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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**.

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. There was a wide range of abilities of the candidates. The Paper was able to distinguish between these differing abilities, allowing the weakest to show what they know, while giving the best some challenges. There were some excellent scripts which were well presented and explained, but there were rather more badly explained, untidy scripts this year than last year. It is in the candidates' interests to set out their working in an orderly fashion so that credit can be given for partially correct answers.

It was pleasing to note that there was some impressive work on the more routine algebra again this year. On the evidence of this Paper, more attention should be paid to Set Theory with Venn Diagrams, the graphical representation of linear inequalities and vectors.

Comments on specific questions

Question 1

This proved to be an encouraging start to the Paper for most candidates. It was well answered in general. There were a few errors due to misplaced decimals, usually leading to 3/10 in the first part, and to finding 150% of $500, leading to $750, in the second part.

Answers: **(a)** $\frac{3}{100}$; **(b)** 30%.

Question 2

This question was also well answered in general. A few failed to cancel in the first part and rather more did not give the second as a mixed number. Some gave the answer as a decimal or as $\frac{49}{6}$. Many quoted $7\frac{7}{6}$.

Answers: **(a)** $\frac{7}{40}$; **(b)** $\frac{1}{6}$.

Question 3

There was a good response to this question also. The order for operations was well understood, and the position of the decimal point was no problem for the majority. Some gave the answer as a fraction, which was accepted. The most common mistake was to reach 0.08.

Answers: **(a)** 22; **(b)** 0.008.

Question 4

This question was a little more demanding. A significant number moved 11 hours in the wrong direction, but a number showed little appreciation of the time shown on a clock face. Many also moved the minute hand through 5 minutes, and several produced mirror images of the given time. A number gave inappropriate forms of answer in the second part, such as 8 15 p.m. or 20 15 a.m.

Answers: **(a)** 8.35 shown on clock face; **(b)** 20 15.

Question 5

This was another well answered question. A few tried to solve an equation in the first part, quoting 3 and 4 in the answer space. Many felt that they ought first to multiply out in the second part, before going on to use the formula, or even to factorise. The latter did not always obtain the given factors.

Answers: **(a)** $(x-3)(x-4)$; **(b)** –1 or 2/3.

Question 6

Many candidates did not understand what a prime number is, and a few did not express the number as a product. The second part also proved testing, a few thinking that they should solve $99n = 24$.

Answers: **(a)** 3 x 3 x 11; **(b)** 8.

Question 7

Stronger candidates found the question on indices straightforward, but weaker candidates found its unusual form quite a challenge. Some started by equating $-2 + k = 1$ and thus obtained $k = 3$. The value of m was often not recognised, with 3 or –3 appearing quite often.

Answers: **(a)** 2; **(b)** 1/3.

Question 8

The first part of the question was well answered in most cases, with 37.40 the most common error. A number muddled the units, producing answers such as 40.037. The muddle in units was also seen when finding the lower bound of the length. Many just converted to 26 millimetres. Other common errors included 25.9 and 0.0255.

Answers: **(a)** 37.04 kg; **(b)** 25.5 mm.

Question 9

The response to this question on standard form was rather disappointing. 64×10^{-8} was either left, or adjusted to 6.4×10^{-9}. Some did not simplify $3.2 \div 8$, and others did not correctly alter 0.4×10^{15} in the second part.

Answers: **(a)** 6.4×10^{-7}; **(b)** 4×10^{14}.

Question 10

The first part was well done, with very many correct answers. There were also many good attempts at the second part with –2 being the most common wrong answer.

Answers: **(a)** $\begin{pmatrix} -7 \\ 10 \end{pmatrix}$; **(b)** – 5.

Question 11

The methods necessary to solve simultaneous equations were well known, but there were rather more arithmetical slips, usually involving signs, than usual. The subtraction of negative terms was the source of most of these mistakes. This led to smaller scores on this question than usual.

Answers: $x = 5$, $y = 11$.

Question 12

A small number of arithmetic slips were seen, but most were able to find the missing cost. Although there were a number of badly plotted attempts at (6.80, 5.90), the intention was usually clear. The same could not be said at the other end of the line. A considerable number did not try to make the line go near the origin. It was expected that the line would be ruled, and its accuracy was tested by the value found in the last part.

