candidates didn't simplify their answer of **p** + ½ (**p** + **r**).

*Answers*: **(a)** **p** + **r** **(b)** 1.5**p** + 0.5**r**

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**Question 15**

In **part (a)**, the majority of candidates demonstrated an understanding of how to square a matrix, although this was sometimes spoilt by arithmetic errors. A small minority of candidates tried squaring the individual elements of the matrix.

In **part (b)**, a significant number of candidates calculated the value 14 but then presented $\frac{1}{14}$ or the inverse matrix as their answer.

*Answers*: **(a)** $\begin{pmatrix} 22 & 18 \\ 27 & 31 \end{pmatrix}$ **(b)** 14

**Question 16**

The response to this question on factorisation was very good with the majority of candidates scoring at least one mark in both parts of the question for a correct partial factorisation.

*Answers*: **(a)** $2pq(2p - 3q)$ **(b)** $(u + 4t)(1 + x)$

**Question 17**

**Part (a)** was the least well answered part of this question on indices. Candidates were most commonly gaining one mark for the $t^{25}$. The most common errors with the constant were to leave the 3125 either unchanged or multiplied by $\frac{1}{5}$ to give 625. A common error in the power was to find the fifth root of 125, giving $t^{2.63}$. Some candidates thought it was sufficient to simply write a fifth root sign around the expression.
**Part (b)** was well answered with common incorrect answers being –3, 2, ½ and writing $3^{-2}$ on the answer line.
**Part (c)** was also well answered with the most common incorrect answers being either 9 or 80.

*Answers*: **(a)** $5t^{25}$ **(b)** −2 **(c)** 64

**Question 18**

The majority of candidates scored 1 mark for showing the ratio of volumes and usually ended up with the answer of 432. A few did proceed to cube root or square this ratio but stopped at one of these processes. Another common error was to perform the inverses of the correct operations, for example thinking that the 1024 and the unknown area needed to be squared and so square rooted the ratio of volumes. Similarly, the volume ratio was often seen cubed. Of those who did find the correct area scale factor, many lost the final accuracy mark through premature rounding. This could have been avoided if candidates had noted that the fraction simplified to 27/64, i.e. very easy cube numbers. In any case, candidates must understand that rounding to just one or two decimal places is not sufficient.

*Answer*: 576

**Question 19**

Very many fully correct simplifications were seen here. Where candidates realised that they had to factorise, they usually went on to gain all four marks although some did struggle to factorise the numerator, giving $(x-7)(x+1)$, $(x-7)(x-1)$ or brackets containing $x \pm 6$, for example. Sometimes candidates factorised the numerator correctly and then didn't do anything with the denominator or after correct factorisation of the denominator, didn't cancel the common factor. The most common errors of those who didn't gain any marks was to 'cancel' terms directly from the numerator and denominator e.g. crossing out $x$'s and the square or subtracting $x$'s and numbers, or to turn the expression into a quadratic equation by equating the numerator and denominator and then attempting to solve it.

*Answer*: $\frac{x-1}{3}$

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**Question 20**

The majority of candidates answered **part (a)** of this question on sequences correctly. The only common error seen was an answer of 39, where the candidates had worked backwards.
**Part (b)** caused the most problems in this question with $n-7$ being the most common incorrect answer. The decreasing sequence caused problems for some candidates who produced answers of $7n+k$ rather than $-7n+k$. Another common incorrect answer was $32-7n$. A significant number of candidates lost the marks due to poor clarity in their expression, most commonly stating $32+(n-1)-7$, i.e. with no brackets round the $-7$ to indicate a multiplication rather than subtraction.
**Part (c)** was well answered with the majority giving 53 as the term even if they had not found a correct $n$th term expression in **part (b)**. Those who had incorrect expressions in **part (b)** involving positive $7n$ found they had a negative value in this part but did not think to go back and look at their expression.

*Answers*: **(a)** $-3$ **(b)** $39-7n$ **(c)** 53

**Question 21**

**Part (a)** of the question was generally well answered with many obtaining the correct answer. The most common error was to add the squares instead of subtracting them thus reaching an answer of 7.21. The accuracy of the final answers varied considerably and in many cases this affected the next part of the question as rounded values such as 4.5 were used later on.
**Part (b)** tested candidates on their three dimensional trigonometric understanding and many candidates struggled with this. Many used the correct method but spoilt this by numerical slips or by premature rounding. A significant number of candidates were unable to interpret the diagram and could not correctly identify which triangle or angle they should be working with.

*Answers*: **(a)** 4.47 **(b)** 48.2

**Question 22**

Very few candidates achieved full marks for this question on sets and probability. **Part (d)** proved to be the most challenging.
**Part (a)(i)** was very well answered by most candidates.
In **part (a)(ii)** errors were made that led to responses which listed the elements of $P'$ or $P' \cap Q$. A significant number of candidates also offered responses which included the elements f, g and h.
In **part (a)(iii)** most were able to identify the correct elements but a number of candidates gave the answer as the elements of the set(m, n) instead of the number of terms. Some offered both and did not score.
**Part (b)** was generally well answered with candidates who had answered the first three parts correctly doing especially well. A popular incorrect response was an answer of $\frac{1}{3}$.
**Part (c)** was also very well answered. The most common incorrect response was to shade all of $P'$.
There were very few correct responses in **part (d)**.

*Answers*: **(a)(i)** i, j **(a)(ii)** i, j, k, m, n **(a)(iii)** 2 **(b)** $\frac{2}{3}$ **(d)** $\subset$ or $\subseteq$

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# MATHEMATICS

**Paper 0580/23**
**Paper 23 (Extended)**

## Key Messages

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

## General Comments

The level of the paper was such that all candidates were able to demonstrate their knowledge and ability. There was no evidence that candidates were short of time, as almost all attempted the last few questions. Candidates showed evidence of good number work and good simultaneous equations work. Candidates found the topics of Venn diagrams, percentiles and matrix transformations challenging.

Not showing clear working and in some cases any working was evident for less candidates this year. Premature rounding part way through calculations was occasionally seen and this caused some candidates to miss out on accuracy marks particularly in questions **14**, **16** and **21**.

## Comments on Specific Questions

### Question 1

This question was well answered by nearly all candidates. The most common errors were to write 16 or to take the average of 3 and -16 and give the answer of -6.5°.

*Answer*: -16

### Question 2

Many candidates scored full marks on this question. Those that did not usually correctly identified the fraction or percentage of the circle required gaining a method mark.

*Answer*: 84

### Question 3

It was rare to see an incorrect answer to this question. Candidates generally rounded answers sensibly i.e. to 3 significant figures, the nearest dollar or nearest cent. The most common incorrect answer was $1772.55 which was the result of multiplying instead of dividing.

*Answer*: 1030

### Question 4

The majority of candidates were able to fully factorise the expression. Of those that did not, some were able to still obtain a mark for partial factorisation. The most common errors were to miss out the power, miss out the 3, have an incorrect sign or a misconception that they needed to do a 'difference of two squares' factorisation on the $(3a^2 - b)$ part.

*Answer*: $5a(3a^2 - b)$

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**Question 5**

The majority of candidates were able to complete part **(a)** correctly with only a few not reading carefully the instruction to write down the full calculator display. A common cause of incorrect answers to part **(b)** were truncation or over rounding rather than being unable to convert to standard form. Common incorrect answers were $5.9 \times 10^{-2}$, $5.91 \times 10^{-2}$ and $6 \times 10^{-2}$. A power of 2 rather than -2 was sometimes seen as well as, very rarely, a value bigger than 10 multiplied by $10^{-n}$.

*Answer*: **(a)** 0.059161... **(b)** $5.9161\ldots \times 10^{-2}$

**Question 6**

This question was generally well answered by most candidates with the most common errors being $3x^8y^4$ or $3x^6y^3$ and quite a few candidates attempted to include brackets as if this was a factorising question.

*Answer*: $3x^6y^4$

**Question 7**

This was one of the best answered questions on the paper with incorrect answers rarely seen. Very occasionally time was wasted with calculations to work out missing side lengths/angles rather than using the information already given.

*Answer*: **(a)** 74 **(b)** 8.69

**Question 8**

This question proved a little more challenging for some candidates with the most common error being to divide by 15 instead of $15^2$. Other common errors were a result of incorrect attempts at unit conversions, for example thinking $1\text{m}^2$ was $100\text{ cm}^2$.

*Answer*: 48

**Question 9**

Nearly all candidates were able to obtain at least one mark on this question for a correct attempt at separating the number terms and terms in *t*. There was evidence of a misunderstanding with regards to the inequality sign and it was common to see $7t < -6$ followed by $t > -\frac{6}{7}$ where candidates mistakenly thought they had to reverse the inequality because the division involved a negative number. A significant number of candidates wrote $-\frac{6}{7}$ on the answer line rather than the correct inequality and consequently were not able to gain the accuracy mark.

*Answer*: $t < -\frac{6}{7}$

**Question 10**

This was the best answered question on the paper with incorrect answers rarely seen. The most common reason for marks not being awarded was for working not being shown; the instruction was to not use a calculator and show all steps in the working.

*Answer*: $\frac{17}{36}$

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**Question 11**

A large proportion of candidates managed to successfully answer this question. The most successful candidates read the question carefully and used the cube root of ($x$ + 3) and the starting point $y = k\sqrt[3]{x+3}$. The most common errors were to use the cube or square root of ($x$ + 3) or inverse variation. A significant number of candidates had the incorrect starting point $y = k + \sqrt[3]{x+3}$.

*Answer*: 3.5

**Question 12**

Candidates generally answered part **(a)** well with the most common errors being $(3x+4)(x-2)$ or $\left(x-\frac{4}{3}\right)(x+2)$. The most successful candidates used their answer to part **(a)** to answer part **(b)** showing the working $3x-4=0$ and $x+2=0$. Of those that did not show this working occasional sign errors happened. A significant number of candidates did not use their answer to part **(a)** (or did not have an answer to use) yet were still able to successfully find the correct solutions using the quadratic formula.

*Answer*: **(a)** $(3x-4)(x+2)$ **(b)** $1\frac{1}{3}$, $-2$

**Question 13**

Candidates nearly always obtained 1 or more marks on this question. The two most common approaches to this question were to find the gradient using change in $y$ over change in $x$ co-ordinates or to use a method of simultaneous equations. The most common error in both methods were sign errors in finding the gradient, or working the gradient out as -2 rather than -0.5. These errors were less common for those with the starting point 9 = 5m + c and 13 = -3m + c. Most candidates knew the correct method for finding the intercept after having found the gradient.

*Answer*: $y = -0.5x + 11.5$

**Question 14**

A significant proportion of candidates scored 1 or more marks on this question. The most common error was to treat the triangle as though it had a right angle at $P$ and not to use the sine rule but an incorrect single sine ratio instead. Another very common error was to present the answer to 2 significant figures, often with insufficient supporting work to get all the method marks. Occasionally attempts were made to divide the triangle into two right-angled triangles and to attempt trigonometry on those two triangles with various degrees of success, because the algebra of this approach proved difficult for some. Premature rounding part way through the calculation was also an issue for some.

*Answer*: 8.23

**Question 15**

This question proved challenging for many candidates with the most common errors being to find the area, to add the two lengths but to forget to double, or to find the perimeter as 427.6 and then write the upper and lower bounds as 427.65 and 427.55. In the first two of these cases candidates generally still often obtained one mark for correctly writing down at least 2 bounds for the lengths. More candidates were successful with the lower bound than the upper bound calculation, with the most common error in the upper bounds being to use 127.34 and 86.54. Some candidates correctly found the upper and lower bounds then spoilt their answers by rounding these answers to 3 significant figures. Candidates are advised that upper and lower bounds are exact answers that should not be rounded. Another common misconception was for candidates to do 127.3 ± 0.5 and 86.5 ± 0.5 rather than adding and subtracting 0.05.

*Answer*: 427.8 and 427.4

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**Question 16**

This question was well answered by many candidates with clear working presented and the most successful used the easiest route of $AC = \sqrt{3^2 + 4^2} = 5$ followed by $\cos GAC = \frac{5}{12}$. Some made it more difficult for themselves by working out the side length of *CG* and using a different trig ratio, the sine rule or the cosine rule. These candidates generally also often had problems with premature rounding. Quite a few candidates were unable to cope with 3-dimensional trigonometry and had no meaningful work. A common misconception was to calculate angle *GAB*.

*Answer*: 65.4

**Question 17**

This question proved to be a good discriminator with a significant number of candidates unsure about set notation and in particular part **(c)** proved challenging for many. In part **(a)** the most common error was to forget that 1 was a square number and to place it in the wrong region. The other most common error was to miss out the 10 or all three numbers in that region. Part **(b)** was the part more candidates were successful on with the majority correctly listing 7, 8 and 10 or the numbers in that region from their Venn diagram. The most common incorrect answer in part **(c)** was 9 i.e. not understanding the significance of the n and listing the elements in the region rather than counting them.

*Answer*: **(b)** 7 8 10 **(c)** 1

**Question 18**

Part **(a)** was very well answered with the occasional arithmetic slip, although these were quite rare. A common incorrect answer was to square each element of the matrix i.e. $\begin{pmatrix} 25 & 4 \\ 16 & 9 \end{pmatrix}$.

Part **(b)** was generally answered well with most candidates gaining at least one mark for either the determinant correctly used or the adjugate of **A** correctly found. The most common cause of lost marks were due to arithmetic slips in calculating the determinant or errors in writing the adjoint matrix. Those who found the inverse by finding the adjugate of **A** and multiplying by the reciprocal of the determinant were more successful than the candidates who used a simultaneous equations approach. Occasionally some candidates found the inverse of their answer to part **(a)**.

*Answer*: **(a)** $\begin{pmatrix} 33 & 16 \\ 32 & 17 \end{pmatrix}$ **(b)** $\frac{1}{7}\begin{pmatrix} 3 & -2 \\ -4 & 5 \end{pmatrix}$

**Question 19**

It was rare for candidates to not gain full marks on this question. Candidates who used the elimination method tended to be more successful than those who tried the substitution method. Occasionally answers were presented as fractions. Candidates are advised that when questions are set in the context of money this is not good practice.

*Answer*: 2.60 and 0.75

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**Question 20**

Many candidates understood cumulative frequency and were successful on this question with the exception of part **(c)** which was more challenging for them. Part **(a)** was generally well answered. A few candidates did not understand the context of the question, presenting a median answer that was larger than 60 (a common wrong answer was 250, from halving the 500 people). Another more common incorrect answer for **(a)** was 30, which is the score in the middle of 0 and 60. Most candidates were able to gain at least one mark in part **(b)** with 24-40 and 40-24 being the two most common wrong answers (both worthy of one mark). Part **(c)** presented the most difficulty with the most common wrong answers being 200 (40% of 500); 24 (40% of 60), 15 (reading from 40 on the vertical scale) or 380 (reading from 40 on the horizontal scale). Candidates found part **(d)** easier with a significant number getting this right; the most common incorrect answer was 110.

*Answer*: **(a)** 34 **(b)** 16 **(c)** 30 **(d)** 120

**Question 21**

This question was a good discriminator which proved a challenge for many candidates. The most common approach was to split the shape into two parts and find the perimeters of these separately. Errors occurred in lots of different places in the calculations e.g. finding areas instead of perimeters; thinking the radius of the smaller circle was half the radius of the larger circle (i.e. from looking at the 'not to scale' diagram and ignoring the text in the question) or missing out sections (usually some or all of the straight edges or the inner perimeter). The most successful candidates clearly presented their work showing the full calculation. Some lost marks due to premature rounding or using 3.14 or $\frac{22}{7}$ for π instead of 3.142 (which they are instructed on the front of the paper to use if they do not use the π key).

*Answer*: 62.3

**Question 22**

The majority of candidates answered part **(a)** well with the most common error being to translate by the correct absolute value but the wrong direction or to miscount in one direction. Part **(b)** was also well answered by many candidates with the most common correct answer being rotation, centre ( 1, 0 ) by 180°; very occasionally the alternative correct answer of enlargement, centre ( 1, 0 ), scale factor –1 was seen. The most common errors were to miss out one or more of the required three parts to the answer, usually the centre or angle. Occasionally the centre of rotation was given as (2.5, −2) where the candidate had found the transformation from their answer to part **(a)** to *B*, or (0, 1) where they transposed the *x* and *y* co-ordinates. Part **(c)** proved the most challenging. The most successful candidates performed the matrix multiplication $\begin{pmatrix} -2 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} -1 & -1 & -2 \\ 3 & 5 & 2 \end{pmatrix}$. Those who tried to identify what transformation $\begin{pmatrix} -2 & 0 \\ 0 & 1 \end{pmatrix}$ represented generally were less successful.

*Answer*: **(b)** Rotation of 180° about centre ( 1, 0 )

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**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**International General Certificate of Secondary Education**

# 0580 MATHEMATICS

**0580/27** **Paper 27 (Extended)**

Due to a security breach we required all candidates in Kuwait who sat the paper for 0580/22 to attend a re-sit examination in June 2014. Candidates outside Kuwait sat only the original paper and were not involved in a re-sit.

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# MATHEMATICS

**Paper 0580/27**
**Paper 27 (Extended)**

## Key message

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

## General comments

Some candidates do not fully understand how to write their answers to an appropriate degree of accuracy and it is always good practice to keep as many figures as you can in the working and then first write the answer as accurately as possible before rounding to usually three significant figures. In cases where the question is set in a realistic context, money should always be written to two decimal places. In cases of interest, simple interest is rarely used so candidates should always learn compound interest and simple interest can be used as an estimate to be done mentally as compound interest will always yield more interest. The order in which subtraction and division is done is important and particularly in **Questions 1, 5** and **11** this made a real difference to the outcome. It does benefit candidates to learn standard methods because these are tested regularly, such as **Questions 8** and **21**. In probability all answers involving probability must be between 0 and 1, and answers outside of this range should have alerted candidates to errors in **Question 20**. Simple estimation checks could have been used on a number of questions.

## Comments on particular questions

### Question 1

The only real alternative answer seen to this question on directed numbers was 5.

*Answer*: −5

### Question 2

Most candidates gave the correct answer to **part (a)** in this probability question, some gave A/7. In **part (b)** the main error seen was to multiply both numerator and denominator by 63, giving 126/441.

*Answers*: **(a)** $\frac{2}{7}$ **(b)** 18

### Question 3

Some wrote the limits to this bounds question in the reverse order, or they used incorrect values giving a wider range such as 7.3 and 8.3; these were obtained by adding and subtracting 0.5 rather than 0.05.

*Answer:* 7.75, 7.85

### Question 4

Some rounded the correct answer to this compound interest question to 649 or they calculated simple interest, giving an answer of 648.

*Answer:* 648.96

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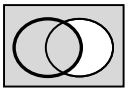
**Question 5**

**Part (a)** tested the use of calculators, so a high level of accuracy needed to be maintained and some candidates rounded or truncated during calculations, giving an answer of 609.2. In **part (b)** candidates were generally able to give their answer in standard form, provided that the digits were written in the range 1 to 9.999 first.

*Answer*: **(a)** 609(.4) **(b)** $6.09 \times 10^2$

**Question 6**

Most answers to **part (a)** did not contain the region A ∩ B. **Part (b)** was omitted by many candidates, but common incorrect answers were R U P' U Q' and R U P' ∩ Q'.

*Answer*: **(a)**  **(b)** $R \cap (P \cup Q)'$ or $R \cap P' \cap Q'$

**Question 7**

This question on proportionality was answered well but many, having solved this correctly, did not write down the correct answer, and instead wrote either 24 or 8. Some used the formula for inverse proportionality instead of direct proportionality.

*Answers:* $[\pm]\ 8\sqrt{v}$

**Question 8**

Most used the correct method in this simultaneous equations question if they doubled the first equation; the main error was in adding, with candidates obtaining $5x$ instead of $7x$. If candidates multiplied the second equation by 3, then the main error seen was in working out $-y - 6y$; some giving $5y$ or $-5y$ instead of $-7y$.

*Answer:* 3, – 1

**Question 9**

This question on Pythagoras' Theorem was answered well; the main error seen was to add the squares instead of subtracting them. Those who tried to use trigonometry rarely obtained the correct answer.

*Answers*: 7.14

**Question 10**

Some did not show all their working in this question on manipulating fractions, despite the demand requesting this, but still achieved the correct answer. In the addition the main error was a common denominator of 11; hence 19/11 was seen. In the division some did not invert the fraction whilst others used a method of cross-multiplying but did not show a clear method; the answer is not enough evidence in questions of this type.

*Answer:* Correct working leading to $\frac{76}{120}$ oe

**Question 11**

In **part (a)** of this algebra question the numbers 49 and 81 were usually calculated correctly. Most mistakes were made in the subtraction of these two numbers. In **part (b)** the common mistake was to arrange the equation with $-q^2$ as the subject, then to take the square root and finally to change the sign.

