MATHEMATICS SYLLABUS D

GCE Ordinary Level

Paper 4024/01 Paper 1

General comments

The paper proved to be of a similar standard to previous years and candidates were able to show their abilities in a wide variety of mathematical topics. Most candidates appeared to tackle the paper with confidence, and only a small number appeared to be out of their depth. Although there were a number of quite searching questions, it was pleasing to see so many scripts of an excellent standard, with successful attempts at many or all of them.

In most cases, the work was well ordered and accurately organised, with construction and drawing questions well presented, although occasionally, candidates appeared not to have the instruments for the constructions. As always, however, a number of candidates ignored the instruction to show their working in the space below the question. Some candidates showed no working at all, presumably using 'rough' paper, which was not handed in. A few crammed all their work into the narrow column headed 'For Examiner's Use', and others produced such a jumble of numbers that Examiners were unable to follow the method. It is hoped that Centres will stress to candidates that method marks are available in many questions, and these will be lost if Examiners cannot see clearly presented working.

Candidates appeared to have ample time to answer all the questions on the paper which were within their capabilities. On the vast majority of papers, attempts were made at all 24 questions.

Comments on specific questions

Question 1

This question was very well answered. Most candidates showed a good understanding of work with fractions and decimals. A few misplaced the decimal point in part **(a)**, giving 0.9 or 0.009 as their answer. In part **(b)** the majority of candidates were able to change the mixed numbers into improper fractions and evaluate the quotient correctly.

Answers: **(a)** 0.09; **(b)** $\frac{24}{35}$.

Question 2

(a) The answer 0.009 was sometimes seen, but most candidates gave the correct value.

(b) This part produced a few more problems, with candidates getting as far as 7^0. Some stopped there, or converted to 7 or 0.

Answers: **(a)** 0.09; **(b)** 1.

Question 3

Candidates did very well here, and the correct ordering was produced on the majority of scripts. A small number of candidates worked with 100 minutes to the hour, and a few had difficulty evaluating 1.7 x 60. There were also some who gave the times in reverse order.

Answer: 99, 100, 102, 105.

Question 4

There was some confusion here, with many candidates unable to, or not wanting to, transfer the given information onto the diagram. Without the use of the diagram it was quite a difficult problem. Many candidates could not relate 2.09 to 2.22 to solve part **(b)**. Many candidates could sort out the required lengths, but some of these lost one or both marks with careless subtraction.

Answers: **(a)** 2.22m; **(b)** 0.13m.

Question 5

This type of percentage question has caused great difficulty in the past but there seemed to be a distinct improvement here. The majority of candidates understood that 30% of the full price was \$180 and from there, they evaluated $180 \div 30$ and multiplied by 70 or by 100. Quite a few candidates lost a mark by leaving their answer as \$600. There was still, however, a minority who had little or no idea how to relate the amounts.

Answer: \$420.

Question 6

(a) Most candidates realised that this part had to be a parallelogram.

(b) There was less success with this part. The correct kite was fairly common, but there were many occasions when a second parallelogram or an isosceles trapezium appeared. Most candidates presented diagrams which were within an acceptable degree of accuracy, but a small number drew very rough sketches.

Answers: **(a)** parallelogram; **(b)** kite.

Question 7

By far the greatest loss of marks was caused by candidates not knowing when a zero must be retained or discarded.

(a)(i) 390 was occasionally 39, and frequently 390.00.

(ii) 0.020 was frequently 0.02 or 0.02000.

(b) Many candidates calculated to 8, but gave 8.0 as their answer.

Answers: **(a)(i)** 390, **(ii)** 0.020; **(b)** 8.

Question 8

This question was very well answered, with many candidates gaining all 3 marks. The most common wrong, or incomplete answers were $3(3a - 4a^2)$ in part **(a)**, $(2y - 1)^2$ or $(4y - 1)(4y + 1)$ in part **(b)**, and either $x(x - 7) + 12$ or $(x - 3)(x + 4)$ in part **(c)**. A small number of candidates attempted to 'solve' the expressions.

Answers: **(a)** $3a(3 - 4a)$; **(b)** $(2y - 1)(2y + 1)$; **(c)** $(x - 3)(x - 4)$.

Question 9

(a) Candidates were generally successful with this part, although occasionally, arithmetical skills faltered.

(b) The majority of candidates dealt with percentage competently, but a significant number simply multiplied the population by 0.2, giving an answer of 2 620 000.

Answers: **(a)** 12.2 million; **(b)** 26 200.

