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FOREWORD

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**.

UNIVERSITY of CAMBRIDGE
International Examinations

MATHEMATICS D (CALCULATOR VERSION)

GCE Ordinary Level

Paper 4024/01
Paper 1

General comments

The overall level of difficulty of the paper compared very closely with that of last year, although there were perhaps one or two more parts which provided real tests for the most able candidates.

Questions which gave the most difficulty were **6 (b)**, **12**, **13**, **14 (b)**, **15 (b)**, **17**, **22 (c)** and **(d)** and the limits of the position of the ship in **Question 23 (b)**.

Almost all candidates were able to gain marks in **Questions 1**, **4**, **7**, **11**, **18 (b)** and **19**.

Presentation of the work was, for the most part, very good, although some scripts were quite disorganised and marks were lost through carelessly planned work and misreading of figures. The graph work was usually quite neat and there were also plenty of good attempts at the construction question, with appropriate use of geometrical instruments.

There were a small number of scripts which contained answers only, with no supporting workings and occasionally workings on separate sheets were inserted in the answer booklet, indicating that some Centres were issuing rough paper.

Candidates seemed to use their time sensibly and only very occasionally was the impression gained that they were struggling to finish in the allotted time.

Comments on specific questions

Question 1

Both parts were well answered by many candidates. Occasionally the decimal point was incorrectly positioned in **(b)**.

Answers: **(a)** 2.44; **(b)** 0.021.

Question 2

Part **(a)** was well answered, but in **(b)** many calculated $\frac{2}{3}-\frac{1}{5}$ rather than $\frac{2}{3}\times\frac{1}{5}$.

Answers: **(a)** $\frac{9}{20}$; **(b)** $\frac{2}{15}$.

Question 3

Many candidates could read the gauge correctly and then find the relevant fraction of 48 litres. Some read the gauge as $\frac{1}{3}$ and a few calculated the number of litres already in the tank.

Answers: **(a)** $\frac{3}{8}$; **(b)** 30.

Question 4

(a) 804 000 in words is "eight hundred and four thousand". A small number of candidates interpreted the words as 800 + 4000 = 4800 giving *L*, *M*, *S* as their answer.

(b) This was well answered although the common error was to take the smaller parts as $\frac{1}{4}$ of the whole and hence 25%.

Answers: *M*, *S*, *L*; **(b)** 20%.

Question 5

Candidates had more difficulty with this question and many struggled with the idea of standard form. Many of those who did show understanding still gave their answers in incorrect forms, e.g. 25% in **(a)** and 2400 000 in **(b)**.

Answers: **(a)** $\frac{1}{4}$; **(b)** 2.4×10^6.

Question 6

Part **(a)** was often correct but very few were able to give the correct answer to **(b)**. Many simply gave the next term in the sequence.

Answers: **(a)** 190; **(b)** $\frac{1}{2}(n+1)(n+2)$ or equivalent expressions.

Question 7

Very well answered with most candidates recognising that they had to divide the volume by 60 x 50. A small number confused volume and surface area.

Answer: 30.

Question 8

There were many correct answers to parts **(a)** and **(b)** but in the last part very many candidates showed that they did not understand the term 'reflex'.

Answers: **(a)** 73°; **(b)** 31°; **(c)** 318°.

Question 9

Many candidates recognised the correct graphs for $y = x^3$ and $y = x - 1$, but part **(b)**, $y = \frac{1}{x^2}$, caused more difficulty.

Answers: **(a)** Figure 6; **(b)** Figure 4; **(c)** Figure 2.

Question 10

(a) Apart from a very small number who believed that the fourth angle was the same as the given three, almost all candidates used the angle sum of a quadrilateral correctly.

(b) This part proved to be more difficult, but those who worked with the exterior angle were more successful than those who started by quoting the formula $\frac{(n-2)180}{n} = 165$.

Answers: **(a)** 75°; **(b)** 24.

Question 11

This was a well answered question. In **(a)** some candidates did not factorise fully and in **(b)** carelessness with the signs occasionally produced an answer of $x = -4$. Weaker candidates had more difficulty with **(c)** and often gave only –2. Some candidates gave –2 and +3 while others gave –2 and $\frac{1}{3}$.