*Answer*: **(a)** −32 **(b)** $[\pm]\sqrt{p^2 - x}$

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**Question 12**

The initial equation was often established in this question on the volume of a cone, sometimes without the square power on the radius. Most errors were made in rearranging this equation. It was common to see π replaced with a numerical approximation and instead of dividing by 4 many candidates would subtract 4.

*Answers*: 2.24

**Question 13**

In **part (a)** of this question on indices many candidates achieved 81, although some left the number as a power. The power of $p$ was sometimes seen as 7, obtained by addition, rather than the correct multiplication. In **part (b)** many candidates forgot that the power of $p$ was – 6 and so by treating it as 6 they gave the answer as 3 rather than −3.

*Answer*: **(a)** $81p^{12}$ **(b)** −3

**Question 14**

The simplest error seen in this question on the perimeter of fractions of circles was that many forgot to add the 10 cm length. Many candidates used the formula for the area of a circle instead of the one for the circumference. Some candidates forgot to halve the circumference of each circle because the shapes are semi-circles. Finally, some used the formula $2\pi r$ but they substituted the diameter for the radius, so obtaining answers that were twice the correct size.

*Answer*: 57.1

**Question 15**

The best method was to multiply by the denominators in this question on solving an algebraic equation involving fractions, or to cross-multiply, whilst keeping the equation intact. Errors happened when candidates tried to bring all the terms over to the left-hand side; the number on the right was often wrong. The left-hand side was often written as $2(2x – 3) – x + 1$ instead of $2(2x – 3) – (x + 1)$, with a bracket missing.

*Answers*: $\frac{7}{3}$ oe

**Question 16**

The most common error seen in this question on similar shapes was to use 56/126 rather than the square root of it as the scale factor. This gave a common incorrect answer of 5.33.

*Answers*: 8

**Question 17**

Many candidates did not use the correct scale factor in this question on maps, and instead used the scale factor of length rather than the scale factor of area. A common approach was to multiply 60 by 20 000 and then divide by 100 000, rather than using the square of both numbers.

*Answer*: 2.4

**Question 18**

In **part (a)** candidates would often carry out 180 – 124, giving 56 as the answer. They did not use the fact that triangle *OAB* was an isosceles triangle. In **part (b)** candidates correctly recognised *BOC* as an isosceles triangle but treated *OC* and *BC* as equal and so often gave the same answer as in **part (a)**. In **part (c)** candidates thought that angle *CAB* was half of angle *BAO* so, as that was marked 56, the answer of 28 was seen quite regularly.

*Answers*: **(a)** 28 **(b)** 76 **(c)** 14

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**Question 19**

In **part (a)(i)** of this question on factorising the most common error was $(a - b)^2$. **Part (a)(ii)** was slightly better answered, but many candidates gave their answer as a partial factorisation only. Hence in **part (b)** candidates could only achieve the answer if they had correct answers to the two previous parts. There was some cancellation of $(a + b)$ with $(a - b)$ seen.

*Answers*: **(a)(i)** $(a - b)(a + b)$ **(ii)** $(a + b)(2 + 3y)$ **(b)** $\dfrac{2+3y}{a-b}$

**Question 20**

**Part (a)** of this question on probability was usually well answered. **Part (b)** was found to be more challenging and 7/8 × 2/3 was a very common attempt. It did not look like many candidates had used their tree diagram and had instead used the information in the stem of the question. Some answers exceeded 1 and so could not be correct.

*Answers:* **(a)** $\frac{3}{10}, \frac{1}{8}, \frac{1}{3}$ oe correctly placed **(b)** $\dfrac{195}{240}$ oe

**Question 21**

In **part (a)** of this question on matrices, the most common error was to square each element. There were also some correct methods seen with arithmetical mistakes. In **part (b)** some calculated the determinant wrongly, usually giving 11 by addition. There was also a general confusion as to which elements are swopped over and which are made negative.

*Answers:* **(a)** $\begin{pmatrix} 7 & 6 \\ 18 & 19 \end{pmatrix}$ **(b)** $\frac{1}{5}\begin{pmatrix} 4 & -1 \\ -3 & 2 \end{pmatrix}$ oe

**Question 22**

In **part (a)** of this question on functions there were some surprising errors in carrying out 4 – 27, and some candidates calculated them the other way round, so finding f(2) = -2 then g(-2) = 9. **Part (b)** had the same problem, giving $4 - 3(x^2 + 5)$. In **part (c)** most did not realise that substituting 2/3 into f($x$) would give the answer and many tried to find the inverse function of f first.

*Answers:* **(a)** –23 **(b)** $21 - 24x + 9x^2$ or $3(7 - 8x + 3x^2)$ **(c)** 2

**Question 23**

The attempts at this travel graph question were very good and many candidates found the units the biggest problem. Those who tried to change the units first usually rounded them inaccurately. In **part (a)** 36/0.5 (=72) was a very common approach. It was carried out more successfully if 36 was divided by seconds (30) so 36/30 = 1.2; then multiplied by 1000 to convert to metres and divide by $60^2$ to convert to seconds. In **part (b)** the area 388 was seen many times and this again needs to be converted into the correct units by division by 60. Many candidates found the area of the two triangles and some rectangles but not all of the rectangles; it was better attempted when the rectangle was taken from 0 to 5. Some forgot to put the half in the area for the triangles.

*Answers*: **(a)** $\dfrac{1}{3}$ oe **(b)** 6.47

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# MATHEMATICS

**Paper 0580/31**

**Paper 31 (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

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. The vast majority of candidates were able to complete the paper in the allotted time, and most were able to make an attempt at all questions. Few candidates omitted part or whole questions. The standard of presentation was generally good. There were occasions where candidates did not show clear workings and so did not gain the method marks available. Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed. This was made clear when candidates were asked to show a solution, part of a ratio, mean of a group of data and interpreting a pie chart. These questions asked candidates to show why a value was true and more successful candidates gave thorough and accurate solutions. Candidates should also be encouraged to fully process calculations 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. A number of candidates did not use a ruler to draw straight line graphs which is essential to gain full marks. Centres should continue to remind candidates that when correcting a solution they should re-write their answer rather than overwriting.

## Comments on Specific Questions

### Question 1

This question assessed candidates' knowledge and ability of ratios and use of a protractor to construct an accurate triangle. Successful candidates were also able to calculate the area of a triangle using a formula and give the correct units of measurement.

**(a) (i)** This question required the candidate to show that the smallest angle of a triangle is 36˚, given the ratio 3:4:8. The most successful candidates only used the ratio and the fact that the angles in a triangle add up to 180˚ to give a full and accurate answer. Candidates must be reminded that if asked to show 36˚ then they must not use or start with the 36˚ as this scores zero marks. Many candidates gave the 3 correct angles, using the multiplier of 12 but did not show where the 12 came from or used the 36˚ to derive it.

**(ii)** This question was well answered with the majority of candidates gaining full or part marks. Many candidates had already worked out the two angles in part **(a)(i)** although scoring no marks in part **(i)** were able to gain full marks in this part. Many candidates were able to gain one out of the two marks by giving a pair of angles which added to 144˚, the most common pairs being: 90˚ and 54˚ or 72˚ and 72˚.

**(b) (i)** The majority of candidates showed an ability to accurately use a protractor and ruler to construct the two angles. Very few candidates reversed the position of the angles, although this still gained one mark if completed accurately. A very small number of candidates did not use a ruler or chose not to attempt this question.

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**(ii)** This part proved to be the most successful of this question. Candidates were able to gain full marks for an accurate measurement even if their triangle was incorrectly drawn. The vast majority of candidates who attempted the question measured accurately although a number of less able candidates gave measurements to the nearest whole centimetre and therefore could not gain the mark for accuracy.

**(c)** Most candidates showed an understanding of calculating the area of a triangle, with the best solutions quoting a formula, substituting in the values for height and base and giving their answer with correct units. The answer space confused some candidates because they had not read the question properly and had not remembered that they had to give the correct units of measurement, thinking the second dotted line in the answer space was for the decimal part of their answer, rather than the units of measurement. The correct answer of 19.6 was often given but not followed by any units of measurement or the incorrect ones (often cm or $cm^3$).

*Answers*: **(a)(ii)** 48, 96 **(b)(ii)** 4.45 to 4.85 **(c)(i)** 19.6 $cm^2$

**Question 2**

Most candidates made a good attempt at this question. It was vital for candidates to read the question fully and to give integers between 50 and 100. A good understanding of factors, multiples and square numbers was required to gain marks, which most candidates showed.

**(a) (i)** This part was well answered by the majority of candidates. Some candidates misread the question and gave an answer of 43, outside the given range, or made no attempt.

**(ii)** Again this part was well answered with most candidates showing a good understanding of factors. Most common errors were to give factors outside the given range e.g. 3, 5 or 33, or give an answer of 82.5 which was simply halving 165.

**(iii)** Candidates had a good understanding of square numbers with the majority of candidates who attempted the question giving a square number. Again candidates lost this mark for commonly giving a square number outside of the range e.g. 25 or 49, or even square numbers e.g. 64 or 100.

**(iv)** Many candidates found this question more challenging with a large number choosing not to attempt it. Candidates commonly gave a square number answer showing their understanding of square numbers is sound, but few were able to give the correct answer of 64, showing less understanding of the meaning of a cube number. Answers of 81 or 100 were commonly seen.

**(b) (i)** This part was very well answered by candidates with the vast majority scoring full marks. Candidates demonstrated good use of their calculator to find the square root of a number.

**(ii)** Finding the lowest common multiple of two values was the most difficult part of this question. More able candidates could find the lowest common multiple by writing a list of multiples of both values and identifying the lowest common multiple from their lists. Some candidates did this correctly but then identified the incorrect common multiple, but still gained one method mark. The most common error was to find common factors of the values with 2 or 3 being the most common incorrect answers.

**(c)** Most candidates were able to find the correct journey time to the North Pole, although many found it difficult to give their answer in the format required. The question asked for their time in days and hours, with most candidates able to give the correct number of days. Many candidates were confused again by the answer space, with many converting their whole time, in days and hours, into hours only and writing this in the answer space. Candidates should be reminded to reread questions to check they have given their answers in the format required.

*Answers*: **(a)(i)** 86 **(a)(ii)** 55 **(a)(iii)** 81 **(a)(iv)** 64 **(b)(i)** 77 **(b)(ii)** 120 **(c)** 12 (days) 15 (hours)

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**Question 3**

This question tested candidates understanding of transformations. Successful candidates were able to accurately reflect, rotate and enlarge a shape and to describe fully a transformation. Candidates were also required to calculate the area of a parallelogram.

**(a) (i)** Most candidates attempted this question with the correct answer of 'parallelogram' seen often. A very common answer was 'quadrilateral'. Although not wrong this was not a specific enough description of the shape as the type of quadrilateral was required. Common other incorrect answers were trapezium and rhombus.

**(ii)** Most candidates attempted this question however there was clear confusion between lines of symmetry and rotational symmetry by many candidates. More able candidates gave the correct value of zero however less able candidates often gave 2 (or 4) as their answer, confusing rotation and reflection symmetry.

**(b)** Good solutions to this question were seen. A few more able candidates also identified the other possible transformation of 'rotation' through '180 degrees' with 'centre (1.5,0)'. Many candidates correctly gave the transformation as a translation but were unable to describe the vector correctly, often writing it as a co-ordinate or missing it out completely. Candidates need to be reminded what constitutes a fully described transformation; a translation must be accompanied with a column vector.

**(c) (i)** Candidates showed good understanding of reflection with the vast majority gaining full marks for reflecting the shape in the correct axis. Candidates should be reminded to draw their shapes with a ruler and pencil as many scribbled out pen drawings were seen and in some cases it proved difficult to identify the correct shape.

**(ii)** The rotation of shape *S* proved to be more challenging than the reflection although many candidates were able to gain one of the two marks for a correct rotation but from the wrong centre.

**(d)** The enlargement of shape *S* was the most challenging transformation with a large number of candidates not attempting this question. The best solutions used lines drawn from point *P* on the grid to the desired image, through shape *S*. A number of candidates correctly drew the enlarged shape *E* but had not taken into consideration the centre of enlargement *P* and drew it in the wrong position. The most common incorrect drawing was to have the correct base and height (6 and 4) but the corner at the top being only one square across from the bottom corner, instead of 2.

**(e) (i)** More able candidates used the formula for the area of a parallelogram to calculate the area by multiplying 3 and 2. Less able candidates often counted the squares but still achieved full marks with an answer of 6 cm². However many incorrect answers came from using the diagonal side of the parallelogram and multiplying 3 and 2.5 cm.

**(ii)** This question proved challenging as it relied on the candidate's correct drawing of the enlargement in part **(d)**, which many candidates had not answered or done incorrectly. Candidates who had gained marks in part **(d)** generally were able to identify the enlargement being 4 times the size of the original shape *S*. A few more able candidates who had not drawn an enlargement still gave the correct answer from an understanding of scale factors and area. Less able candidates however often missed this part out or gave the answer of 2, following a scale factor of 2.

**(iii)** Although parts **(e)(i)** and **(ii)** were written to assist candidates to answer part **(iii)** many did not use their previous two answers to help. Many candidates who had correct answers to parts **(i)** and **(ii)** chose not to attempt this question, with a very large proportion of candidates leaving this part blank. A follow through was available for candidates who had drawn their enlargement incorrectly but still found the correct area of their *E*, or candidates who multiplied parts **(i)** and **(ii)** together.

*Answers*: **(a)(i)** Parallelogram **(a)(ii)** 0 **(b)** Translation $\begin{pmatrix} 9 \\ -6 \end{pmatrix}$ **(e)(i)** 6 **(e)(ii)** 4 **(e)(iii)** 24

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**Question 4**

This question gave candidates the chance to show their understanding of averages, money and percentages. Part **(a)(iv)** was another show question which candidates again found difficult. Part **(c)(iii)** about percentage profit proved to be one of the most challenging questions on the whole paper. Less able candidates however were able to gain marks on the tally chart, mode and range calculations in part **(a)**.

**(a) (i)** The frequency table was completed well by most candidates. A few candidates gave their frequencies in the tally column but gained one method mark if they left the frequency column blank. Some candidates however lost this mark if they then went on and filled in the frequency column with other values, often their calculations for the mean in part **(iv).**

**(ii)** The majority of candidates were able to identify the mode of the data, either from their table or from the original data. Few candidates did not attempt this question.

**(iii)** Again most candidates correctly identified the range using the table or the original data. A few candidates used the frequencies to incorrectly calculate their range.

**(iv)** This question asked candidates to show that the mean mass is 66g. This 'show' question was more successfully answered than in **Question 1** because it was more difficult to start with the 66g. Many candidates used the original data rather than the table but made slips in adding all 25 values, often missing one or two values. Most candidates correctly divided by 25 although they needed the correct sum of the 25 values to gain full marks. A large number of less able candidates added the values in the left column on the table and divided by 7. They then tried to round this to the correct answer of 66g. This approach scored no marks.

**(b)** Most candidates made an attempt at this question with the best solutions using 0.96 x 800. Many candidates need to take more time to read the question as only calculating the 4% which was damaged (32) did not gain any marks. Candidates needed to calculate the number of tomatoes which are not damaged, as clearly shown in the question with the word 'not' in bold. Candidates should be reminded to reread the question once they have found their solution to check it has answered the question set. Another common incorrect answer was to use 4% as 0.4 instead of 0.04.

**(c) (i)** Most candidates made an attempt at this question with the majority able to gain a mark for the correct figures of 495 seen. Candidates who gave the best solutions recognised that 1 kg=1000g and divided their solution by 1000 or used the mean mass of 0.066 in their original calculation. The most common error was to use 1 kg=100g or 10g and to divide or multiply by 10 or 100. Many candidates did not convert, leaving their answer as 49500.

**(ii)** Candidates found this part difficult. Many candidates believed that they had to multiply the 750 by $1.40 and gained an incorrect answer of $1050. More able candidates understood that they had to use their previous answer, which was in kg, and multiply this by $1.40 to find the answer. Candidates who had not gained full marks in part **(i)** often gained full marks in part **(ii)** as a follow through mark was available. Candidates again must be reminded to reread questions and check they have actually answered the question set with their solution.

**(iii)** A large proportion of candidates did not attempt this part. However there were some good solutions seen, with the more able candidates showing their working out in full. Many candidates were able to gain one mark for the first correct step, subtracting the cost of $33 from their answer in part **(ii)**. However many candidates had very large values in part **(ii)**, such as 1050 or 69300, so when calculating the percentage profit many candidates answers were in the 1000's. The correct answer of 110% was rarely seen even from more able candidates, as answers over 100% are less often used. Candidates should be reminded that when calculating percentage profit they must divide by the original cost not the selling price.

*Answers*: **(a)(i)** 2,4,2,5,6,3,3, **(a)(ii)** 70 **(a)(iii)** 30 **(b)** 768 **(c)(i)** 49.5 **(c)(ii)** 69.3 **(c)(iii)** 110

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**Question 5**

This question tested candidate's abilities to construct diagrams using compasses and a ruler. The majority of candidates used the correct equipment, however a number of candidates wrote on their script that they did not have compasses. Centres should remind candidates of the equipment required for the exam. Candidates were also asked to calculate the area of a semi-circle which they had already constructed. This question proved to be the most difficult on the paper.

**(a)** The best solutions showed the use of compasses to construct the remaining two sides of the farm boundary, with candidates leaving their construction arcs as instructed in the question. A significant number of correct positions for vertex *F* were seen but did not use compasses and were drawn using a ruler only. These only gained one of the two available marks.

**(b)** This was the best answered part of this question. Most candidates identified the shape to be a hexagon, even when they had not completed part **(i)** correctly or at all. A number of poor spellings were used which made the answer ambiguous, e.g. hectagon, which were not accepted as correct answers. The answer of 'polygon' was offered on a number of occasions which was not specific enough to gain the mark.

**(c) (i)** Most candidates showed some understanding of a perpendicular bisector with most candidates gaining one of the two available marks. The best solutions showed both sets of required arcs either side of the line *CD*, and joined with a straight line. However many candidates had drawn an accurate perpendicular bisector with only one set of arcs inside the hexagon, so only gained one mark. Candidates need to be reminded that they must show all construction arcs and the minimum number required to gain full marks on construction questions. It was evident that some candidates had drawn in their arcs freehand without a compass, after they had drawn their line, and in these cases could not gain full marks.

**(ii)** Candidates again showed they understood what an angle bisector should look like but lost marks because they did not show all the construction arcs. Good full solutions had two sets of arcs, one on the lines *AB* and *BC* and an intersecting pair inside the hexagon. Many candidates incorrectly used the points *A* and *C* because the lines *AB* and *BC* are not equal in length. Many candidates had a correct angle bisector drawn but only gained one of the two available marks because they only had one set of arcs or no arcs and had used a protractor. Candidates should be reminded that they must not use a protractor to construct an angle bisector.

**(iii)** This part was one of the most difficult to gain marks on because of the requirements from parts **(i)** and **(ii)**. To gain this mark a candidate had to correctly shade the required region but to have also gained at least one mark in their previous two parts. For many candidates this was not possible as they had not drawn an angle bisector or perpendicular bisector accurately enough to gain a mark. Many candidates did not attempt this question.

**(d) (i)** Most candidates who attempted this question understood the requirement of a semi-circle with centre point *P*. However a common error was to draw a whole circle at point *P* rather than a semi-circle inside the hexagon only. Some candidates did not use the scale correctly and drew semi-circles which were too big or small. A large proportion of candidates chose not to attempt this question.

**(ii)** The calculation of the area of the semi-circle was the most difficult on the paper, with the largest proportion of incorrect answers or no attempts. Many candidates who had not attempted part **(i)** did not attempt this part either. Many candidates who had not understood that the shape of the pig pen was a semi-circle could not gain marks in this part. Those candidates who had correctly drawn the semi-circle in part **(i)** made some attempt at the area but many found the area of a whole circle, used the radius from their drawing of 2.5 cm rather than the actual radius of 25m, or used the formula for the circumference of a circle instead of the area formula. It is encouraging to see that candidates are using the calculator pi button or 3.142 as instructed on the front cover of the paper. Very few candidates used 3.14 and even fewer used $\frac{22}{7}$. This is an improvement on previous years.

*Answers*: **(b)** Hexagon **(d)(ii)** 3930

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**Question 6**

This question gave candidates the opportunity to demonstrate their ability to calculate missing values and draw a quadratic curve. Candidates continue to improve at plotting points and drawing smooth curves. Part **(c)** proved most difficult as most candidates did not realise they could use their graph and straight line to solve the equation with many attempting to solve it algebraically with little success.

**(a) (i)** Candidates answered this part well with the majority of candidates correctly calculating all 6 missing values. A large number of candidates simply halved each *x* value but then correctly plotted these in part **(ii)**.