Question 10

In part **(b)**, it was not common to see −3, then ÷2 applied to all 3 elements for a simple, quick solution. The problem was usually treated as two separate inequalities and many slips were made, both in the solving and in the presentation of the solutions. In part **(b)** it was common to see a correct answer after a successful part **(a)**, although −1 was sometimes seen, candidates simply stating the largest value from part **(a)**. A small number ignored the word 'integer'.

Answers: **(a)** $-4 < x < -1$; **(b)** −2.

Question 11

(a) Most candidates coped successfully with this part.

(b) It was often not recognised that the HCF was required, and many candidates gave 3 as their answer.

(c) This part was particularly searching, only the strongest candidates realising that $3^3 \times 168$ became a multiple of 324. It was not uncommon to see 324 ÷ 168 = 27 ÷ 14, indicating misinterpretations of both 'integer' and 'multiple'.

Answers: **(a)** 18; **(b)** 12; **(c)** 27.

Question 12

This proved to be one of the most searching questions on the paper, with many candidates gaining no marks. Few candidates gained both marks in part **(a)**, although some did get one set correct, usually for the time. The upper bounds caused most problems, with 234 and 7.4 being common errors.

Very few candidates realised that the least possible speed came from the lower bound of the distance divided by the upper bound of the time.

It seemed that this topic was somewhat neglected by many Centres.

Answers: **(a)** 225 ≤ distance < 235, 6.5 ≤ time < 7.5; **(b)** 30m/s.

Question 13

This was a popular question, with a good proportion of candidates gaining 2 or 3 marks. Most candidates were successful, with part **(a)**, and although part **(b)** was quite demanding, with the algebra defeating many, it was pleasing to see so many good attempts.

Answers: **(a)** 4; **(b)** $\frac{5}{x-2}$.

Question 14

This question was very well answered, with most candidates showing a good understanding of the topic. There were a few errors caused by misreading of the scales, and in part **(b)**, a number of candidates gave the maximum mark gained by the bottom 70 candidates.

Answers: **(a)** 50; **(b)** 30; **(c)** 60.

Question 15

(a) A good number of candidates understood inverse proportion, but many effectively destroyed the question by writing $y = k(x + 2)$ or $y = (x + 2) \div k$.

(b) Those candidates who wrote down the correct expression for part **(a)** usually gained full marks in this part, although surprisingly many lost concentration and said that 3 + 2 = 6, or 5 x 4 = 9.

Answers: **(a)** $k \div (x + 2)$; **(b)** 2.

Question 16

(a) Few candidates scored full marks for this part. There was no problem using the formula for average speed and very few problems changing kilometres to metres, but '*h* hours' became 60*h*, 60^2, $h \div 60$, or $h \div 60^2$ seconds. Many candidates who did write down $144\,000 \div 60^2 h$ failed to simplify correctly, the common error being to lose the *h* or to put it in the numerator.

(b) Many candidates, even some strong ones, did not deal correctly with $6 - 4\,(2 - x)$; they treated it as $2(2 - x)$ or they converted it to $6 - 8 - 4x$. Many did remove the brackets correctly, but then made careless slips in the subsequent working.

Answers: **(a)** $40 \div h$; **(b)** $9\frac{1}{2}$.

Question 17

(a)(i) This part was usually correct, but the term 'reflex' was still not recognised by many candidates.

(ii) 150º was often given as the answer.

(b)(c) Bearings seemed to be well understood, although there were many answers of 48º in part **(b)** and 153º in part **(c)**.

Answers: **(a)(i)** 30º, **(ii)** 330º; **(b)** 312º; **(c)** 027º.

Question 18

(a) This was generally well answered, although a few candidates, assuming the given ratio 4 : 9 concerned lengths, used 16 : 81.

(b) This part was not well answered. The correct ratio was seen occasionally, but many candidates gave 4 : 9, 16 : 81 or left the answer space blank.

(c) Relatively few candidates realised that the ratio of the masses was proportional to the cube of the ratio of the lengths, and only the strongest candidates gained any credit in this part of the question.

Answers: **(a)** 1080cm^2, **(b)** 2 : 3; **(c)** $10\frac{2}{3}$ kg.

Question 19

(a) Misuse of the rules of sign often led to the wrong values, although two or three elements were usually correct; the candidate were clearly familiar with the topic.

(b) The majority of candidates correctly obtained the determinant, although a number gave its reciprocal, presumably anticipating the next part of the question.

(c) Those who correctly obtained the determinant and the adjoint often failed to give the correct inverse, due to sign errors.

