CONTENTS

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**.

MATHEMATICS

GCE Ordinary Level

┌─────────────────────────┐
Paper 4024/01
Paper 1
└─────────────────────────┘

General comments

This was a successful paper of a standard similar to that set in previous years, but it proved to be a little more difficult to score really high marks than has sometimes been the case. It allowed the weakest to demonstrate their understanding while the best found that they were being challenged in places.

Once again there were some excellent well presented scripts which contrasted with the small number of poor, badly explained scripts. Candidates should be made aware that Examiners are often unable to allow any credit to the working in such cases as they are often unable to see what the a candidate is trying to do.

It was again pleasing to note that there was some impressive work on the more routine algebra.

The response to the geometrical questions was rather disappointing however, and deserves more attention.

Comments on specific questions

Question 1

This question was generally well answered. A very small number of candidates put the decimal in the wrong place in the first part and a similar number did not appear to understand "as a percentage" in the next part, converting the decimal fraction to a vulgar fraction.

Answers: **(a)** 0.07; **(b)** 8 %.

Question 2

This question was also well answered, though a few failed to cancel fully in the first part. The addition of fractions was well understood, but there were a few arithmetic slips.

Answers: **(a)** $\frac{2}{3}$; **(b)** $\frac{19}{21}$.

Question 3

The first part was well done, but the second part proved to be more searching. Some candidates did show the effects of the brackets they had inserted, but did not always modify their answers to produce the required result.

Although only one pair of brackets is necessary, some solutions used extra acceptable pairs.

Answers: **(a)** 70; **(b)** 1 + 72 ÷ (4 x 2) = 10.

Question 4

The first part of the question was reasonably well done, but $9\,x^5$ and $9\,x^9$ were quite common. Some good working was seen for the next part, but it was often spoiled by a failure to evaluate the answer accurately, with many giving $\frac{1}{4}$ or $16^{\frac{1}{2}}$ as their answer.

Answers: **(a)** $9\,x^6$; **(b)** 4.

Question 5

The majority of candidates recognised the corresponding angles in the second part, but the first part was not as well answered. Very many assumed angles *CAE* and *FAB* to be equal, reaching an answer of 61°.

Answers: **(a)** 64°; **(b)** 58°.

Question 6

This was another question that was well answered by many candidates. Sign errors led to an answer of 2 for the determinant in some cases. Most candidates knew how to find the inverse matrix, but several otherwise correct solutions were spoiled by having 5 as the first element, rather than $\frac{1}{5}$.

Answers: **(a)** 10; **(b)** $\frac{1}{10}\begin{pmatrix} 2 & 1 \\ -4 & 3 \end{pmatrix}$.

Question 7

The response to this question was disappointing. The length of an arc was less well known than expected, many took the angle at the centre to be 9° and the cancellation was also badly done. Many failed to divide by the 7 that they had lost in a mass of numbers in an ill presented piece of working.

Answer: 11 cm.

Question 8

In contrast there was much good work here, with very many correct answers produced. The main errors were due to a failure to simplify the brackets in the numerator. This might lead to 2x + 2 - x - 3 for example.

Answer: $\frac{x+7}{(x-3)(x+2)}$.

Question 9

This question was not well answered. Although the better candidates knew what was wanted, the less able clearly did not understand, producing very strange answers, which were sometimes negative. Some gave the answers 11 and 9.

Answers: **(a)** 10; **(b)** 8.

Question 10

This question was quite well done, though some felt that they had to round their answer at the same time. A few gave the answer as 21 730. Those who took the hint to express all of the numbers in standard form usually had no trouble in the second part. The answers were accepted in any form.

Answers: **(a)** 2.173×10^4; **(b)** 0.031×10^5, 217.3×10^2, 22.6×10^3, 2.5×10^4.

Question 11

Although there was a lot of confident work here, with f-1(x) = 3x - 5 being seen in the working of the second part, some had difficulty in writing down the values of c and d from there.

Answers: **(a)** 2; **(b)** *c* = 3, *d* = -5.

Question 12

Sign errors in the first part, leading to 1, were surprisingly common. Although most candidates reached 6 : *t* = 4 : 15 in the next part, very many were unable to go on from there accurately, often stating 6 + 15 = 4 + *t*, leading to *t* = 17. Some of those who reached *t* = $\frac{90}{4}$ then failed to divide correctly.