**(ii)** Candidates plotted their values from the table well with the majority of candidates scoring 3 marks for plotting the correct or follow through points. The quality of curves drawn has improved again this year with very few straight lines drawn and very few with very thick lines or broken lines drawn. A significant number of candidates correctly plotted all 8 points but then did not attempt to join them up with any type of line. Candidates need to be reminded what the requirements of a smooth curve are.

**(iii)** Candidates found giving the order of rotational symmetry more difficult. Few correct answers of 2 were seen, with many candidates giving a worded description instead, e.g. rotate 180˚ clockwise.

**(b) (i)** Completing the table for the straight line proved to be the most successful question on the whole paper. Nearly all candidates who attempted the question were able to give the correct 3 missing points.

**(ii)** Despite getting the table of points correct many candidates did not then go on to plot the points on the graph paper. A large number of candidates plotted the points correctly but then again did not join them up with a straight line and lost the mark. Candidates need to be reminded that straight line graphs need to be joined with a ruler as a number of freehand lines were seen.

**(c)** Candidates were instructed to use their graph to solve the equation. The best solutions were given by candidates who had drawn accurate curves and lines in parts **(a)** and **(b)** and identified the intersection of their curve and straight line and correctly used the scale on the *x*-axis. A very large proportion of candidates did not attempt this part as they had not drawn a curve or straight line in the previous parts. Co-ordinates were given as solutions by a number of candidates. Candidates should be reminded to read the question carefully as only the *x* values were required and giving the co-ordinate meant they lost both marks. Some candidates attempted to solve the equation algebraically with little success.

**(d)** More able candidates could identify the gradient of the line from the equation and give the answer as 1.5. Many less able candidates used a variety of methods to attempt to find the gradient, not using the $y=mx+c$ form of the equation. Some used a rise/run approach from the graph. Some candidates attempted to use the equation but gave their answer as 1.5x instead of 1.5.

*Answers*: **(a)(i)** −1, −4, −8, 8, 4, 1 **(a)(iii)** 2 **(b)(i)** −3, 0, 6 **(c)** 1.4 to 1.6 and −3.6 to −3.4 **(d)** 1.5

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**Question 7**

Candidates were required to interpret a pie chart. The 'show that' question in part **(a)** again proved the most challenging. In part **(b)** candidates had to form an equation from worded information and then to solve it.

**(a) (i)** As in previous questions the 'show that' part proved to be the most difficult. Candidates were asked to show that 45 people travel by car from the information given in the pie chart. The most common response was to use the 45 given in the question and show that the angle of the pie chart was 135°. As with previous 'show that' questions candidates who start using the 45 did not gain any marks. In good solutions candidates first measured the angle from the pie chart and then used the information to derive the fact that 45 people travel by car. Candidates should be reminded that in a 'show that' question where 45 must be obtained that it cannot be used in their calculations.

**(ii)** Many more able candidates were able to identify the fraction $\frac{2}{3}$ immediately with no or little working out. Candidates who measured the angles often went wrong when trying to convert these values to the number of people. Some good solutions were left unfinished when correct fractions for bus and car were found separately but then not added together. Many less able candidates did not attempt this question.

**(b) (i)** Candidates found forming an equation from the information given in the table difficult. Good solutions found an algebraic term for each of the 4 modes of travelling to work and wrote them added together on the answer line. Some able candidates attempted to simplify their terms without any working out; if they made one small error they were unable to access any of the 3 marks available. Candidates should be reminded to show all working out. Most candidates were able to write an algebraic equation which contained at least one of the required elements ($x$+17 or 2$x$). However a large number of candidates missed out the $x$ for people who walk to work. Many less able candidates tried to give numerical answers in this part and without an equation scored no marks.

**(ii)** Candidates who had successfully given the correct equation in part **(i)** generally were able to solve their equation and get full marks in this part. Candidates who gave an incorrect equation in part **(i)** generally gained two follow through marks. Some candidates restarted the question and used trial and improvement to find the correct solution. However some common simplification errors led candidates to wrong solutions, e.g. $17 + x = 17x$ or $x + 2x = 2x^2$.

*Answers*: **(a)(ii)** $\frac{2}{3}$ **(b)(i)** $x+31+x+17+21$ **(b)(ii)** 18

**Question 8**

Most candidates were successful in answering some of this algebra question, with most candidates attempting all or some of the questions. More able candidates could attempt the simultaneous equations in part **(d)** however the majority of candidates were able to attempt the expansion question in part **(b)**. Candidates should be reminded to show all steps in solving equations or simplifying expressions.

**(a)** Many candidates showed good understanding of algebraic expressions and gave the correct solution. However a number 'spoilt' a correct answer by trying to simplify it further to 560*cf*.

**(b)** The vast majority of candidates made a good attempt at this question and were able to gain one of the two available marks for expanding the first bracket correctly. The most common error was expanding the second bracket as $-4x-8y$ instead of $-4x+8y$.

**(c)** Some examples of very good factorising were seen with more able candidates gaining full marks. A common mistake was to only partially factorise the expression leading to answers of $5(x^2y-4x)$ or $x(5xy-20)$ which gained one of the two marks. Many less able candidates chose not to attempt this question.

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**(d)** The simultaneous equations proved challenging this year, with many less able candidates choosing not to attempt it or only able to attempt the first part of the solution. Candidates generally were able to choose the correct method to eliminate one variable and therefore were able to score 2 out of the 4 marks available despite getting the wrong final answers. Fewer candidates chose to use the substitution method of solving simultaneous equations than in previous years. Many were successful in rearranging and substituting into the other equation, gaining 2 method marks, however most got no further than this. More candidates showed their working and were therefore able to gain method marks than in previous years. A common misconception was seen a number of times. Some candidates substituted y=0 into one of the equations and solved it for x and then substituted x=0 into the other equation and solved it for y. This is an incorrect method which should be discouraged.

*Answers*: **(a)** $160c + 400f$ **(b)** $2x - 7y$ **(c)** $5x(xy - 4)$ **(d)** ($x$=) 5 ($y$=) −2

**Question 9**

The first two parts of this sequence question were well answered. The parts involving algebra proved more challenging for candidates, particularly as the *n*th term was a negative.

**(a) (i)** The majority of candidates who attempted this question were able to gain full marks. Most candidates successfully identified the next two terms of the sequence and the best solutions followed this with a worded explanation of how to find the next term. The most common mistake was to attempt to give the rule as an *n*th term, e.g. $n-9$.

**(ii)** Again candidates were successful in identifying the next 2 terms of the sequence but as in part **(i)** found writing the rule more difficult. Candidates who wrote a worded answer were generally correct. However again those that attempted to give the *n*th term lost this mark, e.g. $3n$, $n$x3 etc.

**(b) (i)** Finding the *n*th term for the sequence proved to be the most difficult part of this question. Very few candidates correctly identified $-9n$, because the sequence decreased by 9, with a common mistake being $9n+75$. The most common wrong answer was $n-9$, where candidates had used the term to term rule instead of the *n*th term.

**(ii)** Many candidates were able to gain full marks despite getting part **(i)** wrong. Most successful candidates subtracted 9 repeatedly to arrive at the 21st term of −96. This was done very accurately by the majority who attempted this method. Some however subtracted nine 21 times from 84 and reached a common wrong answer of −105. A number of follow through marks were awarded for candidates correctly substituting into their *n*th term in part **(i).**

*Answers*: **(a)(i)** 48, 39, subtract 9 **(a)(ii)** 162, 486, multiply by 3 **(b)(i)** $93 - 9n$ **(b)(ii)** −96

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# MATHEMATICS

**Paper 0580/32**

**Paper 32 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

This paper gave all candidates an opportunity to demonstrate their knowledge and application of mathematics. Most candidates completed the paper making an attempt at most questions. The standard of presentation and amount of working shown continues to improve and was generally good. Centres should continue however to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required and candidates should be encouraged to avoid premature rounding in workings. Candidates should also be encouraged to read questions again to ensure the answers they give are in the required format and answer the question set. When candidates change their minds and give a revised answer it is much better to rewrite their answer completely and not to attempt to overwrite their previous answer.

## Comments on Specific Questions

### Question 1

All candidates were able to attempt all or part of this question as it offered a wide range of questions on various areas of mathematics and numeracy involving definitions, mathematical signs, brackets, factors, multiples and sequences. In part **(a)** a significant number of candidates lost marks by only giving one example from the given list and not stating all the possible numbers as requested in the question.

**(a)** This part required knowledge of the terms odd, square, cube and prime and was generally answered well although often incomplete as stated above. A common error was to include 9 as a prime number.

**(b)** This part involved the use of mathematical symbols and again was answered generally well although a common error was $\pi = \frac{22}{7}$.

**(c)** The insertion of brackets into the given statement to make it true was well done showing good understanding of BODMAS or BIDMAS. A small number of candidates used more than one pair of brackets. It was also noticed that where candidates changed their minds and attempted to erase brackets and insert new ones it was not always very clear what their final answer was and it would have been better to rewrite the whole statement to show their intended final answer.

**(d) (i)** This part was not answered as well and many candidates were unable to write the given number as a product of prime factors although their answers generally showed some knowledge of the term "factor". Common errors included giving a product of 2 numbers such as 7 x 12,where one wasn't prime, giving a sum of prime numbers such as 43 + 41, listing the factors e.g. 2,3,7, or giving a list of some or all possible factors e.g. 2,3,4,6,7,12,14,21,28,42.

**(ii)** In parts **(ii)** and **(iii)** the lowest common multiple and the highest common factor were often interchanged. Some candidates were able to gain one mark for stating 2, 3, 4 or 6 as the "highest" common factor.

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**(iii)** Candidates who understood the required term were generally able to give the correct answer of 168 although 2016, 504, 840 and 1008 were also seen. A very common error was to give the "lowest" number as 2.

**(e) (i)** The vast majority of candidates were able to identify 19 as the next number in the given sequence.

**(ii)** The majority of candidates were able to explain how they had found their answer to part **(i)** usually by the simple expression of "adding 4". Common errors included $n + 4$, "I used the common difference" and "the common difference is 4".

**(iii)** There did seem to be an improvement in the number of candidates who were able to give a correct expression for the $n$th term of the sequence, although $n + 4$ was still a very common error.

**(iv)** There were a number of excellent answers here that demonstrated a good mathematical understanding of sequences. Correct answers tended to fall into one of the following categories; use of 123 and 127, use of $n$=31.5, use of 123 and add 4, use of 126 and divide by 4. A number of incomplete statements were seen such as "125 is not in the sequence", "127 is in the sequence", "if you go up in 4's 125 is not there". A significant number simply stated answers such as "125 is odd", "125 is a cube number", "the sequence does not go that far".

*Answer*: **(a)(i)** 5 and 9 **(ii)** 4 and 9 **(iii)** 8 **(iv)** 2 and 5 **(b)** <, =, <, > **(c) (i)** (16 + 8) ÷ 4 – 2 = 4
**(ii)** 16 + 8 ÷ ( 4 – 2) = 20 **(d)(i)** 2 x 2 x 3 x 7 **(ii)** 12 **(iii)** 168 **(e)(i)** 19 **(ii)** add 4 **(iii)** $4n - 1$

**Question 2**

This question tested the candidate's ability to find the area of a given shape, to find the volume of a given prism, and to recognise and apply Pythagoras' theorem. The construction part of the question was less successfully answered than in previous years.

**(a) (i)** The cross section *ABCD* was generally correctly named as a trapezium although common errors included quadrilateral (not enough), parallelogram and prism with a number of other responses also seen.

**(ii)** Many candidates appeared to find this question quite demanding. The more successful candidates used the formula for the area of a trapezium although a common error here was to interchange the 120 and the 240. A more common method was to split the shape into a rectangle and a triangle but again incorrect measurements were used particularly for the triangle where the $\frac{1}{2}$ was also often omitted. The majority of candidates chose to work in centimetres but a significant number omitted to give the units in their answer.

**(iii)** This part again proved very demanding and those who appreciated the need to simply multiply their answer to the area of the cross section by 2.5 to get the volume were in the minority and of those who did, very few dealt with the units correctly.

**(iv)** This part involved the use of Pythagoras' theorem in a contextual question and was generally answered well with many correct and accurate answers seen. A common error however was in not finding the required length of 60 cm first.

**(b)** A small but significant number of candidates were able to gain full marks on this construction question with clear and accurate diagrams showing all the required construction arcs and loci. A number did not realise that the two bullet points in the question required two different constructions and attempted one construction to cover both conditions. Few were able to draw the correct angle bisector though the required arc centred on *H* was more successful. A small number were unable to attempt this part.

*Answer*: **(a)(i)** Trapezium **(ii)** 25200 cm² **(iii)** 6.3 **(iv)** 134

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**Question 3**

This question tested geometrical properties requiring knowledge of symmetry, angle properties of triangles, circles and polygons. Candidates should show all working and could benefit from putting the known angles onto the given diagram.

**(a)** The required line of symmetry was correctly drawn by the majority of candidates.

**(b)** This part on rotational symmetry was also well answered although common errors of 1, 4, 90˚ and 180˚ were seen.

**(c) (i)** Knowledge of the fact that there are 360˚ around a point enabled the vast majority of candidates to correctly answer this part although a small number of numerical errors were made.

**(ii)** Knowledge of the two geometric properties required again enabled the vast majority of candidates to correctly answer this part although common errors of 77, 54 and 49 were seen.

**(d)** Knowledge of the fact that the angle in a semi-circle is 90˚ again enabled the vast majority of candidates to correctly answer this part although common errors of 34, 54, 236 and 146 were seen.

**(e)** This part on polygon properties proved very demanding for a significant number of candidates and responses varied from excellent and well-reasoned answers showing clear and full explanation of the method used, to incorrect answers with a complete absence of working and method. A number used the interior angle approach and found the angles of 120˚ and 140˚ to find the required number of sides. A more successful approach was to find the exterior angles of 60˚ and 40˚. Working was deemed vital in this part and stated as such on the question paper and a correct answer without working was only given partial credit.

*Answer*: **(b)** 2 **(c)(i)** 131 **(ii)** 103 **(d)** 56 **(e)** 9

**Question 4**

This question on statistics proved a good discriminator and the full range of marks was seen.

**(a) (i)** A significant number of candidates did not appreciate that a numerical value was required to complete the key. Common errors included 1, 18, 21, 46, “number of”, “goals scored in” and “winning”.

**(ii)** The completion of the pictogram was better answered although a number were unable to attempt this part. A small yet noticeable number also added circles or part circles to all the other lines of the pictogram.

**(b) (i)** This part requiring the modal number of goals was generally well answered.

**(ii)** This part requiring the median to be found was less successful. The more successful candidates made an ordered list, used a cumulative frequency approach or recognised that it was the 23rd/24th value. The very common error was 3 coming from the number of goals column in the table but not taking into account the frequencies.

**(iii)** Few correct answers to the range were seen with 5, 10, 46, 6−0, and 18 being the common errors.

**(iv)** This part on probability proved demanding for many candidates. Few realised that the statement “scored at least 4 goals” meant that the calculation of 6+5+2=13 was required. Common errors included $\frac{4}{46}$, $\frac{39}{46}$, $\frac{6}{46}$, 4,3, 13 and 26.

**(c) (i)** The completion of the scatter diagram was generally done well although as in previous years a small number of candidates did not add any points to the given graph.

**(ii)** The majority of candidates were able to draw a ruled straight line for their line of best fit and it was usually within the acceptable limits of accuracy. However a small yet significant number still simply join two points from the extremities or assume that the line needs to go through the “origin”, or simply to join up all the points in a series of lines.

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**(iii)** This part was generally answered well with the majority of candidates now realising that just a single word is needed to describe the type of correlation.

**(iv)** This part was also answered well particularly with a follow through mark being applied from a positive line of best fit.

**(v)** The correct team was identified by the majority of candidates although A, F and J were common errors.

*Answer*: **(a) (i)** 2 **(b)(i)** 1 **(ii)** 2 **(iii)** 6 **(iv)** $\frac{13}{46}$ **(c)(iii)** positive **(iv)** 65 to 70 **(v)** E

**Question 5**

All candidates were able to attempt all or part of this question as it offered a wide range of questions on various areas of mathematics and numeracy involving money, percentages, fractions, ratio and money conversion. Care should be taken with accuracy in questions of this type. When the answer is an exact amount of money as in part **(a)(i)** the answer should be given in full and not rounded. When the question requires a two-step calculation as in parts **(a)(ii)** and **(iii)** premature approximation should be avoided. If a question requires a specific level of accuracy as in part **(b)**, where the answer correct to the nearest dollar was asked for, this must be done. The working and more exact answer should of course also be shown as normal.

**(a) (i)** The majority of candidates performed the correct calculation accurately although the rounded answer of $462 was often seen.

**(ii)** This part was also generally done well with the common method used being to find 14% and then subtract although those candidates who calculated 86% were more successful and less likely to lose the accuracy mark. The common error was $64.64 from just finding 14%.

**(iii)** The majority of candidates recognised that the first required calculation was to divide by 3 though less recognised that multiplying by 52 was also necessary. Other common errors included the loss of accuracy, not using their value from part **(ii)**, or using the values of 461.70 or 462.

**(iv)** This part on the use of a ratio was generally answered well although common errors of $\frac{140}{5} = 28$, $\frac{140}{3} = 46.67$, and $\frac{140}{3} \times 5 = 233.33$ were seen.

**(b)** The majority of candidates performed the correct calculation for this money conversion question but didn't score full marks as the given instruction to "give your answer correct to the nearest dollar" was not followed. Common errors were then 124.378, 124.37, 124.4 and 125.

*Answer*: **(a)(i)** 461.70 **(ii)** 397.06 **(iii)** 6880 **(iv)** 84 **(b)** 124

**Question 6**

This question gave candidates the opportunity to demonstrate their ability to calculate missing values and to draw a quadratic curve. Candidates continue to improve at plotting points and drawing smooth curves. Part **(d)** proved more difficult as a number of candidates did not realise they could use their graph to solve the quadratic equation with many attempting to use the quadratic formula with little success.

**(a)** The table was generally answered well with the majority of candidates giving 2 correct values although common errors of −27, −5 and 11 were seen for the first calculated y co-ordinate.

**(b)** The graph was generally plotted well although the scale of the vertical axis seemed to cause a few problems in plotting accurately. The majority were able to draw a correct smooth curve with very few making the error of joining points with straight lines.

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**(c)** The line y = 10 was generally drawn correctly although a small number of short or dashed/dotted lines were seen. The drawing of lines such as y = 10 need to be both continuous, ruled and of sufficient length.

**(d)** This part on solving a quadratic equation was still demanding but was answered much better than in previous years. Those who used their graphs usually were able to read off the values from their intersection points correctly.

*Answer*: **(a)** 5, 12 **(d)** 2.7 to 2.8

**Question 7**

This question on algebra proved challenging for a number of candidates. Able candidates were often however able to score full marks. The use of index notation in part **(e)** proved more demanding for many candidates.

**(a)** This part connecting algebra with the perimeter of a triangle was generally well done. Most candidates understood that the question required them to form an expression in $x$, although some thought that it then required an equation, e.g. =180 was a common error. The simplification by collecting like terms was generally well done. It was not uncommon however to collect the $p$ terms correctly but to reach $11r$ because of the negative value involved.

**(b)** The majority of candidates were able to attempt this part well, and were able to substitute the given values into the expression. Marks tended to be lost in manipulating the negative value and/or the minus sign, with a common error being 186. The majority of these were able to score a method mark for working showing a correct full substitution or for correctly calculating the value of 192.

**(c) (i)** This part was very well done with the majority of candidates able to correctly solve the given one-step equation.

**(ii)** This part involving the solution of a two-step equation was less successful but still answered well by many candidates. The common error was an answer of 3 coming from an incorrect first step of 23 – 8.

**(iii)** Some very good attempts were seen at this three-step equation by the more able candidates. Common errors included 2c – 10 from the bracket expansion, incorrect numerical values of 13,−13, 27 and 3, an algebraic term of $7c$, and $3c = -27$ giving a final answer of 9.

**(d) (i)** This part on multiplying out the brackets was generally well done with only the rare common errors of $16x + 11$, $40x$, 40 and $x$=1.5 seen.

**(ii)** Many candidates attempted this part and a great number were able to factorise the expression to some extent, earning marks for a partial factorisation if not full marks for the correct answer. Common partial errors were 2x(3x−6) and 3x(2x−4).

**(e) (i)** This part on index notation was generally answered well although common errors of a coefficient of 8, $q^8$, and a final answer of $15^6$ were seen.

**(e)(ii)** Again this part on index notation was generally answered well although common errors of $6t$, $t^4$, $2 \times t^6$ were seen.