Answers: **(a)** $\begin{pmatrix} 0 & 3 \\ 6 & 3 \end{pmatrix}$; **(b)** −2; **(c)** $\begin{pmatrix} -1/2 & 3/2 \\ 1 & -2 \end{pmatrix}$.

Question 20

This proved to be a demanding question, with few candidates gaining all 3 marks.

(a) Candidates often failed to shade the whole of the region *R*.

(b) Correct responses were rarely seen in this part, with $A \cup B'$ and $B \subset A$ appearing frequently.

(c) Many candidates using a Venn diagram, although showing the right intersection of the History and Geography sets and placing the '5' in the correct region, were unable to proceed. A few attempts at an algebraic solution were seen, but this rarely led to a correct answer.

Answers: **(b)** $A \cap B'$; **(c)** 10.

Question 21

(a) Relatively few candidates realised that the lengths of the sides of the right angled triangle, of which *BC* is hypotenuse, can be seen to be 8 and 6 immediately, from the diagram. Instead, they used the distance formula and tried to evaluate $\sqrt{(2-(-4))^2+(-2-6)^2}$. In many cases, mistakes with signs, squaring etc. meant that correct answers were not as frequent as might have been expected.

(b) The common error was to attempt to evaluate the area using $\frac{1}{2}AB \times BC$.

(c) Only the better candidates knew how to tackle this part of the question. Many thought that the sine was negative, and that it was given by *BC* ÷ area of triangle *ABC*.

Answers: **(a)** 10 units; **(b)** 20 units^2; **(c)** 0.8.

Question 22

(a)(b) These parts were answered very well, although there were a number of answers of 400m for part **(b)**.

(c) The majority of candidates drew a correct speed-time graph, but there was less success with the distance-time graph. Many candidates successfully drew the correct straight line representing the journey from 10 to 20 seconds, but it was unusual to see the correct curve drawn from 0 to 10 seconds. It was common to see a continuous straight line from the origin to either (20, 300) or (20, 400).

Answers: **(a)** 2m/s^2; **(b)** 300m; **(c)(i)** a straight line from (0, 0) to (10, 20) and a horizontal straight line from (10, 20) to (20, 20), **(ii)** a curve from (0,0) to (10, 100) and a straight line from (10, 100) to (20, 300).

Question 23

Part **(a)** was often correct, but common wrong answers were 10, 10*n*, and 1000*n*. A fair number of candidates produced an accurate set of loci and showed a sound grasp of the topic by locating T_1 and T_2. However, in many scripts, the perpendicular bisector of *AC* was either omitted or incorrect, the median from *B* was often drawn instead.

Answers: **(a)** 1000.

Question 24

(a) Triangle *A* was often drawn correctly, but few candidates could describe the inverse transformation correctly. Those candidates who understood that the inverse was required usually gave the wrong scale factor, usually −2.

(b) There were a reasonable number of candidates who calculated the points of triangle *B* correctly, but a good proportion of these misplotted one or more of the points, usually interchanging the *x* and *y* values.

(c) Very few candidates managed to find the matrix correctly.

Answers: **(a)(i)** Triangle (−4, 0), (−6, −2), (−6, −6), **(ii)** enlargement, centre (0, 0), SF = $-\frac{1}{2}$; **(b)** triangle (0, −2), (−1, −3), (−3, −3); **(c)** $\begin{pmatrix} 0 & 1/2 \\ 1/2 & 0 \end{pmatrix}$.

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Paper 2

General comments

There was a good response to the paper in general. Weaker candidates were given the opportunity to show what they could do, but there were also some part questions that tested the strongest candidates. The overall quality of the work was similar to that of previous years. Once again, there were many excellent scripts that were very well presented. Generally, the standard of tidiness was quite good, although there were notable exceptions. It is probably no coincidence that most of these were presented by some of the weaker candidates. A small number of candidates still write their answers in two, or more, columns on each page. This often confuses the candidates and Examiners, and needs to be discouraged. There was no sign that candidates had difficulty in completing the paper in the time allowed.

More attention needs to be given to questions requiring explanations, particularly when an answer is given. Candidates should be aware that their working will be closely inspected and that no credit will be given for quoting a given answer. Any amendments to such a solution need to be made throughout the working if credit is to be gained. Candidates still lose credit by showing and using less than the stipulated degree of accuracy at all stages of their working in arithmetic and trigonometry questions. Once again, accuracy marks were lost by a few candidates, where calculators were set in the grad mode.