Answers: **(a)** -8; **(b)** 22.5.

Question 13

Although a few omitted part or all of this question, most drew a straight line from the origin to (157.5, 40 000) as expected, but some had problems with reading the scale on the horizontal axis. The use of the graph was also good. The response to the last part was less well done. Incorrect answers such as $\frac{1}{2}$ were anticipated, and quite common. Some of the better candidates failed to notice that the ratio of lengths is 1 : 2, so some very complicated solutions involving 17.53 and 353 were seen.

Answers: **(b)(i)** 8500 to 9000 km, **(ii)** $\frac{1}{8}$.

Question 14

The first part was usually correct, but the response to the second part was patchy. Many did write down at least two of the inequalities using the correct sign but the distinction between < and ⩽ was often not appreciated, though on this occasion no penalty for the use of the wrong one was applied.

Answers: **(a)** $2\frac{1}{2}$; **(b)** $y > -1$, $y < x + 3$, $y < 4 - 2x$.

Question 15

Most of the candidates found the first bearing, but some reached 058°. The measurement of the angles in the second part was not done accurately enough in many cases, even when the candidate did know how to find the bearing.

Answers: **(a)** 068°; **(b)** 199° to 200°.

Question 16

(a)   This was not as well done as might have been expected, largely due to a failure to deal with the units effectively. For this reason candidates were required to quote a unit in their response.

(b)   There was a wide variety of responses to this question. Many made a correct start, but a number failed to evaluate it accurately.

Answers: **(a)** 1.515 m; **(b)** 3.96 km.

Question 17

Many started well, and a gratifying number completed the solution correctly. Some stopped at the stage at which the factors $(x + 5)(x - 3)$ had been found, and some went from $x^2 + 2x - 15$ to $x^2 + 3x - 5x - 15$ and hence to $(x - 5)(x + 3)$.

Answers: 3 and – 5.

Question 18

Solutions involving areas and volumes were quite common unfortunately. Those that used Pythagoras as expected did not always appreciate that it was the diagonal that had a length of 6 cm, leading to an answer of 31. There was also some confusion which took the height of the pyramid being taken as ℓ cm. This led to answers such as 40, or an attempt at its evaluation.

Answer: 40.

Question 19

There were good attempts at both parts of this question, with many completely correct solutions. Some failed to evaluate 400 - 280 correctly, and a few gave 70% in the first part. In the second part a few added the original $500 to find the total, but rather more found the interest earned in 8 years.

Answers: **(a)** 30%; **(b)** $20.

Question 20

The response to this question was disappointing. Many drew the first locus correctly, but the second caused problems. Some tried to draw a circle centred on the word "Coastline", while very many only considered the top section of the coastline, sometimes drawing a line on the land side of the coast. Not all of those who did draw three lines joined the ends with circular arcs, and the selection of the required region was sometimes incorrect even when the earlier parts were correct.

Examiners expected to see:

(i)   a circle of radius 6.5 cm, centred on Beacon,

(ii)   three straight lines parallel to the coastine, 2.0 cm from the coastline, on the sea side of the coast,

(iii)   two circular arcs joining the ends of the parallels,

(iv)   the region inside the circle and outside the boundary defined in (ii) and (iii) indicated.

Question 21

(a)   This was question was generally well done.

(b)   Some Centres answered this well. Some tried to consider the line from (1 , 1.5) to (2 , 4.5) leading to k = 3, then $1.5 = 3a^1$ gives $a = \frac{1}{2}$ however. This was not accepted.

Answers: **(a)(i)** 2, **(ii)** 2.65 to 2.70; **(b)(i)** k = 0.5, **(ii)** a = 3.

Question 22

The first part of this question was reasonably well done, but sometimes the answers were reversed. Some assumed that A, E, C and D lie on a circle.

The second part tested even the most able. Some were able to relate the fact that the angle at E is twice the angle at B to the angle at the centre of a circle property, but only a very small number used the angle in the same segment property to deduce that the centre lies on the given arc. Some falsely deduced that the centre is the point E.

Answers: **(a)(i)** 107°, **(ii)** 34° .