Answers: **(a)** $5x(x-2)$; **(b)** $y = 4$; **(c)** $p = 0$ or -2.

Question 12

(a) It was often though that AC being common was part of the required proof and there was much confusion between similarity and congruence.

(b) Most candidates recognised that they had to equate two fractions using corresponding sides, but many failed to pick out the sides that corresponded. Weaker candidates had no ideas or tried to use Pythagoras.

Answers: **(a)** $A\hat{C}B = C\hat{D}A$ and $B\hat{A}C = A\hat{C}D$... ; **(b)** 10.5 cm.

Question 13

This proved to be rather more difficult than previous questions on this topic and there were relatively few correct solutions.

In **(a)** many candidates shaded B' and failed to realise that $A \cap B$ should also have been shaded. The polygon names offered in **(b)(i)** were many and varied, and in **(ii)** it was rare to see T positioned in $Q' \cap R$. Probably the most common error was for it to be in $Q \cap R$.

Answer: **(b)(i)** squares.

Question 14

Part **(a)** was often correct, but in **(b)** only the very strongest candidates reached the correct integers. Many candidates gained a mark by solving the inequalities correctly, although there were many sign errors here with mistakes such as $x \leqslant -4.5$ following on from $-9 \leqslant 2x$.

Answers: $y \geqslant \frac{1}{2}x$; **(b)** –4 and –3.

Question 15

There were many correct answers to part **(a)**, but more problems were encountered in **(b)**, with quite a number saying that the product **AB** was impossible. Others did attempt a multiplication and finished with a matrix of completely the wrong order. A number gave their answers as $\begin{pmatrix} 1 \\ -1 \end{pmatrix}$.

Answers: **(a)** $\begin{pmatrix} 0 & 1 \\ -1 & 2 \\ 0 & -3 \end{pmatrix}$; **(b)** (1, –1).

Question 16

Candidates scored well in this question, with quite a good number earning full marks. Most knew how to find the value of the function when $x = -4$, but fewer were able to reverse the process as required in **(b)**. There was a good response in **(c)** although $\frac{x-5}{3}$, $\frac{1}{3x-5}$ and $3x - 5$ were commonly given. The substitution of 4 in their previous answer was usually carried out accurately.

Answers: **(a)** –17; **(b)** 5; **(c)** $\frac{1}{3}(x+5)$; **(d)** 3.

Question 17

(a) Relatively few candidates realised that 'correct to the nearest 5 cm' implies limits of ±2.5 cm. Most reduced the lengths by 5 cm and a small number used 100 and 75 and subtracted 5 from their answer.

(b) Most candidates simply divided 22 by 3, with no appreciation that the greatest length was obtained by dividing the greatest area (22.5) by the least width (2.5).

Answers: **(a)** 340 cm; **(b)** 9 m.

Question 18

(a) Very few candidates gave the correct value for *x*, very many giving 1. More were successful with *y*.

(b) This part was very well answered with occasional slips leading to answers of 13 2000, 550 and 5000.

Answers: **(a)** $x = 0$, y = –2; **(b)** 13 200 yen, $500.

Question 19

(a) Apart from some confusion between 'more than' and 'less than' this was well answered.

(b) Not as well understood as **(a)**, with some candidates giving 23 to 36 and others giving the median 31.

(c) The standard of the graph work was very good and the majority of candidates gained both marks. There were occasional misplots, the most common being to plot the first point at (10, <u>2</u>5) or the sixth at (3<u>6</u>, 330).

(d) 'Field *B*' was a more common response than the correct answer, probably because the graph of *B* was higher than that of the graph for *A*. Most of those who did give *A* were able to give an acceptable reason, usually by comparing the medians or the number of plants that grew to a height of more than 30 cm.

Answers: **(a)** 220; **(b)** 13; **(d)** *A* with a reason.

Question 20

The first two parts were often correct, although occasionally speed and acceleration were confused.

Many candidates knew that the area under a speed-time graph was a measure of distance and the majority of these calculated the areas correctly. In **(d)** many were confused over what should be straight and what curved, and it was often difficult to decide which the candidates intended between t = 30 and 40.