Answers: **(a)** \$0.51; **(b)(i)** Straight line joining (0 , 0) to (6.80 , 5.90), **(ii)** 1.35 to 1.40 euros.

Question 13

The first part was well done. The necessary inequality sign was often missing from the second part. Others obtained the wrong sign, or reversed the inequality. The answer –5 was popular for the last part. Some gave a string of values.

Answers: **(a)** $\frac{1}{4}$; **(b)** $y > -2$; **(c)** –3.

Question 14

There were many good solutions to this question. Although the right angle at *A* was usually spotted, there were many false methods used to find angle *EAF*. Triangle *AEF* was too often assumed to be isosceles.

Answers: **(a)** 38°; **(b)** 63°.

Question 15

The gradient was well done. The better candidates wrote down the value (but sometimes gave 3 or –3), while others used points on the line.

Work on the second part was less impressive. Examiners expected to see the line $x = -1$ drawn and the area enclosed by the three lines shaded. Many had trouble drawing the line, the *y*-axis or $y = -1$ being common. Others did not draw the boundary, and its position had to be implied from the shading.

Differing conventions on shading also caused problems, and Examiners accepted any *consistent* use of shading in or out on this occasion, but candidates should always check which is expected in a question.

Answers: **(a)** 1/3.

Question 16

(a) This was quite well answered, but 2 or 5 or 9 (ignoring the starting position?) were often seen, as was 36°.

(b) As printed, the three letters required were A, M and U. Since it appeared twice in the word, A was often repeated, and of course this was accepted. Many wrongly included another letter or letters, often N.

Very many candidates mistakenly reflected the word in a vertical axis.

(c) The concept of a locus in three dimensions was being tested here. Even good candidates found it difficult to visualise it and to describe their answer. The better candidates usually managed to quote a "cylinder" but only a minority added a reference to two hemispheres on the ends. Drawing the answer is clearly not possible in such questions. Too many tried to answer this in two dimensions.

Answers: **(a)** 10; **(b)** A M and U.

Question 17

Although there were many correct answers to the first part, there were as many who started from $3k + 4 = 0$ to reach $k = -4/3$. The second part was perhaps more routine, and very many correct solutions were seen.

A few failed to use the variable *x* in their answer, and a few quoted the reciprocal.

Answers: **(a)** –2; **(b)** $\frac{x-4}{3}$.

Question 18

The response to the first part was disappointing, though some of the better candidates used a Venn diagram effectively to gain the required values. The second part was more successful. The symbol n(*B*) was reasonably well understood, and a pleasing number understood the notation well enough to obtain the last answer.

Answers: **(a)(i)** 8, **(ii)** 18; **(b)(i)** 5, **(ii)** { (0 , 1) , (2 , 5) }.

Question 19

Many were able to use Pythagoras to prove the result of the first part convincingly. Most of these quoted correct expressions for the perimeter of the square and circumference of the circle in the second part, but several spoiled their solutions by equating them throughout their proof before introducing an inequality in the last line.

A pleasing number recognised that the numbers were irrational, but some called them surds, or even rational.

Answer: **(c)** Irrational.

Question 20

Candidates seemed to be quite comfortable with this routine algebra question. Although there were some slips, most candidates reached the correct expression, though a few spoiled it by going on to reach $(x - 1)^3$, or to quote a value for x. Very many correct pairs of factors were seen in the second part.

Answers: **(a)** $x^3 - 1$; **(b)** $(a - b)(x - 3y)$.

Question 21

This was another question that was generally well done. A few spoiled the first part by taking the square root of 900 to be either 3 or 300. There were many good attempts at the rearrangement of the formula, though some did lose some credit by falsely "simplifying" correct expressions, for example by going from $\left(\frac{8s^2 + 3d^2}{3d}\right)$ to $8s^2 + d$.

Some did have problems at the first step, by failing to correctly square the initial equation, but credit was given for correct methods thereafter.

Answers: **(a)** 30; **(b)** $V = \frac{8s^2 + 3d^2}{3d}$.