Question 23

Although many stopped at $5(a^2 - 4)$ and some went on to $5(a - 4)(a + 4)$, very many found the correct factors in the first part.

The second part was also quite well done, though some lost the negative sign when finding k. Some did not simplify the value of x or gave the false answer of $\pm\frac{1}{2}$.

Answers: **(a)** $5(a + 2)(a - 2)$; **(b)(i)** − 8, **(ii)** $-\frac{1}{2}$.

Question 24

The majority of candidates were able to visualise the situation described in the question, and most used 50 tan 30° but the arithmetic sometimes let them down. Many reached a final value of 30.65 m but did not complete the solution by rounding to a reasonable degree of accuracy.

Answer: 31 m.

Question 25

Candidates scored well in this question. Some did not realise what was expected for the first answer, but were able to find the square root. Many correct answers to the next part were seen, but some did not find the square roots, giving 81 and 16, while a few found the square roots of the correct answers, leading to 3 and 2.

Many quoted irrational numbers in the last part, but some spoiled their answers by trying to give extra values, not all of which were irrational. The most popular answer was π, but it must be noted that neither 3.142 nor 22/7 is irrational.

Answers: **(a)(i)** $24 \times 3^2 \times 7^2$, **(ii)** 84; **(b)** $p = 9$, $q = 4$.

Question 26

(a)   Although some thought this was a shear or enlargement, most candidates answered this well.

(b)(i)   This was well done.

   (ii)   There were some good answers to this, but although most appreciated that *A*' is at *A*, many took the image of *C* to be the reflection of *B*' in the horizontal axis.

   (iii)   This was also well done.

Answers: **(a)** Stretch with factor 2 with *y*-axis invariant; **(b)(i)** $\begin{pmatrix} 8 \\ 0 \end{pmatrix}$, **(ii)** *A*' at (4 , 0) and *C*' at (-7 , -2), **(iii)** 4.

Paper 4024/02

Paper 2

General comments

It was generally felt that most questions had a spread of parts which offered opportunities for candidates of all abilities to gain credit, and that the *Section B* questions were of a similar standard, each containing some straightforward and some testing parts.

Overall the paper proved to be rather more difficult than in previous years with, perhaps, rather less routine questions and more which required original thinking.

The first question was quite 'wordy' and did not give the candidates a gentle start – this might have discouraged some candidates.

There were, however, many excellent scripts from candidates who clearly had first-class mathematical ability.

The presentation was quite good although there were, perhaps, a few more untidy and carelessly written scripts.

Although there were less instances of premature approximation than last year, there were still a number of candidates who lost marks unnecessarily for this reason. There were also a small number of candidates who had their calculators set as 'Grads' or 'Rad' and thus lost marks.

Candidates did not appear to be short of time and indeed many attempted all five *Section B* questions before deleting one of them.

Comments on specific questions

Section A

Question 1

This question was not well answered. Most candidates picked up some marks, but relatively few gained more than 3 or 4. The question was perhaps rather too 'wordy' for some candidates.

(a)(i) It was sometimes assumed that Ann was travelling at 3 metres per minute and 6 m was given as the answer, but many successfully found 360 as their answer. In **(b)** the majority found the distance Ben had travelled (840 m) but then simply subtracted 360 and gave 480 as their answer.

(ii) Most candidates were unable to start this part – there was a failure to appreciate and use the fact that when they met they had been travelling the same time.

(iii) The division of 6000 by 7 was regularly seen, but relatively few could correctly convert this into minutes and seconds. The most common mistake was to go from 857.14… seconds to 14.2857… minutes and gave 14 minutes 29 seconds as the answer.

(b) In **(i)** many candidates stopped after getting to the ratio 1 cm : 2.5 km, not realising that it was necessary to express the ratio with both quantities in the same units. There was more success with part **(ii)**, with many gaining credit here, even though they had been unsuccessful in the first part.

Answers: **(a)(i)(a)** 360 m, **(b)** 4800 m, **(ii)** 1800 m, **(iii)** 14 min 17 s; **(b)(i)** 1:250 000, **(ii)** 2.4 s.

Question 2

A straightforward question, which was very well answered with many gaining 8 or more marks.

(a) A few candidates equated the expression to zero and gave 'solutions' – but most were successful.