Answers: **(a)** 13 – 14 m/s; **(b)** $\frac{2}{3}$ m/s^2; **(c)(i)** 500 m, **(ii)** 700; **(d)** straight line from (30, 300) to (40, 500), curve with decreasing gradient from (40, 500) to (60, 700).

Question 21

Most candidates were able to attempt this question, and even quite weak candidates were able to pick up some marks.

Part **(a)** was usually correct, although (–4, 4) was a common wrong answer.

In **(b)** most candidates appeared to know the method for finding the mid-point and wrong answers were usually the result of arithmetical slips.

There were quite a number of correct answers to **(c)** although $x = 4$ was seen quite often. Many knew how to answer parts **(d)** and **(e)** and most of the wrong answers were again because of arithmetical errors.

Answers: **(a)** (4, 4); **(b)** ($2\frac{1}{2}$, 2); **(c)** $y = 4$; **(d)** $y = \frac{1}{2}x - \frac{1}{2}$; **(e)** 20 unit^2.

Question 22

(a) The interpretation of $M(P) = Q$ was found difficult by many candidates.

(b) Many candidates found the centre of rotation, although some confused the x and y coordinates. Part **(ii)** was well answered although 90° clockwise was seen occasionally.

(c) This proved difficult with many candidates making no attempt at matrix multiplication.

(d) There were very few correct answers seen, with $\begin{pmatrix} \frac{1}{2} & 0 \\ 0 & \frac{1}{2} \end{pmatrix}$ appearing quite frequently.

Answers: **(a)** (6, 2); **(b)(i)** (–2, 0), 90° anticlockwise; **(c)** Δ (0, –2), (–4, –2), (–6, –6); **(d)** $\begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & -\frac{1}{2} \end{pmatrix}$.

Question 23

A small number of candidates did well on this question, but most candidates had difficulty, particularly with part **(b)**.

(a)(i) Most candidates knew what was required, but relatively few were able to give the correct number of zeros.

(ii) Again many were unable to calculate the correct distance even if they measured the length *AB* on the diagram sufficiently accurately.

(b) A number of candidates picked up one or two marks for the constructions, but very few gained all three and of these it was rare to see *SP* identified correctly.

Answers: **(a)(i)** 1 : 2 000 000, **(ii)** 235 – 237 km.

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Paper 2

General comments

There was a good response to this paper by many candidates, though some of the weakest candidates found it to be challenging. Nevertheless they found enough to show what they did understand. In many cases such candidates produced badly presented solutions. It was noted however, that there were many scripts in which solutions were squashed into a very small space and in which very little detail was shown.

This was particularly noted in the trigonometry questions. Often a literal formula was quoted followed by the numerical answer to the question. If there is any error in the entering of numbers into a calculator the wrong answer will result and the Examiner will be unable to award any credit, since no correct numerical statements will have been seen. The same may apply if insufficient significant figures appear in the only number seen. A small number of candidates still try to economise by presenting solutions in two or even three columns on a page. This is often done by drawing columns or, worse, by putting solutions to some parts in any gap they can find on the page. There is then a risk that such parts, especially if not labelled, will not gain credit. It was felt that this was a misguided attempt to save paper which often resulted in answer books with many unused pages.

The graphical work seen was usually of a high standard, though a small number of candidates chose to use a scale other than that given in the question. This is always likely to make the drawing more difficult, and usually results in the loss of at least one mark. Calculator work was also good, but weaker candidates often lost some credit by only showing answers correct to two significant figures, and also by using premature approximations to previous answers in later parts of a question, especially in **Questions 1** and **8**. Unless otherwise instructed, all answers should be quoted to three significant figures and at least four figure values used in later parts of a question. It is better to use the value stored in a calculator wherever possible.

Comments on specific questions

Question 1

The first part was intended to be an easy hint to candidates to use the trigonometry of right angled triangle in the remainder of the question. Although most, but by no means all, stated that angle *ABO* is 90°, surprisingly many were unable to state that this was because it is the angle between a tangent and a radius.

In part **(b)(i)** most used the fact that sin *OAB* = 6/13, as expected, but a wide range of methods were used to find the two lengths that followed, often unnecessarily employing similar triangles and/or Pythagoras' Theorem. Examiners expected to see *AC* = 15/(tan 27.5°) and *CE* = 2 × AC sin 27.5°, though many preferred to use the sine formula in triangle *ACE* or the cosine formula in triangle *PCE*.

