MATHEMATICS (SYLLABUS D)

Paper 4029/01
Paper 1

Key messages

In order to do well in this paper, candidates need to have covered the entire syllabus and should be able to recall the necessary formulae. In addition, they should be able to deal with basic arithmetic competently, produce accurate diagrams and demonstrate their ability to select suitable strategies for solving more complex mathematical problems.

Candidates should be advised to read the questions carefully and to provide answers in the form required. Candidates should also be advised to give answers to the required degree of accuracy. In cases where the required degree of accuracy is not specified, answers should be given to at least three significant figures.

General comments

This is a non-calculator paper and requires accuracy in basic number work. Many candidates lost marks for inaccurate calculations. It was common to see an incorrect answer resulting from a correct method due to minor arithmetic slips, particularly where negative numbers were involved.

When a question asks for an answer in its simplest form, candidates should be aware that unsimplified answers will not gain full credit in most cases. Candidates should not give more than one answer for a specific problem.

Good arithmetic skills were evident among the high scorers. However, some candidates would further benefit from checking their answers to ensure that these are sensible in the context of the question.

Candidates should present their work in a logical manner. Candidates should be reminded that any incorrect work should be crossed out clearly and that they should not overwrite it. The working leading to their answers should be clear and legible. It is important that the candidates write all numbers clearly. Too often numbers are written hurriedly and are not formed correctly. In some cases, it was difficult to distinguish between 2 and 7, 0 and 6, 4 and 9.

Candidates are advised to read the questions very carefully to ensure that they fully understand what is required of them and that they answer the question being asked. **Questions 16(b)**, **17(a)**, **18**, **19**, **22**, **23**, **24(c)** and **25** posed a certain degree of difficulty as they required higher order thinking.

Candidates should be wary of the instruction on the cover page: ‘Omission of essential working will result in loss of marks’. Opportunities to score marks are often lost when working is not shown.

Comments on specific questions

Question 1

(a) Most candidates answered this question correctly. Equivalent answers were seen quite often, the most common being $\frac{28}{32}$.

(b) Most candidates answered this question correctly. The answer $\frac{15}{18}$ was seen often, rather than the simplified version which was expected.

Question 2

The most common approach seen to ordering these values was to convert all the numbers to decimals or all to fractions with a common denominator. Most of the candidates who tried to arrange the numbers without any attempt to convert to a common form were largely unsuccessful. Some answers were given in descending order rather than starting with the smallest value. Many candidates started with $\frac{7}{200}$.

Question 3

(a) This question was answered well by most candidates.

(b) This question was answered well by most candidates. A common incorrect answer seen was√(36).

(c) The term 'irrational' appeared to be misunderstood by many candidates, who gave $\sqrt{\left(\frac{37}{36}\right)}$ or 3.7 as an answer.

Question 4

Most candidates answered this question completely correctly. Any mistakes seen occurred when dealing with the signs when terms were being collected. A few candidates obtained the correct answer $\frac{1}{10}$ but went on to write $\frac{1}{10}$ = 10 in the subsequent line. Candidates are encouraged to leave answers in fractional form, rather than attempting to convert to a decimal number.

(a) This question was answered well by most candidates.

(b) Many candidates obtained the correct answer. Of those who did not score full marks, many got at least one mark for doing one partial factorisation correctly.

Question 6

(a) Many correct answers were seen to this part. Mistakes tended to occur when writing the time that the movie starts. The digits 827 were seen, but a combination of both 12-hour clock and 24-hour clock notation was often used to state the answer. An example of a common incorrect answer was 08 27 pm. Some candidates had difficulty in carrying out the required subtraction.

(b) Few candidates successfully answered this question.

Question 7

(a) Many correct lines of symmetry were seen. Some candidates joined the extremities of the chords together and used the midpoint to draw the line of symmetry. Some did not use a ruler for drawing the line of symmetry.

(b) This part was generally well attempted by the majority of candidates.

Question 8

Few candidates seemed confident in rounding to a required number of significant figures; many wrote 0.603 to one significant figure as 1, for example. Nearly all candidates who wrote 40 and 9 and 0.6 obtained the correct final answer. Many candidates added superfluous zeros when rounding the initial values given.

Question 9

(a) This question was well answered by many candidates.

(b) Many candidates found this question challenging. Few candidates found the required area scale factor of $\left(\frac{5}{2}\right)^2$.

(c) Few candidates reached the correct answer. This part of the question was not attempted by many.

Question 10

The majority of candidates used the correct relationship between the variables. They obtained the correct value for the constant of proportionality and, thus, found the correct answer. Many candidates were confused as *y* was not given as a numerical value but in terms of '*t*'. Few cases were found where candidates assumed a direct variation.

Question 11

(a) Many correct answers were given to this part.

(b) Few candidates scored full marks in this part of the question. The answer 0.6×10^{-5} was seen quite frequently; the correct value but not written in standard form. Some candidates could not perform the calculation $\frac{2.4}{4}$ correctly.