Question 22

This question was a good test of understanding. Many wrongly multiplied the trigonometric functions to reach 5 x 0.866, 2 x 0.866 and 5 x 0.5. Thus although many correctly quoted the area as $\frac{1}{2}$ x 6 x 5 sin 150, this led to 37.5 cm^2. A few omitted the $\frac{1}{2}$, possibly reaching 75 cm^2.

Answers: **(a)(i)** – 0.866, **(ii)** 0.5; **(b)** 7.5 cm^2.

Question 23

Performance on this question varied from Centre to Centre. The topic had clearly been well covered in some Centres, but had not been effectively grasped at others. Vectors are never a popular topic but require more attention. Some otherwise correct expressions were not expressed in their simplest form.

Better candidates were able to interpret the vectors as hoped, though some were only able to state that they are parallel.

Answers: **(a)(i)** $\frac{1}{2}(\mathbf{q} - \mathbf{p})$, **(ii)** $\frac{1}{2}(\mathbf{p} + \mathbf{q})$; **(b)** $\frac{1}{2}(\mathbf{q} + \mathbf{r})$; **(c)** $\frac{1}{2}(\mathbf{r} - \mathbf{p})$; **(d)** The length of *EF* is half that of *PR* and the lines are parallel

Question 24

The vertical axis was often not read accurately, so credit was lost in too many cases. The speeds should have been read as 11 and 13 m/s^2 at times 10 and 40 s. With this reservation, many found the acceleration correctly and correct methods were used to find the area under the line to calculate the distance travelled.

The last part was intended to allow the best candidates to show their ability. They used a method such as saying the last 65 m take 65 ÷ 13 = 5 s, so the time is 90 – 5 = 85 s. Some assumed a constant speed throughout the motion obtaining $\left(\frac{1000}{1065} x90\right)$ s, which led to a difficult division, but many did not attempt this part.

Answers: **(a)** 1.1 m/s^2; **(b)** 1065 m; **(c)**85 s.

Question 25

Most found the last question to be one where they knew what was expected. The scores were good, but perhaps not as high as might have been expected.

The vacant central column of the table was provided so that tally marks could be shown if candidates wished. Some candidates were puzzled and put the frequencies in that column, using the last one either for cumulative frequencies or frequency x number of goals (to assist in finding the mean later). The frequencies were accepted in either column, but many errors were made where tally marks were not used, often leading to 7 matches with 5 goals in place of 8.

The bar charts did not always gain full marks. Six vertical columns of equal widths, labelled 0 up to 5 at their centres, were expected for one mark. Another mark was given if their heights were as in the table.

Most candidates could quote the median of their frequency distribution. Good efforts were made to calculate the mean, but accuracy was lost either by taking 4 x 0 to be 4, leading to 66/20 = 3.3, or by rounding their answer to one significant figure.

Answers: **(a)** 4, 2, 1, 2, 3, 8; **(b)** 4; **(c)** 3.1.

Paper 4024/02
Paper 2

General comments

This Paper proved to be of similar standard to previous years, although there were rather fewer candidates gaining very high marks (90+) – this may have been attributable to the fact the first ***Section B*** question was perhaps a little harder than earlier Arithmetic questions.

Most of the general concerns mentioned in last year's Report reappeared this year, e.g. many candidates again lost marks through premature approximation. The rubric on the front cover asks for answers to three significant figures (or one place of decimals for angles) but this was often ignored, in **Questions 1** and **9** in particular. For example in **Question 1 (b)(i)** candidates would write $\cos A\hat{D}B = \frac{1.9}{2.2}$ = 0.86 leading to an answer $A\hat{D}B$ = 30.7 (or 30.6), not recognising that it is not sensible to give 3 figure answers if an approximation to two figures has been used in the working. This also illustrated candidates' apparent lack of confidence in their calculators – having to write down and then key in the intermediate step 0.86 rather than using the calculator figures for $\frac{1.9}{2.2}$ to produce the answer.

Candidates again often ignored the help that the indication of the number of marks available might give them; e.g. in **Question 9 (b)**, which was worth 1 mark, many candidates went through long trigonometrical calculations to find the bearing, when 62 + 52 was all that was required.