*Answer*: **(a)** $13p - r$ **(b)** 198 **(c)(i)** 6.4 **(ii)** −3 **(iii)** −9 **(d)(i)** $16x + 24$ **(ii)** $6x(x - 2)$ **(e)(i)** $15q^6$ **(ii)** $t^6$

**Question 8**

This question on vectors proved a good discriminator and the full range of marks was seen.

**(a) (i)** This part was generally well done although sometimes the negative sign was omitted.

**(ii)** This part on finding the sum of two given vectors was also generally answered well although the negative signs again caused some confusion leading to errors.

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**(b)** This part asking for a translation vector proved less successful with common errors of $\begin{pmatrix} 4 \\ -5 \end{pmatrix}$ and $\begin{pmatrix} 8 \\ 11 \end{pmatrix}$ seen.

**(c)** This part proved to be the most difficult with many candidates not appreciating the reverse nature of the question. Common errors included (−3,−1), (11,−5) and (3,−1). Those candidates who used the given grid tended to be more successful. A significant number did not attempt this part.

*Answer*: **(a)(i)** $\begin{pmatrix} 10 \\ -15 \end{pmatrix}$ **(ii)** $\begin{pmatrix} 7 \\ -6 \end{pmatrix}$ **(b)** $\begin{pmatrix} -4 \\ 5 \end{pmatrix}$ **(c)** (3,1)

**Question 9**

This question on transformations was generally answered well. Candidates should be reminded to use a sharp hard pencil when drawing diagrams to ensure their answers are clear. Candidates continue to find describing a single transformation difficult with a significant number omitting part of the description or giving a double transformation as their answer.

**(a) (i)** Drawing the required reflection was generally well done although a common error was to reflect in the *y*-axis.

**(ii)**. Drawing the required rotation was generally well done although common errors included a 90˚ rotation, a correct rotation but about a different centre often (1,1). A small yet significant number had correct vertices at (−3,−1) and (−1,−1) but then drew the third vertex at (−1,−5) rather than (−3,−5) possibly from a correct rotation of the first two then making an incorrect assumption about where the final vertex should be.

**(iii)** Drawing the required translation proved more challenging with a variety of incorrect positions seen.

**(b)** Candidates seemed to appreciate what was meant by a single transformation but found the full description demanding. Most used the correct term of enlargement but were less certain of the terminology relating to the scale factor and the centre of enlargement. There was sometimes a non-specific "x2" or "*B*=2x*A*" which is not acceptable. There was also sometimes reference to a "shift" to the right suggesting that the choice of a centre of enlargement other than the origin proved difficult.

*Answer*: **(b)** Enlargement, centre (0,1), scale factor 2

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# 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. It was noted that the majority of candidates attempted all of the questions with the occasional part question being omitted by individuals. The standard of presentation was generally good. A substantial number of 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. Candidates should be encouraged to give all necessary detail in descriptions, especially in transformations.

Centres should continue to encourage candidates to show all working clearly in the answer space provided. The formulae being used, substitutions and calculations performed, are of particular value if an incorrect answer is given.

Candidates should take the time to read the questions carefully to understand what is actually required in each part, for example, giving an answer to 2 significant figures when asked to do so.

## Comments on Specific Questions

### Question 1

Most candidates answered this question reasonably well. There were very few candidates who did not state a single transformation in each of part **(a)**. Candidates should be encouraged to fully describe transformations.

**(a) (i)** Candidates were generally able to identify that the transformation was a reflection. Very few candidates identified the correct line of reflection with many not providing an answer or assuming it was one of the axes. Those candidates who did not recognise the transformation as a reflection thought it was a rotation.

**(ii)** Many candidates correctly identified the rotation but did not receive full marks as they generally did not state all three necessary components. The main errors were to not identify whether the rotation was clockwise or anti-clockwise even when they stated 90° and/or omitting the centre of rotation.

**(iii)** Most candidates identified the enlargement. The main errors were incorrectly stating the centre of enlargement and/or giving incorrect statements with regard to the scale factor such as “two times bigger”.

**(b) (i)** Candidates generally shaded the correct square.

**(ii)** Nearly all candidates gave the correct reflection.

*Answers*: **(a) (i)** Reflection, $y=-x$ **(ii)** Rotation, centre (3, 2), 90° anticlockwise **(iii)** Enlargement, scale factor 2, centre (3, −3)

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**Question 2**

Candidates appeared to find this question challenging. Centres should emphasise the concepts of bounds and conversion of units.

**(a) (i)** Few candidates provided the correct answer. Common errors involved finding 5, 10, 1, 0.1 either side of 23.6.

**(ii)** Most candidates gave the correct answer. The common error was to just calculate 15% of 8 to give an answer of 1.2.

**(iii)** Most candidates could calculate the time correctly.

**(iv)** Few candidates provided the correct answer. The two most common errors were to just convert the metres into kilometres or to only convert to minutes not seconds.

**(b) (i)** Candidates generally plotted the points correctly on the scatter diagram.

**(ii)** Many candidates correctly stated the scatter diagram had a negative correlation.

**(iii)** Only a minority of candidates gave a correct description. Candidates could improve their answer if they had further practise on describing relationships.

**(iv)** The majority of candidates drew a good continuous line of best fit. The common errors were to either join all the dots or join the corners of the grid or to only have one point on one side of their line and most of the others on the other side. A few candidates attempted to draw a line with a positive gradient.

**(v)** Most candidates understood how to obtain the estimate and gave answers within the acceptable range, even when their line was not the correct one.

**(vi)** Candidates found this part challenging. Few candidates clearly stated that the 5.20 was outside the range of the data. Candidates could improve their answers if they had further practise in when a line of best fit can be used to give an estimate.

*Answers*: **(a) (i)** 23.55, 23.65 **(ii)** 9.20 **(iii)** 12.5 **(iv)** 28.8 **(b) (ii)** Negative **(iii)** The longer the distance the quicker the time **(v)** 17.0 to 17.5 **(vi)** Outside the range of the data

**Question 3**

Candidates generally understood the requirements of this question. They could improve their answers by showing all their working clearly in the given space.

**(a)** Many candidates gave the correct answer. A common error was to incorrectly calculate the total cost for the family, often including \$4.50 for the 2 year old, but to then correctly subtract their value from \$50. Some candidates did not provide any working and lost all marks if their answer was incorrect. Candidates would improve their opportunity to gain part marks if they set out their working in a neat and logical manner.

**(b)** A majority of candidates gave the correct answer. The two most common errors were to only subtract 20 minutes or to add on 1 hour 20 minutes.

**(c)** Many candidates gave an answer of 105, not realising that December 2003 had not been reached.

**(d) (i)** Some candidates gave the correct answer. Candidates would improve their answer if they read the question carefully as many found $\frac{3}{8}$ of 45 instead of $\frac{3}{5}$ of 45.

**(ii)** Candidates found this challenging. Many candidates gave an answer of 6:5 by adding the extra 3 to snakes in the first ratio or 6:8 by adding 3 to both parts. Only a few candidates didn't give their answer in its lowest form.

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**(e)** Some candidates gave the correct answer, a few without any working. Where working was shown candidates usually gained marks for recognising they had to subtract 25 from 85 and divide this by 7.50. From this a common error was to add 1 to give an answer of 9.

**(f)** Almost all candidates divided the values to give g/cents for each bag. Some used correct alternative methods with a few incorrectly multiplying the grams and cents. Many candidates then chose the medium bag rather than the small bag. Candidates would improve their answers by reading the question carefully as it states that they need to show how they decided so just writing small bag was not sufficient.

**(g) (i)** The majority of candidates measured the bearing accurately.

**(ii)** Many candidates drew an arc of the correct radius with a few not extending it as far as the boundaries.

**(iii)** Some candidates positioned S in the correct place. Some candidates did not draw the bearings accurately although they did show they understood bearings. Many candidates placed S on the line between the entrance and the exit.

*Answers*: **(a)** 22.5 **(b)** 0945 **(c)** 104 **(d) (i)** 27 **(ii)** 2:3 **(e)** 5 **(f)** Small bag **(g) (i)** 105

**Question 4**

Candidates showed an understanding of tallies and frequencies. They would improve their answers if they obtained a clearer understanding of statistical terms and probabilities when related to a frequency table.

**(a)** Many correct answers were seen in this part. Tallies were not often used but sometimes the frequencies were placed in the tally column.

**(b) (i)** Some candidates gave the correct answer. A common error was to give the range of the frequencies rather than the ages.

**(ii)** Candidates generally understood the mode and gave the correct answer.

**(iii)** The correct median was often seen particularly where candidates had listed all the ages in order. An answer of 11.5 was seen sometimes, coming from the median of 10, 11, 12 and 13.

**(iv)** Many candidates gave the correct answer. Some candidates divided by 4 instead of 15 whilst others calculated (10+11+12+13) ÷ 4.

**(c) (i)** A majority of candidates gave the correct answer, normally as a fraction which was often simplified. A common error was to give an answer of $\frac{10}{15}$.

**(ii)** The majority of candidates gave the correct answer. A common error was to misread the question and work out the probability of the child's age being 13 rather than more than 13.

*Answers*: **(a)** Frequencies 3, 5, 6, 1 **(b)(i)** 3 **(ii)** 12 **(iii)** 11 **(iv)** 11.3 **(c)(i)** 0.2 **(ii)** 0

**Question 5**

Candidates showed some understanding of the use of formulae. They could improve their answers by practising rearrangement of formulae and carefully reading the questions.

**(a) (i)** A few candidates gave a correct answer. The majority of candidates gave an answer which was a two-dimensional shape or omitted to give an answer at all.

**(ii)** Many candidates gave the correct answer. A common error was to include a $\frac{1}{2}$ in the expression.

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**(b) (i)** Most candidates used the formula correctly to calculate the volume.

**(ii)** Some candidates were able to obtain an answer correctly but then did not give their answer to 2 significant figures. The most common error was to just divide 160 by 150 or vice versa. Candidates would improve their answers if they read the question carefully and practised the difference between significant figures and decimal places.

**(iii)** Some candidates showed they could re-arrange a formula correctly. The most common errors were to subtract instead of divide and only take the square root of some terms.

*Answers*: **(a) (i)** one of for example cone, sphere, pyramid **(ii)** $Ah$ **(b) (i)** 339 **(ii)** 1.2 **(iii)** $r = \sqrt{\frac{V}{\pi h}}$

**Question 6**

Candidates showed good ability at plotting graphs. Fewer cases of using straight lines instead of curves were seen this year and should continue to be encouraged.

**(a)** Many candidates drew the correct lines in both parts although some were not of sufficient length to cover the grid. Some candidates joined the points (3, 5) and (-3, 0) for example.

**(b) (i)** Most candidates gave the correct answer. A common error was to write the co-ordinates down in the order they appeared in the question (5, −3).

**(ii)** Many candidates found this demanding with some not giving an answer. Some candidates just gave a number as the answer rather than an equation and others gave an equation involving $x$.

**(c) (i)** The vast majority of candidates calculated the correct values for the table. The most common error was for $x=-2$ where an answer of 2 was frequently seen.

**(ii)** The vast majority of candidates plotted their points correctly and most drew a good continuous curve through them. Some candidates joined the bottom two points with a straight line.

**(iii)** Only a few candidates gave the correct answer for the minimum point. Candidates needed to recognise the symmetry of the curve to gain the $x$ co-ordinate.

*Answers*: **(b) (i)** (−3, 5) **(ii)** $y = k$, $k \neq 5$ **(c) (i)** 10, −2, −2, 10 **(iii)** (1.5, $k$), $-2.5 < k < -2$

**Question 7**

Candidates showed an improvement in the understanding of compound interest with only a few attempting simple interest. Care should be taken when describing in words.

**(a) (i)** Many candidates gave correct algebraic expressions for the ages. The common error was to write $8-x$ instead of $x-8$. Some candidates gave numerical answers.

**(ii)** Many candidates correctly followed their algebraic expressions from part **(i)** to give a formula although a few omitted the $x$ for Simon's age. A few candidates only gave an expression, not equating it to 40.

**(iii)** Many candidates again followed through correctly. In a few cases poor manipulation of the terms lost marks.

**(b)** Many fully correct answers were seen. Candidates who tried to convert to equivalent fractions, decimals or percentages, add these and then find this as a fraction of the 600 were less successful than those who worked out the three individual quantities first. In this case it was not uncommon for candidates to find out the amount eaten rather than the amount left.

**(c)** Many candidates used the compound interest formula. Those candidates who did a year by year calculation tended to make errors such as adding to 150 each year instead of the current value. Very few candidates used simple interest.

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**(d) (i)** Candidates identified the difference as 4 between each term. Some then correctly stated the requirement to add 4 each day but many did not indicate that 4 needed to be added on.

**(ii)** Many candidates gave the correct answer. The common error was to write $n+4$.

*Answers*: **(a) (i)** $2x$, $x-8$ **(ii)** $x+2x+x-8=40$ **(iii)** 12 **(b)** 195 **(c)** 178.65 **(d)(i)** Add 4 **(ii)** $4n-3$

**Question 8**

Candidates showed an understanding of areas although they found the question challenging.

**(a)** Some candidates gave the correct answer. Many candidates understood they needed to use the formula for the area of a triangle but put the given terms in the wrong places. The most common error seen was to put the area in as the perpendicular height.

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

**(ii)** Many candidates correctly used the formula for the area of a trapezium. Candidates who attempted to spilt the shape into a rectangle and a triangle frequently made an error.

**(c)** Some candidates gave the correct answer. The most common errors were to either repeat the given answer or to write 40, 40, 70.

*Answers*: **(a)** 6 **(b) (i)** Trapezium **(ii)** 77 **(c)** 40, 100

**Question 9**

Some candidates showed a good understanding of trigonometry. Candidates would improve their answers if they correctly recalled the formulae for the trigonometric ratios and practised explanations.

**(a)** A few candidates gave the correct reason. The common incorrect reasons given were “because it is a right angle triangle” or “tangent perpendicular to radius”. Candidates would improve their answers by further practise on the explanations for particular angle results.

**(b)** Most candidates realised this was a Pythagoras’ theorem question with many correct answers seen. The common error was to incorrectly identify the hypotenuse.

**(c)** Many candidates used the correct trigonometric expression. Some candidates rounded their answer to an integer value.

*Answers*: **(a)** Angle in the semi-circle equals 90° **(b)** 12 **(c)** 22.6

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**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**International General Certificate of Secondary Education**

# 0580 MATHEMATICS

**0580/37** **Paper 37 (Core)**

Due to a security breach we required all candidates in Kuwait who sat the paper for 0580/32 to attend a re-sit examination in June 2014. Candidates outside Kuwait sat only the original paper and were not involved in a re-sit.

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# MATHEMATICS

**Paper 0580/37**
**Paper 37 (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. The vast majority of candidates were able to complete the paper in the allotted time, and most were able to make an attempt at all questions. Few candidates omitted part or whole questions. The standard of presentation was generally good. There were occasions where candidates did not show clear working and so did not gain the method marks available. Centres should continue to encourage candidates to show formulas used, substitutions made and calculations performed. Candidates should also be encouraged to fully process calculations 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. The use of correct equipment was evident; protractors used to complete the pie chart and compasses used to construct loci. Centres should continue to remind candidates that when correcting a solution they should re-write their answer rather than overwriting. Attention should be paid to the degree of accuracy required in each question and the format asked for. This was particularly important in questions involving money when candidates were asked to give their answer to the nearest pound. Candidates have made substantial improvements, this year, in using the correct value for pi; the calculator value for π or 3.142.

## Comments on Specific Questions

### Question 1

All candidates were able to attempt all or part of this question as it offered a wide range of questions on various areas of mathematics. Candidates were able to demonstrate their ability to calculate simple interest, use exchange rates, complete a pie chart and solve problems involving time. Many candidates however did not read the instructions clearly when using exchange rates and did not give their answer in the correct form, to the nearest pound.

**(a)** The majority of candidates made a good attempt at this question about time, however a large proportion of answers were not given in the correct format. The best solutions were given in 24 hour time, 1430, or 12 hour time, 2 30 pm. Many candidates' working showed good understanding of the problem and a correct method used but most gave their answer as 2 30 which did not give clear indication if this was 2 30 am or 2 30 pm.

**(b)** This question was well answered by nearly all candidates. Some candidates showed their working, however most simply gave the correct answer of 1840. A few candidates misread the question and attempted to calculate the cost of one night, using $115 as the total cost of 16 nights and dividing instead of multiplying.

**(c) (i)** The vast majority of candidates made good attempts at this question, clearly showing a division sum to change $'s into £'s. A few weaker candidates multiplied instead of dividing, however nearly all candidates made some attempt. Many candidates however missed out on full marks as they had not read the question fully and did not give their answer correct to the nearest pound as instructed. Candidates should be reminded to reread the question once they have reached an answer to check they have given their answer in the correct format.

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**(ii)** This question on simple interest again highlights the importance of rereading the question and checking that the candidate's solution has answered the question set. Most candidates showed good understanding of simple interest, with very few compound interest calculations seen. Candidates generally showed all their working out, however a very large proportion of candidates only calculated the simple interest and did not give the total amount of money as instructed in the question. These candidates only gained one of the two available marks.

**(d) (i)** The responses to this question showed that candidates understood that the angles in a pie chart must add to 360˚ and the total time spent was 216 hours. The best candidates were able to use the information given to complete the table. Many candidates however gave incorrect answers in all parts but still gained a mark if they made their angles add to 360˚ and their time add to 216.

**(ii)** All candidates who attempted the pie chart used correct equipment; ruler and protractor, with the majority of candidates correctly drawing the angles identified in the table. Most candidates labelled each part with the correct activity, with very few candidates not using the words 'Water Park' and 'Beach'.

**(iii)** The best candidates recognised that 90˚ was a ¼ of the pie chart and were able to give the answer of 25% with no working out. A common mistake by weaker candidates was to read the time from the table and give this as their percentage, e.g. 54% or 0.54.

*Answers*: **(a)** 14 30 or 2 30 pm **(b)** 18 40 **(c)(i)** 540 **(c)(ii)** 481.6(0) **(d)(i)** 96, 80, 18, 30 **(d)(ii)** 2 correct sectors with labels **(d)(iii)** 25

**Question 2**

This question tested candidates' understanding of ratios, fractions and area. The most difficult question was part **(a)** which required candidates to read the instructions carefully and calculate the cooking time for a piece of lamb. Most candidates showed a good understanding of calculating a fraction of a quantity.

**(a)** The best solutions to this problem were given by candidates who understood that the 'further 20 minutes' given in the question had to be added after the multiplication stage of the calculation. Many candidates missed this part of the problem and only multiplied the mass by 20 minutes. Although virtually all did this correctly, without adding the 20 minutes they gained no marks. Many weaker candidates added the two 20 minutes and multiplied 4.5 by 40, giving a very common wrong answer of 180 mins or 3 hours.

**(b)** Some very good answers were given to this question on ratios, where candidates showed all their working out. Most candidates understood that they had to add the values in the ratio and then divide. However the value of 4.8 kg for the total mass led to a common misunderstanding; many candidates dividing 12 by 4.8 instead of the correct method of dividing 4.8 by 12. This led to a very common wrong answer of 17.5 kg. If candidates had reread the question after giving their answer they may have noticed that their answer was larger than the total mass given in the question.

**(c)** This question was very well answered by the majority of candidates. Where working was seen candidates gave a clear method to calculate the fraction of guests who ordered the vegetable lasagne. Most candidates however simply gave the correct answer.

**(d)** This question was attempted by most candidates and some very good solutions were seen. Candidates should be reminded to look at the number of marks given to each question as an indication of the level of working out expected. This question was worth 5 marks, however many candidates showed no working out or performed a basic subtraction to reach their answer. The best solutions were made by candidates who showed all their workings out, calculating the areas of a rectangle and circle and subtracting their answers. Most candidates were able to gain two marks for the correct calculation of the area of a rectangle, however the area of the circle proved more difficult with many candidates using 30 cm as the radius instead of 15 cm. Some confusion from weaker candidates from whom the formula for the circumference of a circle was seen. There was a significant improvement on previous years on the number of candidates who used the correct value for pi. Some candidates lost the accuracy mark for incorrectly rounding their area of the circle to 706 instead of 707.

*Answers*: **(a)** 1 (h) 50 (min) **(b)** 2.8 **(c)** 27 **(d)** B, A, 34.9

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**Question 3**

All candidates were able to attempt most parts of this question. Most candidates were able to transform a shape. However most mistakes were made in describing the single transformation in part **(a)**, where many candidates did not fully describe the transformation. Candidates who were successful gave all three parts to describe an enlargement with a scale factor and a centre. The vast majority of candidates could plot and read coordinates correctly, however naming the shape in part **(c)(iii)** proved to be the most difficult part of the question.

