MATHEMATICS

Paper 0580/11
Paper 11 (Core)

General comments

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

Candidates must check their work for sense and accuracy. Candidates' attention must be drawn to the cover instruction referring to the numbers of significant figures to be given as the over-rounding of figures or answers was very noticeable this session, particularly in **Questions 9, 12, 19** and **20(c)**. Also, it was clear that candidates are not using an acceptable value for π. The acceptable values are 3.142 or the π-button on calculators.

The questions that presented least difficulty were **Questions 2**, **3**, **4**, **5**, **10**, **13** and **16**. Those that proved to be the most challenging were **Questions 6**, **9**, **12**, **17** and **18**. The questions or part questions where candidates did not give any answer were scattered throughout the paper rather than being concentrated at the end, indicating that candidates had enough time. The questions that showed a high number of blank responses were **Question 11**, **Question 15(b),** all of **Question 17**, all of **Question 18**, **Question 19(b)** and **Question 20(d)**. In particular, **Questions 17** and **18** were on topics that were challenging for many candidates.

Comments on specific questions

Question 1

Correct answers to this question on rotational symmetry were in the minority but almost all shaded exactly two squares. There was confusion between line and rotational symmetry evident as, more often than not, the completed diagram had one line of symmetry but no rotational symmetry.

Question 2

This question on converting between fractions and decimals was often misunderstood with candidates giving $\frac{3}{100}$, 0.003, 0.3 or 300 as their answer.

Answer: (0).03

Question 3

Candidates did well at finding the missing angle. Wrong answers included 87°, the value of one of the angles shown in the diagram. In a few cases, candidates were let down by inaccuracies in their calculations rather than their knowledge of angles at a point. For **part (b)** the wrong words, acute and reflex, were often seen as the type of angle, along with a wide variety of words which have nothing to do with the size of the angle, for example, exterior, corresponding or isosceles.

Answers: **(a)** 162 **(b)** Obtuse

Question 4

Most candidates gave an answer of the correct order in **part (a)** in this question on rounding and percentages, though 28 800 and 30 000 were fairly common wrong answers. Some gave 28.750 or only 28 or 29. Most used the correct method in **part (b)** and almost all gave the correct answer of 60% although some answers of 0.6 or 40% were seen.

Answers: **(a)** 29 000 **(b)** 60

Question 5

With this first algebra question, the candidates generally did well. Candidates were more successful finding x in **part (a)** than y in **part (b)**. The most common wrong method in **part (b)** was to subtract the 6 instead of dividing. If candidates left their answer as $4\frac{3}{6}$, this did not get the mark as this answer had not been simplified completely.

Answers: **(a)** 7 **(b)** 4.5 or 4½

Question 6

This was one of the more challenging questions that demanded a high level of understanding as well as being confident with directed numbers, but many candidates gained at least one mark here. A lot of candidates gave the answer 30° from workings that assumed the temperature was going up by 10° every 2000 m. Some applied a 3.5° drop in temperature instead of the 6.5° given in the question. A few made the calculation more long winded, but maybe simpler to understand, by working out the temperature at the foot of the mountain instead of applying the temperature drop 6 times.

Answer: –16

Question 7

Here, most candidates knew that like terms had to be collected so that the answer contained only 3 terms. The -8 or the -3k proved the term most often incorrect with +8 and -5k being the common wrong versions. If a candidate only got two of the three terms correct, he gained one of the two marks. The expression could be given in any order as long as the associated sign was correct.

Answer: $8j - 3k - 8$

Question 8

This exchange calculation was of the more complex sort where the sum to be converted is divided by the exchange rate. Candidates should stop to reflect whether the answer should be lower or higher than the original number. This session, the answer did not require any rounding as it was an exact number of pounds.

Answer: 16

Question 9

Often, insufficient working was shown, so that candidates who gave a wrong answer could not gain any part marks. Many candidates attempted to work out the numerator and denominator separately but some rounded each to 3 significant figures at this stage, instead of giving $\frac{85.56}{100.44}$. Some found the correct fraction but then proceeded to turn that into a decimal and then round or truncate it incorrectly. There were many candidates who did not apply the order of operations correctly, so gave answers such as 2148.4116 or –360.2339.

Answer: [0].852 or $\frac{23}{27}$

Question 10

Candidates were more likely to score for a correct answer for **part (a)** in this question on standard form, although some had powers of 4 or -5, than **part (b).** Occasionally, an incorrect format for standard form, for example, 23×10^4 was seen or even just 2.3^5. Many gave answers of 48 000 in **part (b)** or had the wrong number of zeros after the decimal point. A significant number forgot to use a decimal point, giving the answer as 00048. A surprisingly high number of candidates got the positive and negative indices mixed up writing 2.3×10^{-5} and 48 000. However the most common mistake in **part (b)** was giving $\frac{3}{6250}$ as their answer.

Answers: **(a)** 2.3×10^5 **(b)** [0].00048

Question 11

Many did not show all their working in this question on dividing fractions, even though that instruction was in the question. If a reminder to show all the working is given in a question that means that working must be seen in order to access the marks. Most candidates recognised the need to start by adding and then to change to improper fractions. It was quite common for the denominator to be incorrectly given as $\frac{3}{2}$. Although most found $\frac{17}{9}$ and $\frac{5}{2}$ correctly, not many candidates showed the two clear steps (division of the improper fractions then multiplying by the inverted second fraction) to reach the given fraction. Some, that went straight from showing the division to the answer gained just 1 mark. Some tried to use decimals but that approach does not gain marks. However, there were candidates who set out each step clearly.

Question 12

This circle question needed the two areas to be worked out and then subtracted. Many candidates gained one mark by working out the area of the centre hole or a circle with radius 6 cm but then stopped. A common fault was to subtract the radii before applying the area formula. This approach did not get any marks as no part of their stated method was correct. Others found the area of the disc and simply subtracted 0.5. Some confused circle formulae and found circumferences or double the areas. The accuracy mark was lost by some candidates if they used an unacceptable value for π or rounded too early or too far.

Answer: 112

Question 13

In this algebra question, candidates were more successful with **part (a)** than **part (b)**. Most reached $3(3y + 4)$ though some used a common factor of 9 or $3y$. Some ended up combining the two terms to give $21y$. In **part (b)** most gave the second term as $-7a$ (sometimes written as $-a7$) but the a^3 was more often incorrect, and was variously given as a^2, $2a^2$ or $2a^3$. Some left their answer as $a^2 \times a - 7 \times a$. This was only worth one mark as it was not completed. A few had the correct answer in the working then spoiled it.

Answers: **(a)** $3(3y + 4)$ **(b)** $a^3 - 7a$

Question 14

There was very little understanding of the difference between relative frequency and frequency in this probability question. If candidates treated both of these as the same, they lost one mark over both parts. Often **part (a)** was given as 24 rather than $\frac{24}{75}$, $\frac{8}{25}$, 0.32 or 32%, which were all seen and were all acceptable. There were more examples this session of answers such as 24 out of 75 which are not acceptable. **Part (b)** was quite well done but there was some lack of understanding of the expected number, as answers such as 6 300, were seen. Candidates must think about the context of their answers.

Answers: **(a)** $\frac{24}{75}$ or equivalent **(b)** 84

Question 15

The most common insufficient response to **part (a)** of this pie chart question was $45 \rightarrow 360$, $20 \rightarrow 160$ with no more explanation. Some candidates drew a sketch of 160°, wrote 180 – 20 or worked out the angle for the wrong sector. Candidates had the most success with **part (b)** while most candidates gained at least 1 mark for **part (c).** Candidates need to know that writing only the angle in each sector is not correct labelling.

Answers: **(b)** 144

Question 16

Both part of this question on vectors were quite well done with the most common errors made by candidates in forgetting that 7 × 0 = 0 rather than the 7 often seen for **part (a)** and to ignore a minus sign in **part (b)**. A few candidates drew a line in the vector brackets as if to make it into a fraction. Some tried to give a 2x2 matrix made up of the co-ordinates of **q** and **r**.

Answers: **(a)** $\begin{pmatrix} 0 \\ 63 \end{pmatrix}$ **(b)** $\begin{pmatrix} 7 \\ -8 \end{pmatrix}$

Question 17

There were some immaculate, completely correct constructions with the correct region shaded in this loci question, but these were in the minority with many candidates not attempting any part of this question. The construction arcs in **part (a)(i)** are vital so candidates must not rub these out. Also, candidates should not go over their pencil lines with pen especially to draw free hand circles. The perpendicular lines were often in the correct place but construction arcs were missing. Generally these lines were long enough so that the area in **part (b)** could be shaded. Occasionally, two horizontal lines either side of *AB* were seen. The circle was sometimes half sized with a diameter of 4 cm centred at *C*. A common misunderstanding was seen with **part (b)**. Many candidates shaded two regions, that which is nearer *B* than *A*, as well as that which is less then 4 cm from *C* instead of the single region which satisfies both of these requirements. Sometimes a candidate used different shading on the two regions to show a part that was in both but did not say which part was his answer. This part was the second most likely one to be missed out by candidates. It is worth noting here, that if a candidate has difficulty seeing his construction on the paper, the Examiner will have the same difficulty. Pencil lines should not be thick but be easily seen.

Question 18

This question on the equations of lines was one of the most challenging topics on the paper with many candidates making little attempt to answer. The most common wrong answer came from errors in the substitution of the co-ordinates into the formula to find the gradient in **part (a)** with common wrong answers of $\frac{1}{3}$, 2, –2 or –3. This means that $\frac{4-0}{10+2}$, $\frac{10-2}{4-0}$, $\frac{0-4}{2-10}$ and $\frac{4-10}{2-0}$ were all seen for the method. For **part (b),** provided candidates followed through their **part (a)** answer and had the correct constant, they were awarded the mark. But, there were many that, after finding the gradient in **part (a)** did not make the leap to the formula for the line, which tested they knew what *m* and *c* stood for. **Part (c)** had fewer correct responses than the other two parts with candidates sometimes repeating their answer to **part (b)**. This whole question was the one with the most blank responses.

Answers: **(a)** 3 **(b)** $3x - 2$ **(c)** $3x$

Question 19

Those who recognised that **part (a)** required Pythagoras's Theorem generally did well although many got the formula the wrong way round and so added 7.4^2 and 6.5^2. This incorrect method cost candidates 3 marks when they should stop to think whether they are being asked to find the hypotenuse or one of the shorter two sides. Besides this method error, marks were lost by not taking the square root or by answering with only 2 significant figures or truncating at 3 figures instead of rounding up. In the trigonometry question in **part (b)** a few candidates used tan or cos instead of sin but many scored full marks. Some tried Pythagoras's Theorem for a second time. Here again, many answers were not given to the required accuracy, for angles this is one decimal place. Some candidates gave 45° with no workings.

Answers: **(a)** 3.54 **(b)** 44.3

Question 20

Part (a) of this question on travel graphs was done well with most giving 10 minutes. This tested the fundamental skill of understanding the scale, required so that the other parts could be answered. **Part (b)** was also done well with the occasional wrong answer seen. Those that gave 15 h 10 m did not gain the mark as this is a period of time, not a time in the day. Many knew that speed is distance divided by time but this calculation was not well done with many candidates using 12 km (the total distance) instead of 6 km (the distance from the shop to Sara's house) or making errors with the time. Candidates were careless with the conversion of 40 minutes to hours by showing no working as to how they obtained the unacceptable figure of 0.67. Candidates should be working with more figures and not rounding in the middle of a calculation. Some candidates used 100 minutes in an hour. A few tried to divide 6 (or 12) by 1510. Candidates made slips in **part (d)** by not drawing the horizontal line the correct length. Some candidates drew a straight line back to the origin, (14 00, 0) – this is impossible as it denotes travelling back in time.

Answers: **(a)** 10 **(b)** 15 10 **(c)** 9

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 have plenty of straightforward questions on the main areas of the syllabus. There were challenging questions but none that could not at least be attempted by candidates who had been well prepared for the examination.

There were many candidates who clearly lacked understanding of some topics and also many exhibited confusion over formulae that needed to be known.

Although working was shown by most candidates there were a significant number who showed little or no working even when specifically required in the question.

Simple errors made in questions often lead to answers that are impossible in the context of the question. Candidates should look at their answers when a question is completed and think whether they are sensible or even possible. For example finding the amount owed after borrowing $600 for 2 years is not going to be less than the amount originally borrowed.

Comments on Specific Questions

Question 1

Whilst most candidates followed the rules for multiplication of fractions, a significant number thought there was more to do for the 1 mark. Some added to get $\frac{8}{15}$ and others thought inverting (division) was needed, resulting in a common answer of $\frac{24}{35}$.

Answer. $\frac{15}{56}$

Question 2

Whilst most candidates used the correct operation and successfully evaluated the multiplication, some divided instead of multiplied or made errors in the multiplication. A few candidates did not attempt the question.

Answer. 620

Question 3

This question was found challenging by most candidates. In part **(a)** most incorrect responses had more than 1 figure apart from zeros, although the quite often seen response of 7 000 showed some understanding. Common incorrect answers were 768, 7, 7 600 and 8.
Part **(b)** was often answered correctly after an incorrect part **(a)**. However overall it was answered less well and common incorrect responses were 0.0000, 0.01, 0.1 and 0.8.

Answers: **(a)** 8 000 **(b)** 0.08

Question 4

Many candidates had a problem interpreting the worded large number to figures and many inserted zeros between 9 and 17. Some thought they were two separate numbers or even had no figure one.
In part **(b)** many rounded when it was the answer to part **(a)** that was to be put in standard form. Some gained the mark by follow through but many did not know that standard form started with a value between 1 and 10.

Answers: **(a)** 91 700 000 **(b)** 9.17×10^7

Question 5

Although this question was quite well answered, there were many candidates who did not know that probability has values between 0 and 1. Whole numbers were often seen. Also seen quite often was a denominator of 18, rather than 19 and an answer of $\frac{1}{5}$ in part **(a)**. Fractions were the obvious form of the answer and some who gave decimals did not give 3 or more figure accuracy.
In part **(b)** many could not sort out that 'not a peach' meant that the numbers of apples and oranges had to be added.

Answers: **(a)** $\frac{5}{19}$ **(b)** $\frac{11}{19}$

Question 6

This was one of the most straightforward change of subject questions but it was not successfully answered by many. One mark was often scored either from subtracting 32 or dividing by 1.8. Quite a number of candidates did not understand the question and simply added 1.8 and 32 to give an answer of 33.8.

Answer. $\frac{F-32}{1.8}$

Question 7

This vector question was quite well answered but combining the multiplication and addition in one question proved too difficult for many candidates. Many scored 1 mark, often from the answer containing 2 and −4. There were however quite a number of candidates who clearly did not understand the topic of vectors.

Answer. $\begin{pmatrix} -2 \\ -10 \end{pmatrix}$

Question 8

The most straightforward question on the paper was answered correctly by nearly all candidates. Most errors were careless slips with 7 and −15 seen for part **(a)** and −4, 6 and 16 seen for part **(b)**.

Answers: **(a)** −7 **(b)** 4

Question 9

Whilst the vast majority of candidates gained a mark for finding the profit, most did not follow that up by correctly finding the percentage profit. It was very common to see division by the selling price rather than the cost price. Even when the correct division was seen quite a number of candidates stopped at 1.16 or 116. It was felt that this was more a case of not looking at the question requirement rather than not understanding the concept of percentage profit.

Answer. 16

Question 10

Parts **(a)** and **(b)** of this question were very well answered and only a few candidates mixed up factors and multiples. However, some candidates gave values which were not in the given list and these were not allowed. Whilst most managed part **(c)** it was not so well answered and many responses of 17 were seen. Since it is a very quick calculator check to divide 52 by the given numbers, those who knew what a factor was should not have got this part incorrect.

Answers: **(a)** 12 and/or 18 **(b)** 16 **(c)** 13

Question 11

The responses to this question showed a lack of understanding of the context of the question and the possible speeds in metres per minute and kilometres per hour that could be possible for an athlete. Part **(a)** was answered quite well but with only two numbers to put into a calculation, multiplying should clearly have been incorrect since running at 6000 metres per minute is not feasible. Some attempted to do a change of units to manufacture a reasonable answer but 1 mark available should have indicated just one operation. As usual the changing of units in part **(b)** caused problems for the vast majority of candidates. Many went back to the original data and divided 1.5 by $\frac{4}{60}$ but then changed the fraction to a decimal with insufficient accuracy. Those who worked from part **(a)** were not clear about multiplication or division of the numbers 1000 and 60 and again many inappropriate answers resulted.

Answers: **(a)** 375 **(b)** 22.5

Question 12

This question was not very successfully answered with very few candidates understanding the frequency table. Most responses to part **(a)** gave the range of the frequency, although some did give 5, the highest number in a car. With only 1 mark available candidates should have realised that finding the mean, a complex calculation was not going to give a correct answer for the range. All sorts of responses were given for the median but it was common to see 10 as the middle in the table or 20 when the frequencies were in order. For those who did give a value from the first row of the table, the value 3 was most common.
Part **(c)** was answered a little better but many again gave 50 from the frequency line rather than the corresponding number of people in the car.

Answers: **(a)** 4 **(b)** 2 **(c)** 1

Question 13

Knowing the formula for volume of a cylinder was essential for this question and many candidates did not exhibit that knowledge. A mark was still available for converting 85 kilometres to metres but many either ignored that or did it incorrectly. A rather high number of candidates did not attempt the question.

Answer. 113 000

Question 14

The time question was another needing understanding and few candidates could successfully work out what was required particularly in part **(b)**. In part **(a)** the common error was to omit the essential pm. Some did not understand what the 12-hour clock time was and put a length of time.
In part **(b)** quite a number gained one mark for working out the length of time for a weekday and Sunday but few continued successfully to a correct time open for the whole week. The usual error of working in decimals was evident often and so an hour was regarded as 100 minutes.

Answers: **(a)** 5 30 pm **(b)** 67

Question 15

There were many answers of 65° for the value of angle p, most often followed by 115° for angle q. This gave no consideration to the clear fact that angle q had to be acute and so less than 90°. Some candidates assumed all angles were equal and so did not use the information in the question. The follow through mark was gained by some candidates who realised that the two required angles had a sum of 115°. Answers greater than 180° were also seen.

Answers: **(a)** 50 **(b)** 65

Question 16

Some candidates are still not clear about the difference between simple and compound interest. Those who did attempt compound interest often did not add on the second year's interest or added the principal twice. The interest, rather than the amount, as requested, was often given as the answer, even with those who used the formula since they often then subtracted the $600. Many lost the final mark by ignoring or doing incorrectly, the rounding to the nearest dollar.

Answer. 693

Question 17

The algebra question, although a mathematically high skill at core level, was answered quite well and most candidates at least made a reasonable attempt at factorising and simplifying expressions with indices. There were a significant number however who did not understand the operation in part **(a)** and gave a numerical answer or a single algebraic term.
In part **(b)** the numerical term was usually correct but $7a^3$, $7a^{2.5}$, $112a^7$ and $7a^{-3}$ were some of the more common incorrect responses.

Answers: **(a)** $2x(3x - 4y)$ **(b)** $7a^7$

Question 18

The plotting of the points was generally well done, although errors were often made in reading the vertical scale. For those who knew the word correlation, part **(b)** was generally correct but many omitted this part. Since the line of best fit had to be quite accurate, many did not draw a good enough line. Those who did not produce a single straight line but either joined the points or did more of a curve clearly did not follow the wording of the question.

