MATHEMATICS

Paper 4024/11

Paper 11

General comments

This paper differentiated well between the candidates and, in general, the scripts were well presented, with the full range of marks scored. Usually, weaker candidates were only able to score full marks on 1**(a)** and **(b)**, 2**(b)**, 5**(a)**, 8**(a)** and **(b)**, 10**(a)**, 15**(a)** and **(b)**, and often did not attempt several of the later questions.

It is important that care is taken when transferring answers from the working to the answer line as mistakes can lead to the loss of marks.

There was little evidence that candidates did not have sufficient time to complete the paper.

Comments on specific questions

Question 1

(a) This question on addition of fractions was mostly correct. A few added the numerators together and the denominators to get $\frac{3}{11}$.

(b) Again a high success rate was seen in this part.

Answer: **(a)** $\frac{13}{18}$ **(b)** $\frac{22}{27}$

Question 2

(a) Even though BODMAS was quoted, many candidates applied the order of arithmetical operations incorrectly. Frequent wrong answers were: (10-8) ÷ 2 + 3 = 1 + 3 = 4, 10 – 4 + 3 = 7, and (10 – 8) ÷(2 + 3) = 2 / 5.

(b) This percentage question was mostly answered correctly.

Answer: **(a)** 9 **(b)** 12

Question 3

(a) This part was answered quite well, but many failed to score the mark because they began by subtracting 40º from 360º.

(b) Many failed to get beyond quoting the formula for the circumference of a circle. Some used a numerical value for π. Others did not understand “in terms of π”.

Answer: **(a)** 63 **(b)** 28 / π

Question 4

This question proved difficult for most candidates. Many scored a mark for the total distance divided by the total time, where their time was in minutes. A common misunderstanding was to find the speed of each part of the journey, and then give the average of their two values.

Answer: 64

Question 5

(a) This part was answered quite well

(b) A variety of incorrect answers were seen, mostly 140º, suggesting that there are many who do not understand the topic of bearings.

Answer: **(a)** C **(b)** (0)40º

Question 6

(a) Many failed to earn the mark because their answer was not given as an inequality, often just 3.5.

(b) As an inappropriate answer was usually given in part **(a)**, many were denied the opportunity of gaining a follow through mark here. A minority, however, failed to see the connection between parts **(a)** and **(b)**, started again, and correctly found the largest integer.

Answer: **(a)** $x < 3.5$ **(b)** 3

Question 7

Responses to this question were varied. Many stated that $1 / n > 1 / n^2$ was false. Some who correctly stated that $(n – 1)(n + 3)$ was not always odd, failed to justify their decision with an acceptable example.

Answer: TRUE, TRUE, FALSE with valid example

Question 8

(a) This part was usually well done, but answers such as 98 showed that some candidates did not relate their work to the context of the question.

(b) This part was generally correct.

Answer: **(a)** 49 **(b)** 18

Question 9

(a) This part was fairly well answered but 6.95 was a very common wrong answer.

(b) There were very few correct responses. The majority failed to recognise that, in order to arrive at the correct answer, the upper bound of the diameter, 7.5 mm, must be used.

Answer: **(a)** 6.5 **(b)** 6

Question 10

(a) This multiplication question was mostly answered correctly.

(b) This part was well done on the whole, but frequent wrong answers such as 0.003, 0.03 and 0.3 suggest that some candidates are unsure about division by a decimal.

(c) Many scored the mark, although 9 was a common wrong answer.

Answer: **(a)** 0.012 **(b)** 300 **(c)** 3

Question 11

The responses to this question were most disappointing, with almost all candidates finding the topic of geometry somewhat demanding. Two method marks were available, one for stating that either CO = OD or AO = OB, and the other for stating that $A\hat{O}C = B\hat{O}D$. Those who were able to make a sensible start rarely managed to get beyond stating that one pair of radii were equal. Few identified the pair of equal angles. The award of the final mark for a successful completion, including a valid reason and conclusion, was rare.

Answer: congruent triangles established and conclusion

Question 12

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

(b) The response to this question was very disappointing. Most were unable to obtain the correct equations for the boundary lines. Those who did, then had difficulty in inserting the correct inequality signs. Few correct answers were seen.

Answer: **(a)** (1.5, 6.5) **(b)** $x \geq 0$, $y \geq 4$, $x \leq 3$

Question 13

(a) Many candidates answered this part correctly, but in a significant number of answers the matrix was not of the correct shape. A variety of shapes such as 3 x 2, 2 x 1, 3 x 1 or 2 x 3 were seen, or even a single number, 750 usually.

(b) It was expected that candidates would refer to the total cost involved and many did. However, a significant number failed to do this and referred to either the separate cost of each individual item or to the number of items bought.

Answer: **(a)** (400 350) **(b)** Total cost (of each family's order)

Question 14

This question was either answered poorly or not at all. Few candidates scored full marks. Most did not gain any credit because of an inability to calculate the frequency densities. A few scored one mark for correctly drawing just the first column with a width 10 and height 0.4.

Answer: correct histogram

Question 15

(a) This question posed few problems.

(b)(i) This part was frequently correct, but some gave the answer in cents.

(b)(ii) This part was also answered quite well on the whole. Some were aware that it was necessary to divide their answer to part **(b)(i)** by 2.5, but were unable to cope with the arithmetic involved. Others multiplied 6.90 by 2.5 to give 17.25.

Answer: **(a)** 40.81 **(b)(i)** 6.90 **(b)(ii)** 2.76

Question 16

(a) Although a significant number of candidates scored full marks, this question proved difficult for many. Some were unable to proceed beyond finding that the total number of runs scored is 27, whilst others became involved in much complicated arithmetic which was often difficult to follow. Credit was given for a total of 27 with their median equal to 8.

(b) Responses were varied to this part. Some correct answers, but often candidates evaluated 4 x 11 and gave their answer as 44.

Answers: **(a)** 6, 8, 13 **(b)** 17

Question 17

(a) Many candidates understood the correct approach to this question. Having obtained k = 36, some failed to gain both marks because their final answer was given as $y = k / x^2$.