Answers: **(a)** 90°; **(b)(ii)** 28.8 cm, **(iii)** 26.6 cm.

Question 2

This question was very well done by all but the least able. A few lost credit in **(a)** due to failure to complete the solution, or premature rounding or due to a sign error. The simultaneous equations in **(b)** were quite well done, but several found the value of only one variable. The simplification in **(c)** was usually well answered, but a small number "cancelled" single terms or treated it as an equation. Almost all knew what was required in **(d)**, so many correct answers were seen.

Answers: **(a)** $2\frac{1}{3}$; **(b)** $x = -2\frac{1}{2}$, y = 17; **(c)** $\frac{3y+2}{y-2}$; **(d)** $\frac{2f-3h}{g+2}$.

Question 3

This question was more searching, but good solutions were seen. Although in **(a)** many candidates could write down the angles required, they often lost a mark due to faulty, or missing, reasons. Examiners expected to see reference to the angle in a semicircle, the angle sum of a triangle, opposite angles of a cyclic quadrilateral and angles in the same segment, though other methods were available, and acceptable, especially in the third case. It was, however, noted that a small number of candidates quoted reasons without giving numerical answers for the angles.

In part **(b)** Examiners expected to see reference to alternate angles and the deduction that angles *BDX* and *DBX* are equal, leading to the isosceles triangle (or some other explained alternative) for full marks. Most found angle *EBA* correctly. The last part required some careful explanation. Examiners expected to see either a proof that triangle *ABX* is also isosceles, so that *AX* = *BX* = *DX*, or that angle *EAB* = 90° so that *EB* is also a diameter and diameters *AD* and *EB* cut at the centre.

Answers: **(a)(i)** 90°, **(ii)** 34°, **(iii)** 124°, **(iv)** 28°; **(c)** 62°.

Question 4

The bar chart in part **(a)** was quite well done. The main errors were due to poor labelling on both axes. In particular the number of cars (0, 1, 2….) should appear under the centres of columns of equal width, not at one end of the columns.

Parts **(b)** and **(c)** were well done. The main errors in part **(d)** were due to failure to double a value, in recognition of two possible orders, and/or failure to recognise sampling without replacement, leading to a denominator of 625. The last part was intended to be more searching, but a pleasing number of candidates spotted that they should use the total number of cars, 48. Surprisingly, having spotted this, 6 was often used as the numerator of the fraction.

Answers: **(a)** 4, 7, 6, 5, 2, 0 and 1; **(b)(i)** 2, **(ii)** 1, **(iii)** 1.92; **(c)** 1/5; **(d)** 1/25; **(e)** 1/4.

Question 5

Most candidates were able to do the first two parts. It was noticeable that the majority of slips here were found where no logical order was employed when showing the various possible methods of paying. Some new denominations of coins or notes, such as $3, were seen.

It was hoped that candidates would look for a pattern in the sequence 1, 2, 3, 5, 8, … . Many thought the differences increased by 1 each time (leading to 12 then 17) though this did not fit the first two terms. A good number did notice that this was a Fibonacci sequence, in which each term is the sum of the previous two terms. A few found more sophisticated ways of reaching the same results, which was particularly pleasing.

Answers: **(b)(i)** $a = 13$, $b = 21$, **(ii)** $z = x + y$.

Question 6

There were many excellent solutions to this question. Parts **(a)** and **(b)** were usually correct and good efforts to form the equation usually followed, though there was sometimes an initial sign error which was followed by a further, insufficiently disguised, error which appeared to give the correct equation in the end. Most were able to solve the quadratic equation, but a mark was often lost due to failure to quote the final answers correct to three decimal places as required, and emphasised in bold type on the question paper.

Some marks were lost interpreting the solution. A few thought the time to be 2.212 minutes, but most got to 10.85 minutes. A large proportion of these were not able to convert this to minutes and seconds, with 11 minutes 25 seconds being particularly common.

Answers: **(a)** $24/x$; **(b)** $24/(x + 0.5)$; **(d)** 2.212 and –2.712; **(e)** 10 minutes 51 seconds.