Answers: **(b)** Positive

Question 19

This Pythagoras' theorem and trigonometry question is one of the more demanding topics but these questions are straightforward cases of them. Most candidates knew Pythagoras' theorem but many simply squared and added with no thought to the clear diagram showing that line BD had to be less than 5.6. Lack of 3 or more figure accuracy meant marks were lost unnecessarily in both parts of the question.
Trigonometry was not known by some candidates. More able candidates had no difficulty with the mathematics, although over rounding again lost marks.

Answers: **(a)** 4.79 **(b)** 37.9

Question 20

Very few candidates wrote a reason that included the word semi-circle which is the term used in the syllabus for the property and was needed for the mark to be gained in part **(a)**. Many were able to find the angle in part **(b)(i)** as it was clear that angle C was 90°. Part **(b)(ii)** was not so well answered with many giving an acute angle, usually 56° again, when the diagram clearly showed an angle greater than 90°. Few candidates correctly found the sum of the angles in the pentagon from working from their previous parts.
Many did however successfully apply a method for the sum of the angles of a pentagon but there were many who did not attempt this part. Many did not read the question carefully and gave an answer of 108, the angle of a regular pentagon.

Answers: **(a)** Angle in a semi-circle **(b)(i)** 56 **(ii)** 112 **(c)** 540

MATHEMATICS

Paper 0580/13
Paper 13 (Core)

General comments

The standard of performance was generally quite high, and the vast majority of candidates could tackle all questions with some degree of confidence, though quite a lot of errors were made.

Generally presentation was good. Many candidates showed method and were able to earn partial credit if they did not obtain the final answer, although as always, a lack of working, even when specifically requested, was noticeable on some scripts, and reluctance to fulfil the requirements of construction questions caused marks to be lost. Many cases of faint pencil work on drawings made marking a little difficult at times but in general work could be clearly seen. Careful checking of the wording of the questions would help to reduce errors for example not giving the total amount when interest is requested and giving an answer to the required degree of accuracy. Candidates did not appear to have a problem completing the paper in the allotted time.

Comments on specific questions

Question 1

This question on angles was generally correct, suggesting the fact there are 360° in a circle was very well known.

Answer: 74

Question 2

(a) The majority of candidates gave the correct answer to this question on rotational symmetry. The most common error was 180° or 1.

(b) The majority of candidates were able to draw the correct line of symmetry.

Answer: **(a)** 2

Question 3

The majority of candidates gave the correct answer to this question on using a calculator. Of the ones who did not, several scored 1 mark for either 64 or 7.

Answer: 57

Question 4

(a) Most responses to this question on simplifying expressions were correct, with 1t being the most common error. 7^t was also seen.

(b) Again, most responses were correct, with r^{-3} and r^{40} being the most common errors.

Answer: **(a)** 7t **(b)** r^{13}

Question 5

Many candidates scored both marks in this question on simple interest. Some candidates had written the total amount rather than the interest. Quite a number of candidates assumed it was compound interest and it is essential that candidates realise the difference between compound and simple interest.

Answer: 96

Question 6

Few candidates failed to gain 1 mark on this proof question on squaring and adding fractions, but many failed to show the full working required for 2 marks. Some just gave the stated sum with the answer of $\frac{17}{100}$. Others had written this fraction but had then failed to show the conversion to 0.17.

A common response for 1 mark was $\left(\frac{1}{10}\right)^2 + \left(\frac{2}{5}\right)^2 = 0.01 + 0.16 = 0.17$.

Question 7

Answers given to this question on construction expressions were mostly correct but marks were lost by c = included or by continuing to 16pr. A few wrote $5^p + 11^r$.

Answer: 5p + 11r

Question 8

The majority of candidates gave the correct answer to this applied ratio question.

Answer: 180

Question 9

This question on expanding brackets was answered well and it was rare to award no marks. The $y \times y^3$ seemed to cause the most errors. Some misunderstood ‘expand’ and attempted a form of factorising. Several scored 1 mark, usually for 3y seen. Common incorrect answers were $3y - y^3$ and $3y - y \times y^3$.

Answer: $3y - y^4$

Question 10

This percentages question was generally well answered. 84 – 4.2 was seen as well as just 4.2 with no attempt made to add it to 84. It is essential that candidates read the question carefully.

Errors usually occurred from using 1.5 instead of 1.05 or from subtracting from 84 rather than adding.

Answer: 88.2(0)

Question 11

This question on bounds was poorly done with many incorrect values. Some did not know that the values below and above 250 had to be given. On the upper bound some still gave at best 249.4999... which did not score. Other incorrect values were 245 to 255, 249 to 251, 249.9 to 250.1 and even 250 to 300. 250.4 was also seen several times for the upper bound.

Answer: 249.5 [$\le j <$] 250.5

Question 12

(a) This question on estimation was poorly answered. Very few seemed to grasp the idea that that they were meant to write a calculation in **(a)** that they could easily evaluate without a calculator. Some candidates were able to demonstrate some understanding of rounding but not of significant figures. $\sqrt{98}$ rather than $\sqrt{100}$ was often seen.

(b) The majority of candidates who gave the correct answer to part **(a)** gave the correct answer to part **(b)**. For those with an incorrect answer in **(a)** it was difficult to evaluate without a calculator and a lot of complex calculations were attempted with varying degrees of success, however only the correct answer was awarded credit in this part.

Answer: 4.5

Question 13

This factorisation was well done with just a few making slips. Some gained just the 1 mark from partial factorisation, usually taking out $2y$.

Answer: $4y(x + 3z)$

Question 14

Loci again bothered a number of candidates and quite a lot made no attempt at a line bisecting *RT*. Some constructed the arcs but did not draw the line while others drew a line without arcs. Some candidates clearly did not understand what was required and just joined *R* and *T.*

Question 15

The calculation was done correctly by the vast majority but few gave 4 significant figures correctly. 8.470 and 8.4706 were the most common for 1 mark. The most common completely incorrect answers came from −10.3398... where the order of operations had been ignored.

Answer: 8.471

Question 16

Many correct answers were seen to this question on angles and polygons. Although a few candidates did not know a pentagon had 5 sides, most made some progress. Some wrote down the sum of the angles. It was common for just 1 mark to be gained from 360 ÷ 5 or 180 × 3.

Answer: 108

Question 17

This question on subtracting fractions was done surprisingly well. Of course there were a significant number of candidates who just used a calculator and either simply wrote the answer down or tried to work backwards from the answer to show some sort of method. However, the majority knew how to tackle the question and did it in very straightforward steps, showing clear understanding. The most common approach was to change to improper fractions and this usually led to the answer being left as 127/40 but other correct methods also seen. The only error to mention was the use of the wrong common denominator, commonly 45.

Changing to a common denominator caused problems for the less able candidates.

Answer: $3\frac{7}{40}$

Question 18

(a) Almost all responses to this question involving reading from a graph were correct.

(b) Most candidates were able to draw a suitable line of best fit, however, some lines were poorly done with some just joining all the points. For those who drew a sensible line quite a number did corner to corner which was not a good line. Some candidates failed to rule the line.

(c) Those who understood correlation generally gave the correct type. Increasing was often seen.

Answer: **(a)** 9 **(c)** positive

Question 19

(a) This part of this question on coordinates and lines was nearly always correct, the most common error was to plot the point at (1,5).

(b) Many correct responses seen, the most common errors were coordinates of (0, −1) or (1, 0).

(c) Gradient was not understood by many candidates, but those who did understand generally got the correct answer. Some gave the equation which was not asked for. 0.5 was the most common error.

Answer: **(a)** (5,1) plotted **(b)** (− 1, 0) **(c)** 2

Question 20

(a) Mostly correct responses were seen to this probability question.

(b) (i) Generally correct, it was pleasing to see candidates using the correct form throughout the question.

(ii) Answers to this question were generally correct.

(iii) This question was generally correct, but some candidates gave unacceptable words e.g. impossible.

Answer: **(a)** 0.71 **(b) (i)** 0.15 oe **(ii)** 0.75 oe **(iii)** 0

Question 21

(a) (i) Many candidates did not construct the triangle using arcs. Those who did scored both marks. Only a small number of candidates did not score at least 1 mark.

(ii) Most candidates were correctly able to mark the midpoint of the required side.

(b) (i) Sketches were not done well with rectangles and parallelograms being the most common incorrect responses.

(ii) Candidates were not always able to name their sketch. It should be noted for the future that diamond is not a mathematical name.

Answer: **(b) (ii)** Rhombus or Square

Question 22

(a) (i) The majority of candidates were able to correctly measure the length of the line in centimetres.

(ii) Many candidates did not know the name tangent, with straight line or vertical line being a common answer.

(iii) Surprisingly several candidates thought that the centre was the circumference, others drew a diameter. Most understood what the circumference was, however, quite a number did not mark a clear point on the circumference, leaving a '*D*' floating.

(b) Several correct answers were seen. Common errors were to half the diameter or to calculate the area. Others either did not know the difference between the formula for area and circumference or they did not know the difference between radius and diameter.

Answer: **(a)** 7.3 – 7.7 **(b) (i)** Tangent **(b)** 11.3 to 11.3112

MATHEMATICS

Paper 0580/21
Paper 21 (Extended)

Key Messages

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

General Comments

The paper was such that all candidates were able to demonstrate their knowledge and ability.
Questions 5, 10 and **13** proved to be good discriminators between the most able candidates. There was no evidence at all that candidates were short of time and very few candidates did not attempt all the questions.

Particular Comments

Question 1

Whilst this question was generally well answered by most of the candidates, many candidates used 3.5°C as the temperature drop instead of the figure given. The other common error was to have six temperature drops instead of four.

Answer: −16

Question 2

This question was also very well answered by most candidates. Some rounded answers were seen with no working, 0.85 and 0.851 being common errors.

Answer: 0.852

Question 3

Candidates found part **(a)** challenging. 2 was a common incorrect answer but 6 (possibly the number of vertices) and 12 (the number of edges) were also common. Part **(b)** was very well answered.

Answers: **(a)** 3 **(b)** 4

Question 4

This was very well answered by most candidates who now have a clear idea of what is required in this type of question. The main error was showing too little working, particularly the last step of inverting the fraction and multiplying.

Question 5

Only the most able candidates were able to solve this problem. Terms such as $a^{1/4}$ were common errors. Those that recognised the difference of two squares usually scored full marks.

Answer: $a - b$

Question 6

This question was found very challenging. Candidates were mostly assuming that *AOCD* was a cyclic quadrilateral or that *COA* obtuse was 216. The use of letters to name angles or writing angles on the diagram was rare and so it was very difficult to award a method mark.

Answer: 144

Question 7

This was the most successfully answered question on the paper with almost all candidates scoring full marks.

Answer: 16

Question 8

This question was well answered by all but the least able candidates. Most candidates have a clear understanding of the process and there were few instances of simple interest or compound depreciation. Those who used the year by year process sometimes lost accuracy marks for rounding errors.

Answer: 543.19

Question 9

This was well answered with most candidates scoring at least two marks. The most common error was in clearing the denominator incorrectly and arriving at $x - 9 \le 2$. Another common error was $x - 9 \le 30$ followed by $x \le 21$. Candidates should be encouraged to carry out only one operation at a time when solving these problems. Those attempting two moves at once usually make errors.

Answer: $x \le 39$

Question 10

The concept of bounds was better understood this year but the added complication of lower bound for the bottle divided by the upper bound for the glass seemed not to have been understood by many candidates and 98 was the common incorrect answer.

Answer: 70

Question 11

This question was really well answered by more than half the candidates. Almost all candidates now understand the process but many did not use both inverse and square to set up the expression $R = k/d^2$. Common errors were $R = kd^2$ and $R = k/\sqrt{d}$.

Answer: 2.5

Question 12

This question was well answered with most candidates scoring some marks. There was almost no confusion with the formula for circumference. The common errors were using radii of either 5.5 cm or 6.5 cm. Candidates must use 3.142 or their calculator value for π otherwise accuracy marks may be lost.

Answer: 112

Question 13

Candidates found this question very challenging. Those that could work out the two matrices involved sometimes multiplied them in the wrong order.

Answer: $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$

Question 14

The more able candidates answered this question well, whilst others had little idea how to proceed. It was common to see the cosine rule used and some candidates used the wrong formula for the circumference. Some very elegant solutions were also seen.

Answer: 114.6

Question 15

Most candidates recognised that they had to find the area under the graph and did so correctly. Only the most able candidates could then relate this to the distance travelled by Hamid.

Answer: 180

Question 16

This was a challenging question for most candidates as it required them to show careful algebraic manipulation. Many did not write their working down clearly enough for method marks to be awarded.

Answer: $\frac{4y+2}{y-1}$

Question 17

This question was very well answered, with only the shading of the region causing any difficulty. Minor problems included arcs and lines which were almost invisible and a few candidates possibly using reverse shading to that required in the question.

Question 18

This question was well answered by all but the least able candidates. Minor problems included misreading scales and in the last part, not subtracting from 300.

Answers: **(a)** $\frac{7}{25}$ **(b)(i)** 62 **(ii)** 52 **(iii)** 19 or 20 **(iv)** 125

Question 19

Candidates demonstrated a good knowledge of matrices throughout this question. The separate parts did however, highlight some misconceptions.
In part **(a)** many candidates squared the terms instead of multiplying the matrices.
In part **(b)** the common error was to give the answer to part **(a)**.
In part **(c)** many confused the determinant with the inverse or gave the answer of -23 or $\frac{1}{23}$.
Part **(d)** was almost invariably correct despite getting part **(c)** wrong, thus demonstrating their lack of a complete understanding of the process.

Answers: **(a)** $\begin{pmatrix} 17 & -32 \\ 16 & 1 \end{pmatrix}$ **(b)** $\begin{pmatrix} 10 & -8 \\ 4 & 6 \end{pmatrix}$ **(c)** 23 **(d)** $\frac{1}{23}\begin{pmatrix} 3 & 4 \\ -2 & 5 \end{pmatrix}$

Question 20

Candidates generally understood what was required of the function work but some were let down by poor algebra.
In part **(a)** the common error occurred in the algebra when trying to find $f^{-1}(x)$ or else not understanding the question and solving f(x) = 2. The 1 mark allocation should have been a hint to find f(2).

In part **(b)** most candidates knew what to do but some were unable to simplify $4(\frac{x^3}{2})$ correctly.

Part **(c)** was better answered with only slips in the algebra causing loss of marks. Candidates need to be much more careful with the presentation of their work in this type of question.

Answers: **(a)** 12 **(b)** $2x^3$ **(c)** $\sqrt[3]{(2x+2)}$

Question 21

Part **(a)** was well answered by all but the least able candidates. A common error was to use the wrong centre of rotation.
Candidates found part **(b)** more challenging.
Part **(c)** was dependent on part **(b)** so little success was seen here.

Answers: **(c)** Reflection in the *x* axis

MATHEMATICS

Paper 0580/22
Paper 22 (Extended)

Key message

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

General comments

There was no evidence that candidates were short of 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.

Candidates not giving answers to the correct degree of accuracy continue to be a problem. The general rubric needs to be read carefully at the start of the examination and candidates need to ensure that they have noted the accuracy requirements of particular questions in their checks at the end of the paper.

The questions that presented least difficulty were 3, 5, 10, 13 and 16. The questions that proved to be the most challenging were 6, 7, 14**(a)**, 17**(b)**, 19**(b)** and 20**(a)**.

There were a significant number of candidates who did not use the available working space in the answer booklet to show the necessary calculations for obtaining their answers. When there is only an incorrect answer on the answer line and no relevant working the opportunity to earn method marks is lost.

Comments on particular questions

Question 1

The response to part **(a)** was generally good. Incorrect responses seen were 7, 7000, 7700, 7.682, 8 and 8000.00. Part **(b)** was not so well answered with incorrect responses of 0.1 and 0.08000 often seen.

Answers: **(a)** 8000 **(b)** 0.08

Question 2

A significant number of candidates first subtracted the 2.28 from 11.3139 and then multiplied the result by $\sqrt[3]{9^2}$ which resulted in a commonly seen incorrect answer of 39.1. A number of candidates ignored the instruction to give their answer correct to one decimal place which resulted in incorrect final answers of 1.45. Some candidates rounded values prematurely giving incorrect final answers of 1.5.

Answer: 1.4

Question 3

The most common error was in not dealing correctly with the $(-5)^2$. The $(-5)^2$ was often presented as -5^2 which led to an early breakdown in many solutions. A number of candidates who progressed safely to the end of the question made an error when simplifying 475/4, but more evident was not giving an answer as an exact value leading to 118.8 or 119 appearing in the answer space.

Answer: 118.75

Question 4

This question was challenging to a number of candidates. Most correct solutions came from using 360/6. The candidates who chose to work with the interior angle of the polygon were usually unsuccessful in calculating the number of sides correctly.

Answer: 60

Question 5

The general response to this question was good. The most common incorrect method seen was 0.75 × 72 which resulted in an answer of 54. A few candidates mistakenly used 1819 in their calculations.

Answer: 96

Question 6

This question was generally not well answered with many candidates not understanding how to find the range, median and mode from a frequency table. Part **(a)** was the least well answered question on the paper with the range often being given as 1 to 5 or as the difference between the frequencies i.e. 50 – 5 = 45. Correct answers were more common as candidates progressed from part **(a)** to **(b)** to **(c)**. The mean was often calculated for the median and the frequency was often given for the mode.

Answers: **(a)** 4 **(b)** 2 **(c)** 1

Question 7

Many candidates found this question challenging. Candidates often applied a lower bound to the 2600 Rand. It was also common to see 82 000 multiplied by 2600 and then 500 being subtracted from this product. A number of candidates performed the correct calculation but then didn't earn the final mark by not expressing their answer in standard form as requested. Another common error was to round the answer to 2.12×10^8.

Answer: 2.119×10^8

Question 8

Some candidates didn't appreciate that the 85 kilometres needed to be converted into metres. Some common incorrect conversions seen were 8500 and 0.085. There was also some confusion over the correct formula to be used for the volume of a cylinder – it is essential that formulae are learnt correctly in preparation for the examination. Candidates should use 3.142 or their calculator value for π as instructed in the rubric of the question paper – use of 3.14 or $\frac{22}{7}$ should not be encouraged as it may lead to answers outside the range of acceptable values.

Answer: 113000

Question 9

In part **(a)**, a significant number of candidates were unable to express the closing time on Saturday in 12-hour clock time. The most common incorrect response was 5 30 with no pm being used. Candidates were generally more successful in part **(b)**. A common incorrect answer was 24 which came from not multiplying 10 hours 45 minutes by 5.

Answers: **(a)** 5 30 pm **(b)** 67

Question 10

This was one of the best answered questions on the paper. Those candidates who did not score full marks for the question usually earned the first mark for $22 - 6x$.

Answer: 3.4

Question 11

There was a variable level of success with this question. A number of candidates appeared confused by the inequality $16 < 2x - 5 < 48$ and were unable to reduce this to $10.5 < x < 26.5$. Some candidates simply quoted the prime numbers between 16 and 48. The number 21 was often included in the list of prime numbers.

Answer: 11, 13, 17, 19, 23

Question 12

The majority of candidates were able to find the volume of the original cereal box correctly. A significant number then didn't recognise the cubic relation and incorrectly assumed a linear relation between the volume of the original box and the volume of the special edition box.