(b) This caused a few problems, with $\frac{h}{k} = \sqrt{3}$ sometimes appearing as the first step, and $\frac{9}{h}$ occasionally given as the answer after a correct $\frac{h}{k} = 9$.

(c) The quadratic formula was generally well known and well used. The negative value of b resulted in some errors when substituting and carelessness with the fraction line was also a source of error. Correctly expressing the answers to two decimal places was not a problem for most candidates although 18.65 and 4.35 were both seen occasionally.

(d) A number of candidates tried to put $Y = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ into the equation and made errors in the subsequent unwieldy algebra, and others made sign errors and finished with $-Y$ as their answer. A very small number misunderstood completely and tried to use the inverse. Despite these failings there were very many completely successful solutions.

Answers: **(a)** $(t-5)(2v+1)$; **(b)** $k = \frac{h}{9}$; **(c)** 18.66 or 4.34; **(d)** $\begin{pmatrix} 8 & 4 \\ -6 & 0 \end{pmatrix}$.

Question 3

(a)(i) Although not always calculated using the trapezium formula, most candidates found the area correctly.

(ii)(iii) These two parts caused many problems with h regularly assumed to be either the same as $BD\left(\sqrt{6^2 + 4^2}\right)$ or $\sqrt{9^2 - 5^2}$. The height was rarely found from a consideration of areas and the most common successful approach was to find $D\hat{A}B$ first and find h from $9\sin D\hat{A}B$. There were also many long attempts using sine and cosine rules.

(b) This was much more popular and many candidates were successful with the first two parts. They encountered difficulty with **(iii)**. Most recognised that the circle did not pass through *Q*, but their justification was often a vague statement such as "too far from the centre" or "*QR* is too big". More gave correct answers to the last part although again some gave imprecise answers such as "between *P* and *R*" or "on the perpendicular bisector of *PR*".

Answers: **(a)(i)** 30 cm², **(ii)** 7.2 cm, **(iii)** 53.1°; **(b)(i)** 5.03 cm, **(ii)** 69.7°, **(iii)(a)** No: $P\hat{Q}R \neq 90°$ or equivalent, **(b)** Mid-point of *PR*.

Question 4

(a) There were many acceptable answers to this part, although some candidates thought that $\frac{540}{5} = 108$ or $180 - 72 = 108$ was sufficient, without explaining where their 540 or 72 had come from.

(b) Many candidates correctly identified the two line symmetries although a number also quoted *AD* and *BC*. Relatively few mentioned rotational symmetry and even then the order of rotation was not always stated. Rhombus was often given in **(ii)** but kite was also seen many times. Many candidates still do not know what a reflex angle is, and the most common wrong answer was 108°. The angle *AZY* was not often correct, 72° or 18° being seen quite regularly.

(c) Candidates found this difficult. In many cases much work was done without any real understanding of the situation.

Answers: **(b)(i)** 2 lines of symmetry, rotational symmetry of order 2, **(ii)** rhombus, **(iii)** 252°, **(iv)** 36°; **(c)(i)** 40°, **(ii)** 100°, **(iii)** 120°.

Question 5

Only the very best candidates gained full marks in this question.

(a) Many, even good candidates, failed to recognise what was meant by "set notation" despite the fact that an example had been given and they produced answers which did not involve *S* and *F*. Of those who had more understanding, a good number omitted the '*n*' from the expression.

(b) There was a better response here although a large number, including some strong candidates, left their answer in the form 15 = *x* − *y* or an equivalent non-explicit form for *y*. Many candidates' attempts were thwarted from the start when they omitted either *y* or 100 from their initial expression. Others failed to perform the algebraic simplification correctly, errors usually coming from incorrect removal of brackets.

(c) Many gave 15 for the least possible value of *x*, but the correct value for the greatest *y* was rarely seen, few apparently realising that this occurred when *x* took its maximum value of 35.

Answers: **(a)** $n(S \cup F)'$ or $n(S' \cap F')$; **(b)** *x* − 15; **(c)(ii)** 15, **(ii)** 20.

Question 6

(a) Well answered.

(b) There were many correct answers, although some weaker candidates simply rearranged the formula and gave *k* = *B* − 3*n*.