Question 7

The majority found the area of the window correctly, but some used a radius of 1.2 m or the area of a complete circle. This did not stop them reaching 23.6 m² as the area of the walls, but Examiners were looking for such false solutions.

A few included the area of the ceiling (and floor) in this part.

Most knew what to do in the next part, finding the increased area, 26.4 m², to be used and dividing by the area of a tile. A few used 25 in place of 25^2 or 625 cm² or failed to convert the units correctly. The main error when finding the cost of the tiles was a failure to round up, to the next integer, the number of boxes to be bought. Nevertheless very many correct answers were seen.

The profit made by the shopkeeper was also well answered, though many found 20% of $15. A few quoted only the cost price. Many made the work more difficult by using the answer to the previous part and then dividing by the number of boxes in place of the given $15. This is a valid method and gained full credit if correct.

Answers: **(a)(i)** 1.53 m²; **(b)(i)** 423, **(ii)** $330, **(iii)** $ 2.50.

Question 8

The routine part **(a)** was very well done. A small number had some difficulty with the bearings. A few lost credit by going from a general statement of the cosine formula direct to 81 m without ever showing 80.9 m.

There were many good solutions to part **(b)**, but some of the weaker candidates found the three dimensional ideas to be rather difficult. The sine formula was often used to find the height of the kite, rather than the more direct 72 tan 24°.

Answers: **(a)(i)** 292°, **(ii)** 80.9 m, **(iii)** 45.7°, **(iv)** 157.7°; **(b)** 28.1°.

Question 9

Almost all successfully used Pythagoras' Theorem in the first part. When finding the surface area and volume of the toy the main source of error was to fail to halve the given values for the sphere when considering a hemisphere. When finding the area some failed to use the hint of the first part, quoting $\pi \times 5 \times 12$ for the area of the cone. A number had clearly learned the surface area of a hemisphere as $3\pi r^2$, not realising that this includes the plane face. A small number added some circles of contact as part of the total surface area.

The main error when finding the volume of a toy was when quoting the volume of a cone which did not contain π, but many correct answers were seen, and most gained some credit here.

The last part was often well done. The majority of candidates attempted to divide the volume of the cylinder by the volume of a toy just found, though a few used an area or areas or used the reciprocal of the required fraction. The unit conversion caused some problems, but was more likely to be correct when done before finding the volume of a cylinder.

Answers: **(b)(i)** 361 cm^2, **(ii)** 576 cm^3; **(c)** 24 500.

Question 10

Overall marks were high in this question.

Most candidates expressed the three lengths in terms of *x*, but some lost credit when deriving the equation either due to their failure to show the other side of the equation (= *y*) at all, or because essential working was not shown.

Almost all found the value of p and the graphs were good, but a few chose to double the scale on the vertical axis. The tangents were usually good and reasonable attempts made to find its gradient, but the negative sign was frequently omitted. Most candidates took reasonable readings for the values of *x* when $y = 44$, but only the better quoted a range of values of *x* as requested. In the last part several gave the value of $x = 6$ when the area is greatest, whereas a slightly larger value was expected. A number gave the value of the greatest area, which was not required, either in addition to the value of *x* or in place of it.

Answers: **(a)(i)** $x - 2$, **(ii)** $100/x$, **(iii)** $[100/x] - 5$; **(c)** 40; **(e)** –1.60 to –2.00; **(f)(i)** {4.65 to 4.80} to {8.45 to 8.55}, **(ii)** 6.20 to 6.40.

Question 11

Overall the performance on this question was quite encouraging. Most had no trouble in part **(a)**, but only a minority was able to explain that the three expressions are equal because they represent the lengths of the three sides of the equilateral triangle *OAB*. Most candidates did well in parts **(c)** and **(d)**, correctly deducing that *Y*, *A* and *X* lie on a straight line. Many followed the pattern of the previous parts and gained credit for finding either the vector **YZ** or **ZY**, but showing that *XYZ* is an equilateral triangle was rarely convincing. Many gained credit for finding the fraction in the last part, usually by using the areas of similar triangles.

Answers: **(a)(i)** *a*, **(ii)** $b - a$, **(iii)** $a + b$; **(c)(i)(a)** *b*, **(b)** 3*b*, **(ii)** Collinear; **(d)** –3*a*; **(e)** 1/9.