Answer: 12 by 30 by 42

Question 13

This question was well answered by the majority of candidates. Those candidates who started with $m = kL^3$ usually proceeded to the correct answer and gained full marks. The most common incorrect answer was 350 which came from using $m = kL$. A small number of candidates used 'square' rather than '**cube**'.

Answer: 686

Question 14

Part **(a)** was one of the least well answered questions on the paper. A very common incorrect answer was $p = \frac{9}{64}$ and $q = \frac{1}{2}$ which came from multiplying the base numbers and adding the indices. Part **(b)** was better answered than part **(a)** but there were a significant number of candidates who incorrectly simplified $5^{-3} + 5^{-4}$ to 5^{-7}.

Some candidates correctly rearranged to $\frac{5^{-3}+5^{-4}}{5^{-4}}$, but then incorrectly cancelled the 5^{-4} in the denominator with the 5^{-4} in the numerator.

Answers: **(a)** $p = \frac{3}{8}$ $q = \frac{1}{2}$ **(b)** $k = 6$

Question 15

This question was well answered with candidates being particularly successful in part **(b)**. Most errors in part **(b)** were caused by misreading the scales on the axes. However, this year, only a very small number of candidates attempted to use distance = speed × time resulting in an incorrect answer of 875.

Answers: **(a)** 3 **(b)** 637.5

Question 16

The majority of candidates were able to correctly plot the required points in part **(a)** and scored both marks. The small numbers of errors were usually due to misreading the scale on the vertical axis.
Part **(b)** was not so successful with incorrect answers centred on the idea of direct proportionality and there were even a few numerical answers seen. It is essential that candidates learn the correct terminology for correlation.
Part **(c)** was well answered. The candidates who joined up the points to draw the line of best fit were penalised.

Answers: **(b)** positive

Question 17

There were a number of nil responses to both parts of this question.
There were three marks available in part **(a)**, one for shear, one for *x*-axis invariant and one for (shear factor) 3. Candidates often used the word stretch instead of the word shear and the word invariant was often missing.
Candidates were usually less successful in part **(b)** than in part **(a)**. A common incorrect answer was the identity matrix.

Answers: **(a)** shear, *x*-axis invariant, shear factor 3 **(b)** $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

Question 18

The candidates who calculated the matrix **BA** usually did this successfully, though many candidates multiplied the matrices in the wrong order. A further common error occurred when finding the image of *PQRS* because matrices were used that could not be multiplied together.

Answer: trapezium at (-2, -1), (-4, -1), (-4, -2) (-3, -2)

Question 19

Algebraic errors were very common in this question.

The most common error in part **(a)** was not squaring -1 correctly.

The most common error in part **(b)** was not squaring 3*x* correctly. Some candidates obtained $gf(x) = \frac{9x^2 + 3}{3}$ but then went on to cancel the 3's incorrectly to obtain an answer of $9x^2 + 1$.
Candidates were much more successful in part **(c)**, with the majority of candidates earning at least one mark.
A small number of candidates thought that they had to invert the fraction $\frac{x+2}{3}$ to find $g^{-1}(x)$.

Answers: **(a)** 5 **(b)** $3x^2 + 1$ **(c)** $3x - 2$

Question 20

Candidates generally found part **(a)** challenging. A significant number of candidates worked out the distance between the intercepts on the *y*-axis resulting in a common incorrect answer of 20.
Part **(b)** was well answered with most candidates earning at least one of the two available marks.
In part **(c)**, the candidates who had correctly determined the answer to part **(b)** could often state that $y = -4x + c$ and were then usually successful at determining the required value of *c*. A small number of candidates incorrectly substituted (5, 4) into $y = -4x + c$ giving $5 = -4 \times 4 + c$ which resulted in $c = 21$.

Answers: **(a)** 10 **(b)** $y = -4x + 5$ **(c)** $y = -4x + 24$

MATHEMATICS

Paper 0581/23

Paper 23 (Extended)

Key Message

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

General comments

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 are showing evidence of good work in ratio, percentages, expanding brackets and calculator use. Candidates particularly struggled this year with understanding the terminology associated with matrices; working with negative fractional indices; sector area and arc length using an algebraic approach.

Not showing clear working and in some cases any working remains a problem. When there is only an incorrect answer on the answer line and no relevant working the opportunity to earn method marks is lost. More candidates gave their answers to the correct degree of accuracy than in previous years, although this was still an issue with some. Premature rounding part way through calculations caused problems when it came to final accuracy marks in **Questions 18** and **24**. It is important to work to at least 4 significant figures in interim working in order to obtain the final answer correct to 3 significant figures.

Comments on specific questions

Question 1

The majority of candidates answered this question well. Of those not obtaining full marks, in most cases this was because the candidate calculated the amount of interest then included the capital. Consequently 696 was a common incorrect answer. Another common error seen was the calculation of compound rather than simple interest.

Answer: 96

Question 2

Candidates generally performed well on this question. The most successful candidates followed carefully the instruction to write down all the steps in the working. The most common error was to omit one of the stages, for example $\frac{1}{100}+\frac{4}{25}=\frac{17}{100}$ alone is insufficient as the step to convert $\frac{4}{25}$ to $\frac{16}{100}$ has not been demonstrated. The majority of candidates worked in fractions, a few in decimals and some using a mixture of the two. Providing all stages of the working were demonstrated this was all acceptable.

Question 3

Nearly all candidates achieved full marks on this question. There were a very small number of arithmetic slips seen.

Answer: 180

Question 4

The majority of candidates answered this correctly. Where marks were lost this was generally the mark for $-y^4$ with y^3, y^5 or yyyyy occasionally seen. Some candidates were seen to write 3y as y3, however this was a lot rarer than in previous years. Where no marks were awarded this was usually due to an apparent lack of understanding of how to expand the bracket or for showing incorrect subsequent work e.g. an attempt to further simplify.

Answer: $3y - y^4$

Question 5

The correct answer was by far the most common answer. The most efficient working using 1.05 x 84 was used by most candidates with some still preferring to calculate this in stages as 0.05 x 84 + 84. The candidates using the less efficient method were usually the ones to have errors in their working. Candidates should be aware when working with dollars it is the convention to write money answers to 2 decimal places although answers to one decimal place were awarded full marks. There were a small number of attempts involving 95% or dividing by 1.05. Candidates are advised when completing their checking to re-read the question in conjunction with their final answer to make sure that it is of a sensible size. A new rent of hundreds of dollars or a rent lower than the original rent would require further investigation.

Answer: 88.20

Question 6

A high percentage of candidates answered this well with the most successful using their geometrical equipment carefully, having a sharp pencil and with clear construction lines visible. Some construction lines were very faint and difficult to see. It was apparent that some candidates attempted this question without the use of a pair of compasses. A few candidates drew 2 tangential circles, or touching arcs, rather than intersecting arcs. Consequently this made drawing an accurate bisector very difficult. Hardly any candidates attempted this question without a ruler. Occasionally candidates drew only one pair of intersecting arcs and then measured the midpoint of the line *RT* to form the other point. Candidates should note that when the question states that a straight edge is to be used, measuring with a ruler is not permissible.

Question 7

This was well answered by most candidates and usually answers were given to the appropriate level of accuracy (4 significant figures). The most common errors were for candidates to give answers to 4 decimal places, 3 significant figures or to truncate rather than round the answer. There were occasional answers of -10.34 (arising from keying $7.2 \div 11.8 - 10.95$ into the calculator and not following the laws of arithmetic) however such answers were rare. The most common incorrect answers were 8.47, 8.470, 8.4705 and 8.4706; however these answers clearly demonstrated that candidates could use their calculators correctly.

Answer: 8.471

Question 8

Many candidates scored full marks on this question. The most common errors tended to be with the upper bound where 250.49, 250.4 and 251.5 were quite often seen. Other common errors included transposing the values or treating the accuracy as though it was to the nearest 10 ml rather than the nearest 1 ml so 245 and 255 were seen fairly often. On a few occasions the answers of 0 and 250 were seen, demonstrating a lack of understanding of the concept of bounds.

Answer: 249.5, 250.5

Question 9

Many candidates scored full marks on this question. The most common errors in the first diagram were to shade the intersection of *A* and *B* or to not shade all of the region outside of sets *A* and *B*. The second diagram was the less well answered of the two with a large variety of different errors.

Question 10

This question was a good discriminator with 1 or 0 marks being more commonly scored than 2. The most successful candidates where those who worked in stages showing their knowledge of laws of indices clearly, as it was explicitly stated that this was a non-calculator question. The use of the negative power was not always understood with a minority attempting to make the fraction negative or taking the reciprocal of the power fraction instead of the base fraction. Quite a few candidates worked in decimals or cubed 49 and 16, both of these with no supporting work therefore not demonstrating they had been working without the use of a calculator. Where a correct approach was taken this generally involved reaching $(7/4)^{-3}$ or $(4/7)^3$ at some stage in the calculation. In some cases candidates seemed to have the correct ideas, but did not show clearly the calculation steps required.

Question 11

Many candidates were able to obtain at least one mark on this question. A variety of solutions to this question were seen, the most common errors being $4w^4$, $256w^{64}$, $64w^{64}$, $64w^4$ or to not complete operations for example leaving the power as 256x1/4. Candidates could have checked the validity of their answer by substituting in a value for *w*, such as $w = 0.5$ into both the question and their answer, then they could have been more sure that their solution was correct.

Answer: $4w^{64}$

Question 12

About half of the candidates scored full marks on this question. Working was rarely seen here but evidence suggests a common error was for candidates to multiply frequency by the class width instead of dividing, as common incorrect answers were 10 and 13.5. The other most common incorrect answer was 20 and 9.

Answer: 40 6

Question 13

Many candidates understood the need for a common denominator and the first method mark was the most commonly awarded. The most frequent problems arose from dealing with the numerator. Sign errors were very common and $4(x + 2) – 3(2x – 1)$ was often expanded incorrectly to $4x + 8 – 6x – 3$ leading to a common incorrect answer of $\frac{17-2x}{12}$. Dealing with the addition of the whole number was tackled with varying degrees of success. Many realised the 1 needed to become 12/12 but in a lot of cases a 1 was added to the numerator rather than 12 or the 1 was simply written at the front as if it were a mixed number. Common incorrect answers arising from these errors were $\frac{12-2x}{12}$ and $1\frac{11-2x}{12}$ respectively. Incorrect cancelling between numerator and denominator was also apparent. Some candidates appear unaware that cancelling can only take place between common factors on numerators and denominators.

Answer: $\frac{23-2x}{12}$

Question 14

This was well answered by more than half of the candidates, with the most success arising from the starting point $y=\frac{k}{\sqrt{x}}$, then going on to find the value of k. The most common errors were to use direct variation or just x or the square of x instead of the square root of x. Sometimes where candidates had correctly started with $y=\frac{k}{\sqrt{x}}$ there were a few instances of incorrect substitution (e.g. x and y transposed) or incorrect rearranging, for example k=2 was seen quite a lot.

Answer: 3

Question 15

This question proved a good discriminator with about a third of candidates scoring marks. Quite a few candidates understood that they needed to use the area scale factor of 200^2, however completing the calculation was done with varying degrees of success. The most successful realised that they needed to then divide by 100^2 to convert the answer from cm^2 to m^2 although this was often seen as dividing by 100 instead. Another common error was to multiply by 200 rather than the area scale factor. Few candidates changed the scale into metres from the beginning, so 7500 x 2^2 was rarely seen. An even smaller number of candidates used the approach of square rooting the 7500, multiplying by 200, dividing by 100 and then squaring again to obtain the correct answer.

Answer: 30 000

Question 16

Approximately two thirds of candidates answered this question well. The most successful began by either dividing through by pi first or making the term in y^2 the subject with a positive sign. The most common errors were incorrect attempts at square rooting, sign errors or incorrectly cancelling pi in the division. For example $y^2 = \dfrac{\pi x^2 - A}{\pi}$ was often followed by $y^2 = \dfrac{\cancel{\pi} x^2 - A}{\cancel{\pi}} = x^2 - A$. It was common for candidates to believe that terms could be square rooted individually, for example $\dfrac{A}{\pi} = x^2 - y^2$ was often followed by $\sqrt{\dfrac{A}{\pi}} = x - y$. If candidates had the starting point $-\pi y^2 = A - \pi x^2$ it was extremely common for them to then divide by π rather than $-\pi$ and then to think that $\sqrt{-y^2} = -y$ or y.

Answer: $\sqrt{\dfrac{\pi x^2 - A}{\pi}}$

Question 17

This question was a good discriminator with approximately a quarter of the candidates gaining marks. The most common mark awarded was the B1 mark for correctly working with the arc length to find the appropriate angle of the circle, $\dfrac{\theta}{360} = \dfrac{4r}{2 \times \pi \times 5r}$. The most successful then left this in the form $\dfrac{4r}{2 \times \pi \times 5r}$ substituting into the area formula to get $\dfrac{4r}{2 \times \pi \times 5r} \times (5r)^2 \pi$. Some candidates made this step harder for themselves by making the angle the subject then working became $\dfrac{\dfrac{4r}{2 \times \pi \times 5r} \times 360}{360} \times (5r)^2 \pi$ which was harder to simplify, or $\dfrac{45.8}{360} \times (5r)^2 \pi$ which meant an exact answer was not always given. The most common error was to use $5r^2 \pi$ rather than $(5r)^2 \pi$ in the area formula.

Answer: $10r^2$

Question 18

A large number of candidates correctly identified that they should be using the sine rule with the most successful using the version with the angles on the top alleviating many of the rearranging issues having the angles on the bottom caused. There were a significant number of cases of this being misapplied, incorrectly rearranged, instances of premature rounding or insufficient working shown. Candidates need to work to at least 4 significant figures in their working in order to obtain an answer correct to 3 significant figures. The most common score was 3 marks for getting as far as the correct acute angle, 57.8°. Many candidates either did not recognise that this angle was not obtuse or could not correctly identify what the next step was in finding the obtuse angle. Some classified the angle of 57.8° as acute then consequently crossed out all their working assuming it to be wrong.

Answer: 122.2

Question 19

Candidates answered this question reasonably well with many scoring at least 1 mark in part **(a)**. The majority of candidates knew that the gradient (rise/run) gave the acceleration. The most commonly observed incorrect answers were 5/18 and 8/5. Part **(b)** was also generally well attempted with most realising they needed to calculate the area under the graph for the total distance. Many chose to use the area of two triangles plus the area of two rectangles. The most common error was in working out the area of the small triangle, which should have been $\frac{1}{2}\times 4\times 4$. It was often wrongly evaluated as $\frac{1}{2}\times 4\times 5$. Another common error was to wrongly believe that the graph passed through (16, 1). A common incorrect answer was 58 m arising from missing the small rectangle of size 4 under the small triangle on the left.

Answers: **(a)** 0.625 **(b)** 62

Question 20

About half the candidates performed well on this question. The most successful candidates began with a vector path first. The most common errors were directional or in the ratio aspect of *CE* and *ED* therefore halves and quarters were sometimes seen instead of thirds. Candidates are advised that to be more successful, they should be very careful with noting the effect of + and – signs on directions and that a position vector should not be written as a column vector.

Answers: **(a)** $\frac{1}{3}(\mathbf{c}-\mathbf{d})$ **(b)** $\frac{1}{3}\mathbf{c}+\frac{2}{3}\mathbf{d}$

Question 21

Quite a few candidates were able to gain full marks on this question. Many appeared unaware that factorising the numerator and denominator was the appropriate starting point and a large number of candidates simply crossed out matching terms in the numerator and denominator rather than cancelling common factors. A very common incorrect starting point was $\frac{\cancel{h^2}-h-20}{\cancel{h^2}-25}=\frac{-h-20}{-25}$ then some would go on to divide the -20 and -25 by 5 or –5. The other most common errors were generally sign errors in the factorising of the numerator or denominator or following a correct answer of $\frac{h+4}{h+5}$ wrongly cancelling this to $\frac{4}{5}$.

Answer: $\frac{h+4}{h+5}$

Question 22

Part **(a)** was generally answered with much more success than part **(b)**, with most candidates gaining at least 1 mark for either the determinant correctly used or the adjugate of **M** correctly found. For those who had some idea where to start, the most common cause of lost marks were due to arithmetic slips in calculating the determinant or errors in writing the adjoint matrix. In part **(b)(i)** the correct answer of **D** was sometimes seen. 2 x 2 was a common incorrect answer as was **DI**. Part **(b)(ii)** proved to be the most challenging question on this paper with few candidates writing the correct answer $\mathbf{D}^{-1}\mathbf{E}$, with $\frac{\mathbf{E}}{\mathbf{D}}$ being the most common incorrect answer. Candidates are advised that matrix multiplication is not commutative so $\mathbf{E}\mathbf{D}^{-1}$ is not correct; this was sometimes seen.

Answers: **(a)** $\frac{1}{5}\begin{pmatrix}1 & -2\\ 1 & 3\end{pmatrix}$ **(b) (i)** **D** **(ii)** $\mathbf{D}^{-1}\mathbf{E}$

Question 23

Many candidates answered all three parts to this question clearly and correctly. In part **(a)** the most common incorrect answer was 121 arising from g(3) x g(3) rather than gg(3). Occasionally candidates lost one of the two '-1' parts of the calculation; consequently 4[4(3)] – 1 or 4[4(3) –1] were calculated in error.
In part **(b)** a common error was to find f(x) x g(x) so (3x+5)(4x –1) was sometimes seen. Other errors seen were to calculate gf(x). For those with the correct starting point of 3(4x – 1) + 5 the most common errors were in expanding the brackets or in simplifying the expression. It was common to see brackets expanded to 12x – 1 + 5 or the correct 12x – 3 + 5 was often followed by 12x – 2.
In part **(c)**, rather than use the easier method of evaluating f(11) the majority of candidates took the longer approach of finding the inverse function $f^{-1}(x)$ and then equating this to 11, then solving to find 38. The most common incorrect answer was 2 arising from candidates solving f(x) = 11 rather than $f^{-1}(x) = 11$.

Answers: **(a)** 43 **(b)** 12x + 2 **(c)** 38

Question 24

Candidates generally answered both parts of this question well with the most successful candidates attempting three dimensional Pythagoras' theorem in one stage. Of those using Pythagoras' theorem in two stages i.e. calculating the length of *AP* or *DB* first, then those finding *DP* tended to make more errors, often in premature rounding or missing squared signs. In part **(b)** slightly more candidates were successful than not; just under half of the candidates struggled to identify the correct angle. The most common error was to work out angle *PAB* or *PDA* instead of *PDB*. The most successful candidates used their answer to part **(a)** and the sine ratio. Many candidates made working harder than it needed to be by using the sine rule or cosine rule. Tan and cos ratios were also occasionally seen, particularly if candidates had used Pythagoras' theorem in two stages in part **(a)**.

Answers: **(a)** 12.7 **(b)** 28.2

MATHEMATICS

Paper 0580/31
Paper 31 (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 candidates to answer questions from the required perspective.

General Comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of Mathematics. Most candidates completed the paper, making an attempt at all questions. The standard of presentation was generally good. Centres should continue to encourage candidates to show formulae used, substitutions made and calculations performed. Attention should be made to the degree of accuracy required, particularly in those questions involving money, and candidates should be encouraged to avoid premature approximation 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. The use of the correct equipment should be emphasised.