(c) The majority of candidates struggled with this part. Working was often disorganised, with methods not appearing to have any clearly defined route. The partially correct answer of *R* = 7*n* + *k* was not uncommon and many candidates left their answers in unsimplified forms − 6*n* + (*n* − 1) or 6 + 7 (*n* − 1).

(d) There was a lot of misunderstanding in this part. A significant number linked *n* to the number of fences rather than the length, solving 200 = 3*n* + 2 and 400 = 7*n* − 1. Quite a number found *R* = 41 and *B* = 20, but still failed to proceed correctly, some using $\frac{600}{41+20}$ others getting $\frac{200}{20}$ and $\frac{400}{41}$ and then adding the two answers.

Answers: **(a)** *p* = 14, *q* = 27; **(b)** 2; **(c)** 7*n* − 1; **(d)** 9.

Question 7

This was a popular question, but many made a succession of careless errors.

(a) Although the word 'total' was highlighted in the question, many failed to include the area of the circular base. Occasionally $4\pi r^2$ was used for the surface area of the curved part of the hemisphere and occasionally the radius was taken as 4 cm instead of 3 cm.

(b) Very many candidates took the slant height to be 16 and of those who did recognise the need to find l, a significant number used $l = \sqrt{16^2 - 4^2}$.

(c)(i) A large number of candidates did not appear to recognise what was required in this question. Many realised that $\frac{4}{16} = \frac{1}{4}$ or $\frac{16}{4} = 4$ but did not give convincing reasons why $r = \frac{1}{4}d$. Very few mentioned 'similarity' or 'a constant ratio $r : d$'.

(ii) This part was well answered.

(iii) It was pleasing to see candidates using $\frac{V_1}{V_2} = \left(\frac{d}{16}\right)^3$ and although many of them substituted the values obtained in the previous part for V_1 and V_2 rather than going straight to $\frac{1}{2} = \left(\frac{d}{16}\right)^3$, they usually obtained the correct answer. Other candidates used the more obvious $134 = \frac{1}{3}\pi\left(\frac{d}{4}\right)^2 d$ and were usually successful if they avoided $\left(\frac{d}{4}\right)^2 = \frac{d^2}{4}$ or $\frac{d^2}{8}$. Weaker candidates sometimes assumed that $\frac{1}{2}$ volume $\Rightarrow \frac{1}{2}$ height and so $d = \frac{16}{2} = 8$. Others realised that they should equate the new volume to 134 but used the radius as 4 and solved $134 = \frac{1}{3}\pi 4^2 d$.

Answers: **(a)** 84.8 cm^2; **(b)** 207 cm^2; **(c)(ii)** 268 cm^3, **(iii)** 12.7 cm.

Question 8

(a) There was much excellent graph work shown with many perfectly drawn curves. There were very few wrong scales and ruled lines joining points.

(b) The value of y was usually correct, but it was common for only one value of x to be given.

(c) Most candidates drew a reasonable tangent, but the accuracy of the gradient varied considerably. Many did not recognise that the gradient was negative and a good number failed to take account of the scales.

(d) Many candidates did not understand what was required here and some tried to find the equation of the tangent they had drawn in the previous part.

(e) Most candidates were able to derive the given equation and many successfully found a second equation, although some made later work much more difficult by choosing difficult points such as (1.5, 110). The solution of the simultaneous equations was usually completed successfully.

Answers: **(b)(i)** 116 to 117, **(ii)** 1.1 to 1.2 *and* 5.2 to 5.3; **(c)** –40 to –22; **(d)** 98; **(e)** $A = 120$, $B = 20$.

Question 9

A fairly popular question, but only the more able candidate could get beyond **(c)(i)**.

(a)   Most candidates answered this part correctly, realising that it required a direct application of the cosine rule.

(b)   Was generally attempted correctly, using $\frac{1}{2}$ x 7 x 8 x sin120. A few candidates used 13 for 7, or for 8.

(c)   A tiny minority of candidates did not realise that the triangle was the same as the one in the earlier part of the question and after giving the answers to **(i)** and **(ii)** in terms of *AB*, *BC* and *CA* could get no further. Most of those who recognised that *BC* = 13 were able to use $\frac{1}{2}$ base x height to get $\frac{13}{2}r$, but many of these were unable to make progress with part **(ii)** despite the hint "By similarly….".

