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## FOREWORD

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This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned.**

# MATHEMATICS

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## GCE Ordinary Level

Paper 4024/01

Paper 1

### General comments

The overall standard was perhaps a little higher than last year, and some excellent scripts were seen. The questions that were found to be difficult, even by good candidates were **6**, **14**, **19** and **24**.

Presentation was good with erasing fluids and illegible or absent working all being rare.

A few candidates produced little or no work for the last question, perhaps indicating a shortage of time for the Paper.

Many marks were lost due to poor or careless arithmetic; e.g.  $-2 - 4 = 6$ ,  $28 \div -8 = 3 \frac{1}{2}$ ,  $\frac{18}{25} = 1 \frac{7}{18}$  and  $\frac{22}{5} = 4.5$

### Comments on specific questions

#### Question 1

(a) This was generally very well done; occasionally the decimal point would be wrongly placed.

(b) Again well done. A rare misinterpretation was to give the 'decimal part' of the number i.e. 0.85 .

Answers: (a) 42.5%; (b) 4.85 .

#### Question 2

(a) This was well answered.

(b) Many could not cope with this simplification,  $15\sqrt{2}$  was a common wrong answer.

Answers: (a)  $\frac{7}{12}$ ; (b) 30 .

#### Question 3

(a) Some candidates had no idea, or gave answers of the form  $x(x - 5) + 6$ . Many had answers like  $(x + 6)(x - 1)$  showing that the essential checking step in the process had not been carried out. A good number did factorise correctly, but a few marred their work by giving the answer  $x = 2, 3$ .

(b) Many candidates found the correct answer  $-28$ , some found 28. Weaker candidates did not know how to tackle the problem.

Answers: (a)  $(x - 2)(x - 3)$ ; (b) -28.

#### Question 4

Most of the candidates understood what was required to solve this problem. Many tried to use a formula for the sum of the interior angles, e.g.  $(n-2)180$ , but they either misquoted it, or, more often equated it to  $150$  instead of  $150n$ . Many who did obtain a correct equation in  $n$  made algebraic errors solving it. Some took the more straightforward option and worked with the exterior angle but ruined their work by assuming that the two adjacent angles made  $360^\circ$  or that the sum of the exterior angles was  $180^\circ$ .

#### Question 5

- (a) This was often correct, but weaker candidates often either lost the zero or misplaced the decimal point, giving answers of 3.1, 30.01, 3.01 or 0.301.
- (b) This was well answered.

Answers: (a) 30.1; (b) £25.

#### Question 6

- (a) Many candidates knew the relation, distance = speed x time, but many could not cope with the unit conversion as well. Answers often had the 60 in the wrong place or omitted altogether. Other candidates showed that they fully understood the situation, but left their answer as  $\frac{y}{x/60}$ .
- (b) This part caused difficulty to all but the strongest candidates. It appeared that even if the index rules were known, candidates could not interpret the question correctly.

Answers: (a)  $\frac{60y}{x}$ ; (b)  $3\frac{1}{2}$

#### Question 7

- (a) Very few candidates realised that  $2^2 \times 3^2 \times 11^2$  was the required perfect square and so correct answers were rare.
- (b) Many did not know how to find the H.C.F; some knew that 2,3,3<sup>2</sup> were relevant but still failed to get to 18.

Answers: (a) 22; (b) 18.

#### Question 8

- (a) The responses here were generally good. The majority saw that the second column was not half the first and many saw that the origin had been suppressed; these ideas were not always expressed clearly, but they nevertheless gained the mark. Comments involving the intervening years, harsh penalties etc, though interesting, did not, of course, gain any credit.
- (b) Many correctly obtained the first answer, because only the height of the bar was involved, far fewer got the second.

Answers: (a) Since the axis starts at 400, the bars are not proportional to the crimes; (b) 5, 8.

#### Question 9

- (a) An answer of 10 was seen occasionally, but most candidates answered this part correctly.
- (b) Candidates were less successful here. A common misconception was to treat  $-4$  as zero leading to answers of 12 and 1310. It was disappointing to see candidates get as far as  $5\frac{1}{2}$  in part (ii) and then give 1450 as their answer.

Answers: (a)  $18^\circ\text{C}$ ; (b)(i)  $8^\circ\text{C}$ ; (ii) 1430 .

### Question 10

- (a) This was usually well answered.
- (b) The first task was to convert to the same units; this was often done correctly, but 1.75 kg sometimes became 175, 17500 or 1075 g. The second task was to reduce the elements to their lowest terms; many made slips and far too many left 14:35 as their answer.