Comments on Specific Questions

Question 1

Throughout this question on number properties candidates needed to understand mathematical definitions and terms, e.g. factor, multiple, even, prime. Some of these definitions were confused by candidates.

(a) (i) Candidates often gave factors of 10 instead of multiples i.e. common answers were 2 and 5.

(ii) Similarly here the answer of 5 was given being a common factor instead of a common multiple. Some candidates earned 1 for identifying 150 as an example of 30*k*.

(b) (i) Candidates found selecting numbers from a list easier. There again was confusion between factors and multiples, with a common incorrect answer of 36 being given as a factor.

(ii) "Cube number" was better understood. 9 was a common error.

(iii) "Prime" was reasonably understood. A common error was 27.

(c) (i) Many candidates showed that some square numbers are even, rather than demonstrating that some are odd. Some started with a square number e.g. 169 and explained that the square root was odd. Others did not evaluate the square to demonstrate that it was odd e.g. they left the answer as 5^2 not 25.

(ii) This proved challenging. Many candidates used "1" as a prime number so used the example "1 + 2 = 3". A proportion took two odd prime numbers and added them together to give an even number. Other candidates did not complete the sum to give an odd answer e.g. "2 + 3" left without the answer "5".

(d) Generally well done. Many candidates earned at least 1 mark by having only one term out of place. The term which caused the most confusion was 4^{-2}.

Answers: **(a)(i)** e.g. 10 and 20 **(a)(ii)** 30 **(b)(i)** 6 or 9 **(b)(ii)** 27 **(b)(iii)** 23 **(c)(i)** example of odd square number **(c)(ii)** example of odd sum of primes **(d)** 4^{-2}, 8^0, $\sqrt{169}$, 2^5.

Question 2

Throughout this question on money careful reading and interpretation of which particular figures were asked for was required. Many candidates were able to do the maths but did not understand which figure was the final answer.

(a) (i) Very well answered. Candidates generally understood the context and requirements of the question.

(ii) This fractions question was generally well done. Candidates often earned one mark for 175/475, even if they then made mistakes in simplifying the fraction. A few candidates gave the answer as a decimal.

(iii) Some candidates found 7/20 of the rent, or of (475-175). Many scored a method mark for finding 7/20 of \$475 as \$166.25 but then took that away from \$475 to leave \$341.25, i.e. did not take \$175 rent away, or added it onto \$175 to give the total expenditure instead of the amount left.

(b) This question on percentages was generally well done. Common errors were to correctly find 6% as 28.5, but then not to add it to the original \$475 to find the new total wage. Some candidates rounded the answer to \$504, losing an accuracy mark.

(c) This compound interest question proved challenging, with many candidates finding simple interest (28) or finding the total amount that would be left in the account, i.e. omitting to subtract the original amount invested to leave the interest earned. Some correctly calculated the interest for both years i.e. 14 and 14.56 but did not add them together.

Answers: **(a)(i)** 12.5(0) **(a)(ii)** 7/19 **(a)(iii)** 133.75 **(b)** 503.5 (0) **(c)** 28.56

Question 3

This data handling question required knowledge of statistical terms and accuracy in drawing a bar chart. Candidates did not confuse the terms but were confused how to calculate the answers. The probabilities in part **(b)** were generally well done. Most candidates earned some marks.

(a) (i) This question asking for the mode was generally well done. Common errors were 6 or 5, or "1 and 2", being the most common frequencies.

(ii) The median proved challenging. 2.5, from the middle of the hours, and 2, from the middle of the frequencies as set out in the table, were often seen.

(iii) The mean also provided challenge. 15/6 = 2.5 and 24/6 = 4 were common errors. Part marks were earned for summing frequency × hours. "6 × 0 = 6" was seen quite often.

(iv) This bar chart question was generally well done. Candidates were required to draw a bar chart, which many did, with heights and widths correct, Some attempted a histogram and some a line graph but generally the requirements were understood. Incorrect labelling of the horizontal axis as a scale instead of labels in the middle of the bars was where many candidates did not earn full marks. Some candidates omitted the first bar representing "0" and marks were lost by the vertical scale not starting at the bottom with 0, i.e. it was transposed up/down one square.

(b) (i) This probability question was generally well done, requiring a straight forward reading of the table.

(ii) Generally well done. The question required a subtraction from 1 to obtain the probability.

(iii) Generally well done. Candidates who did not give the correct answer often identified the correct probabilities but either did not sum them, or multiplied them together.

Most candidates gave the probabilities in part **(b)** as fractions. Those who gave the answers as decimals sometimes gave truncated answers i.e. not 3 significant figures, and therefore did not score. Very rarely was the incorrect format of ratios seen. Centres should emphasise to candidates that this is not acceptable.

Answers: **(a)(i)** 0 **(a)(ii)** 1 **(a)(iii)** 1.6 **(b)(i)** 5/15 **(b)(ii)** 11/15 **(b)(iii)** 6/15

Question 4

The question tested geometrical properties, requiring candidates to apply known facts, and to use mathematical terms. This needs to be precise. Candidates should be clear on definitions.

(a) (i) Very well done. Most candidates correctly identified the angle. A common error was 40.

(ii) Generally well done with many candidates correctly identifying the triangle as isosceles; although spellings were many and varied. Common errors included scalene and equilateral,

(iii) Many candidates could identify the angle as 40^{o} but did not provide an adequate explanation; many referred to parallel lines, similar triangles or alternate angles, instead of corresponding or "F" angles.

(iv) This proved challenging and was another example of the use of mathematical language. Common errors included congruent, equal, the same, isosceles, parallel or equivalent.

(b) (i) Candidates found this difficult and did not seem to understand the term "reflex". Common errors were 55°, 180-55 = 125 or 235.

(ii) Candidates rarely mentioned the two terms required to earn the mark – "radius/diameter" and "tangent". Many state that it was "a right angle", "perpendicular", "tangent meets a circle at 90^{o}", or the "angle from the centre to the circumference"; so the correct sort of language was used, but not a full reason. The term "radius" was rarely seen.

(iii) Most candidates attempted this but often gave 110 (from 2 x 55).

(iv) Attempted by most. Common incorrect terms were rhombus, trapezium, quadrilateral.

Answers: **(a)(i)** 70^{o} **(a)(ii)** isosceles **(a)(iii)** 40^{o}, corresponding angle **(iv)** similar **(b)(i)** 305^{o} **(b)(ii)** Tangent, radius **(b)(iii)** 125^{o} **(b)(iv)** kite

Question 5

The question considered length, perimeter and area as well as requiring a scale drawing of a given shape. Centres should ensure candidates have access to suitable mathematical equipment.

(a) Candidates were required to use Pythagoras's Theorem to show the required length. Some thought that "show" meant writing 19.2 on the diagram. Many earned a mark for $15^2 + 12^2$ and could show the next stage as $\sqrt{369}$, but did not earn the second mark for showing 19.20 or 19.21, thereby demonstrating that 19.2 was correct to 1 decimal place.

(b) Generally well done. The method was to find the perimeter as 86.2 and multiplying by $35 to find the cost. Some candidates used incorrect figures for the perimeter e.g. 19 instead of the given 19.2, or omitted the 19.

(c) This question was attempted by most candidates, showing that the concept of area was understood. Common errors included 480 (i.e. finding 15 x 32 and omitting to subtract the triangle)

(d) Many candidates could follow through their answer from **(c)** to earn the marks. Common errors included finding 3/10, 3/7.

(e) (i) Many candidates attempted the scale drawing and scored at least one mark. The shape was given earlier in the question, however some candidates produced triangles or rectangles with side 4. Some marks were lost when errors were made in calculating the lengths by dividing the given lengths by 4.

(ii) Measuring the correct angle was quite well done. Some candidates used trigonometry to calculate it. Common errors were to measure the angle at C or to give 90°.

(iii) Most candidates could measure the line accurately, but many did not multiply the measurement by 4.

Answers: **(b)** 3017 **(c)** 390 **(d)** 273 **(e)(ii)** 49 – 53° **(e)(iii)** 34.4 – 36.4

Question 6

This algebra question tested candidates' ability to spot patterns and write expressions. It proved challenging for some who did not understand the need for an algebraic answer rather than a numerical one.

(a) The table was generally completed correctly. A common error was to replace 25 with 24 in the top line.

(b) This proved challenging with the most popular answers being either "even" or "odd" and sometimes "prime".

(c) (i) This was generally well answered. However, a large number of candidates gave the number of black counters instead of the number of white counters. Common errors were 64 or 36 (continuing to the next term in the table).

(ii) Candidates found this difficult. Of those who did attempt it, many gave a numerical answer, not understanding the need for an expression in *n*. Some candidates left correct answers unsimplified but still gained the full marks. The 1 mark for "3*n*" was more common than the "-2", however the most common answer given was n+3.

(d) (i) This was very well answered and most candidates were able to answer "20" despite not giving a correct expression in the previous part. Most candidates returned to the original question and continued the pattern rather than using an algebraic approach. The link between part **(c)** and this part did not seem to be recognised.

(ii) This proved challenging to many and candidates did not seem to link to part **(b)** where they had recognised that the pattern for black counters was square numbers. The follow through was often applied. A large number of candidates omitted this question. The answer of p^2 was seen, but rarely.

Answers: **(a)** 9,16,25 and 7,10,13 **(b)** square **(c)(i)** 22 **(c)(ii)** 3*n* -2 **(d)(i)** 20 **(d)(ii)** 400

Question 7

This algebraic question involved substitution, rearranging equations and simultaneous equations. The manipulation of equations was challenging.

(a) (i) This question was very well answered, with most candidates gaining both marks. Those candidates who did not answer correctly did not earn any marks if they did not show working. Some working showed 8 + 5 × 12. The most common mistake was to write 80 + 5 × 12 without brackets and then continue with 85 × 12.

(ii) This question was less well answered. Many candidates believed they needed to use their previous answer of 140 to answer this part. There were very few occasions of candidates gaining the method mark for showing a full method or giving 150

(iii) Candidates did not find rearranging a formula easy, however it was attempted by most. Most commonly candidates tried to do both operations in one step, rather than showing one step at a time, which could earn method marks. Candidates who attempted the question and scored no marks were generally unable to complete the first step and most commonly wrote $5n = 80 - C$. Nearly all candidates understood the need to divide by 5, however most were unable to do it as the second step, following a correct first step. Other common errors were forgetting the negative sign when moving the $5n$ and attempts at simplifying by dividing 80 by 5 but then forgetting to divide the C also, i.e. $n = \mathrm{C} - 16$.

(b) Candidates rarely scored full marks. The most common area of challenge was that candidates did not understand how to deal with the -3 outside of the second bracket. However, nearly all candidates were able to gain 1 mark for correctly multiplying out the first bracket evidenced by $6x + 8$ or getting to a $9x$ or +2 in their answer.

(c) This question was generally attempted by the majority of candidates, who showed all working. The most popular method was the elimination of x or y, which was done correctly and 3 marks were earned. A common mistake in this method was not to multiply the constant term in one of the equations, although these candidates still gained 1 mark. The method which caused most confusion was the substitution method, which highlighted candidates' weakness at rearranging equations. Candidates could state y in terms of x and substitute it into the other equation, but then struggled to manipulate the resulting equation.

Answers: **(a)(i)** 140 **(a)(ii)** 30 **(b)** $9x + 2$ **(c)** $x = 3$, $y = 4$

Question 8

This question considered volumes and rates of flow. Candidates found working with time an area of difficulty, and this could be an area for future improvement.

(a) (i) Well answered with most candidates scoring full marks or a method mark for showing their sum or figures 165. The most common mistake was to add the values instead of multiplying.

(ii) Again, well answered with candidates understanding they had to do "something" with their previous answer. Common errors were to divide by 100 or 10000 instead of 1000 or multiplying by 1000.

(b) (i) This question was very challenging for most candidates. Candidates showed an understanding of time equalling volume/rate and most were able to divide and get 1 mark for 10.4. However, many could not convert this to minutes and seconds correctly. The most common mistake was to give this as 10 minutes and 4 or 40 seconds. Those that did understand that there were 60 seconds in a minute usually changed the whole time to seconds and gave an answer of 624 seconds. A large number of candidates did not show any working and simply gave the answer of 10 min 4 sec or 10 min 40 seconds. This did not earn the method mark and highlights the need for candidates to show their working for all questions.

(ii) A large proportion of the candidates left this question out or gave answers of 250, 259 or 259.5. The question was to the nearest 10 litres and this seemed to cause confusion.

(c) This proved difficult for many candidates. Those candidates who gave a correct answer often did not show any working, and those with an incorrect answer did not show the cube root so the method mark was rarely earned. The most common mistakes were to divide by 3, or 9 or 9000, or to work out the square root.

Answers: **(a)(i)** 165 000 **(a)(ii)** 165 **(b)(i)** 10 mins 24 sec **(b)(ii)** 255 **(c)** 30

Question 9

This graph question was well attempted by most candidates, with parts **(c)** and **(d)** providing the most challenge to candidates.

(a) The table was generally well done. Some candidates made mistakes in substituting negative values and most commonly gave 6 and 6 as the two negative answers. These candidates did not seem to recognise the symmetry of the values in the table.

(b) The graph was well drawn. The values to be plotted were whole numbers so candidates could plot their values from the table accurately. The drawing of a smooth curve was found difficult by some, and those who used a sharp pencil earned the mark more easily. There were few very thick lines or feathering seen, and few candidates chose to join the points with a ruler. The most common problem was wobbly lines, flat tops or curves which did not go above the line y=10.

(c) This question challenged all candidates. Very few lines of symmetry were seen on the graph with common mistakes being writing the number 1.5 only or $y = 1.5$. $x = 1.4$ or 1.6 were also seen.

(d) (i) Candidates who attempted the question were able to draw a continuous line at $y = 6$. A significant number drew $x = 6$, or a slanted line going through (0, 6) instead. Horizontal lines in the wrong position were very rare and there were few dotted or dashed lines.

(ii) Candidates found reading values from their graph challenging. Many candidates chose the points of intersection with the x axis, and missing out a negative sign was very common. Those candidates who had struggled to draw a graph or $y = 6$ generally left this question out or attempted a complicated algebraic answer which generally did not produce an acceptable answer. Some candidates misread the scale and thought each small square was worth 0.1 instead of 0.2.

Answers: **(a)** -2, 4, 8, 4, -2 **(c)** $x = 1.5$ **(d)(ii)** $x = 3.5$ to 3.7 and $x = -0.7$ to -0.5

Question 10

This question required candidates to describe and carry out transformations. To improve, candidates should be encouraged to understand the number of elements required to describe a transformation fully.

(a) (i) Most candidates recognised that the transformation was a rotation, however they did not give all 3 elements required to fully describe it. 90 degrees was identified by virtually all candidates but the omission of anti clockwise was very common. Candidates did not seem aware that a centre of rotation was also required, but those that did correctly identified the origin. Some candidates did not earn marks as they gave more than one transformation.

(ii) Enlargement was often identified correctly by most candidates, however the required elements were not all given. The number 2 was often seen, although not with the words 'scale factor'. The centre of enlargement was the element often not given. It was identified well by those who drew lines on the diagram. It was often given as a vector instead of a coordinate. Many candidates gave the origin as the centre of enlargement.

(b) (i) The translation was fairly well done. A number of candidates translated the shape 3 left and 4 up. Some candidates correctly translated 3 right and then a variable number vertically which earned 1 mark.

(ii) Candidates were able to reflect the shape in a horizontal line, however this was not necessarily the correct line. A large number of candidates reflected the given shape or their answer to the previous part in a vertical line also.

Answers: **(a)(i)** rotation, 90° anticlockwise, (0,0) **(a)(ii)** enlargement, (scale factor) 2, (-1,1)

MATHEMATICS

Paper 0580/32
Paper 32 (Core)

Key Messages

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

General Comments

This paper gave all candidates an opportunity to demonstrate their knowledge and application of Mathematics. Most candidates completed the paper, making an attempt at all questions. However it was noted that a significant number of candidates omitted parts of some questions. The standard of presentation and amount of working shown was generally good. Centres should continue to encourage candidates to show the 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.

Comments on Specific Questions

Question 1

Throughout this question candidates needed to understand mathematical definitions and uses of ratio, fractions and percentages. Careful reading of the question was required as a significant number of candidates used the wrong values in their calculations. The answering of "show that" questions showed some improvement although a number still use the given value in a reverse argument.

(a) (i) This part on ratio was generally well answered. A common error was finding $\frac{5}{18}$ x 26250.

(ii) A good response to this part was seen by the majority of candidates.

(b) (i) This part proved to be a discriminating question requiring candidates to find the area of a trapezium. Those candidates who used the relevant formula were generally successful. Those candidates who split the given shape into a rectangle and a triangle were less successful with a number omitting the ½ or incorrectly calculating the required base for the triangular part. Other common errors included 45 x 76 x 100 and 45 + 76 + 100.

(ii) Although the area of the park was given as 26250 in part **(a)(i)** a significant number of candidates incorrectly used the total area of the city (94500) as the denominator of the fraction. A common error was $\frac{26250}{3960}$.

(c) Many candidates created a fraction and multiplied by 100 to get the percentage but a large number did not use the correct values in the fraction, particularly the denominator. Common errors included the fractions $\frac{36750}{30625}$, $\frac{30625}{94500}$, $\frac{30625}{100}$ and $\frac{30625}{26250}$.

(d) (i) This part on equivalent fractions was well answered.

(ii) A significant number of candidates did not realise the demands of this "show that" question. The expected method was to use part **(d)(i)** and to show that $1 - \frac{10}{24} - \frac{9}{24}$ equals $\frac{5}{24}$.

(iii) This part was generally well answered with the majority of candidates recognising that $\frac{3}{8} \times 120$ was the required method. However a number of unrealistic answers were seen where 94500, 26250 or 30625 were the values used.

Answers: **(a)(ii)** 36750 **(b)(i)** 3960 **(b)(ii)** $\frac{3960}{26250}$ **(c)** 83.3 **(d)(i)** 10, 9 **(d)(iii)** 45

Question 2

This question on the drawing and use of graphs was generally well answered.

(a) (i) The table was generally answered well with the majority of candidates giving the 3 correct values.

(ii) The graph was generally plotted well although the point (−6, −4.7) seemed to cause the most problems in plotting accurately. The majority of candidates were able to draw a correct smooth curve with very few making the error of joining points with straight lines and most candidates appreciating that the curve was discontinuous.

(iii) Writing down the order of rotational symmetry was less successful with common errors of 1, 180, 8 or no response given.

(iv) Those candidates who appreciated that the intersections of their graph and the x-axis gave the required solutions were largely successful. However a significant number did not know how to use their graph with common errors being +8, −8, +2, −2 or no response given.

(b) (i) The knowledge that $y = mx + c$ compared with $y = \frac{1}{2}x + 1$ gave the answer for the gradient as $\frac{1}{2}$ was not widespread with common errors being 1, $\frac{1}{2}$x, x = $\frac{1}{2}$ or no response.

(ii) Again, the completion of the table was well answered.

(iii) The line was generally plotted well although a small number lost the mark by not using a ruler and thus not drawing an accurate straight line.

(c) The majority of candidates were able to give the correct co-ordinates for the intersections with a follow through being applied when possible. A common error was to omit the negative sign for the *y* co-ordinate giving 0.6 not −0.6.