(b) Those using the correct equation from part **(a)** usually scored the mark.

(c) Although the question asks for two values of q, many gave just the positive value of the square root of 36.

Answer: **(a)** $y = 36 / x^2$ **(b)** 9 **(c)** ± 6

Question 18

(a) This angle was generally correct.

(b) Often an answer of 45º was given following the incorrect assumption that AD is parallel to BC.

(c) Following the same assumption, the answer was frequently given as 65º.

(d) It was apparent that some candidates did not know the definition of a reflex angle as answers below 180º, especially 135º were sometimes given.

Answer: **(a)** 50º **(b)** 65º **(c)** 45º **(d)** 225º

Question 19

(a) This part was generally well done. Common wrong answers were 48 and -48.

(b) A large number of candidates failed to score the mark because they used 162000 instead of 162000 million and gave the answer as 1.62×10^5.

(c) Only a minority scored full marks on this part. A few others earned one mark for the digits 532.

Answer: **(a)** 78 **(b)** 1.62×10^{11} **(c)** 5.32×10^{21}

Question 20

This question revealed that there are many candidates who are not familiar with the properties of similar triangles.

(a) Only a small number of correct answers were seen.

(b) This part was frequently not answered. A correct response was rare.

(c) Few correct answers were seen and it was often not attempted.

Answer: **(a)** 4 : 25 **(b)** 2 : 5 **(c)** 7.5

Question 21

(a) This question proved difficult for many. A frequent incorrect answer was 7, the next term in the series. Some thought the difference between the successive terms was +3. Very few responses earned both marks.

(b)(i) The correct factors were usually given.

(b)(ii) This part was generally well done with many correct answers. Those candidates who did not score both marks usually obtained one mark for the correct extraction of a common factor at some stage.

Answer: **(a)** $22 - 3n$ **(b)(i)** $(2x - 5y)(2x + 5y)$ **(b)(ii)** $(5a - 2)(x - a)$

Question 22

(a) Some correct graphs were drawn. However, it was very common for the first part of the journey to be represented by a line joining the point (10 10, 0) to (11 10, 6).

(b) (i) The mark for this part was not available for the majority because there was no line on their graph representing the return journey.

(b) (ii) For the same reason most failed to earn the mark.

Answer: **(a)** correct distance-time graph **(b)(i)** 10 48 **(b)(ii)** 4

Question 23

(a) (i) Only a minority were able to derive the given equation. Many failed to read the question carefully and solved the equation.

(a)(ii) This part was fairly well done with a good number realising that they had already answered the question in part **(i)**.

(b) This part was frequently omitted. Very few recognised the necessity to equate $(20t - 5t^2)$ to zero and then solve the resulting equation.

Answer: **(a)(ii)** 1, 3 **(b)** 4

Question 24

(a) (i) About a half of the candidates obtained the correct value for x. For the rest, almost all failed to score due to a fundamental error at the outset. The left hand side of the equation was reduced to $3(3x - 1)$ resulting in the solution $x = \frac{4}{7}$.

(a)(ii) This part was generally well done.

(b) Most candidates were well acquainted with a correct method to solve a pair of simultaneous equations and successfully obtained the correct solutions. Those who failed to score full marks usually earned a method mark for an elimination or a substitution.

Answer: **(a)(i)** 0.75 **(a)(ii)** $\frac{8}{15}$ **(b)** $x = 2$ $y = -3$

MATHEMATICS

Paper 4024/12

Paper 12

General comments

Responses covered the whole range of marks available. There were a pleasing number of a good standard although the paper allowed candidates of all abilities to demonstrate positively what they knew. Candidates were able to complete the paper comfortably in the time available.

Candidates generally set out their working clearly in the spaces provided and stated their answers in the expected places. Many scripts were set out and presented in exemplary fashion. However, a number of candidates need to be discouraged from working outside the area given to a particular question. Marks are awarded for working so it is important that it is seen where expected and also that it is set out in full. Occasionally, this was not the case. In a minority of scripts, individual letters and figures were unclear, sometimes even to the candidates themselves, judging by the number of times that an answer did not tally with the final working shown.

Nearly all candidates got off to a confident start in this paper, scoring well on **Questions 1** to **4** and **Question 6**. Marks continued to be available to most candidates in **Questions 9, 13, 14(a), 15, 19, 24(b)** and **26(a)**. When a standard routine was required, such as, in algebra, solving simultaneous equations or factorisation, or in geometry, a particular construction, good marks were obtained. In **Questions** such as **5, 10(a), 18(a)** and **(b), 22(b)(ii), 23(a)** and **(b)** and **25(a)** that dealt with more difficult concepts where methods had to be more carefully thought out, marks were harder to earn. These questions proved to be more challenging to nearly all candidates.

Comments on specific questions

Question 1

(a) This part was generally well done. 5.2 was the most common error, with 5.8 also seen.

(b) This part was also usually correct. The digit 6 was generally found, with 6 or 600 given as common wrong answers.

Answer: **(a)** 0.7 **(b)** 60

Question 2

In this type of question, basic number work such as 25 – 14 and 5×7 needs care. These are not 9 and 25 respectively. There were a few decimal answers given despite the instruction in the question.

(a) The subtraction of fractions was well done, with just a few answers of $\frac{3}{2}$ seen.

(b) The multiplication of fractions was usually correct, with just a few giving $\frac{35}{18}$ as the final answer.

Answer: **(a)** $\frac{11}{35}$ **(b)** $\frac{18}{35}$

Question 3

(a) This percentage question was well answered.

(b) This part was generally well understood. However, some candidates worked out only the increase.

Answer: **(a)** 22 **(b)** 1380

Question 4

(a) This question was well answered. 9 was the most common wrong answer.

(b) This part was clearly harder, but nevertheless, quite well done. The exact value, $\frac{1}{3}$, was expected, however, and not a decimal approximation. 81 was a common wrong answer.