Answers: (a) \$5.40; (b) 2:5.

### Question 11

- (a) Almost always correct.
- (b) Usually correct, although a few left their answer as  $3(7)-1$ .
- (c) Only stronger candidates were successful here with  $n + 4$  being the most common answer.

Answers: (a) 10; (b) 20; (c)  $4n + 1$ .

### Question 12

- (a) This part was quite well answered, although marks were often lost by candidates leaving their answers in unacceptable forms e.g.  $434 \times 10^8$  or  $43.4 \times 10^9$  in (i) and  $28 \times 10^8$  in (ii).
- (b) Well answered.

Answers: (a)(i)  $4.34 \times 10^{10}$  kg; (ii)  $2.8 \times 10^9$ ; (b) 20%.

### Question 13

- (a) Many recognised the relevance of  $y = 2$ , but weaker candidates wrote  $y \leq 2$ , probably making it similar to the given inequality  $x \leq 4$ . Good candidates found the line  $y = x + 1$  and produced the correct inequality, others wrote  $x + y \leq 1$ ,  $y \geq x + 1$  or  $x + y \leq 3$ .

Answers:  $y \geq 2$ ,  $y \leq x + 1$ .

### Question 14

- (a) Just a few made it clear which part of the diagram represented  $(A \cup B) \cap C$ , the majority were clearly wrong. If a candidate shades  $A \cup B$  one way and  $C$  another way the Examiner will see the double shading of the correct area, but that cannot be assumed to be the answer unless the candidate has labelled it clearly in some way.
- (b) The working in this part very rarely led to the correct answer. Although nearly all candidates produced the Venn diagram with 8 correctly placed, they immediately erred by thinking that 'History only' was 16.

Answer: (b) 3.

### Question 15

- (a) This was well understood, with little or no confusion between 1 and 7.
- (b) The median of this distribution was not so well understood. Some gave 4 as their 'middle value'. Even after finding the middle two values quite a number of candidates gave either one or both as their answer, rather than the average.
- (c) This part was not very well answered. There were many 'method' errors with answers often coming from  $\frac{35}{6}$ ,  $\frac{21}{6}$  or  $\frac{20}{5}$ .

Of those who did get to 1.75 in their working, quite a number went on to give either 1 or 2 as their answer, assuming that their answer had to be a whole number of children.

Answers: (a) 1; (b) 1.5; (c) 1.75.

### Question 16

- (a) This was well answered; marks were lost only to sign slips made during the four multiplications and four subtractions.
- (b) Many candidates gained both marks in this part. Others incorrectly manipulated the four elements and either miscalculated the determinant or did not use it at all.

Answers: (a)  $\begin{pmatrix} 3 & -3 \\ -6 & 6 \end{pmatrix}$ ; (b)  $\frac{1}{6} \begin{pmatrix} 0 & -3 \\ 2 & 5 \end{pmatrix}$ .

### Question 17

- (a)  $f(-2)$  was usually calculated correctly.
- (b) The method was quite well known and there were many correct answers. Nevertheless many candidates made algebraic errors and lost the mark.
- (c) There was a mark for those candidates who gave a correct equation, but many were unable to do this. Many equated  $3x + 7$  to their  $f(-2)$  or their  $f^{-1}(x)$  to  $f(-2)$ . Quite a number of good candidates got as far as  $-8x = 28$  but failed to reach  $x = 3 \frac{1}{2}$ , usually by losing the negative sign.

Answers: (a) 1; (b)  $\frac{1}{3}(x - 7)$ ; (c)  $-3 \frac{1}{2}$ .

### Question 18

- (a) The two lettered right angles were usually found and named correctly, a number gave  $BCD$  and a few thought  $AT$  and  $BD$  were perpendicular.
- (b) Most candidates gained marks here, since even when  $O\hat{A}B$  was found incorrectly 'follow through' marks were available for finding the other angle by using correct geometric steps e.g. correctly using an isosceles triangle and/or using 'angles in the same segment'.

Answers: (a)  $A\hat{B}C$  and  $O\hat{B}T$ ; (b)(i)  $34^\circ$ , (ii)  $124^\circ$ , (iii)  $34^\circ$ .

### Question 19

- (a) Only the very strongest candidates appreciated that doubling the distance implies finding a quarter of the force, even though many of those who gave 5 or 20 here were successful in part (b).
- (b) This part was very well answered and many candidates gained all three marks.