Answers: **(a)(i)** 2, −7, 2 **(a)(iii)** 2 **(a)(iv)** 2.7 to 3, −3 to −2.7 **(b)(i)** $\frac{1}{2}$ **(b)(ii)** −1, 1, 5
(c) (5.1,3.6), (−3.1,−0.6)

Question 3

This question on transformations was generally not answered well with a small number of candidates appearing to find the use of a square grid more difficult.

(a) (i) The majority of candidates were able to identify the transformation as a translation although common errors included reflection, rotation and transformation with a few attempting to describe in words. The correct column vector was less successfully stated with common errors being sign errors or inverted vectors.

(b) (i) The reflection was generally drawn correctly although a significant number lost the accuracy by plotting one of the points incorrectly.

(ii) The rotation was drawn less successfully with a number of diagrams not retaining the size of the given triangle *ABC*. A number of inaccurate diagrams suggests that some candidates did not know a suitable method to draw rotations.

(c) The enlargement proved challenging for many candidates with a significant number unable to attempt this part. Many attempted to use lines of enlargement and did not appreciate that the required triangle could be drawn from the point *P* by doubling the original sides.

Answers: **(a)** Translation $\begin{pmatrix} -6 \\ -5 \end{pmatrix}$

Question 4

This question tested geometrical properties requiring mathematical names of shapes, lines of symmetry and similarity.

(a) A full variety of names were seen with Kite being the most common correct answer followed by Trapezium, Parallelogram and then Rhombus. The number of lines of symmetry correctly identified followed the same pattern with the common error of 2 for the parallelogram and 1 for the trapezium. Few candidates appeared to draw the lines on the given diagrams which may well have helped identify the correct number.

(b) (i) Many candidates did not appreciate that all they had to do was identify *Q* as the corresponding angle.

(ii) Many candidates did not appreciate that as the two triangles were stated as similar this meant that proportionality could be used to calculate the length of *PQ*. A significant number attempted to use Pythagoras' theorem or trigonometry.

Answers: Parallelogram 0, Kite 1, Rhombus 2, Trapezium 0 **(b)(i)** *Q* **(b)(ii)** 15

Question 5

This question considered the drawing and use of both pie charts and bar charts.

(a) (i) Those candidates who appreciated that the angle for red cars had to be measured usually did so correctly. It proved challenging for many to "show that" the total number of cars was 270 by stating that $\frac{60}{80}$ x 360 (=270).

(ii) This part was generally answered better although a number left their answers as decimals. Other common errors included stating both as 105, and incorrectly using $\frac{65}{270}$ for Blue and $\frac{77}{270}$ for Green. The majority who measured the angles of the two relevant sectors correctly as 65 and 77 were awarded one of the method marks available.

(b) (i) This part was generally well answered although common errors of 39, 29.25 and 140 were seen.

(ii) The pie chart was generally completed correctly or on a follow through basis. A small number only labelled one sector or omitted labels entirely.

(c) (i) The bar chart was generally answered well with the majority of candidates able to draw good quality bar charts with a sensible scale. Common errors included the use of a non-uniform scale, the frequency axis not labelled, and the reluctance to use half squares when needed.

(ii) Only the more able candidates appreciated that the required method was $\frac{40}{100}$ x 900 or just simply 9 x 40. Common errors included 22.5, 400 and 860 with a significant number unable to attempt this part.

Answers: **(a)(ii)** (Blue) 47, 48 or 49, (Green) 56, 57 or 58 **(b)(i)** 52 **(c)(ii)** 360

Question 6

This question on drawing and using a distance-time graph proved demanding for many candidates. Careful reading of the question and an appreciation of the relative positions of Blenheim, Picton and Wellington as outlined in the question was required. Follow through marks were available.

(a) (i) The majority of candidates were able to read off the value required from the graph. A small number gave the answer as a time interval of 7 hours 10 minutes rather than the time of 07 10. Common errors included 07 15, 07 20, 08 10, 08 20 and 16 50.

(ii) The majority of candidates were able to calculate the required time interval. Common errors included 8 h 20 min by just reading off the time of the ferry, 1 hr 50 min from 08 20 – 06 30, and 1 h 20 min.

(b) Few candidates had the correct answer on this part of the question with the most common error being a line to (11 40, 92) having measured the distance of 92 km from Home not a sailing distance from Wellington. The time scale was more often correct than distance plotted correctly.

(c) Many candidates were able to score one of the available marks by correctly indicating on the graph the length of time Johno was waiting to get off the ferry, but few appreciated that they had to calculate the distance travelled once he had left the ferry.

(d) This part was not answered well with many candidates unable to find the correct distance and/or time to use in the required calculation. Common errors included incorrect distances of 92, 192, 304 and incorrect times of 6.5, 12.5, 6.30, 12.30 and 6 h 30 min.

(e) (i) This part was not answered well with a significant number of candidates not appreciating that this second ferry left from Picton not Johno's home.

(ii) The graphs drawn made it difficult for a number of candidates to answer this part as their ferries did not pass each other. Those who had a feasible graph were often successful although a very common error was in not appreciating that the required distance was from Wellington and thus did not subtract 50 from their reading off the graph.

Answers: **(a)(i)** 07 10 **(a)(ii)** 1 (h) 10 (min) **(d)** 27 **(e)(ii)** 70 to 72

Question 7

This standard question on constructions proved challenging for a number of candidates with a significant number unable to attempt the question. Candidates should be reminded to leave all construction arcs on their diagram. Those candidates who drew good constructions often managed to score all of the first 6 marks, demonstrating a good knowledge of straight edge and compass techniques.

(a) Significant numbers of candidates scored full marks here, but a number lost the accuracy mark by drawing their arc at an incorrect distance from the point *T*. Other common errors included incomplete arcs, straight lines and bisecting the angle *T*.

(b) (i) The construction of the bisector of angle *RQT* was generally answered well although a number lost the accuracy mark or omitted the required arcs. Other common errors included bisecting one of the other angles, drawing an arc from point *Q*, or drawing a series of parallel lines.

(ii) The construction of the bisector of line *QR* was generally answered well although again a number lost the accuracy mark or omitted the required arcs. Other common errors included bisecting one of the other lines, drawing an arc from points *Q* and *R*, or drawing a series of parallel lines.

(c) (i) This part involving the labelling of the correct region was not answered as well suggesting that candidates did not understand the meaning of the two loci drawn. A significant number labelled the top vertex of the triangle formed, and others used their arcs as boundary lines as well.

(ii) A significant number of candidates were unable to answer this part as they did not have a simple area to calculate due to previous errors. Those who did have a triangle often did not appreciate that they had to measure the base and height, apply the scale and then use the correct formula.

Answers: **(c)(ii)** 1200 to 1700

Question 8

This question on sequences was generally answered well although candidates continue to find expressing the *n*th term in an algebraic form challenging.

(a) (i) The majority of candidates were able to complete the diagram correctly. Common errors were the inclusion of the extra line at the top of the diagram and omitting the horizontal lines above the V shapes throughout the diagram.

(ii) The majority of candidates were able to complete the table correctly. Common errors included stating 29 rather than 27, and using a gap of 7 rather than 5.

(b) (i) Stating the *n*th term proved more difficult with common errors of $n + 5$, $n + 7$, $n + 2$, $5n$, $7n$, and simply giving a numerical value.

(ii) This part was generally answered well with candidates either using their previous expression or using repeated addition.

(c) (i) Although the correct answer was often seen, many other values were given, the most common errors being 6 and 9.

(ii) This part was less well answered with few algebraic answers seen. Common errors included $n + 4$ and $4n$, although in most cases a number was given, the most common being 4, 8 and 12.

(d) Correct algebraic expressions were rarely seen in this part with many candidates giving a numerical answer. Common errors included $n + 2$, $n + 4$, 0, 6 and 8. The possible methods of either using $(5n + 2) – (4n − 4)$ to get $n + 6$, or generating the sequence 7, 8, 9 to obtain $n + 6$ were rarely seen.

Answers: **(a)(ii)** 17, 22, 27 **(b)(i)** $5n + 2$ **(b)(ii)** 147 **(c)(i)** 8 **(c)(ii)** $4n − 4$ **(d)** $n + 6$

Question 9

This question on algebra proved challenging for a number of candidates. The writing of algebraic expressions from the given statements proved difficult for many with a significant number unable to attempt this last question at all.

(a) (i) This part was generally answered well although careful reading and understanding of the given statement was needed to avoid the common errors of $d + 160 = 430$, $5d + 160 = 430$ and $7d + 160 = 430$.

(ii) This part was generally answered well by those who had an algebraic expression in part **(i)** with a follow through allowed.

(iii) This part on finding a percentage increase was answered less well than in previous years. Common errors included 24, 160 – 24 = 136, 160 + 15 = 175, and 160 + 115 = 275.

(b) (i) The equation required in this part proved difficult for weaker candidates with common errors including $3p + 2c$, $5pc$, $p + c$, $5pc = 92$, and $p + c = 92$. A significant number of candidates attempted to use numerical values for p and c.

(ii) The equation required in this part also proved difficult for weaker candidates with common errors including $2p + 5c$, $7pc$, $p + c$, $7pc = 153$ and $p + c = 153$. A significant number of candidates attempted to use numerical values for p and c.

(iii) Those candidates who did have two correct equations were often able to find the two correct solutions. The most successful method was the elimination method although the accuracy marks were often lost through numerical errors. Those candidates who used the substitution method were often able to substitute a correctly rearranged expression but the fractions then caused considerable difficulty in trying to solve the resultant equation.

Answers: **(a)(i)** $6d + 160 = 430$ **(a)(ii)** 45 **(a)(iii)** 184 **(b)(i)** $3p + 2c = 92$ **(b)(ii)** $2p + 5c = 153$ **(b)(iii)** $p = 14$, $c = 25$

MATHEMATICS

Paper 0580/33
Paper 33 (Core)

Key Messages

To succeed in this paper candidates need to have completed full syllabus coverage, remember necessary formulae, show all necessary 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 the candidates were able to use the allocated time to good effect and complete the paper. It was noted that the majority of candidates answered all of the questions with some omitting parts of a question on a particular topic. The standard of presentation and amount of working shown was generally good. In the drawing of curves there were few instances of joining points with straight lines evident. There were still a few instances of candidates rubbing out construction lines and/or working in questions, losing marks for themselves. Centres should continue to encourage candidates to show clear working in the answer space provided; the formulae used, substitutions and calculations performed are of particular value if an incorrect answer is given.

Comments on specific questions

Question 1

All candidates attempted this question with many scoring well.

(a) This part was generally well answered. Some candidates appeared to assume that there were 100 minutes in an hour.

(b) Again this part was well answered and many candidates were able to give the correct answer. However, answers of 30000 and 25900 were seen.

(c) Many candidates understood the need to divide 5 litres by 250 millilitres.

(d) (i) Many candidates drew good bar charts. Occasionally the scale was not linear or did not start at zero.

(ii) Although some candidates gave the correct answer for the mode many gave an answer of 11 or 2.

(iii) This part was the least answered part of the question. The common incorrect answers seen were $\frac{29}{7}$ or $\frac{57}{7}$.

Answers: **(a)** 2 hours 45 minutes **(b)** 26000 **(c)** 20 **(d)(ii)** 1 **(iii)** 1.97

Question 2

Overall candidates showed a good understanding of travel graphs.

(a) (i) The majority of candidates understood what was happening but some could not express it in words. Some mentioned stopping but also conjectured why. The most common incorrect answer was to say that Helva was travelling with constant speed.

(ii) Candidates understood how to read the graph to obtain the travel time but some made errors in reading the scale correctly.

(iii) A small majority of candidates gave the correct answer. The most common error was to convert the time into minutes rather than into hours (in decimal form). Some candidates wrote 5 hours 30 minutes as 5.3 hours.

(iv) Many candidates understood that the fastest travel time equated to the steepest part of the curve.

(v) Most candidates drew a straight line to show the husband's journey but some mirrored Helva's journey.

(b) (i) Candidates found this part challenging. Many candidates used times beyond 24 00 such as 27 55.

(ii) The majority of candidates correctly understood how to find the difference between two temperatures when one is positive and the other negative.

(c) Although the overwhelming majority of candidates understood how to convert one currency to another many lost marks because of accuracy and not reading the question carefully, which required a 2 decimal answer.

Answers: **(a)(i)** stopped **(ii)** 5 hours 30 minutes **(iii)** 32.7 **(iv)** 10(00), 12(00)
(b)(i) 0355 **(ii)** 26 **(c)** 135.43

Question 3

There was an improvement seen in the compound interest question with fewer attempts at calculating simple interest.

(a) Most candidates gave a correct answer.

(b) Most candidates gave good answers, clearly showing how to divide an amount in a ratio.

(c) Many excellent answers were seen for compound interest. Some candidates used simple interest or just gave the amount of interest.

(d) (i) Many candidates gained full marks. Some only calculated the angle as they realised there are 360^0 in a circle whilst others realised that the two amounts had to add to 3150.

(ii) The pie chart was generally very accurate. The majority of candidates used a ruler but some attempted to draw the segments freehand.

Answers: **(a)** 240000 **(b)** 1200, 450, 750 **(c)** 224973 **(d)(i)** 2250, 900, 36

Question 4

Many candidates demonstrated a good understanding of solving equations in one variable. A small majority of candidates could completely solve a pair of simultaneous equations although in many cases it was poor arithmetic which lost the marks.

(a) (i) This part was generally well answered. The main error was not changing the sign associated with a term when moved to the other side of the equation. This was seen most in the x term rather than the constant term.

(ii) This part was completed correctly by even more candidates. The main error usually followed a correct expansion of brackets to subtract 12 rather than add 12. Few candidates used the alternative method of dividing by 4 rather than expanding the bracket.

(b) This part was less well answered. Some candidates do not have a full understanding of the process for solving simultaneous equations. There was evidence of many methods which were mathematically incorrect. This included removing one unknown from an equation and solving the resulting equation and using this result in the other equation for the second unknown.

Answers: **(a)(i)** 2.5 **(ii)** 4.5 **(b)** x= 3, y=−4

Question 5

Candidates in general showed a good understanding of transformations but were less able to correctly state the name of a shape or describe a single transformation. However, it was evident that the vast majority of candidates know that a single transformation cannot have two describing words.

(a) Only a minority of candidates correctly answered this part. The common incorrect answers were rectangle and trapezium.

(b) Similarly, few candidates scored full marks. However, many did correctly state ‘rotation’ but did not qualify 90^0 as being in the clockwise direction.

(c) (i) Drawing the reflection was the best answered part of this question.

(ii) Many candidates understood how to translate but didn’t do so accurately, with errors in either the *x* or *y* direction.

(iii) A large minority of candidates drew the correct enlargement. Many other candidates drew a correct enlargement but in the wrong place. This was closely followed by a group of candidates who drew shapes with correct bases but sides which had the wrong slope.

Answers: **(a)** parallelogram **(b)** Rotation, 90^0 clockwise, origin

Question 6

Many candidates found parts of this question challenging. Although the vast majority of candidates could evaluate specific terms, many could not translate this into general equations for the n^{th} term etc.

(a) (i) This part was very well answered. A common error was 23, 27, that is going “up” from the first term.

(ii) Although the majority of candidates understood how to find the next term, many could not express this correctly, writing an equation instead of an expression.

(iii) As already mentioned many candidates found this part challenging. The common error was to write $n - 4$.

(b) A large majority of candidates gave the correct answer. Some candidates gave an answer of 6, 8, 10 using $n = 0$ for the first term.

(c) Many candidates could find the answer for the 8^{th} diagram but not the n^{th} diagram. However, some candidates did understand that the n^{th} diagram would be a term of the form $3n+k$.

Answers: **(a)(i)** 3, −1, **(ii)** subtract 4 **(iii)** $-4n + 23$ **(b)** 8, 10, 12 **(c)** 27, $3n+3$

Question 7

Candidates did not fully understand the requirements of this question. Many understood how to calculate the angles but could not give fully reasoned arguments, simply stating the numerical work they had completed or giving long written reasons which did not use any of the mathematically required words. Part **(a)** was answered the most successfully, with many candidates recognising the angle on a straight line adding to 180°.

Answers: **(a)** 63 **(b)** 90 **(c)** 117 **(d)** 90

Question 8

Candidates found this to be the most challenging question overall. Many candidates answered the trigonometric parts but had problems with perimeter, volume and conversion of units.

(a) The main error for most candidates was the use of sin or cos instead of tan. Some candidates thought the angle at *D* was a right angle.

(b) Candidates generally found the area correctly.

(c) The majority of candidates realised the need to use Pythagoras' theorem but some did not recognise which side of the triangle was the hypotenuse. Some candidates did not give the required accuracy.

(d) Candidates understood the need to add lengths to obtain the perimeter but some did not include the side by the house and others made errors in obtaining the lengths of the two unknown sides. Some candidates did not show any working so method marks were lost.

(e) Very few candidates gave the correct answer. However, some candidates did obtain figures 333 but then could not convert the units correctly. Other candidates used the perimeter obtained in the previous part instead of calculating the area.

Answers: **(a)** 5.40 **(b)** 32.4 **(c)** 5.66 **(d)** 64 **(e)** 33.3

Question 9

Candidates continue to improve in their performance generally with the graph question. There is still a need for a few candidates to use a curve instead of straight lines to join points. Drawing the line of symmetry was the least well answered part.

(a) Generally candidates could complete the table apart from the odd slip.

(b) Candidates continue to produce good graphs. The main errors are the use of ruled lines instead of a curve and some double lines between points. In a few instances the graph was drawn with a point at the bottom.

(c) (i) A large minority of candidates did not draw a line of symmetry. Those candidates that did draw a line normally drew the correct one.

(ii) Where a line of symmetry had been drawn many correct equations were given. The main error was to use *y* instead of *x* in the equation.

(d) Some candidates did not answer this part. Those that did understood they were looking for points and many gave correct answers. However, there were some candidates who misread the question and found the values from the quadratic =0 instead of =3 whilst others read the axis the "wrong" way as, for example, −4.2 instead of −3.8. There was evidence of some careless omission of negative signs.

Answers: **(a)** −1, −5, −1, 4 **(c)(ii)** x = −1 **(d)** 1.85, -3.85

Question 10

Candidates showed some understanding of bearings but did not show a clear understanding of bearings greater than 180°. A small majority of candidates showed a good understanding of numbers in standard form whilst others preferred to change to normal numbers.

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

(ii) Many candidates gave the correct answer. The common error was to have the correct length but an incorrect angle.

(iii) Candidates found this part challenging. The most common error was to find the bearing of *C* from *A*. Alternatively some candidates stated the distance of *C* from *A*.

(b) (i) Although some candidates gave the correct answer, the majority of candidates gave the correct digits and correct power of 10 but not as standard form. For example, 324×10^3 was seen frequently.

(ii) The correct answer was seen in the work of about half the candidates. They understood the concept of subtracting one population from another but in order to do that some reverted to ordinary numbers.

Answers: **(a)(i)** 15 **(iii)** 262 **(b)(i)** 3.24×10^5 **(ii)** *C,* 2.48×10^5

MATHEMATICS

Paper 0580/41
Paper 41 (Extended)

Key messages

To succeed in this paper, candidates need to have completed full syllabus coverage, recall and apply necessary formulae, show working clearly in the working space provided and use a suitable level of accuracy.

Centres that issue extra paper can disadvantage their candidates as it is often difficult to award method marks when this working is not numbered and an incorrect answer is seen in the booklet.