**(a) (i)** Most candidates were able to gain one or two marks for this question by reflecting the shape A in a vertical line. The most common mistake however was to reflect it in the wrong vertical line, with many candidates reflecting in the line $x = 1$ or more commonly in the $y$-axis.

**(ii)** Candidates were more successful in rotating shape A, with most candidates gaining full marks. The most common mistake was to rotate shape A through 180° but about the wrong centre of rotation; this gained one of the two marks.

**(iii)** The description of the enlargement proved to be more difficult with fewer candidates giving the full description of an enlargement. Enlargement was identified by the majority of candidates. The scale factor was found by many but the centre of enlargement was often missed out. More candidates gave two transformations in this part of the question compared to previous years, enlargement followed by a translation was the most common double transformation given. Candidates again should be encouraged to read the question carefully and identify what is meant by a 'single transformation'.

**(b)** In calculating the area of triangle B most candidates used the correct values of 3 and 6, however a number of candidates did not use the correct area formula and did not divide by 2.

**(c) (i)** The vast majority of candidates identified the correct coordinate with very few coordinates given in reverse order.

**(ii)** Again most candidates were able to correctly plot the point *Z* on the grid with very few points seen at (4,2).

**(iii)** Naming the quadrilateral proved to be the most difficult part of the question with the most common wrong answer being 'rhombus'. The parallelogram *WXYZ* was very close to a rhombus and candidates should be reminded to measure sides to check if it is a rhombus or parallelogram.

*Answers*: **(a)(i)** (-5,1) (-4,1) (-4,3) **(a)(ii)** (-3,-1) (-2,-1) (-2,-3) **(a)(iii)** Enlargement, (sf) 3, (centre) (0,0) **(b)** 9 **(c)(i)** (-5,4) **(c)(ii)** Z plotted at (2,4) **(c)(iii)** parallelogram

**Question 4**

This question gave candidates the opportunity to show their number skills. Most candidates were able to use their calculators successfully. Candidates found finding a prime number the most difficult part of the question.

**(a) (i)** Nearly all candidates used their calculators to gain full marks and give the correct answer of 4096.

**(ii)** Again nearly all candidates used their calculator successfully to find the square root of 2.25.

**(iii)** The vast majority of candidates gave the correct answer of 1.

**(b)** Candidates found writing a prime number between 50 and 60 more difficult. Most answers given were between 50 and 60, showing candidates had read the question fully, however most common wrong answers were 51 and 57. Candidates should be reminded of the quick method to test if a value is divisible by 3.

*Answers:* **(a)(i)** 4096 **(a)(ii)** 1.5 **(a)(iii)** 1 **(b)** 53 or 59

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**Question 5**

This question gave candidates the chance to show their understanding of averages, rounding and forming and solving equations. Part **(d)** tested even the strongest candidates to form an equation and then solve it. However part **(b)(ii)** proved to be the most difficult of the whole paper as candidates were asked to interpret the difference in ranges of two football teams, with most answers not giving enough detail. Weaker candidates were able to gain marks calculating the mode, median, mean and range in part **(a)**. An improvement in the number of candidates correctly identifying which calculation to use for each measure of average was seen this year.

**(a) (i)** Nearly all candidates attempted this question in the correct manner. Good solutions had an ordered list of all 20 values and the middle two values clearly identified. Full marks were awarded to those candidates who correctly identified that the average of 3 and 3 is 3. Some candidates gave a correct ordered list and identified 3 and 3 but did not give a correct final answer, often giving 6 or 3.5. The other common mistake was to omit one value from the list and find the middle two values to be 3 and 4 and give the answer of 3.5. This however still gained the candidate one method mark.

**(ii)** The vast majority of candidates were able to identify the mode as 2. Only a very small number of candidates did not attempt this question.

**(iii)** Most candidates attempted this question and used the correct method. However many candidates did not give the correct answer of 11, but left it as a range i.e. 11 – 0, or gave the wrong answer of 10 from 11 – 1.

**(iv)** Most candidates correctly showed that they understood how to calculate the mean by adding the values and dividing by 20. A small number of candidates made mistakes in adding the values however still gained a method mark by showing their addition and division by 15. A number of candidates, however, showed no working out and an incorrect answer meant they could not gain any marks. Candidates should be encouraged to show all workings out.

**(b) (i)** Candidates found interpreting the information given on mean and range of the two football teams difficult. This part was more successful and many candidates correctly interpreted that both teams having equal means meant that they had scored the same total number of goals. A common mistake was to say one team had scored more than the other.

**(ii)** Interpreting the difference in the ranges proved to be the most difficult question on the paper. A number of good candidates attempted to give an explanation that one team had scored more goals in a game than the other, but this did not give enough detail as they had to also mention that the same team also scored less in other games also. The best answers used the word consistency or that one team was more consistent than the other. Most common wrong answer was to say that Pool City had scored more goals than XR United.

**(c) (i)** Most candidates were able to round the figure given to the nearest ten. Most common mistakes were to leave the zero off their answer, e.g. 7555, or give the answer of 75556.

**(ii)** Candidates found rounding to two significant figures difficult with only the best candidates giving the correct answer of 76000. Some correct answers were given in standard form. Most wrong answers simply gave two digits, e.g. 76 or 75.

**(d)** Candidates found forming an equation from the written information difficult. Good solutions gave a full method of solving their equation, with each step shown. Many candidates were unable to form an equation so were unable to gain the follow through marks for solving their equation. A number of numerical solutions led to the correct answer which gained full marks. Some candidates formed two separate equations but did not equate them and solved them individually and then added their two solutions. This method gained no marks.

*Answers*: **(a)(i)** 3 **(a)(ii)** 2 **(a)(iii)** 11 **(a)(iv)** 4.15 **(b)(i)** Same (total) **(b)(ii)** XR United are more consistent **(c)(i)** 75550 **(c)(ii)** 76000 **(d)** 13.2(0)

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**Question 6**

This question tested the candidates on a number of topics; probability, standard form, speed and money calculations. All candidates attempted all or part of the question. Candidates are increasingly using the speed, distance, time triangle to solve problems involving speed, an improvement on previous years.

**(a) (i)** The vast majority of candidates correctly identified that the most likely drink was blackcurrant. Very few candidates gave the probability of choosing a blackcurrant drink instead.

**(ii)** Candidates found drawing the arrow in the correct position of the probability scale more difficult. Many good candidates showed that the probability was 0.25 but then indicated this at 0.75 on the scale. Some candidates wrote 0.25 at the correct position on the scale but then drew a horizontal line from 0 to 0.25 as their indication of the probability. This was not accepted as a correct indication of the probability that an orange drink was chosen.

**(b)** This question was attempted by nearly all candidates, however only half gained the mark. Good solutions showed 2 x 500 and the correct final answer. Common errors were to divide by 2 or find 2/12 of 500.

**(c) (i)** The majority of candidates were able to gain one of the two marks available for finding the number of drinks delivered to be 123 000. Candidates found writing this in standard form more difficult. Many showed understanding of the required form but did not start with a value between 1 and 10, e.g. $123 \times 10^3$, $12.3 \times 10^4$ were often seen.

**(ii)** The use of the correct formula for speed was seen in increasing numbers this year with the vast majority of candidates gaining full marks on this question.

**(d)** Candidates were confident in dealing with money with many good full solutions seen with clear workings out given. The majority of candidates gained full marks. Some weaker candidates did not multiply the \$8.75 by 5 before subtracting from \$50.

*Answers*: **(a)(i)** Blackcurrant **(a)(iii)** Arrow at 0.25 **(b)** 1000 **(c)(i)** $1.23 \times 10^5$ **(c)(ii)** 50 **(d)** 6.25

**Question 7**

This question offered the candidates the opportunity to demonstrate their understanding of the parts of a circle, and angles in parallel lines, and to explain why their solution was correct. Most candidates found giving a reason difficult and most gave a list of calculations or reasons without using the terminology required to gain the mark. This question also asked candidates to find a missing angle in a right angled triangle.

**(a) (i)** Stronger candidates were able to correctly identify *OB* as the radius of the circle. Many candidates however gave answers of diameter, parallel or named a type of angle, e.g. acute or obtuse.

**(ii)** Few candidates correctly identified *BD* as the chord of the circle. Most candidates identified this line as part of the parallel lines and gave the answer of parallel instead.

**(b)** This question was well answered by the majority of candidates. Good solutions clearly identified the two angles in the triangle as 53˚ and 90˚ and subtracted these from 180˚. Some good solutions were spoilt as candidates had given all three correct angles in their working and then wrote 180˚ in the answer space.

**(c)** Many candidates correctly identified the value of *x* to be 41˚, but then struggled to give a reason for their answer. Some long explanations using parallel lines were given but without using the correct terminology of 'alternate angles' they were unable to gain the mark. A large number of candidates gave the reason as Z angles. This is not accepted as a correct answer.

*Answers*: **(a)(i)** Radius **(a)(ii)** Chord **(b)** 37 **(c)** 41, Alternate angle

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**Question 8**

Candidates were asked to measure and calculate the area of a farmyard using a scale of 1 cm to 10m. Many accurate measurements were seen, however some candidates found difficulty in converting an area calculated with measured values to the actual area. Many candidates did not attempt to draw the loci on the diagram and of those that did attempt it; very few gained more than one or two of the five marks available. Percentage profit again proved difficult this year, with very few good solutions seen. An improvement in the calculation of the circumference of a circle from previous years as, again, most candidates are using the pi button on their calculator or 3.142 as instructed on the front of the paper.

**(a)** Candidates showed good measuring skills, with the majority of candidates correctly giving the correct length of *BD* on the diagram. Many candidates however did not use the scale to find the actual length of *BD* and therefore did not gain the mark despite measuring accurately.

**(b)** Some very good solutions were seen, especially when candidates converted their measured lengths to actual lengths before multiplying. Candidates who multiplied their measured lengths first found it more difficult to convert into m², with the most common error being multiplying by 10 instead of by 100. A very large proportion of candidates had not read the information above the diagram and therefore measured the rectangle *ABDE*, believing this was the farmyard, instead of rectangle *ABCF*.

**(c)** Drawing the two loci proved to be the most difficult part of this question, many candidates did not attempt it and the vast majority of answers seen gained zero, or one or two marks only. Many circles were seen but very few were drawn with the pond as its centre and even fewer lines parallel to *FE* were seen.

**(d)** Candidates found drawing the path across the farmyard equally difficult, with more candidates choosing not to attempt the question. Some good answers seen with clear construction arcs used; two sets of arcs and correct straight line drawn. Common errors were to draw the line *BF* or attempt the bisector of the angle without compasses.

**(e)** Candidates again this year found calculating percentage profit difficult. Very few fully correct answers were seen, but those that did gain full marks showed all their workings out. Most candidates were able to gain one mark for correctly identifying the cost of 3 cows. Many candidates went on to calculate the profit but then divided by the selling price instead of the original cost. Candidates should be reminded that when calculating percentage profit they must divide by the original cost not the selling price.

**(f)** Most candidates were able to quote the correct formula for the circumference of the circle. An improvement in the calculation of the circumference of a circle from previous years as, again, most candidates are using the pi button on their calculator or 3.142 as instructed on the front of the paper. Many candidates however used 20m as the radius of the circle and multiplied pi by 40 instead of 20.

*Answers*: **(a)** 200 **(b)** 5600 **(e)** 91 **(f)** 62.8

**Question 9**

This question gave candidates the opportunity to demonstrate their ability to calculate missing values and draw a quadratic curve. Candidates continue to improve at plotting points and drawing smooth curves. Part **(a)(iii)** proved more difficult as many candidates did not realise they could use their graph to solve the quadratic equation with many attempting to use the quadratic formula with little success. Part **(b)** caused the most difficulty with many candidates not attempting the question.

**(a) (i)** Candidates answered this part well with the majority of candidates correctly calculating all 3 missing values. Candidates found calculating the value for $x$=-3 most difficult with $y$=-7 being a common mistake, from -(3)² instead of (-3)². Most candidates correctly identified the value for $x$=1.

**(ii)** Candidates plotted their values from the table well with the majority of candidates scoring 3 marks for plotting the correct or follow through points. The quality of curves drawn has improved again this year with very few straight lines drawn and very few with very thick lines or broken lines drawn.

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**(iii)** Candidates who gained full marks on this question were able to link the drawing of the curve with the solution of the equation. Those that did generally scored full marks having read correctly the points of intersection of their curve and the *x*-axis. However a large proportion of the candidates tried to solve the equation using the quadratic formula and only a very small number of candidates could do this correctly. Weaker candidates chose not to attempt this part of the question.

**(b)** Candidates found this part of the question very difficult. Very few answers gained full marks but many candidates gained part marks for partially correct solutions, most commonly $y=-x$. Many candidates drew lines parallel to line *L* on the grid and some used rise/run to calculate the gradient to be -1, which gained one mark. A small number of candidates correctly gave the answer of $-x+k$ but forgot to include the $y=$ at the beginning and gained two of the three marks. Again, weaker candidates chose not to attempt this question.

*Answers*: **(a)(i)** 11, -1, -5 **(a)(iii)** -0.8 to -0.6 and 2.6 to 2.8 **(b)** $y = -x \pm k$ oe $k \neq 0$

**Question 10**

Most candidates were successful in answering this algebra question, with all candidates attempting all or some of the questions. The stronger candidates were able to attempt the rearrangement in part **(e)**, however all candidates were able to attempt solving the equations and the simplification in parts **(a)** and **(b).** Candidates should be encouraged to demonstrate their method of solving equations and simplification as a large number simply wrote the answer which in some cases lost method marks.

**(a) (i)** The majority of candidates were able to solve this one step equation. Most candidates showed their working out leading to the correct answer of 3.5. Very few mistakes were seen, the most common being subtraction instead of division.

**(ii)** Again this equation was solved by the majority of candidates correctly. Clear working out was shown by most candidates. A small number of candidates made a mistake in the first step of the solution by subtracting instead of adding.

**(b)** This simplification question was not as well answered as the solving questions in part **(a)**. Although attempted by nearly all candidates, a common mistake was to give the answer as $2p^3$ instead of $2p$.

**(c)** Some good factorisation was seen in this question, however many weaker candidates did not understand the term 'factorise' and often multiplied or added the terms together. A common wrong answer was $20xy$.

**(d)** The majority of candidates made a good attempt at this question and were able to gain one of the two available marks for expanding the first bracket correctly. The most common error was expanding the second bracket as $-3x - 21$ instead of $-3x + 21$.

**(e)** Most candidates gained one of the three available marks for correctly expanding the bracket. Some excellent rearranging was seen with complete methods shown, therefore if errors were made candidates were still able to gain one or two marks for the correct first and second steps. Candidates should be reminded to always show their working out and methods used fully. The most common error following a correct expansion was to leave '*a*' on both sides of the equals sign. A very common wrong answer was $a = 3a + 3b - 2$.

*Answers*: **(a)(i)** 3.5 **(a)(ii)** 5 **(b)** $2p$ **(c)** $5(x + 3y)$ **(d)** $x + 13$ **(e)** $\frac{2-3b}{2}$ or $1-\frac{3b}{2}$

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# MATHEMATICS

**Paper 0580/41**
**Paper 41 (Extended)**

## Key Messages

Candidates who performed well on this paper consistently showed their working out, formulas used and the calculations performed in obtaining their answer. Attention should be paid to the degree of accuracy required in each question and, in order to avoid unnecessary loss of accuracy marks, candidates should be encouraged to avoid premature rounding in workings.

## General comments

As always a large proportion of the paper was accessible to many of the candidates although some questions proved more challenging. The presentation of work was generally good with some scripts showing working that was clearly set out. For some candidates, working was often haphazard and difficult to follow making it difficult to award method marks when the answer was incorrect. There was no evidence to suggest that candidates were short of time on this paper although less able candidates made no attempt at some questions.

## Comments on specific questions

### Question 1

**(a) (i)** A majority of candidates gave the correct answer with a few interpreting 2**A** as $\mathbf{A}^2$.

**(ii)** A small majority gave the correct answer but many others felt this was possible with $\begin{pmatrix} -4 \\ 10 \end{pmatrix}$ being a common incorrect answer. A few attempted the matrix product **BC**.

**(iii)** In contrast to the addition, the multiplication of matrices was more often correct. Most seemed to have an idea and most errors were a result of slips in the working out of the elements.

**(iv)** The process for inverse was understood by many, often gaining 1 mark for a correct adjoint or occasionally the correct determinant. Incorrect calculation of the determinant was a common cause of error.

**(b)** It was apparent that a significant number had some appreciation of why it was not possible to work out **CD**. Unfortunately, insufficient explanation meant that many of these lost the mark. It was common to see references to rows and columns and the order of the two matrices but to earn the marks candidates were expected to comment that the number of columns in **C** was not equal to the number of rows in **D**.

**(ii)** Few candidates earned all three marks with many omitting at least one of the key features of the transformation. Many others lost all of the marks by giving answers that involved more than one transformation.

*Answers*: **(a)(i)** $\begin{pmatrix} 6 & 4 \\ -2 & 2 \end{pmatrix}$ **(ii)** Not possible **(iii)** $\begin{pmatrix} 6 & 4 \\ -2 & 2 \end{pmatrix}$ **(iv)** $\frac{1}{5}\begin{pmatrix} 1 & -2 \\ 1 & 3 \end{pmatrix}$ **(b)** 1 column in **C**, 2 rows in **D**
**(c)** Enlargement, scale factor 2, centre (0, 0)

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**Question 2**

This question was generally well answered. Dealing with time and conversion of units gave rise to the greatest number of errors.

**(a)** A large majority of candidates gave the correct answer. Some gained one mark for using a correct method for speed but incorrect conversion of 1h 30mins into hours meant that the accuracy mark was lost. Some less able candidates misread the scale and a few attempted to calculate the area under the graph.

**(b)** Those that were successful in part **(a)** usually gained full marks on this part. Some candidates misread the scale, often as 35, obtained an answer that rounded to 12 but did not appear to go on and check their working. A small number attempted to calculate the average speed for each section of the journey and average their answers. As in part **(a)** some attempted to calculate the area under the graph.

**(c)** Although a majority gave the correct answer many of the others struggled with the conversion of the units. It was not rare to see 12 multiplied by 10 or 100. Some went on to multiply their speed in metres per hour by 60.

**(d)** Those with a good understanding gained both marks, rarely losing marks for any inaccuracies in the completion of the graph. Common errors usually involved the omission of Ali's stay at his grandmother's house. As no information was given other than the timings, candidates were free to draw any graph for the return journey. Most had Ali returning in one journey but a few included a rest period at the same location as on the outward journey.

*Answers*: **(a)** 8 **(b)** 36 ÷ 3 **(c)** 200

**Question 3**

It is important that candidates check the validity of their answers, particularly in questions involving a context.

**(a)** Although a large majority gained two marks, some candidates multiplied by 5 (not realising that the labour costs should not be greater than the total running cost) and others just divided by 5.

**(b)** Whilst this was fairly well answered, the lack of clear working was very noticeable. Quite a number of candidates based their percentage on the 2013 profit. Some attempted a trial and improvement method but these attempts rarely led to the correct answer.

**(c)** Only a minority of candidates were able to apply the reverse percentage process correctly. For many others, calculation of 7% of the 2012 profit and subtracting was by far the most common incorrect method.

**(d) (i)** In general only more able candidates gained all three marks. There was a significant number using an incorrect formula for the volume, ranging from formulae for the surface area of a cylinder to the volume of a cone or sphere. Other errors tended to revolve around confusion between radius and diameter and, more often, premature rounding errors leading to the loss of the final mark.

**(ii)(a)** Many were able to convert from millimetres into centimetres. Obvious errors included division by 100 and 1000.

**(ii)(b)** Those candidates with the previous answers correct usually went on to gain 3 or 4 marks. The majority tackled the question using the volume of a single sheet. In some cases, candidates reverted to the given thickness instead of using their answer to the previous part. Yet again, the answers varied considerably, from answers lower than 10 to answers in the millions. Candidates must be prepared to check whether their answer is suitable in the context of the question.

*Answers*: **(a)** 62705 **(b)** 10.9 **(c)** 127000 **(d)(i)** 59100 **(ii)(a)** 0.0125 **(ii)(b)** 7580

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**Question 4**

**(a)** Candidates need to take their time to think out which section of the diagram represents subsets such as 'a book and a toy'. Many completed the Venn diagram incorrectly, placing the numbers 4, 5 and 7 in the three empty subsets.

**(b)** A correct answer in part **(a)** usually led to a correct answer here. Most of the other candidates realised that the total of all the subsets must be 40. Some were able to pick up a mark for an appreciation that the sum of the various subsets was 40, even though it often did not lead to an equation. Answers such as $x = 0$ or $x$ as a negative number did not seem to prompt the candidate to revisit part **(a)**.

**(c) (i)** Many candidates gave a correct probability in this part. A small number took the total number of children as 36, ignoring the four who did not receive any of the mentioned toys.