The majority of candidates seemed to have sufficient time to complete the Paper, although perhaps rather more than usual appeared to be rushing this last ***Section B*** question – often because of the unnecessarily long methods used, as suggested in the previous paragraph.

Comments on specific questions

Section A

Question 1

Very many candidates lost marks here by failing to give answers to three significant figures – either because they used 2 figure values early in the question, or because they gave more than 3 figures or because in giving 3 figures they failed to correct. Overall it was disappointing to see so many marks lost through careless errors of this sort when candidates clearly understood the methods.

(a)(i) Most candidates appeared to use their calculators correctly, but many left their answers as 2.469. A small number tried to 'cancel' the 4.8 s and 1.7 s.

(ii) Some stopped at $\sin x = 0.908$ and others used $\tan 12 = 0.21$ and $\cos 46 = 0.69$ leading to $\sin x = 0.90$ and $x = 64.2°$.

(b)(i) This was often correct, although long methods (e.g. using Pythagoras to get *AB* and then sin, tan or even the cosine rule) were fairly common. These long methods were often spoilt when candidates found *AB* = 1.109 but then used 1.1 in the rest of their calculations.

(ii) *DC* was sometimes found first, followed by Pythagoras. Many gave 2.83 as their answer.

(c) More candidates recognised 'angle of elevation' than in previous years, but there were *still many who found the angle* at the top (54.2°).

Answers: **(a)(i)** 2.47, **(ii)** 65.1; **(b)(i)** 30.3°, **(ii)** 2.84; **(c)** 35.8°.

Question 2

(a) The majority of candidates were able to factorise as far at $5(4t^2 - 1)$ but many failed to take the further step. Relatively few, this year, attempted to solve an equation.

(b) This was not well answered. Most candidates realised that they had to use a common denominator of either $6x$ or $6x^2$, but many made errors and many left their answers as $\frac{11x}{6x^2}$.

(c) This proved to be a difficult question for a large number of candidates. Many were unable to distinguish between the number of tickets and the cost and gave $4x + 80 = 9360$ as their equation. Of those who did arrive at, and solve, the correct equation, a number thought they had finished when they had found x, and *failed to find the total number of tickets sold*.

Answers: **(a)** $5(2t - 1)(2t + 1)$; **(b)** $\frac{11}{6x}$; **(c)(i)** $30x + 960$, **(ii)** 1200.

Question 3

(a)(i) Instead of writing 65 : 35 and simplifying to 13 : 7 a significant number calculated the tax, subtracted this from 72 and wrote the ratio 46.8 to 25.2. Some left this as their answer, some approximated, giving 47 : 25 or 2 : 1, but relatively few were able to simplify correctly. A small number left their answers as 65 : 35 or 1.3 : 0.7.

(ii) The answer to this part had often been found in part **(i)** and was almost always correct.

(b)(i) Most candidates knew the correct method, but a good number converted $20 into 200 or 20000 cents. A number of candidates gave decimal answers or rounded up to 28.

(ii) This part was usually correct if the correct answer had been given in **(i)**.

(c) This was very well answered. A few used $\frac{81-72}{81}$ and arrived at 11.1%. A small number, having arrived at 9 cents increase, simply gave 9% as their answer.

(d) It was very pleasing to see so many candidates identifying 72 with 90% and competently solving to find 100%. Nevertheless there were quite a number giving 64.8 (from 90% of 72) or 79.2 (from 110% of 72).

(e) This proved to be an extremely difficult question, with many candidates not understanding what was required. Many achieved either 140 or 240, but very few gave both.

Answers: **(a)(i)** 13 : 7, **(ii)** 46.8c; **(b)(i)** 27, **(ii)** 56c; **(c)** 12.5; **(d)** 80c; **(e)** between 140 and 240 km.

Question 4

(a) Well answered by very many candidates although very long methods were common. In part **(i)** a number found $C\hat{B}D$ = 67° and then assumed that *BC* and *AD* were parallel and that $B\hat{D}C$ was an alternate angle also equal to 67°. Parts **(ii)** and **(iii)** were very well done but 23° was a common wrong answer to **(iv)**.