Answers: (a)  $2 \frac{1}{2}$  N; (b)(i)  $F = \frac{k}{d^2}$ , (ii) 0.72 N.

### Question 20

- (a)(b) These were usually correct but sometimes they were reversed indicating a lack of understanding.
- (c) Again generally well answered. 500, 350, 225 and 275 were common incorrect answers, the first perhaps an estimate of the total distance.
- (d) Perhaps a lack of appreciation of the accuracy required caused the award of this mark to be a rare event, 25 was a common wrong answer.

Answers: (a) 15 m/s; (b)  $2.5 \text{ m/s}^2$ ; (c) 375 m; (d) 25.5 to 26.5 s.

### Question 21

- (a) This was usually well answered but  $5f$  was a common wrong answer after a sign error when the brackets were removed.

There were a few correct but rather inelegant answers like  $0 + 1f$ .

- (b) Weaker candidates failed to remove brackets, transpose and collect like terms correctly. A substantial number dealt with the inequality correctly in the working but wrote  $a = 4.4$  or just  $4.4$  in the answer space, not realising that the answer to an inequality needs a range.
- (c) This was generally well done, the methods being widely understood. Solutions were marred by slips, usually sign errors.

Answers: (a)  $f$ ; (b)  $a < 4.4$ ; (c)  $x = 3, y = -4$ .

### Question 22

- (a) The point  $D$  was usually the correct distance from  $C$  but there was difficulty with the bearing  $057^\circ$ . Sometimes the north line through  $C$  was inaccurate, sometimes  $57^\circ$  was measured from  $CB$ .
- (b) The perpendicular bisector of  $BC$  was usually drawn accurately and it was rare not to see an acceptable arc, centre  $C$ . Many candidates, however, failed to realise that the angle bisector of  $\hat{A}BC$  was required, corresponding to statement II. Only the very best candidates placed  $S$  and  $P$  in the appropriate positions.

### Question 23

- (a)(i) This was almost always correctly recognised as a reflection, but relatively few candidates were able to name the mirror line.
- (ii) This was usually recognised as a rotation, the angle often given but relatively few gave the correct centre.
- (b) A small number produced the correct image, but there were many incorrect responses with no evidence of matrix multiplication and no evidence of an enlargement with a negative scale factor.

Answers: (a)(i) Reflection in the line  $y = 4$ , (ii) Rotation of  $90^\circ$  clockwise about  $(1, -1)$ ;  
(b) Triangle  $D$   $(-4, -2), (-6, -2), (-4, -6)$ .

### Question 24

- (a) Successful candidates usually started by writing down the length, width and height of the box as  $(20 - 2x), (14 - 2x)$  and  $x$  and then went on to write down the correct expression, although many did much more than was necessary in getting from  $x(20 - 2x)(14 - 2x)$  to  $4x(10 - x)(7 - x)$ . Others said that the length and width were  $(10 - x)$  and  $(7 - x)$  and that the 4 corners made  $4x$ . Some simply expanded the printed result and made no progress.
- (b) Many did not attempt this part and many who did make some progress made arithmetic errors. Those who correctly obtained  $V_2, V_3, V_4$  etc and used them graphically scored well. Only the best candidates recognised that although  $V_3$  was the largest value found,  $x = 3$  was not the value giving the greatest volume.

Answer:  $2.4 \leq x < 3$ .

**General comments**

This proved to be a satisfactory test for candidates of all abilities. There did not appear to be any problem in completing the Paper in the time allowed. Work was usually well presented and explained, but some candidates still lost credit by failing to show all of their reasoning. Once again a very small number of candidates wrote answers in two columns on each page, and there appeared to be more calculators set in the grad or rad mode this year. Candidates should be encouraged to use the value of  $\pi$  stored on their calculator where possible, but otherwise to use the value quoted on the Paper.

Although it is not in the syllabus, some candidates were clearly aware of compound interest. They need to be careful to use the form of interest intended in the question, which is always likely to be simple interest on this syllabus. More attention needs to be given to the solution of geometric problems and giving simple explanations involving similarity and congruence. Simple explanations were also rather poor elsewhere, such as in interpreting the values in the graph question. Examiners are looking for simple statements which give an impression that the candidate does understand what is happening. They are not expecting any formal statements.

**Comments on specific questions****Section A****Question 1**

The majority of candidates scored well on this question. Though the most direct methods were used by most candidates, surprisingly many used very inefficient procedures, such as first calculating the length of  $AB$  before calculating angle  $B$  in the first part. The unnecessary use of the sine or cosine formula was also fairly common throughout the question. The required degree of accuracy was usually used, but some lost credit by quoting the first answer as  $55^\circ$ , or by prematurely approximating the length of  $AD$  to 1460 metres when calculating the area in the last part.