Answer: **(a)** 10 **(b)** $\frac{1}{3}$

Question 5

It was expected that 50, 0.2 and 4 would be seen in the working so that those who did not get the right answer could be given some credit. Many candidates did indeed earn this mark. Common rounding errors were to offer 5 or 49 instead of 50, and 0 instead of 0.2. Many candidates did not understand what was being asked, however. They attempted this calculation without adjusting the numbers given in the question. This led to insurmountable long multiplications and divisions for which no credit could be given.

Answer: 0.5

Question 6

(a) There were many correct solutions. Sadly, some candidates failed to find x correctly after successfully reaching $3 = 2x - 2$. A common working error seen was $3 = 2x - 1$.

(b) This rearrangement was usually well understood. A common wrong answer was $\frac{p-r}{2}$. The correct answer was sometimes seen in the working, but became $\frac{p+r}{t}$ when transferred to the answer line.

Answer: **(a)** 2.5 **(b)** $\frac{p+r}{2}$

Question 7

(a) The demands of this question were usually understood, but care was needed not to miss out one of the diagonal lines of symmetry. A significant number of candidates managed only 3 or 4 lines of symmetry.

(b) Again, this part was usually understood. Care was needed when electing to draw a rhombus that it was not in fact a square. The common wrong answers were trapezium and kite. Weaker candidates attempted hexagons, or compound shapes. Quite a number of candidates omitted this part of the question.

Answer: **(a)** All six lines indicated **(b)** Rectangle, parallelogram or rhombus drawn

Question 8

(a) Finding the difference between the temperatures was quite well done. (±)67 was a common wrong answer.

(b) Again, this calculation was quite well done. -118 was one of the common wrong answers in this part.

Answer: **(a)** 81 **(b)** 24

Question 9

(a) This part was usually well understood and well answered.

(b) Again, this part was well understood and well answered. A common wrong answer, however, was 7.

(c) This part proved demanding for many candidates, and was often avoided. Some thought the answer was 2.

Answer: **(a)** $2^2 \times 5 \times 7$ **(b)** 28 **(c)** 42

Question 10

(a) Candidates who were not successful in this question usually failed also to gain any credit for their method. Those attempting an algebraic solution with Jane's share as x, usually gave Ken's share as $16 - x$ instead of $x - 16$. Candidates who tried to use $\frac{5}{8}$ and $\frac{3}{8}$ directly seemed to think that the shares would be $\frac{5}{8}$ of 16 and $\frac{3}{8}$ of 16, instead of constructing an equation to reach the total 64.

(b) This part also proved challenging, with an answer such as 250 000 frequently seen.

Answer: **(a)** 40 24 **(b)** 2.5

Question 11

(a) The correct numerator of 9 and the correct denominator of – 6 were usually achieved but it was expected that the fraction should be resolved further than $\frac{3}{-2}$ to gain the final mark.

(b) Candidates generally showed some competence with the technique required here, but care was needed in rearranging $3xy = 5 - 2x$.

Answer: **(a)** - 1.5 **(b)** $\frac{5}{3x+2}$

Question 12

(a) Many candidates seemed to think that the formula meant $y = \frac{k}{x^2}$, for which only 1 mark was given. Wrong answers frequently had a correct method gaining credit, but working such as $48 = \frac{k}{\frac{1}{4}}$ followed by $k = 192$ was often seen. Many candidates, however, did not know what inversely proportional meant.

(b) Candidates using $y = \frac{k}{x^2}$ usually got both values of x, but occasionally only (+)2 was given.

Answer: **(a)** $\frac{12}{x^2}$ **(b)** 2 - 2

Question 13

Candidates answered this question well. Usually, appropriate multiples of the equations were found in order to eliminate one of the variables. However, care was needed with the subsequent subtractions and transpositions in order to reach a successful conclusion. On the whole, candidates who chose this method fared better than those who attempted substitution. The minority of candidates who attempted a matrix method were rarely successful.

Answer: 5 - 4

Question 14

(a) This part was mostly correct. A common error was to give +2 for the x coordinate. Care, however, is needed in writing the coordinates, once found, in the correct answer spaces.

(b) This part was generally well understood, with candidates gaining credit for at least a correct m or c, or for finding a line passing through one of the given points. Again, some candidates were let down by their inability to negotiate basic processes accurately, for example, rewriting $y = -\frac{3x}{4} + 4$ as $4y = -3x + 4$. A minority of candidates tried to find the length of PQ.

Answer: **(a)** (- 2, 5.5) **(b)** $y = -0.75x + 4$

Question 15

Candidates generally demonstrated a good knowledge of the appropriate angle properties of the circle. Disappointingly, some candidates did not question the validity of reaching answers such as 142°.

(a) This angle was usually correct.

(b) This angle was usually correct.

(c) Quite a number of candidates benefitted from the follow through mark here.

Answer: **(a)** 52 **(b)** 52 **(c)** 38

Question 16

(a) Completing the tree diagram was well understood, and with care, most candidates gained credit here. There were a number of tenths and eighths seen however, together with the correct $\frac{6}{9}$ and $\frac{3}{9}$ sometimes reversed.

(b) The probability of a combined event was well understood by many candidates. Again, to gain full marks, this had to be followed by correct manipulation of the fractions. This let a number of candidates down. Candidates who worked through correctly from an error in part **(a)** were not penalised. In the expression for the combined probability, although all the individual fractions were correct, some candidates interchanged the addition and multiplication signs required, for which no credit could be given.

Answer: **(a)** $\frac{4}{10}, \frac{4}{9}, \frac{6}{9}, \frac{3}{9},$ **(b)** $\frac{7}{15}$

Question 17

In general, the response to this question was encouraging. Vectors remain a mystery to many candidates, however, as frequently, non-vector answers such as 2**p** + 3 were given.

(a) This part was generally correct.

(b) The use of $\frac{2}{3}$ **q** here instead of $\frac{2}{3}$ 3**q** seemed a common error.

(c) In the follow through here, it often seemed that the answer given in part **(b)** was being subtracted from **q** instead of 3**q**.