Candidates should also possess the ability to problem solve in multi-step questions and interpret the mathematics required in contextual questions.

General comments

Overall this paper proved to be accessible to most of the candidates, but was also challenging to many. Most candidates were able to at least attempt most questions, and solutions were often well-structured with clear methods shown using the working space provided on the question paper. Some candidates choose to show their working in pencil which Examiners will always mark, but all solutions, both working and answers (apart from graphs and drawings) would be better written in pen. Centres should not encourage candidates to submit rough working on extra pages as all working should be included on the question paper alongside the solutions it supports. The questions/parts of questions on solving equations, finding a percentage of a volume, rearranging a formula, verifying a formula for the volume of an open box, calculating an estimate of the mean, and drawing graphs of functions were very well attempted. The parts of questions involving histograms, probability from sets, similarity and volume, magnitude of a vector and areas and ratio were those that candidates found most challenging.

Candidates appeared to have sufficient time to complete the paper and omissions were due to difficulty with the questions rather than lack of time. The use of at least three significant figure accuracy unless specified was noted by many candidates but there were some approximating answers early and this led to inaccurate answers. The questions affected by this were on parts of **Question 5, 7, 8** and **9** involving volume and similarity, areas and lengths, the use of the quadratic formula and calculations with large numbers. It should be noted that any answers or figures in working given to two significant figures will not result in method marks being awarded unless a clear correct method is also shown.

Candidates generally followed the rubric instructions in respect to the values to use for π although a few used $\frac{22}{7}$ or 3.14 on **Question 7** which could result in final answers that are outside the required accuracy.

Comments on specific questions

Question 1

This question on statistics and charts was found challenging by many.

(a) (i) Most candidates were successful in calculating the angle x as 126°. Some candidates measured the angle even though the pie charts were drawn not to scale. Others were able to set up a correct equation involving x and 360°, but then made errors in solving this.

(ii) Many added 18° to their previous answer and gave a correct response. The most common error was to use a protractor to measure the angle.

(b) The majority understood the method to find 60° as a percentage of 360° and demonstrated this with full working showing the fraction multiplied by 100. A number of candidates lost accuracy however and truncated rather than rounded giving an answer of 16.6%. A few did not use the 60° for grades *E*, *F* and *G* given on the diagram.

(c) (i) This proved much more challenging than the previous part. Candidates had to calculate the numbers of boys and girls each gaining grades *A* or *A** before combining them to find the % of the total of the boys and girls gaining *A* and *A** grades. A significant number of candidates answered this well by obtaining 35 and 36 before adding and then dividing by the total number of boys and girls (320). Many correctly found the percentages of A or *A** from the charts (25% for the girls and 20% for the boys) but either added these together or worked out the mean without taking into account the numbers of girls and boys. So it was quite common to see incorrect answers of 22.5 or 45.

(ii) Many were successful in calculating the numbers of boys and girls achieving grades *B*, *C* or *D* before subtracting and credit was given to those that used their incorrect angle for the girls pie chart from **part (a)(ii)**. The most common error was to use angles that were measured from the pie chart.

(d) (i) Well answered by the majority who were well prepared for a standard estimated mean question. Those that were successful showed clear use of the products of the frequencies with the mid-interval values and then division by the sum of the frequencies. Because the intervals were of different widths, there were some errors in the mid-interval values given.

Some common misunderstandings were using the upper or lower class boundaries instead of the mid-interval value for the calculation. Others found $\sum fx$ correctly but then divided by 4 which was the number of intervals instead of the total frequency. A few found the sum of the mid-interval values and then divided by 4.

(ii) Candidates found this histogram question very challenging. Most were able to score one mark by giving the height of the first column as 1 as this had the same interval width as the one given in the question. The other heights of 2.9 and 4.27 were only given by the most able candidates. The most common answers were 5.8 and 6.4 from using an interval width of 20 for the other groups.

Answers: **(a)(i)** 126, **(ii)** 144; **(b)** 16.7; **(c)(i)** 22.2, **(ii)** 58; **(d)(i)** 106, **(ii)** 1, 2.9, 4.27.

Question 2

The graph question proved accessible to many candidates but presented challenge in parts **(c)** and **(d)**.

(a) (i) All were able to score at least one mark by completing the table. The majority scored all 3 marks. The most common error was with the value at x = -2 where a number gave the y value as 6 and not 14 which resulted from an error in processing the directed number.

(ii) The majority were able to plot the points correctly. The vertical scale presented problems for some however and the y -values of -2.5, 16.5, 7.5, -5.5, 1.5 were all plotted incorrectly on occasions. Candidates should ensure that they plot points in the correct position if they lie on an exact grid line or in the correct small square if they lie in between grid lines. The majority of graphs were good curves but a minority still clearly use a ruler to join pairs of point together for which the curve mark is not awarded. For those that made an error in the table in **part (a)**, some knowledge on the expected shape from a cubic function may have been a useful checking strategy.

(b) Many were successful at reading the x – values at three intersections of their graph with the line y = 2 although a few chose the wrong horizontal line such as y = 0 from which to read the x - values.

(c) Some candidates drew an accurate tangent at x = -4. A few were too steep to give the gradient in the required range. Candidates need to carefully interpret the scales on both the x-axis and the y-axis to ensure that the correct values are used in their calculation for the gradient. A number of candidates did not understand the term 'tangent' and drew a vertical line at x = -4.

(d) (i) The drawing of the straight line $y = 10 - 5x$ produced a range of responses. The most successful candidates appeared to select two or three points to calculate then plot and join them with a ruled line or some were clearly used to using the 'zeros/cover up method' to calculate the intercepts with the axes. Some used the fact that the y- intercept of the line was the point (0, 10) and that the gradient of the line was -5. It was surprising to see a number of candidates attempting to work out multiple coordinates using different x-values which is unnecessary to draw a linear graph. With this method there were sometimes one or two values incorrectly calculated or plotted resulting in a non-straight line. This should have alerted candidates that an error had been made but many demonstrated a lack of understanding of nature of the graph of the form $y = mx + c$. A number drew a freehand but otherwise correct line for which they gained partial credit.

(ii) Responses to this part were very much linked to a correct line drawn in **part (d)(i)** to find the correct x- value of the intersection of the line and the curve.

Answers: **(a)(i)** 14, -5.5, 20 **(b)** -4.8 to -4.6, -0.4 to -0.2, 3 to 3.1; **(c)** 6 to 11 ; **(d)(ii)** 2.5 to 2.7.

Question 3

This question on sets and probability produced a range of answers and very few candidates were successful in answering the entire question correctly.

(a) Often well answered. Most scored at least 2 marks, usually for the value in set D and at the intersection of S and M. Some confused the values 5 and 15 but most used the fact that 20 was the total of D intersection S and D.

(b) (i) This was answered very well and most gave the value 5.

(ii) Many were successful in giving a correct answer or an answer that followed through from their value 15 on the Venn diagram. Full credit was given to those using their value from the diagram added to 36.

(c) (i) Many interpreted the set notation correctly to give the answer 15. A common error was to give an answer of 2 presumably by counting the values in the intersection rather than interpreting the 10 and 5 as the number of candidates.

(ii) Similarly many were successful in interpreting the set notation and gave the answer 10. A few gave an answer of 1 with a similar error made to that in **part (c)(i)**

(d) (i) A number were successful in giving the correct answer of $\frac{13}{90}$. A common error was to give an answer of $\frac{39}{90}$.

(ii) Fewer were successful here and a significant number gave the incorrect answer $\frac{10}{90}$ by not including the 5 candidates that did all three sports as being in the group that did both music and drama.

(e) (i) This part was more challenging and although many candidates showed a correct probability in their working for the first candidates attending all three clubs, the probability that the second candidate chosen attended all three clubs was often incorrect. Many did not consider the dependency of the second event on the first and gave both probabilities as the same value i.e. $\frac{5}{90}\times\frac{5}{90}$. Some did not combine the probabilities correctly and added rather than multiplied.

(ii) Only a minority were successful in scoring all three marks. Those that considered the correct probabilities for attending the sports club and the music club usually only included one order for the choice and did not consider the reverse option leading to an answer of $\frac{299}{8010}$. Many did not consider that dependency of the second probability on the first choice again and a number were not sure of how to combine the probabilities.

Answers: **(a)** 11, 5, 15 and 8; **(b)(i)** 5, **(ii)** 51; **(c)(i)** 15, **(ii)** 10; **(d)(i)** $\frac{13}{90}$, **(ii)** $\frac{15}{90}$; **(e)(i)** $\frac{20}{8010}$ **(ii)** $\frac{598}{8010}$.

Question 4

Candidates generally found this question accessible and were able to demonstrate a variety of algebraic skills although it was only the most able candidates that were successful in all parts.

(a) (i) This was very well answered. The majority showed clear working leading to the correct solution. A few chose to leave their answer in an unsimplified fraction as $\frac{15}{6}$ and candidates should be advised to either use their calculators to evaluate the solution as a decimal or to give it as a fraction in its simplest form to score the accuracy mark.

(ii) This equation involving a fraction was also well answered, although a few, after a correct first step of multiplying by 3, were unable to complete the solution by adding 7 and chose to subtract 7 instead. Some incorrectly chose to add 7 as the first step.

(b) (i) Answers were more varied. A range of incorrect answers were seen, but quite often only 2 elements of the three element expression were correct and candidates gained one of the marks. The most common error was to give $9x^3y^{12}$ or 27 x^3y^7 or a combination of these errors.

(ii) There were some excellent answers but again it was common to see two elements with errors such as $8a^3b$. Some were unfamiliar with the rules of indices involving brackets and gave answers such as $8a^{6.5}b^{2.5}$.

(iii) Those that recognised the need to factorise the numerator and denominator of the fraction before cancelling common factors were usually successful in obtaining the simplified expression. Some made an error with the signs in factorising the numerator but were given credit where their factors when expanded gave two of the correct terms in the quadratic expression.

Less able candidates cancelled without factorising by incorrectly using an 'x^2' factor.

Answers: **(a)(i)** 2.5, **(ii)** 13; **(b)(i)** $27x^3y^{12}$, **(ii)** $4a^3b$, **(iii)** $\frac{x+1}{x+8}$.

Question 5

(a) Many candidates successfully applied Pythagoras's theorem using two of the three sides of fish tank. Some gave the result of this as the final answer for the length of the diagonal shown in the diagram whilst others correctly applied Pythagoras's theorem a second time using the square of their first answer and the square of the remaining side. In some cases candidates did not use their first answer to a sufficient degree of accuracy to give the final answer within the acceptable range. Candidates should be aware that they should work with at least four significant figures or leave all the figures on their calculator. It was very rare to see the most efficient method using Pythagoras's theorem in three dimensions to give $\sqrt{20^2+46^2+24^2}$.

(b) This part was answered very well with many candidates earning full marks. The majority of candidates correctly calculated the volume of Jose's fish tank and, although a few gave $\frac{22080}{22000}\times 100$ or $\frac{22080-20000}{22080}\times 100$, most gave the correct percentage. A few candidates gave a truncated answer of 90.5%.

(c) Very few candidates were successful in this challenging part of the question. The most efficient correct method was to consider the ratio of the sides of the two tanks as $3\sqrt{2}$ and some of the more able candidates did this.

A small number obtained this ratio by considering the ratio of the volumes as $\frac{44160}{22080}$ and taking the cube root of the numerator and the denominator.

The vast majority assumed the ratio of the sides was 2, the same as the volume ratio, and thus gave answers for the sides that are double the sides of the original tank.

(d) This was answered well with the majority of candidates well prepared for this part and rearranging the formula correctly. A few gave an incorrect rearrangement such as $r^3 = 20\,000 - \frac{4\pi}{3}$. Some calculated $\frac{4\pi}{3}$ as 4.19 prior to rearrangement but usually obtained an answer within the acceptable range. A few candidates took the square root instead of the cube root.

Answers: **(a)** 55.6; **(b)** 90.6; **(c)** 25.2, 30.2, 58.0; **(d)** 16.8.

Question 6

This question on vectors gave a full range of responses with very few scoring full marks.

(a) (i) This part was done well by many but there were surprising errors with the directed numbers with many making a sign error when carrying out the arithmetic with the negative elements of the vectors.

(ii) This part was poorly done as most candidates did not interpret the notation for the modulus of a vector as meaning the magnitude. Some omitted this part and others assumed that the notation refers to the determinant of a matrix. As a result there were very few correct answers. Incorrect answers included 2 x -7 = -14, 2 -- 7 = 9, -7 + 2 = -5, $\frac{2}{-7}\times\frac{2}{-7}=\frac{4}{49}$ and $\frac{2}{7}$.

(iii) There were a number of candidates who substituted the vectors **a**, **b** and **c** into the given vector equation. No marks were awarded for just carrying out this step. Many candidates obtained a correct acceptable form for the two equations such as $\begin{pmatrix}-2m\\3m\end{pmatrix}+\begin{pmatrix}2n\\-7m\end{pmatrix}=\begin{pmatrix}-10\\21\end{pmatrix}$ but were not able to write down the two equations in a non-vector form. Those that did write down the two separate equations often made a correct attempt to equate one set of coefficients to earn a method mark and then usually earned the second method mark for a correct attempt at elimination. There were candidates who rearranged one equation and then substituted the rearranged equation into the other equation correctly. There were some errors in manipulating the directed numbers in the equations with both methods. In addition some candidates rearranged both equations for either *m* or *n* and then equated the rearrangements. Many of the candidates who wrote down the two equations obtained full marks.

(b) (i) Many candidates gave the correct solution. The most common incorrect answer was **p** - **q**.

(ii) There were also many correct solutions to this part as well as correct 'follow through' answers from **part (b)(i)** for those correctly using the correct fraction from the given ratio. The most frequent incorrect solutions were $\frac{1}{2}\mathbf{q}-\frac{1}{2}\mathbf{p}$ or $\frac{2}{3}\mathbf{q}-\frac{2}{3}\mathbf{p}$.

(iii) Many candidates stated that the lines were parallel. Most incorrect answers referred to similar, equal or perpendicular.

Most stated that the triangles were similar. Incorrect solutions included congruent, equal, proportional or scalene.

The ratio of the areas of the triangles was rarely answered correctly. Incorrect solutions included 3:5, 2:3 or 4:9.

Answers: **(a)(i)** $\begin{pmatrix} -2 \\ -1 \end{pmatrix}$, **(ii)** 7.28, **(iii)** 3.5 and -1.5; **(b)(i)** –**p** + **q**, **(ii)** -0.6**p** + 0.6**q**, **(iii)** Parallel, similar, 9 : 25.

Question 7

This question on polygons, trigonometry and areas discriminated achievement between the candidates and there were some excellent candidates scoring full marks. All managed to access some parts of this question

(a) (i) The most common correct answer was from 360/5 = 72. A few correct answers from longer methods were also seen such as finding the interior angles of a regular pentagon from (5 – 2) × 180 and then dividing by 5 and then by 2 to find angle *OCD* or *ODC* and then using the isosceles triangle *ODC* to find angle *DOC*.

Many candidates gave 180 – 108 = 72 without any attempt at an explanation for 108°.

(ii) There were some correct solutions starting with (5 - 2) x 180 or 3 x 180 but there were also a number of candidates who assumed the 540° for the angle sum of a pentagon without any explanation as to why. There some correct solutions starting with (180 – 72) ÷ 2 and a small number of correct attempts starting with 360÷5. A common incorrect attempt was to give 180 - 72 = 108 and to assume that the 108° is angle *DCB* without further explanation.

(iii) There were more correct solutions to this part than the previous two parts. Many candidates wrote down 180 - 90 - 72 = 18 either as a single step but more frequently as two or three steps. There were a number of methods that were unclear or insufficiently explained. For example, 90 – 72 = 18 or 108 – 90 or 72 ÷ 4.

(b) Most attempts at this part started with either the cosine rule or the sine rule. Those using the cosine rule were usually able to quote the appropriate version of the rule correctly and then to make the correct substitutions to earn method marks. Similarly those attempting to use the sine rule gave a correct first step and also made the necessary substitutions but not all candidates made *CD* the subject of their formula. A small number of candidates correctly used either 2 x 7 x sin 36 or 2 x 7 x cos 54. Irrespective of the method used in a large number of cases the answer of 8.23, given in the question, was written down without first giving a more accurate version in the range 8.228 to 8.229. Candidates should be made aware that the final mark cannot be earned without showing an answer to greater accuracy than that given in the question.

(c) (i) Some candidates obtained correct solutions from 1/2 x 7 x 7 x sin 72 or 1/2 x 8.23 x 7 x sin 54 and also some correct solutions from finding the perpendicular height from *O* to *CD* and 1/2 x 8.23 x perpendicular height were seen. Quite a large number of candidates incorrectly used either $\frac{1}{2}\times 8.23\times 7$ or $\frac{1}{2}\times 8.23\times 7\times \sin 54$.

(ii) Many candidates earned the mark for multiplying their answer to **part (c)(i)** by 5. Rather a large number of candidates either omitted this part or used an incorrect method such as 8.23 × 5 or did not appreciate that 5 triangle areas gave the area of the pentagon.

(iii) Many candidates used the correct formula and most substituted the appropriate values and earned full marks for the area of the sector *ODC.* A few quite a few used a sector angle of 54° rather than 72° and some found the arc length rather than the sector area.

(iv) Many candidates found this part difficult and a number did not attempt it. Those that were able to give a solution often made errors such as finding the perpendicular length from *O* to *DC* and then doubling it. Others found 2 x *BY* and some found *YZ* and assumed it was equal to *XY*.

(d) Very few totally correct solutions were seen, mainly because many candidates thought that the rectangle was actually a square. There were some correct attempts at finding *YZ* and a few candidates were awarded 1 mark for correctly obtaining *CY*. The incorrect area for the rectangle often came from an incorrect calculation of *XY* in **part (c)(iv)**.

Answers: **(c)(i)** 23.3, **(ii)** 117, **(iii)** 30.8, **(iv)** 12.7; **(d)** 1.43 to 1.453.

Question 8

The vast majority of candidates were able to score some marks on this algebra question and a number were well prepared for it and scored full marks.

(a) The correct lengths were seen often, although there were candidates who did not give them in their simplified form. A common error was to give answers of $2x + 5$ and $x + 7$ from adding 2 to the lengths rather than 4.

(b) This part was answered quite well with many candidates writing down a correct expression for the volume and showing good algebraic skills to obtain the required expression. Some candidates omitted this part and a few incorrectly used the lengths from **part (a)**.

(c) (i) Not all candidates were able to rearrange the quadratic equation into a correct form to apply the quadratic formula and many mistakenly attempted to solve the equation $4x^2 + 26x + 30 = 0$. This was given some credit if the formula was applied correctly. A number of candidates quoted an incorrect formula but most substituted into the formula correctly and gave the final answers to the required degree of accuracy.

(ii) A number of candidates were awarded the mark or follow through mark for this part of the question. Some candidates did not obtain a positive value for x and therefore did not think to check solutions to **part (c)(i)** when this was the case. Others who did obtain a positive value did not check if x + 5 or 2x + 3 gave the length of the longest edge of the box.

Answers: **(a)** $2x + 7$ and $x + 9$; **(c)(i)** -7.92 and 1.42, **(ii)** 6.42.

Question 9

The final question provided an opportunity for all to score and for the most able to demonstrate their knowledge and skills in parts **(b)**, **(c)** and **(d)**.