**(ii)** Many of those with a value for $x$ gave their answer to this part as a probability.

**(iii)** It was common to see n($B$) interpreted as the number of children receiving only a book and so 9 was a common answer.

**(iv)** More able candidates with a value for $x$ usually gained this mark. Many could not interpret $B \cup P$ correctly and a variety of answers were seen.

**(v)** Candidates were more successful in this part and a significant number gained the mark.

**(d)** Although many had struggled with the notation previously, quite a lot of candidates interpreted the notation correctly in this part and shaded the correct region. Some candidates approached the task by shading the various subsets as they went through the statement. This gave a diagram with a variety of shading and it was not always clear which subset was their final answer.

*Answers*: **(a)** $4 - x$, $5 - x$, 7 **(b)** $x = 3$ **(c)(i)** $\frac{9}{40}$ **(ii)** 2 **(iii)** 15 **(iv)** 25 **(v)** 4

**Question 5**

**(a)** Only a small majority were able to give a correct bearing for $S$ from $P$. Many of those with an incorrect answer simply gave a distance, quite often 7cm.

**(b)** Candidates fared much better in this part and a significant number coped well with the scale. Some simply multiplied or divided the map distance by 2 or by 3, some gaining a mark for writing down the measured distance.

**(c)** Only the more able candidates coped with the reverse bearing. It was common to see answers such as 180 – 160, 360 – 160 and 160 itself.

**(d)** It was rare to see a correct answer. Many appeared not to realise that for 1 : $n$ the two distances are required to have the same units and so 1 : 1.5 was extremely common. Some did attempt to convert the kilometres to centimetres but not always successfully.

**(e)** Many struggled to cope with the construction, either through a lack of understanding of the method required or through a lack of the appropriate equipment. Several examples of freehand arcs and freehand lines were seen. Where correct constructions were seen candidates were generally more successful with the line bisector than the angle bisector.

**(f)** Yet again it was rare to see a correct answer. The most common error was simply to just square 1.5, taking the area factor to be the same as the linear factor.

*Answers*: **(a)** 46 **(b)** 12.9 **(c)** 340 **(d)** 1: 150000 **(f)** 3.375

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**Question 6**

**(a) (i)** A large majority of candidates gained both marks by adding the correct pair of probabilities. A few candidates multiplied the correct probabilities and some chose the wrong pair of probabilities.

**(ii)** Many correct answers were seen although an answer of $\frac{1500}{5000}$ lost the mark.

**(iii)** Candidates were less successful in this part. Some candidates added instead of multiplied and there were several answers of $0.1 \times 0.3 = 0.3$. In this part, and in part **(i)**, a significant number of candidates attempted to convert their probabilities into fractions or percentages. Providing a correct decimal had been seen they did not lose a mark if this was carried out incorrectly.

**(b)** Attempts at tree diagrams were seen, many of which were correctly labelled. The probability of at least one red appeared to cause some confusion. Some multiplied one pair of probabilities, others two pairs and in a minority of cases three probabilities. Only a few approached the problem as 1 – probability of no reds. Choosing a disc with replacement was seen but was not too common. When the correct three probabilities or an acceptable pair were chosen some struggled to cope with the multiplication of the fractions.

*Answers*: **(a)(i)** 0.6 **(ii)** 1500 **(iii)** 0.03 **(b)** $\frac{112}{132}$

**Question 7**

**(a) (i)** A large majority were able to draw the image after the translation. As always a few candidates translated *A* correctly in one direction only, earning just one mark and some translated by $\begin{pmatrix} -4 \\ -5 \end{pmatrix}$ earning no marks.

**(ii)** Slightly fewer candidates gained the marks for the rotation. Common errors included rotation about (1, 1) and less frequently *A* was rotated anticlockwise. In addition there were a number of rotations about random points.

**(b) (i)** Some more able candidates recognised the transformation represented by the matrix and were able to draw the image without needing to show any working. Some candidates chose to show some working, some dealing with individual matrices and others as one matrix. For these, errors with the numbers were sometimes seen but candidates gained some part marks. Overall, only a minority earned all three marks.

**(ii)** This was the most challenging part of the question. Those who were able to draw the image without working often gained full marks, but some lost a mark for not identifying the invariant line correctly. Those with partially correct images also picked up some marks. In a significant number of cases candidates suggested further transformations and lost all the marks.

*Answers*: **(b)(ii)** Stretch, scale factor 2, invariant line *y*-axis.

**Question 8**

**(a)** Most candidates completed the table correctly. Some errors arose by using $x^2$ rather than $x^3$ in the equation.

**(b)** Some good graphs were seen with relatively few drawn using line segments. Marks that were lost usually resulted from incorrect points from part **(a)** or plotting incorrectly on the graph, usually from misreading the scale on the *y*-axis.

**(c)** The quality of the tangents was generally poor, sometimes with gaps between the tangent and curve, sometimes crossing over the curve, often at points other than $x = 2$. Some candidates with a correct tangent showed no working for the gradient and possibly lost a method mark when their answer was incorrect. Candidates would be well advised to show the co-ordinates of the points they are using to find the gradient.

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**(d)** Only a minority were able to earn some marks for the solutions to the equation. Some did earn one of the marks by giving two correct solutions; usually 0 was the missing or incorrect solution.

**(e)** Many found this a challenging part of the question. Although a minority gave a correct pair of values, many simply gave the largest and smallest values of $y$ from their graphs, not appreciating the need for the equation to have three solutions.

*Answers*: **(a)** 2.125, 2.375 **(c)** 7.8 to 10.2 **(d)** –1.75 to –1.65, 0, 1.65 to 1.75
**(e)** –1.2 to –0.8 < $k$ < 2.8 to 3.2

**Question 9**

(**a**) **(i)** This was well answered by many candidates. Most errors resulted from misreading the graph and occasionally giving the frequency of 40 as the median.

**(ii)** Candidates were generally less successful in finding the inter-quartile range with only a small majority gaining both marks. Some gained a mark for a correct lower quartile or upper quartile (usually the lower quartile) but some candidates either misread the scales or had little idea of what was required.

**(iii)** Those that were successful with the inter-quartile range usually coped with the 70th percentile. Less able candidates simply read off the time with a cumulative frequency of 70 and so 46 was a common incorrect answer. A small number gained a mark for a cumulative frequency of 56 but then read incorrectly from the graph.

(**b**) **(i)** Able candidates had no trouble in calculating the mean of the grouped data, with only the occasional slip resulting in the loss of a mark. Other candidates had some idea of the process required but a variety of errors resulted in the loss of some marks. Instead of using the interval midpoints some used either the upper or lower boundaries whilst others used the interval widths. Some correctly divided their totals by 80 but others divided by 4.

**(ii)** Those with an understanding of frequency density had little trouble in drawing the histogram, sometimes with an occasional slip when drawing one bar or using incorrect widths resulting in the loss of marks. Some candidates drew a frequency polygon. A significant number made no attempt at all.

*Answers*: **(a)(i)** 37.5 to 38.5 **(ii)** 19.5 to 20.5 **(iii)** 43 **(b)(i)** 31.8

**Question 10**

(**a**) **(i)** Most candidates gained the mark for a correct substitution.

**(ii)** Several candidates misinterpreted fh(–1) as f(–1).h(–1). Some of those with some understanding of composite functions struggled to get from $3^{-1}$ to $\frac{1}{3}$. Some attempted to work with decimals but often lost the accuracy mark because of answers such as –2.34.

**(iii)** Candidates were generally less successful in finding the inverse. Those with a correct answer usually started with $y = 2x - 3$ or with $x = 2y - 3$, although those using the first option sometimes forgot to switch the $y$ to $x$. Reverse flowcharts were few and far between. Common misconceptions that were often seen were $f^{-1}(x) = \frac{1}{f(x)}$ and $f^{-1}(x) = -f(x)$.

**(iv)** A small majority were able to write the composite function ff($x$) in its simplest form. As in part **(ii)**, a significant number treated ff($x$) as f($x$).f($x$) and answers of $(2x - 3)^2$ expanded and simplified were common.

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**(v)** As in all 'show that' questions it is important for candidates to set out their working using correct mathematics, showing all the stages leading to the required answer. Earning the first mark proved difficult for many candidates, frequently omitting brackets from around the terms to be multiplied, for example $2x - 3(x + 1)$. These candidates were allowed to recover and gain one mark for the correct expansion of their intended $(2x - 3)(x + 1)$. Eliminating the fractions led to many errors and $(2x - 3)(x + 1) = 1 + 2$ was another common error.

**(vi)** This part proved slightly more accessible than the previous part with many of the successful candidates correctly using the quadratic formula. Very few using completing the square obtained all four marks. As always in this type of question, some candidates take little care with their presentation and errors creep in. Writing $(-3)^2$ as $-3^2$ was common but not all went on to evaluate it as 9. Some divide only the root by the $2a$ term in the denominator. Poor use of the calculator also led to some errors.

**(b)** A minority of candidates displayed a sound understanding of this type of algebra and had little trouble in simplifying the expression. For others attempting to factorise, errors with the signs was a common source of error. Less able candidates had a tendency to cancel individual terms without any attempt at factorising first.

*Answers*: **(a) (i)** 5 **(ii)** $-2\frac{1}{3}$ **(iii)** $\frac{x+3}{2}$ **(iv)** $4x - 9$ **(vi)** 2.64 and –1.14 **(b)** $\frac{x-1}{x+5}$.

**Question 11**

**(a) (i)** A significant number of candidates gained the mark for the correct co-ordinates of Q. Many showed no working but slips with the directed numbers were often seen. A common incorrect answer was $\begin{pmatrix} -1 \\ 1 \end{pmatrix}$ obtained from the subtraction of vector $PQ$ and the position vector for $P$.

**(ii)** There weren't many successful attempts at this part of the question. It would appear that many were unfamiliar with the idea of magnitude of a vector and 5 was rarely seen.

**(b) (i)(a)** Only the most able candidates made much headway with this question, showing clear steps leading to a correct answer. Some others gained a mark for defining a vector path for $ON$ but dealing with the ratios involved often led to errors. It was not uncommon to see thirds being used rather than fifths.

**(i)(b)** Those successful in part **(i)(a)** were usually successful in this part with similar errors in evidence.

**(ii)** Many of those with correct answers in part **(i)** were able to write down two conclusions although some lost one or both marks by referring to vectors rather than the line segments.

*Answers*: **(a)(i)** (–5, 7) **(ii)** 5 **(b)(i)(a)** $\frac{3}{5}\mathbf{a} + \frac{2}{5}\mathbf{b}$ **(i)(b)** $\frac{2}{5}\mathbf{a}$, **(ii)** $NY = \frac{2}{5}BC$, $NY$ is parallel to $BC$.

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# MATHEMATICS

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

## Key Messages

Candidates who performed well on this paper consistently showed their working out, formulas used and the calculations performed in obtaining their answer. Attention should be paid to the degree of accuracy required in each question and, in order to avoid unnecessary loss of accuracy marks, candidates should be encouraged to avoid premature rounding in workings.

## General Comments

This paper proved to be accessible to the majority of candidates. Most were able to attempt almost all of the questions, and solutions were usually well-structured with clear methods shown in the space provided on the question paper.

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.

The standard of drawing was improved on previous years and many excellent graphs were seen in **Question 2**. Candidates' recall of formulae, particularly the cosine rule and quadratic formula, contained a few more errors than seen in previous years.

Most candidates followed the rubric instructions with respect to the values for $\pi$ although a few still use $\frac{22}{7}$ or 3.14 giving final answers outside the range required. There continue to be 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 three significant figures.

The questions on the topics of ratio and interest, graph drawing, using sine rule, simple transformations, mensuration and probability were well answered by candidates.

Weaker areas were problem solving with areas, matrix transformations, tangents and gradients and problem solving with averages.

## Comments on Specific Questions

### Question 1

This question involving ratio, percentage and interest, was generally well answered with many completely correct answers.

**(a)** Almost all candidates scored full marks with only a very small minority using 140 as part of the verification. Candidates should arrive at the given answer and not use this as part of their working.

**(b)** This part was well answered although some ratios were reversed and a number did not give the ratio in its simplest form. A few made errors in subtracting initially.

**(c)** The majority of candidates gained full marks on this question. Some misunderstood simple interest and used a compound interest method. A common incomplete answer was to just work out the interest as \$24 and not add this to the initial investment of \$120. There were also a few arithmetic errors when adding \$120 and \$24.

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**(d)** Many understood the compound interest method and made a correct calculation. Some did spoil an otherwise correct method by adding the initial investment of 80. Those who used a method involving annual steps were less successful in obtaining an accurate final answer as rounding errors usually occurred.

**(e)** Candidates found this part of the question the most challenging. Most candidates scored at least a method mark for evaluating the value of the investment as \$216.32 or for stating $\frac{200 \times r \times 2}{100}$ within their method. The majority of incorrect solutions came from using the total investment rather than the interest only in their equation usually arriving at an answer of \$54.08. In a small number of cases candidates rounded 216.32 to 216.3 or 216 and ended up with inaccurate answers. There were also significant numbers who produced excellent, concise, correct solutions

*Answers*: **(b)** 2 : 3 **(c)** 144 **(d)** 89.99 **(e)** 4.08

**Question 2**

This question involved graphing a function and then using the graph to solve equations related to the function and then drawing a tangent at a point to estimate the gradient of the function at that point.

**(a)** The three values for the table were often correctly evaluated. A common error was to give the value for $x = -1$ as 1 rather than 3.

**(b)** For the graph, point plotting was generally very accurate, with only a few candidates making errors on the vertical scale, usually with the first three plotted points. Curves were often well drawn with the curves passing through the plotted points. A significant number did not recognise the nature of the function and chose to link the two branches of the curve.

**(c)** This was answered very well and most gave a correct value for f($x$) = 2 using their graph. The most common error was to give the value for f(2).

**(d)** Many candidates tried to solve the equation algebraically without drawing the line $y = 2x + 3$. Those who used the graph and drew the line correctly were almost always successful in this part. There were a number of incorrect lines attempted with some lines passing through (0, 3) but with negative gradients or lines with a correct gradient but not passing through (0, 3).

**(e) (i)** Tangents were generally well drawn and usually at the correct point to the curve at $x = -1.5$, although some tangents were drawn at other points and a few drew a vertical line at the point where $x = -1.5$.

**(ii)** Those that drew correct tangents were usually able to give a correct gradient although a positive gradient was sometimes given. A number had difficulty with the different scales on the two axes, and some left their answer as a fraction with non-integer values. Candidates are advised to evaluate the division in all cases.

*Answers*: **(a)** 3, 3, –1 **(c)** 0.5 to 0.6; **(d)** 0.4 to 0.5 **(e)(ii)** –2 to –1.

**Question 3**

This question on using general trigonometry was answered well by many, although a few lost unnecessary accuracy marks through premature approximation of trigonometric values.

**(a)** The vast majority were able to apply the sine rule correctly to earn the first method mark, and many completed the calculation routinely as required. A significant number approximated their trigonometric values at an early stage, e.g. sin 55 = 0.82, leading to a loss of accuracy in the final answer and some did not show the second stage of the method. Candidates are advised to show both the implicit stage and the explicit stage of the sine rule in their working to ensure that method marks are scored when the final answer is inaccurate.

**(b)** This part was generally well answered. Many quoted the $80^2 = \ldots$ version of the cosine rule and then re-arranged it to find cos *BCD,* but this often had errors in the rearrangement. Some quoted the cos *BCD* = … form of the cosine rule and were generally successful and worked to the required accuracy. A number were unable to recall the correct cosine rule formula to begin with.

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**(c)** Answers were mixed to this part. The use of the formula $\frac{1}{2}ab\sin C$ was well known and normally used; the main problem was in choosing a wrong angle or side in the calculation for the area of each triangle. Some candidates tried to use $\frac{1}{2}$ base $\times$ height but these generally either assumed that the perpendicular height bisected the base of the triangle or made errors in using basic trigonometry to find the sides they required.

**(d)** This was expected to be an easier part and most candidates found this to be the case. Some candidates divided by 3250 however and a few others did not handle the hectares correctly, even though the conversion was given. Among those who knew what to do, a common error was to approximate the area from **part (c)** before completing the calculation.

*Answers*: **(a)** 86.8 **(b)** 51.2 **(c)** 6700 **(d)** 2180

**Question 4**

Candidates answered this transformations question quite well, with **parts (a)** and **(b)** meeting with much success, whilst **part (c)** did discriminate.

**(a)** This was very well answered with the only common error being a reflection in a vertical line other than $x = -1$. A small number reflected in the line $y = -1$.

**(b) (i)** This was a little more challenging with the enlargement scale factor being negative. The rate of success was still high. Common errors were enlargements of factors $\frac{1}{2}$ or 2.

**(ii)** Most candidates demonstrated their knowledge of an enlargement matrix, although a few put the negative 2s in the reverse diagonal of the matrix.

**(c)** This was a more challenging transformation and it proved to be a discriminating part.

**(i)** There were many correct stretches. A number of candidates stretched the figure from its base line and not the *x*-axis and a few had the *y*-axis as the invariant line. Also a number of candidates omitted this part.

**(ii)** This part tended to be answered well only by those candidates who had drawn the correct stretch on the graph in the previous part, although a small number of candidates did appear to know the form of the stretch matrix.

**(iii)** This was a full follow through question and a number of candidates, who had not succeeded in **part (ii)** were able to work out the inverse matrix, or either the reciprocal of the determinant or the transpose matrix for partial credit.

**(iv)** A whole mixture of answers were seen in this part. The more able candidates had no difficulty in describing this single transformation accurately. Most candidates did give the stretch but the factor was quite often 2 and the invariant line often the *y*-axis, thinking that the inverse would have the other axis as the invariant line. One positive aspect of this part was that most candidates did use the word invariant and are now realising that parallel to or *x* invariant etc. are not sufficient.

*Answers*: **(b)(ii)** $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$ **(c)(ii)** $\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$ **(iii)** $\frac{1}{2}\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$ **(iv)** Stretch, factor $\frac{1}{2}$, *x*-axis invariant.

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**Question 5**

The question was often correctly answered but some made errors in conversions and in working to sufficient accuracy.

**(a) (i)** This part was usually correctly answered with the only drawback being the need to give an answer to more than three figures. The wording of the question requires this and also rules out any verification method. "Calculate and show that it rounds to" should give a clear signal for this.

**(ii)** The conversion between $cm^3$ and litres should be familiar to all candidates, but the answer of 24.1 occurred much more often than anticipated.

**(b)** This was a basic question including units of time but presented a challenge for many candidates. To divide a volume by 2 and then change a decimal value in minutes to minutes and seconds, to the nearest second should have been a straightforward problem. Most candidates did calculate the volume of the cone correctly and most also went on to divide by 2, usually picking up the third mark for a correct decimal in minutes. The final process of arriving at minutes and seconds, to the nearest second was a step too far for many. As most unit conversions are metric, it appears that candidates need more practice on the few non-metric conversions on the syllabus.

**(c)** This part was more successful with almost all candidates understanding the need to divide the volume of the cylinder by the volume of the cone. Most candidates did go on to round down for the required integer answer.

*Answers*: **(a)(ii)** 2.41 **(b)** 1 min 24 secs **(c)** 14

**Question 6**

This question on angle properties and similar shapes was well received by most candidates.

**(a) (i)** This was well answered with the only common error giving $x$ = 42° and $y$ = 21° probably from candidates incorrectly using alternate angles.

**(ii)** There were several methods used in this part including the use of the sine rule and comparing ratios in similar triangles. Both methods were frequently applied correctly to give fully correct accurate answers. Occasionally one side of the sine rule or ratio was inverted. Some candidates using a correct method did not work with a sufficient number of figures and so could not be awarded full marks. Examples of this were $\frac{9.43}{8.23}$ or $\frac{9.43}{\sin 117}$ being written to only one or two decimal places. Some candidates mistakenly assumed that *TR* was the same length as *TQ* and a few candidates incorrectly attempted to use trigonometry for a right-angled triangle.

**(b)** Many complete correct solutions were given. The common approach to this part was to work out angle *FEG* as 25° from (115° – 90°) and then use alternate angles to find angle *EGH*. A few were unable to make further progress at this point. Some candidates then found that angle *GHE* was 115° by recognising the angle in a semicircle at *FGE* and then using opposite angles in a cyclic quadrilateral from angle *GFE*, although other methods using tangent and chord properties were also seen. These candidates invariably then went on to achieve a complete correct solution by using angles in a triangle.