Answer: **(a)** 2**p** +3**q** **(b)** 2**p** + 2**q** **(c)** - 2**p** + **q**

Question 18

(a) Finding the area of a sector was generally correct, although there were a number who used $\frac{60}{180}$. Numerical values of π and *r* tended to creep in.

(b) The formula for the length of a circular arc was well known, most candidates gaining credit for this. In the final result, a common error was to leave out 2*r*. Keeping the 2*r* in however led many candidates to an incorrect final expression. Attempts to factorise and insert brackets into the full expression caused problems.

Answer: **(a)** $\frac{\pi r^2}{6}$ **(b)** $2r + \frac{\pi r}{3}$

Question 19

(a) Mostly correct. A common error was (-1) – (-1) = -2 instead of 0.

(b) The process of finding an inverse matrix was generally well known. Candidates scored well on this question. Care was needed, however in applying the factor $\frac{1}{2}$ to the adjoint matrix. Numerical errors were seen at this stage. Many candidates picked up the mark for the adjoint matrix, but used an incorrect determinant, such as -2, 5 or 3.

Answer: **(a)** $\begin{pmatrix} 3 & -1 \\ 0 & -1 \end{pmatrix}$ **(b)** $\begin{pmatrix} \frac{3}{2} & -1 \\ \frac{1}{2} & 0 \end{pmatrix}$

Question 20

(a) The median was generally correct. It was expected that the graph would be read correctly, so that no credit was given for answers such as 40.

(b) A common error was to use 45 and 15 as the values of the quartiles. Usually, it was evident that at least one of the quartiles had been read off correctly.

(c) As in part **(a)**, it was expected that the graph would be read accurately, so that in this part, no credit was given for answers such as 8, 9.5 or 10. Giving the answer as 51 was a common misunderstanding.

Answer: **(a)** 39 **(b)** 14 **(c)** 9

Question 21

(a) (i) There were many correct answers. Some candidates anticipated the difference of two squares in this part, however.

(ii) This part was found to be more difficult, with many candidates not recognising the expression as a quadratic.

(b) Some confident work from stronger candidates was seen. Many candidates gained credit for factorising either the numerator or denominator correctly, having ended up with an incorrect answer, perhaps having cancelled incorrectly. However, a significant number of candidates could be given no credit at all since they indulged in false cancelling from the start of their working.

Answer: **(a)(i)** $3x(x- 4)$ **(ii)** $(x + y)(x – 2y)$ **(b)** $\frac{x}{x-4}$

Question 22

(a) This was an easy mark for many candidates, but a wide variety of answers were seen from many who were not confident with this conversion.

(b) (i) It was a pity that quite a number of candidates continued to work in metres here. Generally, the idea of upper and lower bounds is difficult and so it was encouraging to find that many candidates found the required lower bound successfully. A common wrong answer was 350.

(ii) The understanding required to negotiate this question proved beyond many candidates. A number gained some credit for realising that they needed to use the upper bound 5.5, but generally there was confusion between 5.5 and 4.5, and between using 400 and 395. The link with part **(i)** was often not used.

Answer: **(a)** 2 500 000 **(b)(i)** 395 **(ii)** 340

Question 23

(a) There were a good number of correct answers using right-angled triangle trigonometry as expected. There were some correct attempts using longer methods, such as Pythagoras. However, many candidates failed to see the significance of the fact that triangle *ABC* was isosceles, and so did not have a suitable right-angled triangle to work with. Instead, the cosine and sine rules were attempted, without success. A common misunderstanding was to say $\cos\theta = \frac{32}{AB}$.

(b) Again, a good number of correct answers were seen using ½ Base ×Height or using the sine formula with their answer to part **(a)**. A common misunderstanding was that the area was ½×32×*AB*.

Answer: **(a)** 34 **(b)** 480

Question 24

(a) Many correct attempts were seen. Candidates were given credit if their triangle T had two vertices correct, or if it was of the correct size and orientation.

(b) A good number of full descriptions were given. It was generally appreciated that rotation was involved. The centre or angle of rotation, however, were frequently missed.

(c) The matrix was often missed out, but a number of correct answers were seen.

Answer: **(a)** Triangle T with vertices (5,6), (3,6) and (3,2) **(b)** Rotation 90° anticlockwise centre (0,0)
(c) $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

Question 25

(a) The distance calculation was mostly correct, with 144 the common wrong answer.

(b) Examiners expected to see that the tangent drawn was clearly at $t = 18$, so some care was needed in drawing to gain this mark. Most candidates attempting this question seemed to understand what was meant by a tangent, but some simply drew a vertical line at $t = 18$. Those drawing a tangent usually arrived at a correct gradient. The range 0.5 to 0.9 was allowed for the gradient, but it was expected that candidates would simplify their answers, so that for example, no credit was given for unconventional fractions such as $\frac{2.3}{3}$.

(c) For this mark, Examiners expected to see a smooth curve from (0,0) to (8,36) with the correct curvature, and a straight line from (8,36) to (16,108). Credit was given if the straight line was consistent with the answer to part **(a)**. Common errors were to draw a straight line from (0,0) to (8,36), losing 1 mark, or to draw one straight line from (0,0) to some point at $t = 16$, losing both marks.

Answer: **(a)** 108 (**b)** 0.7 ±0.2 with tangent at $t = 18$ **(c)** Correct distance/time graph

Question 26

(a) Almost all candidates managed to draw the correct triangle. Examiners expected to see the necessary construction arcs in order to award full marks, but if not seen, credit was given for the correct triangle.

(b) Many candidates scored full marks in this part, but there were some with two correct loci drawn who then shaded incorrectly. Nearly all candidates attempting this question drew the arc, radius 7 cm, with centre B. The perpendicular bisector of AB seemed to cause problems for some of the weaker candidates.