Question 12

Many correct answers were noted. Some candidates calculated the size of an interior angle using $\frac{(n-2)180}{2}$ or found the value of an exterior angle using $\frac{360}{12}$ but did not know how to proceed after this.

Question 13

(a) This part was generally well answered by most candidates. '0' was a common wrong answer.

(b) This part was also well answered by most candidates. However, incorrect answers such as $3x^6$ or $9x^9$ were seen in many scripts.

(c) Many candidates found this part challenging. Laws of indices were partially applied by many candidates, who obtained one mark for correct but incomplete simplification. Some common incorrect answers given were in the form of $\left(\frac{x^3}{8}\right)^3$ or $\frac{8}{x}$.

Question 14

(a) Few candidates obtained the correct value of 36.6°C. Many candidates did not calculate the 20th percentile, by reading across from 24 on the *y*-axis, but instead read across from 20.

(b) Most candidates did not know how to proceed on this part. A wide range of answers were noted.

Question 15

(a) Many correct answers were seen. A common wrong answer given was 8.

(b) Many candidates completed the histogram correctly. There were a significant number of candidates who drew the rectangle with base 6 to 8 with a height of 4 units instead of 2. Many freehand drawings were also seen. Candidates are encouraged to use pencils and rulers to undertake such work.

Question 16

(a) Candidates found this part very challenging. Few were able to make meaningful progress in determining the required angle.

(b) Many candidates either shaded the incorrect region or shaded more than one region.

Question 17

(a) Few candidates drew the correct tree diagram showing all correct probabilities.

(b) Some common wrong answers given were 'impossible' or 'no probability'.

Question 18

(a) Many candidates started with the correct distance formula but, due to arithmetic slips in their calculations, they could not reach the value of 10 as required. A significant number of candidates worked with the formula for gradient and, therefore, could not find the answer. Some candidates tried to make a grid and plotted the points to draw triangle *ABC*; if this approach was expected then a grid would be given to aid candidates.

(b) Few correct answers were seen. Many candidates used the array method. A few did not obtain the value of 40 because of arithmetic of mistakes left when multiplying by negative numbers or zero (0). For example, $0 \times -1 = -1$ was a common mistake.

Question 19

(a) Many candidates obtained full marks for this question. However, some candidates drew triangle *ABC* correctly without drawing the arcs.

(b) Few candidates drew triangle *ABD* within the accuracy required of the question, with many producing an inaccurate obtuse angle. Some candidates also drew both triangles *ABC* and *ABD* on the same side of the line. In a few cases, candidates drew triangle *ABD* above the line and triangle *ABC* below the line.

Question 20

(a) Few candidates gave the correct answer of 34°.

(b) Some candidates did not get the correct answer because they carried forward an incorrect value from **part (a)**.

(c) This part was generally well attempted by most candidates.

Question 21

(a) Most candidates were able to score the mark for this part. Some candidates drew the vector $2\mathbf{p}$ correctly but did not label the point *A*.

(b) This part proved difficult for many candidates. Only a few candidates scored the mark for placing point *B* in its correct position.

(c) A large variety of answers were given of which only a few were correct.

Question 22

This question was well answered by only a minority of candidates. However, many were able to score at least one mark by finding the total volume of 400 drops of water. Subsequently, responses became confused and only a minority recognised that a next step was to equate the volume of water to $5 \times 4 \times h$ where h is the height of water level.

Question 23

(a) A good attempt was made by many candidates. A few candidates found the coordinates of two points other than (0,0) and (12,6) and, using those, calculated the gradient.

(b) (i) Very few correct answers were seen to this part.

(ii) Very few correct answers were seen.

(c) (i) Very few correct answers were seen to this part.

(ii) Few correct answers were seen.

Question 24

(a) This part was generally well answered with most candidates getting at least one mark for two or three correct entries given.

(b) Many candidates either gave the reciprocal of the determinant correctly with the incorrect adjoint or gave the correct adjoint with an incorrect reciprocal of the determinant. The fact that the determinant was $\frac{1}{2}$ seemed to have confused many candidates. Many took $\frac{1}{\text{determinant}}$ as $\frac{1}{2}$ itself. Many arithmetic errors were made when multiplying the entries in the matrix by the reciprocal of the determinant. Candidates are encouraged to leave the reciprocal of the determinant outside of the matrix if appropriate. Common arithmetic errors seen were $\frac{1}{2} \times 1 = 1\frac{1}{2}$ and $0 \times \frac{1}{2} = \frac{1}{2}$.

(c) Many candidates were not able to answer this question correctly because the matrix **X** was not taken as a 2x1 matrix in the form of $\begin{pmatrix} a \\ b \end{pmatrix}$. Some candidates who started with **X** as $\begin{pmatrix} a \\ b \end{pmatrix}$ were unable to reach the final correct answer as they made errors in the matrix multiplication. Some candidates gave the final answer as a 1x2 matrix.

Question 25

(a) This part of the question was answered by most candidates satisfactorily. The values 3.2 or –3.2 were seen in most scripts.