(b)(i) Complete proofs were rare and many high scoring candidates lost a mark here. Many stated properties of similar triangles – equal angles and/or proportional sides without giving the specific details which applied to the given triangles.

(ii) Many candidates left answers in non-numerical form, often in terms of sides. Predictably very many who did give a numerical answer gave $\frac{1}{2}$.

Answers: **(a)(i)** 55°, **(ii)** 23°, **(iii)** 67°, **(iv)** 12°; **(b)(ii)** $\frac{1}{4}$.

Question 5

(a) This was generally well answered. Most candidates understood what was required in all the parts and those who did fail to get full marks had usually had difficulty reading the scales.

(b) Most candidates realised that the event in **(i)** was impossible but a significant number left their answer as $\frac{0}{6}$ or $\frac{0}{7}$. There was mixed success with the three remaining parts with many presenting worthless answers, often with probabilities greater than 1. In part **(iii)** quite a number started by writing down $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ but then subtracted from 1.

Answers: **(a)(i)(a)** 60, **(b)** 22, **(c)** 32, **(ii)** 72°; **(b)(i)** 0, **(ii)** $\frac{1}{36}$, **(iii)** $\frac{1}{4}$, **(iv)** $\frac{1}{18}$.

Question 6

Parts **(a)**, **(b)** and **(c)(i)** proved very straightforward for most candidates. The only real concern here was for candidates who wrote that their answers (usually just **(a)**) were on the Question Paper.

The formula required in **(c)(ii)** was only found and used by a small minority. A few managed to get the answer 64 without producing the formula.

Answers: **(a)** (13), 14, 15, 16; **(b)** 40; **(c)(i)** 58, **(ii)** $16r - 6$, **(iii)** 64^{th}.

Question 7

This proved to be a difficult question and a stumbling block for many candidates who initially saw it as a relatively easy option. There were, of course, a number of excellent, clearly explained solutions, but many more attempts were full of misinterpretation, misquoted formulae and careless arithmetic.

(a) The semicircular section of the wet surface was often forgotten. Alternatively the formula $2\pi r(r + h)$ was used, division by 2 followed, leaving the curved surface area correct but including an extra semicircular section.

Many candidates correctly found a quarter of the sphere surface. Of the few who had the correct idea for all three parts and who reached a correct numerical answer, only a handful remembered to correct this to the nearest square centimetre.

(b) Because the answer was given candidates had the opportunity to devise ways of combining formulae so as to ensure that they reached 972π. Many simply gave $\frac{4}{3}\pi 9^3 = 972\pi$. A good proportion used a value of π and then tried to regain accuracy at the end.

(c) A significant number saw the need to add the two volumes together and equate to 972π, but confusion with formulae etc, meant that many initially promising attempts came to nothing.

(d) There were relatively few attempts at this part, but from those attempts there were a pleasing number of correct solutions.

Answers: **(a)** 891cm^2; **(b)** $\frac{1}{2}.\pi.9^2.18 + \frac{1}{2}.\frac{2}{3}.\pi.9^3 = 972\pi$; **(c)** 15cm; **(d)** 12cm.

Question 8

(a) Although a few candidates used wrong scales, the points were almost always accurately plotted and many produced an acceptably smooth curve.

(b) Answers to part **(ii)** were often wrong because candidates did not apply enough care in drawing a smooth curve through the turning points. Very many candidates had no part of the graph showing above the 3.5 value and this led to the very common answer of 5.5 which was not accepted.

It is felt that candidates should recognise the shape of the curve at the turning points. Many candidates appreciated what was required in **(iii)** but failed to carry out the subtraction or to convert a decimal answer in hours to hours and minutes.

(c) Many candidates clearly knew the technique required to find the gradient but left their answers as fractions with decimal values in numerator and denominator. The negative value was often missed.

(d) There were some good attempts at this part, even from less able candidates. Most understood the need to substitute (x, y) coordinates in the equation but a good proportion failed in the subsequent algebra. One incorrect approach was to regard B as the gradient of the straight line.