**(c)** The most common method was through the recognition that triangle *AOB* was isosceles and then giving angles *OAB* and *OBA* as 20°. The majority of candidates also applied 'angle at the centre is twice the angle at the circumference' to give angle *ACB* = 70°. For many candidates this was as far as they got. To continue successfully some candidates found angle *ABC* from angles in a triangle or angles in quadrilateral *AOBC* but the application of opposite angles in a cyclic quadrilateral adding to 180° to give *ADC* = 104° proved difficult for some candidates to recognise. Candidates that found angle *ADC* correctly almost always used the isosceles triangle *ADC* to give a fully correct solution to angle *ACD*. Common errors included the incorrect assumption that angle *CAO* = angle *CBO* and also that angle *ADC* = 140°. Treating *DB* as a diameter also led to incorrect work.
There were many other creative correct methods used by candidates in obtaining the correct answer including setting up an equation using the fact that angles *DAB* and *DCB* were the opposite angles of a cyclic quadrilateral.

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In both of parts **(b)** and **(c)** most candidates scored marks by indicating angles clearly on the diagram. Some candidates did not score method marks because they were unable to identify angles clearly in their working. Candidates should be encouraged to give the correct notation for angles in their method e.g. angle *CAB* = 70°, rather than angle *C* =70°.

*Answers*: **(a)(i)** 21, 42 **(ii)** 3.79 **(b)** 40 **(c)** 38

**Question 7**

This question on interpreting histograms and calculating averages had a range of responses and mixed success for candidates.

**(a) (i)** This was well answered with the majority of candidates giving 30 × 0.4 = 12. It must be emphasised to candidates that in a 'Show that' question all steps in their method must be shown explicitly. Candidates who wrote only that $\frac{x}{0.4} = 30$ followed by $x$ =12 did not score the mark.

**(ii)** Many completely correct solutions were seen for the estimate of the mean but a significant number of candidates had difficulty with one or more aspects of the question. Some candidates were able to apply 'frequency = frequency density × class width' to list the correct frequencies for each given class on the graph. Others attempted to work with the frequency densities throughout, never appreciating the need to use the frequencies. In the calculation for the mean most candidates did use the mid-point of each class and not the boundaries but a number of candidates incorrectly used the class widths. Candidates who chose to further divide the given classes to create classes of width 10 were occasionally successful but more often made errors with the associated frequencies or mid-points for these new classes. Candidates who correctly found the frequencies and continued to correctly calculate the sum of fx invariably correctly divided by 39 and gave their answer to at least three significant figures to score full marks.

**(b)** This question proved to be a challenge for many candidates. Many did not appreciate the need to reverse the problem to find the total mass of the oranges first. Common errors included a simple subtraction of 70.5 and 70 to get 0.5. Some calculated 20 × 70.5 and/ or 19 × 70, choosing the wrong combination to get the total mass. Others were able to calculate 20 × 70 but were then unable to complete the question by calculating 19 × 70.5 and then subtracting.

*Answers*: **(a)(ii)** 60.9 **(b)** 60.5

**Question 8**

**(a) (i)** Candidates demonstrated a good understanding of the distance, speed and time relationship with the vast majority able to write the algebraic fraction $\frac{600}{x}$.

**(ii)** This was also answered well with most able to give the correct fraction. A few spoiled their answers to part **(i)** and **(ii)**, by writing, for example, $x = \frac{600}{x+1}$.

**(b) (i)** Many candidates were able to write the correct equation $\frac{600}{x} - \frac{600}{x+1} = 20$.

A few candidates reversed the order of the fractions and then followed this with a sign error in expanding –600($x$ + 1) to give –600$x$ + 600 and thus didn't identify their initial error.
For those that started with the correct equation, creating a common algebraic denominator and expanding the single bracket 20$x$($x$+1) was generally well done. Candidates should be encouraged to work with an equation throughout the process. The omission of ' = 0 ' at any stage for example, is penalised in the final mark.
Less able candidates often did not understand what was required and tried to solve the given quadratic equation.

**(ii)** Many candidates were successful in this part, although this proved to be challenging for some.

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Although many candidates solved the quadratic equation given in part **(i)** correctly here it was not always evident that they understood the context of the question. Some candidates did not appear to understand what *x* represented while others substituted *x* = 5 into $\frac{600}{x}$ instead of $\frac{600}{x+1}$.

The concise method of solving the quadratic equation by factorising was used by many but using the quadratic formula also proved popular but less successful and errors were made with the substitution and evaluation. Some have been taught a calculator method to obtain solutions but then are unable to provide a written justification for their answers.

*Answers*: **(a)(i)** $\frac{600}{x}$ **(ii)** $\frac{600}{x+1}$ **(b)(ii)** 100

**Question 9**

**(a)** This part involving completing the tree diagram was answered very well. Occasional errors seen were $\frac{3}{4}$ given for the not fine branch and repeating $\frac{1}{10}$ and $\frac{9}{10}$ for late and not late after the not fine branch.

**(b)** Candidates also answered this part very well. An incorrect answer $\frac{45}{60}$ was occasionally seen as was an answer such as 450, following the correct working of $\frac{3}{4}$ x 60. A few worked out $\frac{1}{4}$ of 60.

**(c)** A large majority answered this part correctly. The most common error was to add the probabilities giving $\frac{3}{4}+\frac{1}{10}=\frac{17}{20}$. Other incorrect answers seen were $\frac{3}{4}\times\frac{9}{10}$ and $1-\frac{3}{4}\times\frac{9}{10}$.

**(d)** Candidates answered this part well with many giving the correct answer. Some identified the correct combination of probabilities and reached $\frac{27}{40}+\frac{1}{6}$ but did not carry out the addition correctly.

Quite a large number of candidates only considered the Not late branches giving answers resulting from either $\frac{2}{3}\times\frac{9}{10}$ or $\frac{2}{3}+\frac{9}{10}$.

Some used the correct 4 fractions but in an incorrect way such as giving $\frac{1}{4}+\frac{2}{3}$.

**(e)** Candidates found this part very challenging although it was usually attempted. By far the most common answer given was $\frac{1}{4}\times 5=\frac{5}{4}$, even though this answer is greater than 1. Another incorrect answer given was $\frac{1}{4}\times\frac{1}{5}=\frac{1}{20}$. Quite a large number of candidates wrote down different combinations of powers of $\frac{1}{4}$ and $\frac{3}{4}$ in an attempt to find all the possible options, but it is very difficult to ensure that all the correct elements are used. Attempts of this type included $\frac{81}{1024}$ from $\frac{1}{4}\times\left(\frac{3}{4}\right)^4$ which was quite common, and $5\times\frac{1}{4}\times\left(\frac{3}{4}\right)^4$ = $\frac{405}{1024}$. A few candidates found the probability of no fine weather across the 5 days as $\left(\frac{1}{4}\right)^5=\frac{1}{1024}$ and a small number gave the probability of at least 1 fine day as $1-\left(\frac{1}{4}\right)^5=\frac{1023}{1024}$.

*Answers*: **(a)** $\frac{1}{4}, \frac{9}{10}, \frac{1}{3}, \frac{2}{3}$ **(b)** 45 **(c)** $\frac{3}{40}$ **(d)** $\frac{101}{120}$ **(e)** $\frac{781}{1024}$

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**Question 10**

**(a)** This part was answered very well with the majority of candidates giving the correct answer. A small number of candidates gave $\frac{1}{1-\frac{1}{2}}$ but did not evaluate this correctly and a few gave $\text{gf}\left(\frac{1}{2}\right)$.

**(b)** There was a mixed response to this part. The most common incorrect answers were $1 + x$ and $x - 1$.

**(c)** Most interpreted the notation hg($x$) correctly with the majority stating correctly $(1 - x)^2 + 1$.

A significant number of candidates did not then go on to achieve full marks by simplifying their answer correctly. The expansion of $(1 - x)^2$ was poorly executed and common errors included $1 - x^2$, $1 - x - x - x^2$ and $1 + x^2$. Candidates who wrote the step $(1 - x)(1 - x)$ were generally more successful than those that did not.

**(d)** This was almost always correct.

**(e)** Virtually all candidates identified the quadratic formula as being the most appropriate method to answer this part. A small number quoted an incorrect version of this formula and some did not attempt to rearrange $x^2 + 1 = 3x$ to $x^2 - 3x + 1 = 0$ or rearranged it incorrectly and so did not substitute the correct values into the formula. Candidates should be aware that the numerical version of the formula should be written down carefully, ensuring that for example, the division line is drawn underneath all of the numerator and that $(-3)^2$ is written with the brackets in order to earn the marks given for the substitution. Many candidates went on to give the correct answers. Some did not round the answers to 2 decimal places correctly giving 0.381966 as 0.382 for example.

**(f)** Most candidates thought that just one answer was expected nearly all gave f($x$) or g($x$) but not both.

*Answers*: **(a)** 2 **(b)** $1 - x$ **(c)** $x^2 - 2x + 2$ **(d)** $-6$ **(e)** 0.38 and 2.62 **(f)** f($x$) and g($x$)

**Question 11**

This problem solving question involving shape and area was poorly answered in general.

The first part of the question introduced two "variables" and there was evidence that some candidates found this difficult to understand. It was very rare to see fully correct responses and very often answers were given in terms of X and/or $k$.

The lack of measurements on the diagrams also added to the difficulties.

Of those candidates who made attempts at this question they were often successful in getting $k = \frac{1}{3}$, and $k = \frac{72}{360}$ in the first and second shapes although the incorrect answer $k = \frac{72\pi r^2}{360}$ was also common in the second shape.

For the third shape, a common incorrect answer was ½. Candidates who appeared to recognise the similar triangles with sides in the ratio 1:2 did not apply the square of the linear ratio to this problem.

Some correct answers for the hexagon in the fourth shape were seen but the answer $\frac{1}{4}$ was also common. A number of candidates recognised that the interior angles of a regular hexagon are 120° and attempted to use this to find the area of the four isosceles triangles but did not then recognise that the remaining two triangles were equilateral and each had the same area as the isosceles ones. Many candidates that gave the correct answer did not show any working out.

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Most candidates who gained any marks for the fifth shape assigned a value to the radius. Of these, a few lost accuracy along the way in their work with decimals and so their correct method did not always lead to an accurate answer. Others found the area of the segment but did not express this as a fraction of the sector. A surprising number of candidates did not indicate that they understood that $OA=OB$, giving the area of the triangle as $OA \times OB \div 2$ instead of, for example, $OA^2 \div 2$. Many candidates correctly stated $\frac{90\pi r^2}{360}$ for the area of the sector to earn a method mark.

*Answer*: $\frac{1}{3}$ , $\frac{72}{360}$ , $\frac{1}{4}$ , $\frac{1}{6}$ , $\frac{\pi - 2}{\pi}$

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# MATHEMATICS

**Paper 0580/43**
**Paper 43 (Extended)**

## Key Messages

Candidates who performed well on this paper consistently showed their working out, formulas used and the calculations performed in obtaining their answer. Attention should be paid to the degree of accuracy required in each question and, in order to avoid unnecessary loss of accuracy marks, candidates should be encouraged to avoid premature rounding in workings.

## 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.

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 still confuse the equations of horizontal and vertical lines. Many candidates did not draw an accurate tangent to the curve in **Question 4(e)** but gained a mark for calculating the gradient of their line. Care is needed to ensure that the point of contact is the required one.

A significant number of candidates gave interim answers as well as final answers to only 2 significant figures. In some cases this proved to be very costly as 2 significant values are not taken to be evidence of correct method so candidates who did not show all the steps in their working lost some or all the method as well as the accuracy marks.

## Comments on Specific Questions

### Question 1

**(a)** This question was correctly answered by the majority but there was a significant number of candidates who omitted to or incorrectly rounded their answer to the nearest hundred.

**(b)** The common errors of multiplying by 0.17 or 0.83 occurred as often as in the past. Those who realised that 45981 was associated with 117% usually gained full marks.

**(c)** This ratio question was often answered correctly.

**(d)** The correct calculation was nearly always seen but some candidates ignored 'completely filled' and gave the final answer as 4.5 or 4.55 or 5.

**(e)** This question involving fractions was usually answered correctly.

***Answers*: (a)** 62100 **(b)** 39300 **(c)** 20436 **(d)** 4 **(e)** 25545

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**Question 2**

**(a)** The correct intervals were often stated but occasionally candidates used ≤ at each of their ends. Some candidates thought that the blocks had equal widths and used 20 30 40 and 50 as their highest values. The frequencies were either all correct or all incorrect. Many candidates did not realise that it is the area of each block which represents the frequency and merely used the heights and gave answers which included at least one decimal value.

**(b)** There were many correct solutions to this question when **part (a)** was correct. Some candidates used the interval widths instead of the mid-values in their calculation whilst others used the maximum value in each interval.

*Answers*: **(a)** $10 < x \leq 25$ $25 < x \leq 30$ $30 < x \leq 35$ $35 < x \leq 50$ $50 < x \leq 60$ and 13 33 19 15 6 **(b)** 25.1

**Question 3**

**(a)(i)** The vast majority of candidates used the correct formula for the area of the triangle but a significant number approximated the value of sin*P* to 0.95 and reached 71.8 instead of 71.99. A few rounded the correct value to 71.9 instead of 72.0.

**(ii)** A number of candidates used the implicit version of the cosine rule for the angle and some of these made errors in the rearrangement. By far the most common error was to use 12 instead of 6 for the length of *XP*. After the correct start of 325 – 204cos72 there were still candidates who went on to calculate 121cos72.

**(b)** This question proved to be problematic for many as premature approximation, often to 2 significant figures without complete method being shown, meant that method marks were lost. The candidates who gained full marks often did not calculate the height of the figure but used 9.4sin37 in the later working to arrive at 9.4sin37 ÷ cos42 as the calculation for *a*. Vital working was often omitted and with 2 significant figures as the answer the method could not be inferred. Candidates should know that if answers are required to 3 significant figures then their working should always be with at least 4 significant figures so the final answer is accurate.

**(c)** Many correct answers were seen but by far the most common incorrect value was –50.

***Answers*: (a)(i)** 72.0 **(ii)** 16.2 **(b)** 7.61 **(c)** 50 130

**Question 4**

**(a)** The common errors were 2 or –2 when $x = -1$. Occasionally candidates truncated 3.11 as 3.1.

**(b)** Points were usually plotted accurately and most candidates realised that two separate branches were required. Many lost a mark because their curve did not have the minimum point below $y = 2$.

**(c)** Marks were lost here due to the poor quality of the curve rather than not knowing where the solutions were situated.

**(d)** Many candidates knew which line to draw but again the quality of the curve at the intersection led to an inaccurate answer.

**(e)** The drawing of an accurate tangent at the required point is a skill that many candidates need to practice as many lines had the point of contact too far left or right of $x = 2$. Despite the inaccuracy of the tangents most gained some credit for correctly calculating the gradient of their line.

**(f)** This question was frequently not attempted except by the most able candidates. Many candidates merely substituted –1 into the function or indicated where the solution was found on the graph.

***Answers*: (a)** 0 4.5 3.11 **(c)** −0.6 to −0.5 0.6 to 0.7 2.8 to 2.9 **(d)** −0.7 to −0.6 **(e)** 0.62 to 0.8

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**Question 5**

**(a) (i)** This question was often answered correctly. The errors were to find vector *AB* or transpose *x* and *y* or give the answer as co-ordinates.

**(ii)** Most candidates recognised the need to use Pythagoras' theorem to find the length of the vector but a significant number of these incorrectly assumed that since two sides were 3 and 5 the difference of two squares was needed to give the answer as 4.

**(b)(i)** As in past years, the direction of the vector was not carefully considered in a lot of cases as the answer was given as 2**p** – **q**.

**(ii)** This question was more challenging. Working was often poorly set out and difficult to follow as it was not clear which vector was being found. Many managed to find a correct expression for *PS* but lack of consideration of directions led to numerous errors when finding *PM*. Some candidates ignored the instruction to use vectors and found the ratio by considering similar triangles for which they were awarded one mark for a correct answer. Many candidates found the correct expressions for the required vectors then gave the answer as 3 : 1.

*Answers*: **(a)(i)** $\begin{pmatrix} 2 \\ 4 \end{pmatrix}$ **(ii)** 5.83 **(b)(i)** −2**p** + **q** **(ii)** 1 : 3

**Question 6**

**(a)** All three parts of this probability question were usually answered correctly.

**(b)** Many candidates considered only one possibility as they gave half of the required value as the answer.

**(c)** There were many correct solutions to this question. The usual error was to treat this as with replacement and consequently all the denominators in the product of fractions were 6.

*Answers*: **(a)(i)** $\frac{1}{6}$ **(ii)** $\frac{4}{6}$ **(iii)** $\frac{2}{6}$ **(b)** $\frac{16}{36}$ **(c)** $\frac{48}{360}$

**Question 7**

**(a) (i)** The angle was usually found correctly.

**(ii)** The angle was usually found correctly.

**(iii)** The angle was usually found correctly.

**(iv)** Most candidates correctly used the total of the interior angles of the hexagon. Some used a pentagon and others a quadrilateral or an isosceles triangle with both interior and exterior angles being found.

**(b)** Both parts of this angles question were usually answered correctly.

*Answers*: **(a)(i)** 148 **(ii)** 122 **(iii)** 148 **(iv)** 106 **(b)(i)** 63 **(ii)** 54

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**Question 8**

**(a)(i)** Most candidates correctly and clearly showed the required result. In the working a few candidates did not ensure that fraction lines went below all the numerator and others made errors with the expansion of the brackets.

**(ii)** The most popular method was to use the quadratic formula with just a few using completion of the square. A few errors with signs and short fraction and/or square root lines were seen. Nearly all candidates gave the answers to the required degree of accuracy.

**(b)** The common error was to not include the area of the base of the cone and when $r^2 = 3x^2$ was reached many thought that the square root of 3 is equal to 2. Those who did include the area of the circular base usually completed the question correctly.

***Answer*: (a) (ii)** 1.14 and −2.64

**Question 9**

**(a)** The most common error was to double f($x$).

**(b)** This composite function was usually found correctly.

**(c)** Many candidates gave g(3) = $\frac{1}{3}$ as the first step whilst others who correctly reached $3^{-3}$ or $\frac{1}{3^3}$ gave the answer as $\frac{1}{9}$. There were a few candidates who interpreted gg($x$) as g($x$) × g($x$).

**(d)** Several correct variations of the answer were seen. A few candidates who rearranged to find $x$ in terms of $y$ forgot to change the variable and gave the answer in terms of $y$.

**(e)** Many candidates solved $-3x + 4 = 1$. Only the most able candidates earned full marks.

*Answers*: **(a)** $4 - 6x$ **(b)** $9x - 8$ **(c)** $\frac{1}{27}$ **(d)** $\frac{4-x}{3}$ **(e)** $1\frac{1}{3}$

**Question 10**

**(a)** A very wide variety of methods were seen with most candidates earning some credit for a correct implicit equation in $r$. Candidates rarely gave the value of their calculation to the required 2 or more decimal places to verify that it corrected to 2.3.

**(b)** Here accuracy was again lost by those who rounded prematurely their interim value for the area of the triangle.

**(c) (i)** By far the most common method was to divide the volume of the box by the volume of a biscuit. Candidates must be encouraged to think carefully about practical situations such as this and then perhaps they would realise the simple method that was needed.

**(ii)** The volume was usually found correctly.

**(iii)** Most candidates used the correct method with their answers from the previous parts. A few found the percentage of the space taken by the biscuits but then omitted to subtract this from 100%.

*Answers*: **(b)** 333 **(c)(i)** 30 **(ii)** 6.65 **(iii)** 40.0

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**Question 11**

**(a)** The numerical values in the table were often correct with only a few giving $\frac{1}{6}$ $\frac{1}{8}$ $\frac{1}{10}$ in the top row. Occasionally the lack of brackets in the formula with $\frac{1}{2}$ used in the top row meant that marks were lost. The values with powers of 2 were nearly always correct but the incorrect sign was often seen in this formula.

**(b) (i)** Nearly all candidates gained full marks in this question. A very small minority gave 32, 64 and 128 along with their corresponding powers of 2 as the solution.

**(ii)** Many candidates gave the correct formula but there were a significant number of blank answer spaces.

**(c)** There were many correct solutions to this question. Some found $n = 8$ but went no further whilst others used $n = 7$ to give the answer 4096.

*Answers*: **(a)** $\frac{1}{8}$ $\frac{1}{16}$ $\frac{1}{32}$ $\frac{1}{2^{n-1}}$ $2^{-3}$ $2^{-4}$ $2^{-5}$ $2^{1-n}$ **(b)(i)** 64 256 1024 $2^{6}$ $2^{8}$ $2^{10}$ **(ii)** $2^{2(n-1)}$
**(c)** 16384

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**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**International General Certificate of Secondary Education**

# 0580 MATHEMATICS

**0580/47** **Paper 47 (Extended)**

Due to a security breach we required all candidates in Kuwait who sat the paper for 0580/42 to attend a re-sit examination in June 2014. Candidates outside Kuwait sat only the original paper and were not involved in a re-sit.