(a) Many were able to score at least one mark here. The most common errors here were either getting the decimal point in the wrong place, in particular for the third value, or over approximating, particularly for the 5.207, which many times was just 5.2, rather than 5.21. There was some evidence that calculators were being used incorrectly with the standard form values for Jupiter and Pluto as answers sometimes had powers of 16 and 17 in them.

(b) (i) This was answered quite well. A few candidates divided 300 000 by 1.496×10^8 and some had the decimal point in the wrong place possibly from calculator errors with the standard form value.

(ii) This was also done reasonably well. Some were unable to convert to minutes correctly having obtained the answer in seconds.

(c) This was rarely correct with most candidates giving the wrong conversion from seconds to years. This was as a result of omitting one part of the conversion such as the 24 (hours) or one of the 60 (minutes or seconds).

(d) Many candidates divided their answer to **part (c)** by 1.496×10^8 to earn at least one mark. A few showed no working and gave answers to insufficient accuracy to imply the correct method.

Answers: **(a)** 5.79×10^7, 5.21, 39.5; **(b)(i)** 499, **(ii)** 328; **(c)** 9.46×10^{12}; **(c)** 63200.

MATHEMATICS

Paper 0580/42

Paper 42 (Extended)

Key Messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus.

The accurate statement and application of formulae in varying situations is always required.

Work should be clearly and concisely expressed with an appropriate level of accuracy.

All working should be in ink and in the working space provided.

Centres who issue extra paper can disadvantage their candidates as it is often difficult to award method marks when this working is not numbered and an incorrect answer is seen in the booklet.

Candidates need to be aware that in geometry questions parallel lines and symmetry of shapes are indicated in the diagrams by the appropriate symbols or described in the question so that they avoid making false assumptions.

General Comments

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

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 x and y co-ordinates. Others insist on giving both co-ordinates even when the question asks them for the values of x.

Most candidates followed the rubric instructions with respect to the values for π and since there was a decrease in the use of $\frac{22}{7}$ or 3.14, answers were more accurate.

Some candidates did not appreciate that a question worth 6 marks would require more than two lines of working and consequently scored little or no marks in **Question 2(b)**. Those who did appreciate that the number of marks available was an indication of the amount of work needed for success often gained full marks for their clearly constructed solutions.

It was extremely encouraging to see so many varied solutions to the unstructured **Questions 1(b)** and **2(b)**. The thinking candidates were rewarded for their concise solutions which used all the given information without making any false assumptions.

Comments on Specific Questions

Question 1

(a) (i) This part on ratios was generally well answered. Occasionally accuracy was lost by the premature rounding of 15 ÷ 9 to 1.67 which gave the answer 5.01.

(ii) There were many correct solutions to this question. The common error was to multiply by $\frac{5}{9}$ instead of $\frac{9}{5}$.

(b) This part on exchange rates was very well answered by the majority of candidates. There were a wide variety of methods with sufficient accuracy to achieve full marks. The most predominant method was to convert both Ann and Jon's prices into dollars per kilogram or euros per kilogram. A minority of candidates efficiently converted Jon's price into euros for 20 kilograms by calculating 204.5 × 20 × 0.718 ÷ 30 or converted Ann's price to dollars for 30 kilograms. Some candidates correctly evaluated the four calculations 96.4 ÷ 0.718, 204.5 × 0.718, 96.4 ÷ 20 and 204.5 ÷ 30 but did not reach values for equalised weights or money and so a direct comparison could not be made between the farms. A minority of candidates calculated the amount of seed that could be purchased for one dollar or one euro. These values were correctly calculated but then occasionally the wrong conclusion was drawn when the units of their answer were not stated. Some candidates wasted time by finding the cost of one kilogram of Ann's and Jon's in both dollars and euros.

(c) There was a mixed response to this question. Many correct answers were seen and the answer of 302.4 was equally popular when candidates did not realise that the number of *completely* filled bags was required. Many candidates were unable to deal accurately with the time and/or the weight conversion. The most common errors were to use 240 seconds in 4 hours or to forget the 4 hours and/or 420 g = 4.2 kg instead of 0.42 kg. Further confusion was often seen in multiplying by 20 instead of dividing by it. Successful candidates often showed a single step at a time in the working such as 420 × 60, then × 60, then × 4, then ÷ 1000 and finally ÷ 20.

(d) There were many correct solutions seen but the usual errors of finding 87.5% or 112.5% of $15.30 were seen a significant number of times.

(e) This part was usually well answered. Solutions as $\frac{12}{600}$ and 120 were the more common errors.

Answers: **(a)(i)** 5, **(ii)** 108; **(c)** 302; **(d)** $13.60; **(e)** 12.

Question 2

(a) (i) Candidates demonstrated an excellent ability to recall and use the cosine rule in this trigonometry question. Unfortunately many did not work to the required level of accuracy to show that angle *CAB* = 37.0 correct to one decimal place. Many candidates found cos *CAB* = 3271/4096 but then went straight to 37.0° without stating a four or more figure value of the angle to rigorously establish the rounded value. Candidates who began with $43^2 = 64^2 + 32^2 - 2 \times 64 \times 32 \cos A$ often reached $1849 = 1024 \cos A$. A small minority of candidates used an incorrect combination of sides or calculated the wrong angle.

(ii) There were many correct solutions. Successful candidates used ½*ab*sin*C* or found the height of the triangle through *B* and then ½ × 64 × height. The common error was to use 43 instead of 64 or 32.

(b) This question discriminated well at the higher grades. The correct solution to this multi step question required accurate use of the sine rule and/or the cosine rule. The most popular method was to use the sine rule to find angle *ADC*, then the sum of the angles of a triangle to find angle *ACD* before applying the sine rule again or the cosine rule to find *AD* and hence the perimeter of the quadrilateral. A significant number of candidates applied the cosine rule immediately to produce a quadratic equation in *AD* which they then solved by the quadratic formula. The candidates who successfully used the latter method often scored very well on the rest of the paper.

Most candidates retained sufficient accuracy in their calculations to give the required value. A few candidates forgot to find the perimeter of the quadrilateral after reaching *AD* = 83.1.

The more common errors were to assume that the opposite angles of the quadrilateral were supplementary or that triangle *ACD* was isosceles.

Answers: **(a)(ii)** 616; **(b)** 228.

Question 3

(a) (i) Most candidates scored only 2 out the 3 marks available in this question on factorising quadratics. Even very good candidates failed to realise that there was a common factor of 2 which could be extracted first before then using two brackets for the enclosed quadratic. Some weaker candidates reached $2(2x^2 – 9x – 5)$ but then made no further progress. A very small minority completely lost the factor of 2 and others attempted to work backwards from the solution of $4x^2 – 18x – 10 = 0$ obtained from use of the quadratic formula and gave $(x – 5)(x + ½)$ as the answer. Fractions are not accepted as part of a correct factorisation since ½ is not considered to be a factor of 10.

(ii) This part was well answered as the marks were given for the correct values or the follow through values from the factors in **part (a)(i)**.

(b) There were many fully correct solutions to this question as candidates followed the instruction to show all their working. The errors included using b as 7 in the formula, squaring – 7 to reach – 49 and writing the formula with a division line which was too short to reach under the – b. Most candidates gave the answers to the required accuracy but the truncated values of 4.58 and – 1.08 as well as 4.6 and – 1.1 were seen.

(c) Most candidates knew that the common denominator was $(3x – 1)(x – 2)$ and the numerators became $6(x – 2)$ and $– 2(3x – 1)$. Unfortunately a completely correct solution was not often seen as most candidates expanded $– 2(3x – 1)$ as $– 6x – 2$. Of those who did reach $– 6x + 2$, many went on to simplify the numerator as + 10, - 14 or $x – 10$. Some candidates spoiled their answer by incorrectly expanding the denominator.

Answers: **(a)(i)** $2(2x + 1)(x – 5)$, **(ii)** – ½ and 5; **(b)** – 1.09 and 4.59; **(c)** $\dfrac{-10}{(3x-1)(x-2)}$.

Question 4

(a) (i) Many candidates identified the angle between the tangent and radius as 90° in this question on circle theorems. They then used the sum of the angles in quadrilateral *AOCD* as 360° to give the correct value. Some found angle *BOA* but then forgot to double this to give angle *AOC*.

(ii) This was well answered as most knew to halve their answer to part **(i)**.

(iii) There were many correct solutions to this question. The common error was to assume that quadrilateral *ABCD* was symmetrical and consequently angle *OCD* = 53°.

(iv) This question was well answered by the majority of candidates by using tan 16 or by the sine rule in triangle *AOB*. Those who found *OB* and then used Pythagoras often lost accuracy by prematurely approximating at the end of their first calculation.

(b) (i) There were many correct solutions but unfortunately some candidates did not recognise the angle in the semicircle *AOB* and consequently were unable to proceed.

(ii) This part was well answered.

(iii) Most candidates did not appreciate that the reason required here was the correct circle theorem stated in words. Many merely gave a calculation or talked loosely about parallel lines or triangles.

(iv) The common answer here was 17° from the assumption that *AB* was parallel to *DO*. Candidates should note that parallel lines are always indicated in a diagram or stated in the question.

(v) This part was rarely correct. Many used the arc length formula with the incorrect angle and others used 360° – angle *AXD* instead of 360° – angle *AOD*. A few treated the arc as a chord and used trigonometry.

Answers: **(a)(i)** 148, **(ii)** 74, **(iii)** 21, **(iv)** 20.9; **(b)(i)** 51, **(ii)** 56, **(iv)** 22, **(v)** 68.3.

Question 5

(a) This part of this data handling question was well answered by the majority of candidates, all of whom showed sufficient working. A few candidates used the ends of the intervals instead of the mid values and weaker candidates used the interval width of 40 which obviously gave the answer as 40.

(b) (i) This part was usually well answered.

(ii) Many candidates correctly calculated the frequency densities and drew the blocks of correct height and width. When errors occurred it was usually from the misuse of the vertical scale as the height of 1.05 was frequently drawn at just above 1 or at 1.1.

(c) This part proved to be more challenging than expected as there were few correct answers.
The answer of 133 from (130 + 136) ÷ 2 was very common. Some candidates gave a partially correct method of 136 × 15 + 130 × 3 = 2430 but then divided by an incorrect number, often 2, or did not divide at all. Candidates should ask themselves if their answer is sensible to avoid such errors.

Answers: **(a)** 137; **(b)(i)** 16 and 126; **(c)** 135.

Question 6

(a) The correct solution to this question on vectors was rarely seen. It was clear that candidates did not understand the meaning of 'magnitude of the vector'. The few successful candidates often drew the vector before using Pythagoras but others assumed that it was a 3, 4, 5 triangle so the magnitude was 4**.**

(b) (i) Most candidates drew the correct line segment but did not indicate the direction of the vector by using an arrow.

(ii) There were many correct positions of the images of *P* and *Q*. Some candidates rotated clockwise instead of anti-clockwise and a few rotated through 180°. Surprisingly, a few used *P* instead of *R* as the centre of the rotation.

(c) This part on adding vectors was not as well answered as expected. The most common answer was 4**b** + **a** which was the result of adding the given vectors. Candidates who realised that the correct route was $\overrightarrow{CD}$ + $\overrightarrow{DE}$ did not always use brackets effectively and wrote – 3**b** – **a** + 2**a** + **b** instead of the correct – (3**b** – **a**) + 2**a** + **b**.

(d) The vector $\begin{pmatrix} 3 \\ 4 \end{pmatrix}$ from the addition of the vectors without consideration of a correct path was as common as the correct answer. Examiners were surprised to sometimes see a 2 by 2 matrix as the answer.

(e) (i) This part was well answered. The usual incorrect answer was **c** – **b**.

(ii) This question discriminated well at the higher grades. Many candidates made a reasonable start by finding a correct route but then spoiled their solution by misinterpreting the ratio 1:3 to mean *CX* = 1/3*CB* instead of *CX* = ¼ *CB*. Many candidates considered $\overrightarrow{BX}$ and $\overrightarrow{CB}$ to be in the same direction.

Answers: **(a)** 5.83; **(c)** 3**a** – 2**b**; **(d)** $\begin{pmatrix} 7 \\ -6 \end{pmatrix}$; **(e)(i)** **b** – **c**, **(ii)** ¼ (3**c** – **b**).

Question 7

(a) (i) Many candidates successfully wrote the four required inequalities in this linear programming question. Errors seen included reversing the inequality signs or using strict inequalities. Some candidates confused the x and y in the final statement and others used 2 instead of ½. A small number of candidates did not use inequalities but used = throughout.

(ii) The vast majority of candidates drew the lines $x = 5$, $y = 8$ and $x + y = 14$ accurately. The line $y = \frac{1}{2}x$ was frequently omitted or $y = x$ or $y = 2x$ was drawn instead, even after the correct inequality had been stated earlier. The region R was usually clearly indicated using the four lines but an incorrect fourth line meant this region was incorrect.

(b) (i) This part was reasonably well answered, even by those who did not score well in part **(a)**. Many demonstrated a correct method by using a point (x, y) in their region and evaluating $20x + 45y$. A common wrong answer was 460 from using (5, 8).

(ii) This part was as well answered as **part (b)(i)**.

Answers: **(a)(i)** $x \geq 5$, $y \leq 8$, $x + y \leq 14$ and $y \geq \frac{1}{2}x$; **(b)(i)** 480, **(ii)** 6 and 8.

Question 8

(a) (i) Many excellent tangents at the correct point were seen in this question on functions and graphs. Some candidates misinterpreted the horizontal scale and drew the tangent at $x = 2.25$ or occasionally at $x = 2.75$. There were very few chords drawn.

(ii) There were many accurate calculations of the gradient from correct or nearly correct tangents. Some candidates misread at least one of the coordinates of their chosen points which were often far too close together as the x co-ordinates differed by only 0.1 which resulted in a value outside the required range.

(b) This part was usually well answered with almost all candidates correctly reading at least one value.

(c) (i) The vast majority of candidates calculated the required values correctly. Some candidates forgot to correct to one decimal place and gave 4.43 as the first value.

(ii) Most candidates plotted the points from the table accurately. Occasionally the point (0.7, 4.4) was plotted at (0.75, 4.4) or at (0.7, 4.5) and the final point (3, 1.7) was plotted at (3, 1.8). The quality of the curves was generally good with very few candidates inappropriately ruling lines.

(iii) This part was well answered.

Answers: **(a)(ii)** 1.55 to 2.2; **(b)** 1.42 to 1.45 and 2.8 to 2.82; **(c)(i)** 4.4, 2.5, 1.5, **(iii)** 0.75 to 0.9, 1.6 to 1.7, 2.6 to 2.7.

Question 9

(a) (i) Many fully correct diagrams were seen in this question on Venn diagrams. Of those who were unable to complete the whole diagram, the majority were able to correctly position the 2 for the candidates who studied neither French nor Spanish. Weaker candidates often did not use the significant information that there were 25 candidates in the class as they had 16 in the French only section, 18 in the Spanish only section and 11 in the intersection of French and Spanish.

(ii) This part was very often correct. Those candidates who had an incorrect diagram usually added their 2 and their 7.

(iii) This part was often well answered. A few candidates listed what appeared to be the elements 2, 5, 7 rather than adding the values which indicated lack of understanding of sets notation.

(iv) This part was often well answered. Occasionally answers of $\frac{1}{11}$ or fractions with a denominator of 23 were seen.

(v) Many candidates correctly calculated the probability using values from their Venn diagram. Errors seen included adding the probabilities instead of multiplying, using the same denominator in the two fractions and calculations which led to an answer greater than 1.

(b) (i) Candidates who correctly interpreted 'candidates who study German is a proper subset of the set who study French' by drawing the circle for G wholly inside the circle for F, were the most successful. Of these a significant number had 9 and 3 instead of 5 and 7 in F only and $F \cap S$ respectively. Other candidates drew three intersecting circles with $S \cap G \cap F$ empty. Generally candidates who chose this drawing made more errors in placing the given 4 and 12. A significant number of candidates drew a diagram in which the circle for Spanish did not intersect with either the circle for French or the circle for German.

(ii) There were many correct answers to this question or answers that followed through from the Venn diagram.

Answers: **(a)(ii)** 9, **(iii)** 14, **(iv)** 11/25, **(v)** 42/600; **(b)(ii)** 28.

Question 10

(a) (i) This part of this question on number sequences was very well answered.

(ii) There were many correct algebraic expressions but some candidates gave numerical answers.

(iii) Many candidates started correctly from their algebraic expressions in part **(ii)** but they were not careful with the signs when expanding their brackets resulting in the loss of the final mark.

(b) (i) This part was very well answered.

(ii) As in **part (a)(ii)**, those who realised that an algebraic answer was required were usually successful.

(c) Most candidates gave 11 × 23 – 9 × 25 but omitted 253 – 225 which was a necessary part in rigorously establishing the result of 28. Some candidates attempted an algebraic approach from $(n - 6)(n + 6) - (n - 8)(n + 8)$ and then repeated the sign error made in **part (a)(iii)**.

(d) Very few candidates gave the simplified answer. Most candidates who attempted this question wrote a more complex expression involving both n and t such as $n^2 - (t - 1)^2 - \{n^2 - (t + 1)^2\}$ but again most were not rigorous enough to use brackets correctly.

(e) This part was often correctly answered.

Answers: **(a)(i)** 20, **(ii)** $n - 4$, $n + 4$, $n + 6$; **(b)(i)** 24, **(ii)** $(n - 5)(n + 5) - (n - 7)(n + 7)$; **(d)** $4t$; **(e)** 28, 30, 52.

MATHEMATICS

Paper 0580/43
Paper 43 (Extended)

Key Messages

To do well in this paper candidates need to be familiar with and practiced in all aspects of the syllabus.

The accurate statement and application of formulae in varying situations is always required.

Work should be clearly and concisely expressed with an appropriate level of accuracy.

All working should be in ink and in the working space provided.

Centres who issue extra paper can disadvantage their candidates as it is often difficult to award method marks when this working is not numbered and an incorrect answer is seen in the booklet.

General Comments

This paper proved to be accessible with almost all candidates able to attempt all questions. Most candidates set out the work clearly and showed sufficient working in the space provided on the question paper. Some candidates started a solution, realised that a mistake had been made, and then decided to use an alternative method or corrected some of the calculation by overwriting the figures already written. Candidates that alter figures instead of replacing them risk losing the marks because their working becomes unclear. Those making several attempts at a question are advised to delete the work that is being replaced so that Examiners can clearly see the intended method and award marks accordingly.

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

Good calculator skills were demonstrated and appropriate levels of accuracy were usually seen. When answering a multi-step question several calculations may be needed and candidates are advised to write down the answer to each step using more than 3 significant figures and then correct to the required accuracy at the end of the calculation.

Questions on arithmetic (percentages, ratio etc.), interpreting cumulative frequency graphs, calculating an estimate of the mean, drawing graphs, basic mensuration and simple sequences were particularly well answered. The more challenging questions and the aspects that candidates need to develop further include reverse percentage, similarity, describing transformations, more difficult sequences, general trigonometry in context and solving equations from graphs.

Comments on Specific Questions

Question 1

Most parts of this question were well answered with many of the more able candidates gaining full marks.

(a) (i) This question on time was answered well. A few candidates added 25 minutes instead of 1 hour 25 minutes and gave an answer of 08 15.