Answers: (a)  $55.1^\circ$ ; (b) 480 m; (c) 1550 m; (d)  $484\,000\text{ m}^2$ .

**Question 2**

Much good work was seen on this question, and it enabled the stronger candidates to demonstrate their skills.

- (a) Only the better candidates saw that they could start by using  $x - 5 = \pm 9$ . Many found only one answer or multiplied out and tried to solve the quadratic equation, often by formula. Many assumed that  $(x - 5)^2 = (x - 5)(x + 5) = x^2 - 25$  however.
- (b) This was usually well done, but the fact that the numerator could be factorised tempted some to try some false continuation.
- (c) Two methods were seen in this part. Those who first multiplied out the right hand side found the completion of the question rather easier than those who first divided by  $h$ , who did not always resolve the final step correctly.

Answers: (a) 14 and -4; (b)  $\frac{(a-1)(a-2)}{(2a-1)(a+1)}$ ; (c)  $m = \frac{A-h^2}{4h}$

**Question 3**

Candidates demonstrated a sound grasp of coordinate geometry in most cases, though some spoiled otherwise good solutions by incorrect attempts to cancel in (b)(i).

Answers: (a)(i)  $-\frac{3}{4}$ , (ii)  $y = -\frac{3}{4}x - \frac{1}{2}$ ; (b)(i)  $(\frac{1}{2}(4+p), \frac{1}{2}(5+q))$ , (ii)  $(10, -3)$ .

#### Question 4

Although there were some notable exceptions, this question was not well answered. Candidates were usually incapable of distinguishing what had been given from what they were expected to show, and reasons were rarely seen.

In part **(a)** candidates were expected to use the right angles  $ABF$  and  $CBE$  to justify the equality of angles  $ABC$  and  $FBE$  either by subtracting  $CBF$  or by subtraction from  $ABE$ . Some justified the result by long methods, but most assumed that  $AC = EF$ , or the congruence of the next part, or falsely stated that one square could be rotated on to the other in spite of only being given one square. It was expected that candidates would use the result of part **(a)**, with  $BC = BE$  and the right angles  $BAC$  and  $BFE$  to justify the congruence. Many solutions quoted the equality of elements that had not been justified at this stage, including the statement  $AB = BF$  which should have been deduced from the congruence to justify the last part.

It is clear that more attention should be paid to this part of the syllabus. In particular candidates should be encouraged to read right through the whole question before starting their answer, to ensure that they do not assume results that they are later to justify.

#### Question 5

There were many assured and confident solutions to this vector question. The magnitude of the vector was well done. Some candidates confused vectors and coordinates in the following parts and weaker candidates often added vectors that should have been subtracted. Although the correct answer to part **(c)(i)** was quite common, many questionable methods were employed in the next part, often using gradients or even the equations of straight lines. Some of the stronger candidates noticed that the triangles were similar, so the ratio of their areas is the square of the ratio of corresponding sides. Rather than using the given  $CD = 3 AB$ , many of these calculated the length of  $ED$ , which they used with the length of  $AB$  they knew. The majority tried to calculate the two areas first, with varying success.

Answers: **(a)(i)** 17, **(ii)** (2, 16); **(b)(i)** (18, 61), **(ii)**  $\begin{pmatrix} 8 \\ 60 \end{pmatrix}$ ; **(c)(i)**  $\begin{pmatrix} k-10 \\ 15 \end{pmatrix}$ , **(ii)** 12; **(d)**  $\frac{1}{9}$ .

#### Question 6

**(a)** The work on percentages was well understood in most cases. Many lost some credit in the first part by rounding the answer too much, usually after expressing \$4.50 as a percentage of \$4.20 first. Weaker candidates often found percentages by dividing by \$4.50 however. There were many correct answers to the second part, with weak candidates finding 20% of \$264 first. In the third part there were again many correct solutions, but some calculated the full price of \$13 000 rather than the discounted cost.

**(b)** Simple interest seemed to be well known, though a few used compound interest.

Answers: **(a)(i)** 7.14%, **(ii)** 220 g, **(iii)** \$12 090; **(b)(i)** \$216, **(ii)** \$4140.