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# MATHEMATICS

**Paper 0580/47**
**Paper 47 (Extended)**

## Key Messages

Candidates who performed well on this paper consistently showed their working out, formulas used and the calculations performed in obtaining their answer. Attention should be paid to the degree of accuracy required in each question and, in order to avoid unnecessary loss of accuracy marks, candidates should be encouraged to avoid premature rounding in workings.

## General Comments

This paper proved to be accessible to the majority of candidates. Most were able to attempt almost all of the questions, and solutions were usually well-structured with clear methods shown in the space provided on the question paper.

There were a number of excellent scripts with those candidates demonstrating an expertise with the content and showing excellent skills in application in 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.

The standard of drawing was good and there were some excellent graphs in **Question 5**. Candidates' recall of formulae, particularly the quadratic formula, contained a few more errors than seen in previous years.

Most candidates followed the rubric instructions with respect to the values for $\pi$ although a few still used $\frac{22}{7}$ or 3.14, giving final answers outside the range required. There continue to be 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 three significant figures.

The questions on the topics of time, speed, ratio and percentages, simple transformations, graph drawing, reading cumulative frequency curves and calculating averages, simple vectors and linear sequences were well answered.

Weaker areas were problem solving with volume, matrix transformations, algebraic manipulation and the verification of given results, frequency density, and harder sequences.

## Comments on Specific Questions

### Question 1

This question involving ratio, percentage and interest was generally well answered with many completely correct answers.

**(a) (i)** This part was usually answered correctly.

**(ii)** The distance/time relationship was well known. Some candidates could not sensibly handle the time of 1hr 50 mins however in order to achieve an answer in km/h. Some converted $1\frac{5}{6}$ to 1.83, which led to an inaccurate final result.

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**(b)** Many correct answers were given. When sharing out in a ratio 6 : 7 the number 13 is usually important; in this problem it did not help as candidates were not given the total value but the value of one of the parts and this did catch some of them out.

**(c) (i)** This part was very well done.

**(ii)** Many realised that 12.4 was 80% of the previous catch, so 100% of the previous catch was 12.4/0.8; some candidates did not understand these "reverse percentage" problems and made the common error of finding 20% and then either adding or subtracting.

**(d)** Most, but not all, candidates knew that time = distance ÷ speed, so 88 ÷ 55 became 1.6 hours. This then had to be converted to hours and minutes, some struggled to do this. The majority achieved the correct answer however.

*Answers*: **(a)(i)** 08 35, **(ii)** 48; **(b)** 14; **(c)(i)** 35.4, **(ii)** 15.5; **(d)** 17 16.

**Question 2**

This question involving drawing and describing transformations had a full range of responses.

**(a) (i)** Most candidates were able to draw the correct image and gain the two marks for the correct translation. The most common error was a translation by $\begin{pmatrix} -2 \\ 8 \end{pmatrix}$ or a translation by either the correct horizontal or vertical component.

**(ii)** A large majority drew the correct reflection. Some incorrect images were displaced by one square vertically from the correct position or reflected in the *x*-axis or *y*-axis. A few rotated shape *T* by 180° about the origin.

**(b)** If the matrix was recognised then candidates generally gained all three marks. If a mark was lost it was usually for failing to give the centre of rotation. There was no pattern to the wrong answers and a variety of reflections, shears and stretches were seen.

**(c) (i)** Many were able to describe the transformation as a shear but not all were able to describe its features correctly. The invariant line was usually defined correctly but the scale factor was either incorrect or omitted more often.

**(ii)** This proved the most challenging part of the question and less than half of the candidates gained both marks. Most of the others had little idea of the correct matrix, although some did earn one mark for a matrix of the correct form but using an incorrect scale factor.

*Answers*: **(b)** Rotation, 90° clockwise, around (0,0); **(c)(i)** shear, factor 2, *y*-axis invariant, **(ii)** $\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$.

**Question 3**

The more able candidates answered this question on using trigonometry in three dimensions well.

**(a)** Many candidates identified the angle to be found and appreciated that it is necessary to calculate the height of the flagpole as the first step. Most used right-angled triangle trigonometry with the tangent ratio although there were a small number who used the sine rule. Quite a large number of candidates gave the height to only 3 significant figures and then used this answer of 15.4 in the second part of the calculation. Almost all candidates who found the height also used right-angled triangle trigonometry with the tangent ratio in triangle *BCT* to calculate angle *CBT*. As in the first step a few candidates used the sine rule and there were others who used Pythagoras' Theorem to calculate *BT* and then used the cosine rule.

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It is very important for candidates to understand that it is necessary to work with at least 4 significant figures in working at the intermediate stage (that is 15.39, or better, in this case) to guarantee that the final answer will fall within the acceptable range. A good strategy in this case is to leave the value of the height on the calculator or to write the height down the height as $11.6\tan 53^\circ$ and then to work out the final answer of $\tan\theta = \frac{11.6\tan 53}{24.5}$ as a single calculation. This gives an answer of 32.1 whereas many gave 32.2 as a result of only working with 3 significant figures as described above.

There were a considerable number of candidates who found this part challenging and either omitted this part or did not appreciate that the diagram given in the question represents 3-dimensional space and so were not able to identify the angle of elevation required. Some who did try to calculate angle *CBT* assumed that the diagram is symmetrical and so gave an answer of 53°.

**(b)** Candidates generally answered this part well. It was pleasing to see that many were able to recall the version of the cosine rule with cos $\theta$ as the subject and then to make the correct substitutions. There were some who substituted into the version of the cosine rule with $AB^2$ as the subject and then went on to convert this to give $\cos\theta$ as the subject. Some made an error with the rearrangement but, in most cases, went on give an answer in the range 103.7° to 103.8° and to score full marks. A small number only gave an answer of 104° following the correct use of the cosine rule and it is very important for candidates to know that, in a question in which the answer is given, it is necessary to give an answer to at least one more significant figure than that of the given answer. In this case if the candidate wrote down 104° without the intermediate step of cos $\theta$ = -0.238… then only 2 marks were scored.

**(c)** This was answered well. A small number used area = ½ × base × height, assuming that the triangle *ABC* was right-angled. As in part **(a)** some candidates did not score full marks as a result of lack of accuracy, giving the final answer as 137.8, rather than an answer in the range 138.7 to 138.1.

**(d)** Many found this part challenging and sometimes no response was given. Those candidates who identified the correct triangle with angles of 60° and 104° generally used the sine rule correctly. The most common error was to make an assumption the triangle was right-angled and give $\sin\theta = \frac{11.6}{AD}$.

*Answers*: **(a)** 32.1; **(b)** 103.7 to 103.8; **(c)** 138; **(d)** 13.0.

**Question 4**

This question on mensuration proved to be one of the more challenging on the question paper.

**(a)** This part was answered well by many candidates who calculated the volume of the sphere and subtracted this from the volume of the cylinder of liquid of height 10 cm. A small number of these only wrote an answer of 1016, rather than giving an answer to at least 1 decimal place and so did not score full marks as the required answer was given in the question. Some candidates correctly gave the volume of the sphere as $\frac{4}{3}\pi 5^3$ but made no further progress, possibly because they were unable to recall the formula for the volume of the cylinder. There were some incorrect attempts to find the volume of the cylinder that included $\frac{4}{3}\pi 7^3$ or $\frac{1}{3}\times\pi\times 7^2\times 10$.

**(b)** There was a mixed response to this part. Some candidates thought the total mass of the sphere was 7.85g and that the total mass of the liquid was 0.85g and so did not carry out any calculations using volumes. A small number of candidates used 0.85g, or 7.85g with both volumes and some divided the volumes by 0.85g and 7.85g. Many candidates correctly multiplied the volume of the sphere by 7.85g but some of these multiplied the volume of the cylinder by 0.85g rather than using the volume of the liquid. A number of candidates who carried out the first two steps correctly made an error with the units: for example adding 1.14 to the sum of the two masses before dividing by 1000. There were quite a number of candidates who had a completely correct method and then gave the final answer as 6.1 and not to three significant figures and thus scored only 3 marks.

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**(c)** Some candidates found this challenging and either omitted the part or made no progress. The question stated that 'the sphere is removed from the cylinder' and this led to the most common error of using 523.6 instead of 1016 for the volume that is required in the calculation.

**(d) (i)** Many candidates also found this part challenging. Some candidates divided the volume of the sphere by 6.5 instead of $6.5^2$.

**(ii)** Many also found this part challenging and it was frequently omitted. Some candidates gave the correct first step when using the most common method which is $\pi \times 7^2 \times$ (the answer to part **(d)(i)**) and then often correctly subtracted 1016 but did not subtract the volume of the cuboid. Only a very small number of candidates used the most efficient method which is $\pi \times 7^2 \times$ (the answer to **(d)(i)** – 10).

*Answers*: **(a)** 1015.7 to 1015.9; **(b)** 6.11; **(c)** 6.60; **(d)(i)** 12.4, **(ii)** 366 to 370.

**Question 5**

This question on graphs of functions gave a full range of responses.

**(a)** The table for the function was nearly always completed correctly.

A few candidates gave $y$ = -3.5 instead of $y$ = -4.5 and $y$ = 0 instead of $y$ = -2.

**(b)** A large majority of candidates were awarded 5 marks for a correct curve, some unevenness was condoned in joining the plotted points. In the section of the graph between $x$ = -0.3 and $x$ = -0.5 the curve was sometimes concave, particularly when the point (-1, -2) had been assumed to be the maximum. A few candidates plotted (-2, -4.5) at (-2.5, -4.5) and similarly with (2, -3.5) mistakenly plotted at (2.5, -3.5).

Those candidates with an error in part **(a)** usually went on to plot their points accurately but lost the mark for the correct curve. A few joined the two separate parts of the graph together across the $y$-axis and did not observe a key property of this function.

**(c) (i)** A large majority scored the mark for a correct ruled line. A few drew the line too short.

The most common error was to draw a line passing through (0, -1) and (-1, 0). A few vertical lines through $x$ = -1 were also seen.

**(ii)** Many correct answers were given. Candidates usually lost a mark for the coordinates being slightly off (-1, -2) with (-1.1, -2.1) as the most common error. Some described the line as 'intersecting' often accompanied by the coordinates (1, 0) or very occasionally described the line as a 'bisector'.

**(d) (i)** The table was completed nearly always correctly.

**(ii)** A large majority scored full marks. Sometimes the graph was somewhat 'pointed' between $x$ = -0.5 and $x$ = 0.5 but nevertheless remained within acceptable limits. Only a few plotted the point (0.5, 0.5) at (0.5, -0.5) and the point (1, 2) at (1, 4). A very small number lost the mark for the curve because its minimum dropped below (0, 0) or did not go down far enough to reach it.

**(iii)** Nearly all gave 0.7 as the value and nearly all of the rest gave a value that was within range.

**(iv)** This part of the question caused the most problems. Many candidates scored full marks using either the method of re-arranging the equation or a substitution of the answer to part **(d)(iii)**. However, there were many others who failed to reach $3x^3 - 1 = 0$. It was common to see candidates starting with $kx^3 - 1 = 0$ and trying to make $k$ the subject; obviously not reaching any numeric value for $k$. Others substituted their value of $x$ from **(iii)** into $kx^3 - 1 = 0$ but obtained an approximation for $k$ and earned a method mark.

*Answers*: **(a)** -4.5, -2, -3.5; **(c)(ii)** Tangent, (-1, -2) ; **(d)(i)** 0.5, 2, **(iii)** 0.65 to 0.75 **(iv)** 3.

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**Question 6**

This question on statistics was generally well answered. Accuracy of readings affected a number of candidates in part **(b)**.

**(a)** All parts were done well with a majority of candidates earning full marks. A very small number lost the mark for the inter-quartile range because they only stated 96 or 70 as the upper and lower quartiles and did not continue to subtract their values; a few others made errors in reading the vertical scale of the graph. Some gave the answer as 36 in part **(iii)** without subtracting it from 100. There were also a few that misread the vertical scale here as well.

**(b) (i)** Many candidates scored 2 marks but it was common for candidates to give either one or two incorrect values.

Usually the answers were close to the correct values, indicating a valid method was used but a slight misread on the scale was the error; 17 being a common replacement for 18 and 25 replacing 24. A few misunderstood the question and gave the cumulative frequencies rather than the frequencies.

**(ii)** A large majority used the correct method for calculating the mean of grouped data. Consequently those who had part **(b)(i)** correct usually scored full marks while those who had incorrect values in the previous part were still able to score all of the method marks. A few candidates multiplied the frequencies by the interval lengths rather than the mid-interval values, a few divided by 5 instead of 100 and a few just added the frequencies and divided by 5.

**(iii)** This part of the question caused most problems. There were many correct answers seen but many incorrect answers as well. The most common error made was to add the frequencies together in the first two intervals so 36, 44 and 20 were often seen or with similar follow through values from the candidates' readings. Others divided the length of the interval by the frequency giving rise to 1.38/1.4, 0.45 and 2.5. A few multiplied the length of the interval by the frequency giving 1800, 880 and 1000. The term frequency density is not understood by a significant number of candidates.

*Answers*: **(a)(i)** 88, **(ii)** 25 to 27, **(iii)** 64; **(b)(i)** 18, 24, **(ii)** 85.5, **(iii)** 0.72, 2.2, 0.4.

**Question 7**

This question involved setting up equations and proved more of a challenge and in general candidates were less successful than most of the other questions.

**(a) (i)** Many candidates wrote down the correct algebraic relationship between the areas of the rectangle and the square but some gave area $B + 8$ = area $A$. Those with the first step correctly written down or with the sign error almost always wrote down one, or both, of $(2x + 1)(x - 1) = 2x^2 + x - 2x - 1$ or $(x + 1)^2 = x^2 + x + x + 1$ to earn partial credit. In order to earn full marks it is essential for the algebra to be set out very carefully and accurately with no omissions. Many did so but some made an error, such as omitting an 'equals' sign or the final ' = 0'.

**(ii)** This part was usually answered correctly. Very occasionally the factors were incorrect with the signs the wrong way around or $x(x - 3) - 10$ given.

**(iii)** There was a mixed response to this part. Many candidates understood that the positive solution to the quadratic equation already factorised in the previous part is required and so used $x = 5$ to give the perimeter. A small number gave an answer of 12, one half of the perimeter. There were quite a large number who assumed that an algebraic form for the perimeter was required and so an answer of $4x + 4$ was seen fairly regularly.

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**(b) (i)** Candidates usually gave the correct answer with the most common incorrect answers being either $\frac{x}{20}$ or $20x$.

**(ii)** This was a challenging question and many were not able to write down a correct equation at the first step. There were different reasons for this. Some did not have the answer to **(b)(i)** correct and even of those that did some that did were not able to write down a similar expression for the second part of the journey with $20(x + 1)$ being an example. Quite a large number of candidates gave $\frac{20}{x+1}-\frac{20}{x}=\frac{1}{4}$ or $\frac{20}{x+1}+\frac{20}{x}=\frac{1}{4}$ as incorrect expressions. Those candidates who did have the first step correct often went on to 'clear' the fractions and finished with the correct result. As in part **(a)(i)** there were some cases of the algebra not being set out carefully enough to score full marks.

**(iii)** The majority of candidates correctly identified the appropriate method and most were able to write down the quadratic formula correctly. Some errors were seen at the substitution step. These included making a sign such as using 1 rather than -1 or 80 rather than -80 and there were some square root or division lines that were not drawn of sufficient length to be considered a correct method. Those candidates who did show the correct numerical version of the quadratic formula often gave correct answers rounded to 2 decimal places. However there a substantial number who did not work with sufficient figures, or truncated the decimals, and gave answers of 8.45 and -9.45 both of which are incorrect. A small number gave answers correct to 1 decimal place.

**(iv)** There was a mixed response to this part. Many candidates used the correct method but, as in the previous part, some only worked with 3 significant figures and so gave a final answer that was just out of range, usually 4 h 28 min. Some only gave the time for part of the journey, usually $\frac{20}{\textit{the positive root}}$.

*Answers*: **(a)(ii)** $(x - 5)(x + 2)$, **(iii)** 24; **(b)(i)** $\frac{20}{x}$, **(iii)** -9.46 and 8.46, **(iv)** 4 h 29 min.

**Question 8**

Almost all candidates used the Venn diagram given in the question. Those who completed the Venn diagram correctly usually went on to score well in the question.

**(a) (i)** A number of the candidates gave the answer as 21, but many gave 14.

A few gave the answer as a fraction or probability.

**(ii)** The majority obtained the correct answer and again a few probabilities were seen instead of values.

**(b)** Candidates found it easier to interpret the previous worded questions than to interpret the set notation and only a minority obtained the correct answer of 5.

**(c)** Two common errors were seen, those where candidates had worked with replacement and those that interpreted the question as 'both play football only'. Apart from these candidates many of the rest obtained the correct probability.

**(d)** Some candidates ignored the reference to hockey and $\frac{7}{24}$ was a common wrong answer. Others had no trouble in obtaining the correct probability.

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**(e)** Most of the candidates giving 14 as their answer in part **(a)(i)** gave this answer as $\frac{9}{14}$. Of the rest many gave the correct probability.

*Answers*: **(a)(i)** 21, **(ii)** 7; **(b)** 5; **(c)** $\frac{10}{23}$; **(d)** $\frac{7}{12}$; **(e)** $\frac{16}{21}$.

**Question 9**

This question on vectors proved to be accessible to a large number of candidates.

**(a) (i)** This part was answered well with many candidates scoring full marks. Some made a sign error with one or both of the elements, and some made an error with 2**q**, such as writing down $\begin{pmatrix}25\\24\end{pmatrix}$.

**(ii)** There was a mixed response to this part. The majority of candidates attempted to form a vector equation and those who did this correctly often went on to earn both marks. Quite a common error was to write down $k\begin{pmatrix}2\\3\end{pmatrix}+\begin{pmatrix}5\\12\end{pmatrix}=\begin{pmatrix}1\\6\end{pmatrix}$ followed by $k\begin{pmatrix}7\\15\end{pmatrix}=\begin{pmatrix}1\\6\end{pmatrix}$.

**(b) (i)** This part was usually answered correctly with the most common mistake being to make a sign error and give **a** – **c**.

**(ii)** There was a mixed response to this part. Although many gave the correct answer some wrote down one third or one half of their answer to **(b)(i)** and some omitted the brackets and gave $\frac{2}{3}$**c** - **a**.

**(iii)** Most candidates responding to this part added the vector **a** to their answer to **(b)(ii)** and scored one mark even if their answer to part **(b)(ii)** was incorrect. Others also scored a mark by identifying a route such as $\overrightarrow{OA}+\overrightarrow{AE}$. Those attempting to use part **(b)(i)** to find $\overrightarrow{OE}$ often made a sign error which gave $\overrightarrow{OC}+\overrightarrow{EC}$ rather than $\overrightarrow{OC}+\overrightarrow{CE}$.

*Answers*: **(a)(i)** $\begin{pmatrix}-8\\-21\end{pmatrix}$, **(ii)** -2 **(b)(i)** -**a** + **c**; **(ii)** $\frac{2}{3}$(-**a** + **c**); **(iii)** $\frac{1}{3}$**a** + $\frac{2}{3}$**c**.

**Question 10**

This question on sequences and patterns was generally well answered.

**(a) (i)** Nearly all candidates found 23 in Sequence A and many were able to give the correct $n^{th}$ term as $5n - 2$. The common error for a few was to give the $n^{th}$ term as $n + 5$. Sequence B caused more problems and although many were able to find 81 as the missing term most were unable to find the correct $n^{th}$ term for this sequence. Many recognised 3 was involved but often this was translated as $3n$.

**(ii)** This was usually correct, nearly all who had found $5n - 2$ in part **(a)(i)** gave the correct answer and many of those who had not still found the value 127. Some managed to pick up a method mark for equating their expression to 633.

**(iii)** There were many correct answers and many also that scored one mark usually for 6561 but sometimes for a correct conversion to standard form but without the required accuracy i.e. $6.56 \times 10^3$.

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**(b) (i)** This was surprisingly well answered. Those who had full marks had usually solved simultaneous equations using $n$ = 1, 2 and 3 rather than 4. Others used the alternative method, rarely seen in full but involving the difference method with coefficients of the general quadratic equation. With this method some only managed to find the second difference of 2 and then made no further progress. A very small number successfully used the approach $a + D_1(n - 1) + ½D_2(n - 1)(n - 2)$ where the first term $a$ = 1, the differences $D_1$ = 5 and $D_2$ = 2.

**(ii)** Those who had full marks in part **(b)(i)** nearly always had this part correct also. The rest were usually unsuccessful.

*Answers*: **(a)(i)** 23, $5n - 2$, 81, $3^{n-1}$, **(ii)** 127, **(iii)** $6.561 \times 10^3$; **(b)(i)** 2, - 4, **(ii)** 10196.

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