Answer: **(a)** Correct triangle **(b)** Correct region shaded

MATHEMATICS

Paper 4024/21

Paper 21

General comments

There was a wide spread of ability on this paper. There were a number of excellent scripts which were well presented and demonstrated a firm grasp of the ideas. There was another group of scripts that were poorly presented and showed little sign of connected thinking. Candidates who discipline themselves to produce ordered answers usually find it leads to better answers and results. There were many cases where the solutions appeared in two columns, which were usually very cramped. The saving of paper is usually minimal, and often lost by leaving the back of the pages blank. The resulting cramped and untidy working often leads to many slips and errors. This practice should be discouraged.

Comments on specific questions

Question 1

Although the first part of this question on functions was usually well answered, the response to the remainder of the question was very poor, with many candidates not answering either part. Surprisingly many of those who did equate f(t) to f to reach $4t = -2$ went on to state that $t = -2$. There was a slightly better response to the last part, but only a minority knew what was required of them, with $\frac{5}{x-2}$ being common.

Answers: **(a)** 1 **(b)** $t = -\frac{1}{2}$ **(c)** $5x + 2$

Question 2

There was a much better response to this percentage question, with many good scores.

(a) Most first found the profit as \$18, and many reached the correct answer. The main error was to express that as a percentage of the sale price of \$66.

(b) The stronger candidates treated \$19.50 as 130% of the sum required, but very many candidates subtracted 30% of the sum from \$19.50.

(c) Many were able to calculate the sale price to be \$88, but a large proportion of these failed to reduce that price by 10% to find the price in the sale on a Thursday.

Answers: **(a)** 37.5% **(b)** \$15 **(c)(i)** \$88 **(ii)** \$2.80

Question 3

Candidates found this question very hard. Most, but by no means all, drew a rectangle with sides 13 cm and 8 cm, though a few tried to use some other scale. Some lost credit because the bisector failed to cross the rectangle and the arc was too short. If both of these boundaries had been drawn, only about half of the candidates managed to identify the region R. The point P only rarely appeared where WX cut the arc, though most did have Q at the middle of YZ. A small number of those who had reached this stage then quoted the length on their diagram or the acute angle.

Answers: **(c)(ii)(a)** 41 to 43 m **(b)** 105° to 109°

Question 4

There were some good attempts at this routine algebra question by all but the weakest candidates.

(a) Most knew how to start and the scores were good. A few lost the denominator towards the end, but the most common error came in the expansion of the bracket -3(x + 3).

(b) This was well done by very many candidates.

(c) The idea was well understood, but solutions were spoiled by sign errors too often. The 4 in the formula was replaced by -4 quite often and $\sqrt{208}$ by $\sqrt{176}$. When looking at the final answers, it was noted that the rounding often led to -1.73 and that the negative sign had vanished.

Answers: **(a)** $\frac{5x-13}{(2x-1)(x+3)}$ **(b)** $\frac{k^2-3n}{2l}$ **(c)** 3.07 and – 1.74

Question 5

(a) There were some easily available marks here. The common error in part **(ii)(a)** was to use 0.5 + 0.5. The two possible orders in the next part were often not used, leading to many answers of 0.1.

(b) Many were able to read off 17 directly from the Venn diagram. The last part was more testing. Common errors were to use $2x + x = 78$ or 78 – 36. Even when use was made of 78 – 54, this sometimes led to 1/2 x 24. Even after $x = 8$ was found, some went on to state that $2x = 16$ for "bus only".

Answers: **(a)(i)** $p = 0.5$, $q = 0.2$ and $r = 0.3$ **(ii)(a)** 0.25 **(ii)(b)** 0.2 **(b)(i)** 17 **(ii)** 8

Question 6

(a) Many obtained correct values for one of the angles required or both.

(b) Although "isosceles" was commonly quoted, in very many cases this was because candidates thought that angles A and C are 68° and angle B is 44°. Some stated that all three angles are 68°, so that the triangle is equilateral.

Answers: **(a)(i)** 136° **(ii)** 44° **(b)** A = 44°, B = C = 68° Isosceles

Question 7

(a) This part was not well done in general. Many did not use the mid-interval values. Some assumed that they ought to use 2 with all of the given frequencies, reaching a mean value of 2 of course. Several divided by the number of intervals, 5, in place of 80.

(b)(c) Most completed the table accurately and good curves were drawn.

(d) The median was quite well done, but some mis-read the horizontal scale, taking each small square to represent 0.1. The interquartile range was less well done. Too often, after figures of 60 and 20, the numbers 40 and 3.3 appeared. The values were followed through from the graph.

Answers: **(a)** 3.45 **(b)** 73 and 78 **(d)(i)** 3.3 **(ii)** 2.5

Question 8

The majority of candidates successfully found the correct value for p, but the plot was sometimes placed at x = -3, -3.4 or -2.4. Some candidates chose to use a scale other than that given, losing some credit and making it more difficult for themselves. Otherwise the graph was fairly well done generally, and many read off the value of x where $y = 2$. Only a few were able to spot that the line $y = x$ could lead to the solution of part **(d)**. Many found the gradient of the line *AB,* but the negative sign was sometimes ignored. There were some good tangents parallel to *AB* drawn and several found the coordinates of the intercept and its equation. Values were accepted from their graphs.

Answers: **(a)** p = -2.6 **(c)** 2.55 to 2.65 **(d)(i)** $y = x$ **(ii)** 2.40 to 2.50 **(e)** -4
(f)(ii) (0, 12) **(iii)** $y = -4x + 12$

Question 9

Candidates found this question quite difficult and it was not well done on the whole.

(a) Perimeter and area were often muddled. When finding the perimeter of the sector the two radii were often ignored. When finding the depth of the water many knew that they should divide 800 by something, but several used their answer to the previous part in place of the area of the sector. Many of the weaker candidates took the volume to be 1/3 Ah.

(b) Very few correct answers for MN were seen. Among the better answers was the response x = ½ MN. Some tried to quote Pythagoras involving OM. Many explained how the 16π was derived, but very few justified the x^2 term. The correct equation, $20(16\pi - x^2) = 800$, was not commonly used. Some obtained the correct answer without the use of the equation however.