Comments on specific questions

Question 1

The first question was a fairly routine piece of trigonometry. As such, it gave candidates confidence and it was well answered in most cases. Although a few candidates added 15^2 and 8^2 in the first part, the majority obtained correct answers to the first two parts. The third part required more thought, but a pleasing number of correct answers were seen. Some candidates gave an obtuse angle, however, and minor inaccuracies due to the use of a rounded value from part **(a)** were also seen. The candidates who used the cosine of angle *BDA* with the given data avoided this difficulty. Weaker candidates attempted to use 55º in sine formula.

Answers: **(a)** 12.7m; **(b)** 12.5m; **(c)** 67.2º.

Question 2

This question led to a wide range of responses. The majority of candidates spotted the patterns that led to the values of p, q and r, but fewer noticed that the values in the fourth row were the sums of the values in the first three rows. The generalisation for x, y, z and t was well done by the more able, but defeated many. Some candidates, who spotted that the second row consisted of squares, thought that $y = n^2$. Although it was hoped that the value of t would be simplified, it was accepted unsimplified.

Answers: **(a)** 17, 36, 125, 178; **(b)** $3n + 2$, $(n + 1)^2$, n^3, $n^3 + n^2 + 5n + 3$.

Question 3

This was well done by the majority of candidates, who allowed themselves to be led through the parts of the question. A few assumed, falsely, that *AB* was parallel to *EC*. More credit would have been given to some candidates if they had explained how they were trying to obtain the required angles.

Answers: **(a)** 20º; **(b)** 105º; **(c)** 55º; **(d)** 55º; **(e)** 30º.

Question 4

(a) There was a good response to the this part of the question, although some candidates omitted necessary brackets in the answer. A common error was in the first line of the simplification, where $mv = u + Ft$ often appeared.

(b) Surprisingly, many candidates assumed that the equation in this part was to be rearranged, but they could recover the mark when solving the equations, as long as they had two equations. All that was expected was $43 = c + 50d$ and $49 = c + 80d$. The solution of the simultaneous equations was well done, but a fair number of candidates correctly reached $30d = 6$, from which they deduced that $d = 5$. Most candidates then used their values of c and d with $x = 40$, but some good arithmetic solutions were seen. It was hoped that c would be identified as the length of the unstretched or unloaded string. Many candidates did make such statements, but some odd answers, such as the elasticity of the string or even the mass of the nail were seen.

Answers: **(a)** $t = \dfrac{m(v - u)}{F}$; **(b)(ii)** $c = 33$, $d = 0.2$, **(iii)** 35.

Question 5

(a) The response to this question was rather disappointing, with full marks being rare. The volume of the cylinder was quite well done, although a few candidates multiplied by one third. The conversion to litres defeated many however. The surface area was less well done. Many candidates included the area of a circular top. These were given some credit, but the conversion to square metres was badly done. The wise candidates avoided the problem by working in metres throughout.

(b) The depth of the trough was usually correctly found, but the distinction between the trough and the tank in the last part escaped the majority of the candidates. Candidates were expected to divide the volume of water that escaped by the area of the circular top of the tank and by the time of $2\frac{1}{2}$ hours, in either order. Many candidates used the area of the top of the trough however. The most common answer, 8000, resulted from only the latter, but a few tried to obtain the required unit by then taking the cube root.

Answers: **(a)(i)** 226 litres, **(ii)** 2.07m^2; **(b)(i)** 16cm, **(ii)** 4.42cm/h.

Question 6

There were many good answers to the transformation question, carefully drawn and correctly labelled. A few candidates used the translation of 4 up and 3 along, rather more rotated anticlockwise, but the order of the operations in the combined transformation was the main reason for loss of credit. The majority recognised the shear and a pleasing number quoted the correct shear factor, rather than −2. The invariant line was less often recognised. Surprisingly, many candidates plotted the third vertex at (4, −5), deducing that it was a reflection.

Answers: **(b)** Vertices at (10, 1), (12, 1) and (10, −2); **(c)** Vertices at (−3, −1), (−3, −1) and (−6, 1); **(d)** Vertices at (1, 4), (1, 2) and (−2, 4); **(e)** Shear with shear factor 2, with x-axis invariant.

Question 7

There was a good response to the algebraic problem question. The simplification of the fractions was well done in most case. Many candidates convincingly formed the given quadratic equation, often seeing the connection with part **(a)**. Candidates should be aware that when an answer such as this is given in the question, Examiners will be looking at the working carefully. They expect to see all steps shown in full. Solutions that *started* with $\dfrac{800}{x(x+4)} = 5$ were not considered to be sufficiently fully explained.