Answers: **(b)(i)** $2.8 < t < 3.3$, **(ii)** $5.5 < t < 5.8$, **(iii)** 3h 12min to 3h 18min; **(c)(i)** $-1.4 \leqslant g \leqslant -1.1$, **(ii)** Rate of cooling (in °C per hour); **(d)** $B = -4$, $C = 2$.

Question 9

This proved a very popular question and most candidates gained good marks.

(a) Apart from a small number who simply used $\sqrt{54^2 + 31^2}$, the majority of candidates could quote, and use the cosine rule. A small number left the negative sign, some gave 3877 – 3348 cos128 = 529 cos128 and a very small number used sin128 instead of cos128.

A significant number, however, approximated cos128 as –0.61 or –0.62 and lost accuracy marks.

(b) There were some very long methods used here, with many not recognising the significance of [1] mark.

(c) There were many excellent solutions achieving full marks. Again some candidates lost marks through premature approximation.

(d) The sine rule was often used for this part though the isosceles triangle rendered it unnecessary. It was noticeable, however, that although most realised that the triangle *HLA* was isosceles, there was confusion as to which sides were equal. Some weaker candidates did not realise where *L* was situated.

Answers: **(a)** 77.1km; **(b)** 114°; **(c)** 65.2km; **(d)** 57.5 km.

Question 10

This was perhaps the least popular question, although those who did attempt it usually gained reasonable marks.

(a) Most recognised the right-angled triangles and used $A = \frac{1}{2}bh$ and a few used $A = \frac{1}{2}ab\sin C$.

(b)(i) Candidates who gave $5xy = 80$ usually went on to complete this part correctly.

(ii) Many were successful in producing the equation and even more were able to solve the equation. Only a few did not give the required degree of accuracy. Many were able to progress to find the correct values of y, usually by applying $y = \frac{16}{x}$ or $y = \frac{1}{2}(38 - 10x)$ but occasionally by substituting $x = \frac{16}{y}$ into the equation $5x^2 - 19x + 16 = 0$, leading to $y^2 - 19y + 80 = 0$ and the correct values of y.

(iii) There were very few correct answers to either part of **(iii)**. In **(i)** the majority failed to connect $xy = 16$ and $x = y$ leading to $x = y = 4$. In **(ii)** both rhombus and kite were more common than the correct answer.

Answers: **(b)(ii)(b)** $x = 2.54$ or 1.26, **(c)** $y = 6.30$ or 12.7; **(iii)(a)** 48, **(b)** square.

Question 11

Many candidates answered this question quickly, competently and clearly and scored full or almost full marks.

(a) Almost all candidates gave translation and many also gained the second mark for the correct column vector.

(b) This was answered well on the whole. Many recognised the transformation as an enlargement and gave the correct matrix immediately, although a few gave the scale factor as 2 or $\frac{1}{2}$. Many more attempted to find the matrix by mapping individual points onto their images by means of the matrix $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ and finding a, b, c and d by solving simultaneous equations. This method involved a substantial amount of working and although many were successful a number were not.

(c)(i) Surprisingly few correct answers here with many candidates failing to see the 'clockwise' reference in the question. 90° was by far the most common answer.

(ii) Very many more were able to give the centre correctly, although there were a few answers such as (1.2, 4.1), presumably from an inaccurate construction.

(d)(i) This was very well answered, even by relatively weak candidates.

(ii) Again there were many complete answers; almost all recognised that it was a stretch and although a few missed out either invariant line or the factor, very many gave both.

(iii) As with part **(b)** there were many long methods, but those who knew the direct route wrote a matrix of the form $\begin{pmatrix} k & 0 \\ 0 & 1 \end{pmatrix}$ immediately. A few gave k as 2 or $-\frac{1}{2}$ but the majority were correct.

Answers: **(a)** Translation $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$; **(b)** $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$; **(c)(i)** 270°, **(ii)** (1, 4); **(d)(i)** (4, 1), (8, 1) and (8, 4), **(ii)** (one way) stretch, y axis invariant, st factor 2, **(iii)** $\begin{pmatrix} \frac{1}{2} & 0 \\ 0 & 1 \end{pmatrix}$.