Answers: **(a)(i)** 28.6 cm **(ii)** 15.9 cm **(b)(i)(a)** $2x$ **(ii)** 3.20 cm

Question 10

This was a popular question, with some good answers.

(a) Almost all found the first angle, but only a minority gave a correct answer for the second, since they did not use the angle sum of a polygon. Common wrong values were 140° or 40°.

(b) The use of trigonometry to find CT was well done, though the use of the sine formula was more common than the simpler method using the tangent ratio. There were many good attempts at the area of the pentagon by dividing it into two or more simple shapes. Many gained credit for multiplying that answer by 4 for the area of the octagon. Although many quoted the correct length for the card, the breadth was often not corrected up to the next integer, so the last answer was often not accurate.

Answers: **(a)(i)** 140° **(ii)** 130° **(b)(i)** 19.3 cm **(ii)** 2650 cm^2 **(iii)** 10600 cm^2
(iv)(a) 146 cm and 79 cm **(b)** 946 cm^2

Question 11

This was the least popular question. More attention needs to be given to this area of the syllabus, since scores were low when the question was attempted.

(a) The correct vector was rare. Although enlargement did appear fairly often, the scale factor was often thought to be –2 and the centre was very rarely seen. The shear was not often recognised, but candidates had more success with the equation of the line of symmetry.

(b) There was almost no work of merit submitted in these parts.

Answers: **(a)(i)** $\begin{pmatrix} 6 \\ -5 \end{pmatrix}$ **(ii)** Enlargement, scale factor ½, centre (4, 1) **(iii)** Shear **(iv)** $y = x + 1$

(b)(i) $(-q, -p)$ **(ii)** $(q, -p)$ **(iii)** $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$

Question 12

This was a popular question which was well done in very many cases.

(a) The vector part of the question had a mixed response. Many gave **q** – **p** as their first answer in place of **p** – **q**. Many spoiled their answer to the next part by taking *OS* to be 1/3 **p** in place of 1/4 **p**.

(b) The trigonometry was well answered in many cases, with many correct answers. The main error in the area of the triangle was the omission of sine 55°. The cosine formula was also well done. The main error was to go from 865 – 816 cos55 to 49 cos55, while a few used sin55 in place of cos55. Surprisingly many took the length of *WZ* to be 1/4 rather than 1/4 of 24 (= 6), but otherwise the use of Pythagoras was sound. The calculation of the volume was rather disappointing, since only a fraction of the solutions used the calculated value of the area of the triangular base found earlier. Examiners followed through from the answers to parts **(i)(a)** and **(ii)(a)**.

Answers: **(a)(i)** $\mathbf{p} - \mathbf{q}$ **(ii)** $\frac{3}{4}\mathbf{p} - \frac{1}{2}\mathbf{q}$ **(b)(i)(a)** 167 cm^2 **(b)** 19.9 cm **(ii)(a)** 13.7 cm **(b)** 766 cm^3

MATHEMATICS

Paper 4024/22

Paper 22

General comments

The paper proved, on the whole, to be of an appropriate length. The majority of candidates were able to attempt four ***Section B*** questions although a few candidates appeared to spend too long on ***Section A*** and tended to rush their work on ***Section B***.

The presentation was generally excellent and many scripts were a pleasure to mark.

Algebraic work, in general, was very good, but quite a number of candidates do not understand the importance of brackets. For example in **Question 10(b)(ii)**, the answer was sometimes given as nxn+1 instead of n(n+1).

A considerable number of candidates lost marks by not reading the question carefully enough. For example, in **Question 3(c)** and **(d)** the wrong planet was used and in **Question 8(d)** the answers were not given correct to 2 decimal places.

In Trigonometry questions, candidates should realise that they should use simple ratios in right-angled triangles and to reserve the use of sine and cosine rules for triangles that do not have a right-angle. Some candidates seemed averse to using the cosine and tangent ratios in right-angled triangles, preferring to use Pythagoras and sine. These candidates often lost accuracy marks by approximating a value to be used later in the question to only two or three significant figures. Candidates should be aware that when a method involving several stages is chosen, it is imperative that they keep intermediate answers to at least 4-figure accuracy, and make use of the memory facility on the calculator.

Comments on Individual Questions

Question 1

(a) Most candidates found *p* and *q* correctly, although a few gave *p* as 0.07 or r as 4 or 250 grams.

Part **(ii)** was well answered although a significant number omitted it altogether. A small number rounded \$7.75 to \$7.8.

(b) This part was usually answered correctly although some stopped at \$1060, perhaps not noticing the word 'more'. A few did not seem to understand the word 'deposit'.

(c) Candidates had more difficulty with this part. Many took the interest to be \$763.75 producing 23.5% as an answer. A number, who did work with \$113.75, failed to divide by either 650 or by 5.

Answers: **(a)(i)** $p = 7$, $q = 2.90$, $r = 0.25$, **(ii)** \$7.75; **(b)** \$80; **(c)** 3.5%.

Question 2

(a) (i) Most gave 110° immediately, but it was surprising to see answers of 70° and even 60° (180–120) occurring occasionally.

(ii) Almost all candidates appreciated the need to subtract their previous answer from 120° to obtain EÂD.

(b) Many candidates found this a difficult question. Many assumed that triangle AED was isosceles, or right-angled. A few assumed that ABCDE was a regular pentagon. A significant number gained the mark for part **(ii)** with an answer which followed through from their incorrect answer to part **(i)**.

Answers: **(a) (i)** 110°, **(ii)** 10°; **(b) (i)** 80°, **(ii)** 90°.

Question 3

Many candidates gained good marks in this question, showing a sound grasp of standard form.

(a) This part was usually answered correctly, either with names or values.

(b) Almost all candidates arrived at 3395, but many left this as their answer and others, trying to do the correction, gave 3,4000 or 3400.

(c) There were very many correct answers, most candidates realising that they needed to write each value to the same power of 10. A few then left their answer as 55.12×10^{23} while others continued from that to 5.512×10^{22}. A small number multiplied, or added the 4.87 and 6.42. Answers with 10^{47} were seen occasionally.