The solution of the quadratic equation was well done, but not always corrected to the required degree of accuracy. The last part was rather disappointing. Candidates were expected to use the positive root they had found to calculate the volume of petrol required for this journey arithmetically. Some candidates tried to do it as an algebraic expression and some drove 200km in and out of town. Answers were expected in litres, but other units were accepted.

Answers: **(a)** $\dfrac{800}{x(x+4)}$; **(b)(i)** $\dfrac{200}{x}$; **(c)** 10.81 and −14.81cm; **(d)** 11.8 litres.

Question 8

The histogram was not well understood. The widths were usually correct, but in too many cases it was the heights of the columns that were in the ratio of the frequencies, rather than their areas. The interval containing the median was usually identified, although a few candidates tried to find a value, but the mean defeated many. Often, the interval widths were used, rather than the mid interval values. The centres of the central two intervals were sometimes taken to be at 93 and 98 in otherwise correct calculations.

The probability was less well done than usual. The single event was often correct, but combined probabilities defeated very many candidates. Factors of 2 were often included in part **(i)** but not in part **(ii)**. The denominators were often 80 x 80 and the wrong numbers were used in the numerators.

Answers: **(b)** 95 to 100; **(c)** 98.2; **(d)** $\frac{7}{40}$; **(e)(i)** $\frac{7}{790}$, **(ii)** $\frac{4}{395}$.

Question 9

The graph question was popular and quite well answered, with some excellent curves seen. A few candidates plotted the second point at (1.125, 21), but had the other plots right. Most candidates used their graph to solve the equation correctly, but the least value of the function was less well done. Too often, values of *x* were quoted.

Tangents were quite good on the whole, and it was noted that more sensible points were used to determine the gradient than has been the case in the past years. The straight line was usually ruled, as expected, and many candidates found acceptable values of *x* at the intersections. Many candidates obtained the required equation, but a number merely put one of the values of *x* found into the form of the equation quoted in the question.

Answers: **(a)** 29; **(c)(i)** 1.28 to 1.33, **(ii)** 13.7 to 13.99; **(d)** −9 to −12; **(f)(i)**1.20 to 1.25 and 3.20 to 3.28, **(ii)** $7x^3 - 25x^2 + 25 = 0$.

Question 10

Although many candidates managed to gain reasonable marks on this question, it was one of the less popular ones, and very high scores were not common. The explanations offered in parts **(a)** and **(c)(i)** were often not convincing. It was hoped that the solutions would refer to the whole angle of 360º at *O* being divided into 5 equal parts in part **(a)** and that reference to the angle at the centre of a circle theorem would appear in part **(c)**. Although other explanations were accepted, too often unjustified, more advanced, assumptions were used.

The area of the pentagon was usually correctly attempted, but the simple 2 x 1.5 cos 18º for *AD* was not common. Candidates preferred to use either the sine or cosine formula instead. Either 2.85 or 2.853cm was then used to calculate the area of triangle *DAB*. It was anticipated that candidates would use sector *DAB* to find the area of the segment, but too often an angle of 72º appeared, often with a radius of 1.5cm. The stronger candidates gained credit for adding the area of five of these segments to the area of the pentagon to find the area of the face of the coin.

Answers: **(b)** 5.35cm^2; **(c)(iii)** 2.39cm^2, **(iv)** 0.165cm^2, **(v)** 6.17cm^2.

Question 11

There was an encouraging response to this vector question. Candidates did not always simplify the expressions in part **(a)**, but they often displayed an understanding of the methods required. Examiners noticed that the solution of part **(b)** sometimes did not follow on from the working shown. No credit is given in such cases. It was hoped that the value of *k* would be quoted in part **(d)(i)**, but the mark could only be awarded if one vector was a scalar multiple of the other. Candidates were expected to state or imply that the points *E*, *C* and *D* are collinear and that the length of *ED* is $\frac{5}{3}$ of the length of *CD*. Statements that the lines are parallel, or that one line is longer than the other were not considered sufficient.

In the last part it was hoped that candidates would see that the ratio of the areas was equal to the ratio of their bases. Some candidates thought that the triangles were similar, and squared the fraction.

Answers: **(a)(i)** $\mathbf{b} - \mathbf{a}$, **(ii)** $\frac{2(\mathbf{b}-\mathbf{a})}{3}$, **(iii)** $\frac{(\mathbf{a}+2\mathbf{b})}{3}$, **(iv)** $\frac{5\mathbf{b}}{3}$; **(c)** $\frac{5(3\mathbf{b}-\mathbf{a})}{9}$; **(d)(i)** $k = \frac{5}{3}$; **(e)** $\frac{4}{5}$.