(d)   The majority of those who found a value for *r* were able to calculate the required percentage, although a few found the percentage occupied by the circle, rather than that not occupied.

Answers: **(b)** 24.2 cm^2; **(c)(i)** $\frac{13}{2}r$, **(ii)** 14*r*, **(iii)** 1.73; **(d)** 61.1%.

Question 10

This was quite a popular question.

(a)   Most, though not all, candidates used the scales given. A few started their horizontal scale with the '8' one centimetre from the vertical axis and then drew their first rectangle from the '10' line to the vertical axis i.e. 3 cm wide instead of the correct 2 cm. Apart from this error, the width of the bars was usually correct. Those who showed any understanding of histograms usually did well although a significant number did not understand frequency density and simply drew a bar chart.

(b)   Most could identify the correct interval, although a few gave 12 < x $\leqslant$ 14.

(c)   Answers to this part varied enormously and even weaker, but well-practised candidates, could score well. Common errors were to use the end points of interval rather than the mid-points, not to multiply by the frequencies, or to divide by 6 rather than 40. A surprising number seemed to think that their answer should be corrected to the nearest whole number.

(d)   Quite well answered, but a number of candidates took the wording to mean the number who were 12 or under and gave 21 as their answer.

(e)(i)   Most candidates realised that this part was impossible and gave 0 as their answer. A few however left their answer as $0/40$. Some thought the answer was $7/40$.

   (ii)   There was a high success rate here although $6/40$ reduced to a number of strange fractions.

(f)   This part yielded a wide variety of responses, many of which revealed a rather shallow understanding of probability. Of the more serious attempts, expressions like $\frac{5}{39}\times\frac{34}{38}$ and $\frac{6}{40}\times\frac{34}{40}$ showed that candidates did not read the question carefully enough. Better candidates used $\frac{6}{40}\times\frac{34}{39}$ and then stopped or else added an expression like $\frac{35}{40}\times\frac{5}{39}$. A small number gave their final answer as $\frac{51}{195}$ without reducing to its lowest terms.

Answers: **(a)** Widths 2, 1, 1, 2, 2, 3, Heights $3\frac{1}{2}$, 8, 6, 5, $1\frac{1}{2}$, 2; **(b)** 11 < *x* $\leqslant$ 12; **(c)** 12.4; **(d)** 26;

   (e)(i) 0, **(ii)** $\frac{3}{20}$; **(f)** $\frac{17}{65}$.

Question 11

(a)(i)   This was seldom correct. Candidates usually wrote about total places or positives or numbers or students in first, second, third and fourth places or number of places in each position.

(ii)   The matrix product was usually correct although there were a number who gave $\begin{pmatrix} 30 & 9 & 5 & 0 \\ 20 & 21 & 5 & 0 \end{pmatrix}$.

Most candidates realised that the product related to points scored.

(iii)   Some candidates tried to discuss the situation, others obtained $\begin{pmatrix} 55 \\ 55 \end{pmatrix}$ but were unable to relate this correctly to the question asked.

(b)   The first three parts were answered well although simplification of the vector expressions proved beyond some candidates.

In **(iv)** few candidates used the result $\lambda \overline{OX} = \overline{QY}$ (or its equivalent). It was common to see expressions such as $k = \dfrac{4q-p}{3q}$, obtained from $\overline{OX} = \overline{QY}$. Some used $k\,\overline{OX} = \overline{QY}$ or $\overline{OX} = k\overline{QY}$ which led to confusion between the k in the question and the k introduced the by candidate.

Only a very small number of candidates answered part **(v)** correctly.

Answers: **(a)(i)** Number of events, **(ii)(a)** $\begin{pmatrix} 44 \\ 46 \end{pmatrix}$, **(b)** School scores, **(iii)** $\begin{pmatrix} 55 \\ 55 \end{pmatrix} \Rightarrow$ Yes, now a tie;

(b)(i) $-\dfrac{1}{3}p + \dfrac{1}{3}q$, **(ii)** $\dfrac{2}{3}p + \dfrac{1}{3}q$, **(iii)** $p + (k-1)q$, **(iv)** $\dfrac{3}{2}$, **(v)** $\dfrac{1}{2}q$.