(d) A small number of candidates misread and either used the diameter of the Earth or worked with a different planet or used r^2 or r instead of r^3. A few went on to change a correct answer so that the power of 10 became 15 or 18 (possibly in an attempt to allow for cubic kilometres?)

Responses to **(c)** and **(d)** suggested that some candidates did not know how to enter standard form numbers into a calculator.

Answers: **(a)** Mercury, Mars, Venus, Earth; **(b)** 3000; **(c)** 5.51×10^{24}; **(d)** 1.10×10^{12}.

Question 4

In part **(a)** most candidates gave strict inequalities, suggesting that they realised the importance of the word 'inside' in the stem of the question, but in **(b)** they often used points that were on the boundary lines.

(a) Most candidates gave $y < 12$, but $y > 2x$ was seen rather less often. There were many answers of $y < 2x$, $y = 2x$ or $y > 2x$ + a numerical value. A few gave $y > x$.

(b) (i) Many did not know what was required in this part. Of those who did, few realised that (5, 11) was the correct point to be used. Some used non - integral coordinates, but the common answers were 18 (from (6, 12)) and 14 (from (4, 10)).

(ii) Again, very few realised what was required in this part and the point most often used was (4, 12).

Answers: **(a)** $y < 12$ and $y > 2x$; **(b) (i)** 16, **(ii)** 9.

Question 5

(a) (i) There were very many correct answers, but a number of candidates gave a 2 × 3 matrix.

(ii) Most mentioned cost or price, but some omitted to mention 'weeks' or introduced 'kilograms'.

(iii) There were many incorrect answers, even from good candidates, and sometimes in contradiction of the part **(ii)** answer. A large number gave $2165 as their answer.

(b) This part was usually correct. A few candidates replaced M with $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ and spent much time and space setting up and solving the resulting equations.

(c) (i) (a) This part was reasonably well attempted although many gave a list of elements for the answer. The response 6 was quite common from a failure to take 1 as a factor of 24.

(b) Very often one element (usually 14) was omitted, or extra ones (usually 4 or 8) were included.

(ii) A pleasing number of candidates reached A ∩ B = {3, 6, 12} but did not then know how to proceed. Some candidates did not recognise 3 as a multiple of 3 and so gave n(A ∩ B) = 2 and an answer of $\frac{1}{8}$.

Answers: **(a) (i)** $\begin{pmatrix} 930 \\ 1235 \end{pmatrix}$, **(ii)** cost of fruit in each week; **(iii)** \$21.65; **(b)** $\begin{pmatrix} -6 & 0 \\ 2 & -4 \end{pmatrix}$;

(c) (i)(a) 7, **(b)** {10, 14, 16}, **(ii)** $\frac{3}{16}$.

Question 6

(a) Almost all candidates gave the correct value for *n*, but a number gave either –0.5, –1, 0.5 or 1 for *m*.

(b) Most candidates plotted the points accurately and drew a smooth curve.

(c) Candidates should be told to give their solutions in the form *x* = ... and not to simply put a value on the axis. A few candidates used logarithms and others, trial and improvement.

(i) Most candidates found the value of *x* where the line *y* = 3 intersected the curve. A few left their answer as $\frac{2^{3.6}}{4}$.

(ii) Many candidates gave the x value 4.6 where the line y = 6 intersected the curve.

(d) Few candidates understood what this question was requiring and many made no attempt.

(i) A common solution was to go from $\frac{2^x}{4} = 2^t$ to $2^x = 8^t = 2^{3t}$ to $t = \frac{x}{3}$.

(ii) Of those who made a serious attempt at this part, most ended with *y* = 0.6. A few tried to find the equation of the tangent to the curve at the point (1.25, 0.6) and a few others plotted the graph of $y = 2^t$.

Answers: **(a)** m = $\frac{1}{8}$, n = 8; **(c) (i)** 3.6, **(ii)** 2.6; **(d)(i)** $t = x - 2$, **(ii)** $x = 1.25$.

Question 7

(a) (i) This part was usually answered correctly, either by using the trapezium formula, or by splitting into a rectangle and a triangle.

(ii) The majority of candidates used the direct method of arctan $\left(\frac{8}{12}\right)$ but a significant number used longer methods such as finding PS by Pythagoras, or by the cosine rule in triangle PRS or by even longer methods. Many candidates, particularly those using the longer methods, lost the accuracy mark by approximating prematurely, often using 0.66 for $\frac{8}{12}$.

(b) (i) and **(ii)** A good number of candidates did not attempt these parts, or else tried to use Pythagoras. Others assumed, incorrectly, that triangles LKN and MLN were also similar. Some used a combination of ratios to find NM and then used the cosine rule. These who were familiar with similar triangles usually answered both parts correctly.

(iii) Few candidates made a realistic attempt at this part. Some tried to use trigonometry or Pythagoras. A common wrong answer was 16/25, from $(NM/KN)^2$.

Answers: **(a)(i)** 184 cm^2, **(ii)** 33.7°; **(b)(i)** 27 cm, **(ii)** 15 cm, **(iii)** $\frac{16}{65}$.

Question 8

This question was often started by candidates and then abandoned. For those who continued, only a minority were able to gain full marks and many gained marks only in parts **(a)**, **(b)** and **(d)**.

(a) and **(b)** The majority of candidates were able to write down the correct expression although $\frac{15}{0.5x}$ and $0.5 + x = \frac{15}{t}$ were regularly seen in **(b)**.

(c) There was much confusion over the use of the 2 and the 7, and whether to add or subtract the expressions from parts **(a)** and **(b)**. Only good candidates were able to simplify their equation in x correctly. Some got as far as $5x^2 – 22.5x – 5 = 0$ but could not see the link to the required equation.

(d) Most candidates were able to make a reasonable attempt here, but sometimes with errors such as –9 for 9, 65 for 97 or 2 for 4. Many failed to give their answers to the requested 2 decimal places. A small number decided not to give the negative solution.