(ii) The majority knew how to calculate the average speed. Those that used the fraction $\frac{85}{60}$ or the exact decimal were usually successful. A significant number of candidates wrote 1 hour 25 minutes as 1.25 hours and calculated 92 ÷ 1.25. Using a rounded version of $\frac{85}{60}$ as 1.4 or 1.41 or 1.42 led some candidates to find a value outside the acceptable range.

(iii) Many correct answers were given to this percentages question with $\frac{10}{85}$ x 100 or $\frac{10}{85}$ = 0.1176 followed by a correct answer seen in the working. Some did not use consistent units and attempted $\frac{10}{1.25}$. Others reached 0.1176 and then gave the answer as 12% without showing a more accurate percentage value.

(iv) This part on reverse percentages was less well answered. Better candidates associated 92 with 115% and realised the need to divide by 1.15, correctly obtaining the answer 80. The most common mistake was to calculate 0.85 x 92 or to subtract 15% of 92 from 92. Some found the value 80 but spoiled their work by then subtracting 80 from 92.

(b) (i) This part on ratios was very well done with most achieving full marks.

(ii) There were many fully correct answers to this question on ratio. Candidates need to ensure that they give the ratio in the **simplest form**. Unsimplified answers such as 8.25 : 6.75 and 33 : 27 were common. A few gave their answer in the form *n* : 1.

Answers: **(a)(i)** (0)9 15, **(ii)** 64.9 or 65.(0) **(iii)** 11.76 or 11.8, **(iv)** 80 ; **(b)(ii)** 11 : 9.

Question 2

This transformation question produced a wide range of responses, with some candidates not attempting several parts. It was pleasing to note that in part **(b)** most candidates gave a **single** transformation and only a few lost all the available marks by giving two transformations. The use of the appropriate terminology in this part of the question was varied; candidates would improve their responses by using precise explanations and not adding additional information that may spoil their work. The mark allocation is an indication of the amount of detail required e.g. a description question with 3 marks requires 3 pieces of information. Plotting of points was generally accurate and most candidates had ruled lines.

(a) (i) Well done overall. The most common error was to translate 1 left and 11 down. A few miscounted, usually by 1 square.

(ii) Again, well done by the majority of candidates. When incorrect the shape was usually correctly sized and orientated but with an incorrect centre. Several used (– 4, – 6) as a centre and a few attempted a scale factor of – ½.

(b) (i) There were many fully correct answers. Some just wrote reflection and did not give a mirror line.

(ii) Well done with most using a rotation to describe the transformation. Those that used enlargement were usually successful in gaining all 3 marks.

(iii) This proved difficult for many candidates and was often left blank. A common error was to describe the transformation as a shear. If attempted, the invariant line was usually written incorrectly with 'in *y*-axis' and 'along *y* = 8' being the most frequently seen wrong answers.

(c) Many stronger candidates were able to simply write down the matrix from their description in part **(b)(iii)**. Others attempted matrix multiplication using the points for X and W, usually with little success. A significant number of candidates left this part blank.

Answers: **(a)(i)** image at (– 3, 1), (– 7, 7), (–3, 7), **(ii)** image at (– 4, – 1), (– 4, – 4), (– 2, – 4) ; **(b)(i)** reflection, $y = 1$, **(ii)** rotation, (3, 2), 180, or enlargement, (3, 2), (factor) – 1, **(iii)** stretch, (factor) 0.5, invariant line y-axis or $x = 0$; **(c)** $\begin{pmatrix} 0.5 & 0 \\ 0 & 1 \end{pmatrix}$

Question 3

Candidates displayed a good understanding and were able to use the formulas for volume and surface area. Overall they performed well on this question with many achieving full marks. It is encouraging to note that most candidates used an appropriate value for π in their calculations.

(a) Most candidates calculated 8000 ÷ 1 080 and correctly gave the answer as 7.41. Some showed the calculation and then lost the accuracy mark by writing their answer directly as 7.4 or 7.40 without writing a more accurate value e.g. 7.407. Good advice to candidates would be to always write a full answer before rounding to the appropriate degree of accuracy. Surprisingly, a significant number of candidates calculated 1080 ÷ 8000 and 0.135 was a very common incorrect answer.

(b) This was very well done. Only the weaker candidates made errors, some giving an answer of 900 from calculating 1080 ÷ 12 x 10 instead of 1080 ÷ (12 x 10).

(c) (i) There were many correct answers with working clearly showing the necessary steps. Some found the square root rather than the cube root. Writing $r = \sqrt[3]{}$ would help candidates avoid errors and they are advised to show this step rather than proceed directly from $r^3 =$ to $r =$. A common mistake was to find $\sqrt[3]{1080}$ as the first step.

(ii) This was very well done. Most were able to take their answer to **part (c)(i)**, substitute correctly into the given formula for surface area and gain the method mark.

(d) A few used the efficient scale factor method and were able to find √2. The vast majority of candidates found R by using $4\pi R^2 = 2$ x their **(c)(ii)** and then compared this with their r from **part (c)(i)**. This method often led to premature rounding within the calculations and to a final answer out of the acceptable range.

Answers: **(a)** 7.407… or 7.41 ; **(b)** 9 ; **(c)(i)** 6.36 to 6.37 , **(ii)** 508 to 510 ; **(d)** √2 or 1.41

Question 4

Parts of this question tested the more demanding concepts of algebraic equations and function notation and only the best candidates were able to score marks in parts **(c)** and **(d)**. The instruction at the start of part **(c)** to **use your graph to solve the equations** was largely ignored. Candidates would perform better if they followed the hints given in the question.

(a) Most completed the table successfully. The most common error was an answer of 1 when $x = -1$.

(b) Some excellent curves were seen. The plotting of points was generally good with most using neat and accurate points or crosses. Candidates using pen rather than pencil often find it difficult to correct errors and can end up with several attempts at joining the points. Any wrong working should be clearly deleted so that Examiners have a clear indication of the final answer, using pencil and rubber would improve the quality. Some candidates continue to connect the two separate branches with the consequent loss of 1 mark.

(c) (i) Better candidates realised the need to use their graph to find the value of x when $y = 4$. The drawing of the curve between $x = ½$ and $x = 1$ required a good degree of accuracy and some candidates lost the mark here because of a poorly drawn curve. Others seemed confused by $f(x) = 4$ and calculated f(4) instead with –11.875 being seen on numerous occasions.

(ii) Very few candidates realised that they needed to draw the line $y = 3x$ on the graph and use it to find the x value of the point of intersection. Some obtained a value in the range despite not drawing the line.

(d) A challenge that proved to be beyond the majority of candidates with many not attempting this part. Those that started with $\frac{2}{x^2} - 3x = 3x$ usually obtained the correct answer. A common incorrect response was to find 0.7^3 and give the answer 0.343.

(e) (i) An easy 1 mark and most drew the line correctly. It was not always clear that the line passed through the point (3, - 9) and some candidates seem confused by the proximity of the plotted point (3, - 8).

(ii) The more able candidates realised the need to find the gradient using the given points, correctly obtained –3.5 and then used this with $y = mx + c$ to find the exact value of the intercept as 1.5. Many candidates attempted to use their graph to find the gradient and intercept rather than use the algebraic method. Gradient values of $+\frac{7}{2}$, $-\frac{2}{7}$ and $-\frac{7}{4}$ were common errors and the intercept value 1.4 or 1.6 was seen on numerous occasions. Candidates can improve their work by making clear what they are finding e.g. write the word gradient by the appropriate calculation, and by giving a full answer with the correct notation.

(iii) This was usually correct.

Answers: **(a)** 5 and –1 ; **(b)** correct graph ; **(c)(i)** 0.55 to 0.65 , **(ii)** 0.65 to 0.75 ; **(d)** $\frac{1}{3}$; **(e)(i)** ruled line through (– 1, 5) and (3, –9) , **(ii)** y = –3.5x + 1.5, **(iii)** tangent.

Question 5

Many candidates found parts of this question on algebra in the context of area and perimeter to be very demanding, particularly parts **(b)(i)** and **(c)(i)** that required candidates to show clearly how to form the given equation. It was common to see candidates attempt to solve these equations with the quadratic formula being used repeatedly throughout the question.

(a) Well answered by the majority of candidates with many gaining full marks, often by using a numerical approach rather than an algebraic method. Those that used algebra gave well-worked solutions, clearly writing a single equation or a correct pair of simultaneous equations. Incorrect answers usually came from confusing the connection between w and l and writing $w = l + 0.25$. Some candidates introduced other variables instead of using w and l and this often led to confusion.

(b) (i) This was the most demanding question on the paper with many weaker candidates leaving this part blank. It proved a challenge for the more able candidates with many making little progress past the $xy = 5$ and $(x + 2)Y = 6$ stage. Some confused y and Y, others did not make use of $y + Y = 1$. Although a variety of starting points were seen, most successful candidates usually wrote expressions for y and Y, then equated to 1 and proceeded to give a clear and logical proof of the required equation. A significant number attempted to solve the equation.

(ii) This was generally well done. Many were able to factorise correctly and gain the 2 marks. There were some cases of reversed signs but overall this part was well answered.

(iii) Many candidates found the correct perimeter or gained the follow through marks by using their values from **part (b)(ii)**. Some obtained the perimeter 21 despite not being able to factorise. The most common errors were: simply quoting the positive x value, finding the sum of two adjacent sides and incorrect addition of 10 + 10 + 0.5 + 0.5.

(c) (i) Although this was another 'show that' question candidates were generally more successful than in **part (b)(i)**. Many were able to use Pythagoras's Theorem correctly and expand the brackets then collect terms to obtain the required equation. Incorrect expansions $4x^2 + 9$ and $x^2 + 9$ were seen occasionally and it was noticeable that candidates made more mistakes if they started with $(2x + 3)^2 – (x + 3)^2$. Some errors or omissions were made in the final line of working. Candidates should check carefully that they have written the equation precisely to avoid losing the accuracy mark. A common error was to start with $(2x + 3)(x + 3)$. Several candidates attempted to solve the equation using the quadratic formula.

(ii) The majority of candidates knew the formula and applied it well, clearly showing all their working. Most observed the 2 decimal places but truncating to 2.05 and –4.05 was a common error. A minority used completing the square and they were usually successful. Those using the formula need to take greater care with their presentation to avoid losing marks unnecessarily. They need to ensure that the division line is completely drawn and the square root sign encloses all of $b^2 – 4ac$.

(iii) Generally well done. Most found the area correctly or chose a correct positive value and were able to gain the follow through marks for correct use of the basic area of triangle formula. A few only multiplied their value of $(x + 3)$ by 5 and some used 2.5 multiplied by their x.

Answers: **(a)** 0.57 ; **(b)(ii)** (x – 10)(x + 1), **(iii)** 21 ; **(c)(ii)** –4.06 and 2.06 , **(iii)** 12.63 to 12.65

Question 6

This question using trigonometry was well done by some candidates but many found part **(a)** challenging and were unsure about how to show that angle ABC = 40.5º, correct to one decimal place.

(a) Those that realised that they needed to use the area of a triangle formula ½ $ab\sin C$ were able to write ½ .16.25 sin$B$ = 130 and rearrange to sin$B$ = 0.65. Some found the height of the triangle first and then used sin$B$ = 10.4/16. As this was a 'show that' question candidates needed to give an angle value to at least 4 figs. and state that it was 40.5 to one decimal place. Numerous candidates lost a mark by writing only one value instead of both 40.54…. **and** 40.5. Some used the 40.5 answer and calculated ½ .16.25 sin40.5 as 129.889… stating that this was approximately 130. This method is not an acceptable proof and candidates can improve their work on this type of question by making sure that they do not use the given answer in any calculation.

(b) Many candidates correctly used cosine rule and gave a clear, concise and accurate calculation. The most common error was seen in attempts to evaluate $16^2 + 25^2 – 2 \times 16 \times 25 \times \cos 40.5$ as 81cos40.5. Some found the perpendicular height from A to BC as 10.4 and used Pythagoras's Theorem to find part of the base BC as 12.16. Then used Pythagoras's Theorem again with 10.4 and 12.84 to find AC correctly but this more complicated method often led to premature rounding and answers out of the acceptable range.

(c) Good candidates found the shortest distance by either using the area of a triangle ½ x 25 x h = 130 or using $\sin 40.5 = \frac{h}{16}$. A large number of candidates incorrectly assumed the triangle ABC was isosceles and calculated $16^2 – 12.5^2$.

Answers: **(b)** 16.51 to 16.53; **(c)** 10.39 to 10.4[0]

Question 7

There was a varied response to this question on probability and sets. Many showed a good understanding of probability but then found the work on Venn diagrams a little more challenging. The word **without** was emphasised in the question and it was disappointing to see attempts that assumed replacement. Not all candidates used the Venn diagram as an aid to answering part **(b)**. A correctly completed diagram helped many candidates to score full marks. Some misread the information or confused the symbols union and intersection but they appeared more confident when interpreting the wording and were able to use their diagram to gain follow through marks for parts **(iii)** and **(iv)**.

(a) (i) Many correct solutions were seen. Some candidates were unsure about how to combine the probabilities. Common errors were writing the probability of picking only one disc $\frac{2}{5}$, adding $\frac{2}{5}$ and $\frac{1}{4}$ and finding $\frac{1}{5} \times \frac{1}{4}$.

(ii) This proved more of a challenge with many varied attempts. Most were able to identify the pairs that totalled 5 or at least one correct product. The more able candidates generally used efficient methods and took account of the without replacement. Some listed the numbers that added to 5, not realising that some could be obtained in more than one way, and gave an answer of $\frac{3}{20}$. Others incorrectly listed 25 possible outcomes in a two-way table and this usually led to the answer $\frac{6}{25}$.

(iii) Nearly all candidates that completed **part (a)(ii)** gained the mark here by giving a correct answer or by following through their answer.

(b) (i) Many correct responses from the more able candidates. Some seemed confused by the notation $n(E \cap F)$ and found $n(E \cup F)$ instead with 17 a common incorrect answer.

(ii) The common error was to find $n(E' \cap F)$.

(iii) Most that attempted this part realised the fraction needed to be out of 50 and gained the follow through mark.

(iv) Not always attempted but a lot of candidates were able to gain the follow through by using their diagram correctly.

Answer: **(a)(i)** $\frac{2}{20}$, **(ii)** $\frac{6}{20}$, **(iii)** $\frac{14}{20}$; **(b)(i)** 7, **(ii)** 42, **(iii)** $\frac{7}{50}$, **(iv)** $\frac{7}{9}$.

Question 8

Some very good solutions were seen from candidates that clearly knew their circle theorems. Others found this question difficult with part **(c)** proving to be beyond many of the weaker candidates.

(a) There were many correct answers and many more gained at least one mark by correctly finding some of the angles *ABX*, *XDC* or the obtuse angles at *X*. Some used alternate angles and gave the answer as 28º. Others assumed that *X* was the centre of the circle and having found that angle *DXC* = 128º then took the triangle *DXC* to be isosceles leading to an answer of 26º.

(b) Many correct solutions were seen but slightly fewer candidates were successful in this part of the question compared with **part (a)**. Those that worked with angles at the centre usually gave angle *SPQ* as 11x and then formed an equation based on opposite angles of a cyclic quadrilateral. Far fewer gave the reflex angle *SOQ* as 50x and used angles at a point. Some thought that the quadrilateral *SOQR* was cyclic and $25x + 22x = 180$ (or even 360) was a common mistake.

(c) This type of question requires candidates to show a clear progression through the various stages of calculation. To ensure the accuracy of the final answer is within the acceptable range candidates should keep at least 4 significant figures in the working for their answers to each stage. The method to find the area of a sector was well known and many were able to find a correct value. Using 44 ÷ 360 as 12% or 0.12 is not advised as this level of premature approximation leads to an out of range final answer. Those that realised angle *OLM* was a right angle usually made some progress on finding the area of the triangle. Most successful candidates found *LM* using 8tan44 and then used ½ x 8 x *LM* to find the area of the triangle. Some incorrectly assumed *OM* was 8 and attempted ½ x 8 x 8 sin44. It was common to see candidates dropping a perpendicular *LP* from *L* to *OM* and then using a combination of trigonometry and Pythagoras's Theorem to find *LP* and *OP*. A few then calculated *OM* which led to *PM* or *LM* and then the area of the triangle. Some were successful but this inefficient method was often left unfinished or led to mistakes and inaccurate values being obtained.

Answers: **(a)** 24 ; **(b)** 5 ; **(c)** 6.32 to 6.34

Question 9

Candidates performed well on this data handling question with many achieving full marks. Most candidates showed a good understanding of cumulative frequency and completed part **(a)** successfully. The method for calculating the estimated mean was well known by many candidates and most clearly showed the working required to gain full marks.

(a) (i) This was very well answered. Nearly all were able to read the median value as 72.

(ii) Again this was very well answered with most finding the lower quartile as 68.

(iii) Some candidates still write the inter-quartile range as 68 to 76 rather than give a single value.

(iv) This part was answered well with many correctly reading 36 from the graph and subtracting from 200. Only a few gave the answer as 36. Some interpreted more than 1 hour by reading above the curve at 38 and finding 200 – 38 = 162.

(b) (i) Most realised the need to subtract 9 from 20 and gave the correct value 11. A few did not subtract and gave the answer 20. Some thought the answer was 10, maybe from interpreting ≤ 50 by reading at 49 and finding 19 – 9.

(ii) This part was answered very well with most candidates working accurately using the correct mid-values and the correct method for the estimate of the mean. Some used the upper or lower bounds, others used interval widths instead of mid-values and a few used mid-values 35.5, 45.5 etc. Occasional slips within the calculation were seen but candidates clearly showing all their working still gained the method marks. Candidates are advised to show clearly the addition of the *fx* values.

Answers: **(a)(i)** 72, **(ii)** 68, **(iii)** 8, **(iv)** 164; **(b)(i)** 11, **(ii)** 69.95 to 70.0

Question 10

All candidates were able to score some marks on this sequences question but few answered it fully correctly.

(a) Most candidates were able to give the 6th term for sequences *A*, *B*, *C* and *D*, with only the occasional slip. Many did not realise that sequence *E* was the difference between *D* and *C*, those that did nearly always scored full marks for the whole question. Writing the n^{th} term proved more difficult with candidates often recognising *B* as n^2 and *C* as $n^2 + n$, but not attempting *D* and *E*. The linear sequence *A* was not always simplified although answers such as 11 – 2(n - 1) were given full marks. The most common error was to write 11 - 2n and this scored a method mark for writing a linear expression of the form $k – 2n$. Some expressed sequence *D* as n^3 rather than 3^n. Sequence *E* was rarely correct with some of those realising the need to subtract making a slip by writing $3^n – n^2 + n$.

(b) (i) This was often correct with some finding the correct value despite an incorrect expression in the table. Others correctly followed through their expression and gained the follow through mark. Some omitted the negative sign and gave the answer as 187.

(ii) Many correct answers were seen.

(c) Many realised the sequence involved repeated multiplication by 3 and as in **part (b)(i)** despite not writing an expression in the table were able to use their calculator to find the correct value.

(d) This was rarely correct. Only the candidates with the correct expression for the *n*th term were successful.

Answers: **(a)** A : 1 , $13-2n$; B: 36 , n^2 ; C: 42 , $n(n+1)$; D: 729 , 3^n ; E: 687 , $3^n - n(n+1)$.
(b)(i) –187 , **(ii)** 10 100 ; **(c)** 8 ; **(d)** 58 939.