#### Section B

#### Question 7

The response to this question was generally good, with many candidates scoring full marks. Almost all obtained the correct expression in **(a)** and the majority started well in **(b)**, but weaker candidates often omitted brackets and lost their way when forming the equation. The solution of the quadratic equation was well done, but not always corrected to the required degree of accuracy, with 9.63 being very common. The last part was a good test of the stronger candidates. Common errors were only to round the positive root, to forget to subtract 3 after a correct division or to fail to round the final answer as instructed.

Answers: **(a)**  $\frac{500}{x}$ ; **(b)**  $\left(\frac{500}{x} - 3\right)(x + 1)$ ; **(c)(ii)** 9.6 and -17.3; **(d)** 49 litres.



### Question 8

This problem involving sine and cosine formulae was well answered in most cases.

- (a) Some candidates lost a negative sign in the re-arrangement in this part or gave the answer as  $116^\circ$ .
- (b) This was well done.
- (c) This caused more difficulty, with many very long methods attempted when false assumptions had not been made. (The perpendicular from  $C$  is neither  $CA$  nor the bisector of angle  $ACD$ ). The question had been allocated only 2 marks, so candidates should have realised it was not complicated. It was only necessary to find the angle ( $54.5^\circ$ ) between  $BD$  produced and  $DC$  from the previous two answers and then use  $22 \sin 54.5^\circ$ . There were many correct answers to the last part, though a few found angles at  $T$ .

Answers: (a)  $116.1^\circ$ ; (b)  $118.4^\circ$ ; (c)  $17.9$  m; (d)  $36.8^\circ$ .

### Question 9

There was a good response to this question. Almost all were able to justify the length of  $AB$ . The correct formulae were used for the volume, though a few took the height of the cylinder to be 4 metres. The surface area was slightly less well done, but very many correct answers were obtained. Some of the expressions used had the wrong dimensions, being volumes or lengths in fact. The value of  $\pi$  did not appear in all of the expressions, some used 2.7 instead of 4.5 in the area of the cone and some included two or even three circles. It should be noted that the value of  $\pi$  is quoted on the Question Paper, though the value stored on a calculator is preferred. Many correct answers to the length of  $PQ$  were seen, often using trigonometry of some complexity rather than the similar triangles that had been anticipated. The most common errors here were to assume falsely that  $PQ$  bisects  $BC$  or that angle  $PAQ$  is a right angle. Many candidates found only the area of the outer circle, but the last part caused no problems for better candidates.

Answers: (b)(i)  $89.6 \text{ m}^3$ , (ii)  $121 \text{ m}^2$ ; (c)(i)  $8.80$  m, (ii)  $20.1 \text{ m}^2$ .

### Question 10

The graph was well done by the majority of those who opted for this question. The quality of plotting and drawing was good, though a surprising number of candidates plotted  $h = 21.9$  at  $20.9$ . The tangents were usually good and gradients acceptable.

The explanations of parts (a) and (e)(ii) were less satisfactory. Many merely verified the value  $h = -12.5$  instead of stating that the ball was below the top of the tower in the first part. Far too much was read into the negative gradient in many cases. Examiners were expecting to be told that the ball was moving down, but this was often embellished with incorrect additions, such as "at constant speed".

Reasonable readings were usually taken from the graph, though the greatest height was too often given as  $24.4$  m and the difference between the two times at which  $h = 20$  was not always evaluated. Poor curves sometimes led to inaccurate answers. The height of the tower caused some problems, many candidates finding the greatest height of the ball above the ground, by adding the answer to (d)(i) to the reading from the graph.

Answers: (b)  $-44.4$ ; (d)(i)  $24.5$  to  $25.5$  m, (ii)  $1.90$  to  $2.00$  s; (e)(i)  $-14$  to  $-19$ ; (f)  $22$  to  $26$  m.

### Question 11

- (a) The response to this question was rather disappointing in many cases. Successful candidates often drew a possibility space first, and went on to score heavily. Those who did not use this method were much less likely to score well. Otherwise correct answers to the first two parts were mistakenly doubled sometimes. Many answers to the last two parts were the sums of fractions with denominator 11, and were often greater than 1.
- (b) The cumulative frequency curve was usually correct and the correct methods used for parts (ii) and (iii). More candidates took the reading at 210 than at 90, and a few misread their own scales by using 95 in place of 90.

Answers: (a)(i)  $1/30$ , (ii)  $3/10$ , (iii)  $1/6$ , (iv)  $1/10$ ; (b)(ii)  $31$  to  $32.5$ , (iii)  $(46$  to  $47.5)$  - L.Q., (iv)  $33$  to  $34$ .