(e) (i) Many did not realise that the average speed required was given by adding 0.5 to their positive solution in part **(d)** and various long calculations were seen.

(ii) Candidates generally showed a good grasp of what was required here and even if they did not manage the required accuracy for both marks, most gained the method mark.

Answers: **(a)** $\frac{10}{x}$; **(b)** $\frac{15}{x+0.5}$ **(d)** 4.71 and –0.21; **(e)(i)** 5.21, **(ii)** 0.76.

Question 9

This was a popular question and most candidates gained good marks, although this was mainly because of parts **(b)** and **(c)(i)**. Many candidates showed a lack of understanding of bearings.

(a) A relatively small number of candidates were able to give the correct bearing and common wrong answers were 310° (from 360–50), 125° and 285° (from 360–75). It was rare to see a sketch of a line representing PL with North lines and the appropriate angles shown, which would undoubtedly have helped to simplify the problem.

(b) Most candidates realised that the cosine rule was required and many gained all 4 marks. However a significant minority lost marks through a lack of accuracy in their answer which was regularly given as 15.8 or 16.

(c) (i) Most used the sine rule, usually reasonably successfully, although again unreasonable rounding or truncating of values sometimes lost candidates marks. A few found $P\hat{Q}L$ instead of $P\hat{L}Q$.

(ii) A minority of candidates realised that it was an easy step to subtract 55° from their answer to part **(i)** to find the required bearing. Some subtracted 50, but many, despite the word 'hence' in the question, attempted long and complicated calculations. The fact that this part carried only 1 mark should have helped them to realise that they were on the wrong track.

(d) (i) A great number of candidates could not use the 24 hour clock to give a departure time of 2130. Many did the initial work correctly – but then gave 0930 as their answer. (9 30 pm was acceptable but rarely seen).

(ii) Many candidates did not realise that they were looking for the distance from L that is at right-angles to PQ. The best method was to use 17 sin 50° as both 17 and 50° were given in the question, although others successfully found the area of the triangle using ½ ab sin C and then found the perpendicular height of the triangle using 20 km as the base. A number of candidates simply gave 15.9 as their answer and others assumed that the shortest distance was from L to the mid-point of PQ.

Answers: **(a)** 305° **(b)** 15.9 km **(c)(i)** 74.9°, **(ii)** 019.9°; **(d)(i)** 2130, **(ii)** 13.0 km.

Question 10

(a) This was generally well answered, although column 5 sometimes contained errors.

(b) Weaker candidates did not understand what was required and often added the numbers in the two rows to get **(i)** 90 and **(ii)** 70. The response n + 4 was common in part **(i)**.

(c) Candidates who scored fully in **(b)** usually presented a convincing series of steps to reach the factorised form required. Many made no attempt.

(d) This was usually correct, although (10 + 2)(10 + 3) occasionally became 20 x 30.

(e) (i) Many candidates understood what was required and equated the product of the factors to 306 and then almost always proceeded to the correct equation. Inevitably there were those who tried to use the answer, often starting with $k^2 - 5k + 300 = 306$.

(ii) Many attempted to solve the equation by means of the formula, rather than realising that the solutions must be integers and so the expression could be factorised. As in **Question 8** a few candidates ignored the negative solution, rather than stating it as the second solution and then rejecting it when moving on to the next part.

(iii) Some gave 15 as their answer but most candidates appreciated that they had to use their expression in part **(b)(i)**.

Answers: **(a)** 22, 20, 42 and 26, 30, 56; **(b)(i)** $4n + 6$, **(ii)** $n^2 + n$; **(d)** 156; **(e)(ii)** 15 and –20, **(iii)** 66.

Question 11

This was perhaps the least popular question and although there were quite a number of candidates who gained good marks, many did little more than attempt the drawing of the histogram.

(a) (ii) Many neat and accurate histograms were seen, but some chose to use a scale different to the designated one. Common errors were to put the 31 boundary in the wrong place (usually at 30.2), to plot a height of 5.4 instead of 5.6 and to draw the first rectangle from the vertical axis instead of from 22.

(ii) This part was not well answered, many giving an answer of 30. Relatively few seemed to appreciate that approximately 9 children would take between 24 and 25 seconds.

(iii) Candidates had more success here, although many failed to give the answer in its lowest terms.

(iv) A few candidates used 140 rather than 30 in the possibility space, but the majority of those who used 30 were successful. A few thought the second probability was $\frac{11}{30}$ or $\frac{12}{29}$.

(b) This part was often omitted by candidates who had made a reasonable attempt at part **(a)** and of those that did attempt it, many confused percentages, degrees and number of boys. In part **(i)**, as in **(a)(iii)**, a good proportion of candidates failed to reduce their correct fraction to its lowest terms.

Answers: **(a)(ii)** 20 or 21, **(iii)** $\frac{5}{7}$, **(iv)** $\frac{22}{145}$; **(b) (i)** $\frac{7}{60}$, **(ii)** 60, **(iii)** 8.

Question 12

This was a popular question and even weaker candidates were able to gain good marks. Most errors occurred when candidates confused the height of the cone with its slant height.

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

(ii) Some candidates omitted the area of the base, even though 'total' area was emphasised in the question. Some used 12 instead of 15.

(iii) This part was very well answered, although a few candidates used 0.3 or 0.33 for $\frac{1}{3}$ and others 'rounded' their final answer to 102.

(b) (i) and **(ii)** This part was almost always correct, although a few candidates found BX (=5) correctly – but then left that as their answer in part **(ii)**.

(iii) A small number gave the base area and a few gave the diameter although most correctly calculated $2 \times \pi \times 3$.

(iv) Some candidates just found the volume of the smaller cone. Relatively few candidates used the ratios of similar solids and it was rare to see candidates finding $\frac{26}{27}$ × the volume of the large cone.

Answers: **(a)(i)** 15 cm, **(ii)** 679 cm^2, **(iii)** 1020 cm^3; **(b)(i)** 4 cm, **(ii)** 10 cm, **(iii)** 18.8 cm, **(iv)** 980 cm^3.