(b) Many correct answers were seen. However, many of those who tried to calculate the distance travelled by dividing the area in two parts, a rectangle and a triangle, used an incorrect value for the height of the triangle.

(c) Candidates who started with $\frac{v-8}{60-10} = 0.4$ were able to score 2 marks for obtaining 28 as answer. Others used gradient = 0.4 and reached $0.4 \times (60 - 10) = 20$ but did not go on to add 8 to reach final answer.

MATHEMATICS (SYLLABUS D)

Paper 4029/02
Paper 2

Key messages

In order to do well in this paper, candidates need to:

- study the whole syllabus
- remember all necessary formulae and facts
- recognise and carry out the appropriate mathematical procedures for a given situation correctly
- perform calculations accurately, and
- show all necessary working in the appropriate place clearly.

General comments

There were many well-presented scripts of a good standard. Scripts were seen covering the whole range of marks. Although some candidates did not attempt all the questions, most candidates appeared to have had sufficient time to complete the paper.

Candidates need to take care when using mathematical formulae. They were usually able to quote the cosine rule correctly but mistakes were sometimes seen in the quadratic formula.

In numerical questions, marks were sometimes lost due to premature approximation. Generally, final answers need to be given correct to three significant figures. This means that intermediate working should comprise more than three significant figures.

Exact answers involving currency should not be rounded to an appropriate accuracy, or to that specified in the question.

Candidates performed well on **Questions 1(b)**, **3(a)(i)**, **(iv)**,**(v)**, **4(a)**,**(b)**,**(c)**, **6(a)**,**(c)**, **7(b)(i)**, **8(b)**, **9(a)** and **10(b)(i)**. **Questions 1(c)**, **3(a)(ii)**, **4(d)(iii)**, **5(b)**, **7(b)(ii)**, **8(c)**, **9(d)** and **10(a)**,**(b)(ii)** proved to be more challenging for many candidates.

Comments on specific questions

Question 1

(a) Many candidates identified the total amount of money Tanya had to pay as the product of the four given values. Candidates had difficulty working with the time of $7\frac{3}{4}$ hours and used 7.45 hours while other used 7 days instead of 5 days in their calculation.

(b) This part was well done. A majority of the candidates gave the correct answer.

(c) Many candidates found this question demanding. They had to determine 115% of the cost inclusive of sales tax and then 108% of the initial cost, before using the reverse percentage method. However, many of the candidates calculated 77% $(100\% - 8\% - 15\%)$ of \$465.75 leading to \$358.63.

(d) Most of the candidates were able to use the formula for compound interest correctly, obtaining an amount of \$9901.76. Few candidates went on to subtract \$9300 from this total. The calculation of simple, rather than compound, interest was often seen.

Question 2

(a) This was usually well done. Some candidates gave the equation of the line of reflection as *x*-axis, *y*-axis, $y = x$ or $x = -1$.

(b) The majority of the candidates correctly stated that the transformation was an enlargement and attempted to describe it fully by giving the coordinates of the centre as $(-3,2)$, but an incorrect scale factor of 3 instead of -3 was often seen. Many candidates did not state a single transformation to map shape *A* on to *C*.

(c) The correctly plotted shape *D* was commonly seen. Some candidates used the given matrix to calculate the four vertices of shape *D* while others used their knowledge of the transformation which was represented by the given matrix; each method a creditworthy approach.

Question 3

(a) (i) The points were correctly plotted by many candidates. In some cases, the points at 56, 63, 61 and 53 on the horizontal axis were not positioned correctly in the horizontal direction due to a misinterpretation of the scale, where 2 mm for 1 unit was taken rather than 4 mm for 1 unit.

(ii) Few candidates answered this part well. Candidates overlooked the fact that the runners should have satisfied both conditions simultaneously. A common error was to add together the five runners who took less than 55 seconds to run 400 m (49, 52, 51, 50 and 53 minutes) and the five runners who took less than 125 seconds to run 800 m (118, 124, 121, 124 and 119 minutes). This led to an incorrect answer of 10 runners.

(iii) Most of the candidates correctly identified that it was a positive correlation. Some gave extra facts such as strong or weak correlation.

(iv) Many candidates knew what was expected from them and drew a ruled line which had approximately the same number of points on either side of the line and was long enough to cover the whole range of information. However, in some scripts, 'zig-zag' patterns joining the plotted points were seen.

(v) In this part, candidates were expected to use their graph to find the answer and many of them correctly read the value at 65 seconds.

(b) (i) Most of the candidates tried to explain their method using words rather than adopting the algebraic approach of equating the sum of the five frequencies to 50. Attempts to explain the approach using words was often not mathematically convincing; the algebraic approach was more successful.

(ii) This part proved challenging to many candidates. Only a few made an attempt to find the estimated mean by correctly using the midpoints of the intervals but could not proceed further.

(iii) Many correct answers for both *p* and *q* were seen. Most of the candidates realised that they had to use the equations in **parts (i)** and **(ii),** solving them simultaneously. The elimination method, as well as the substitution method, was used. Some rare cases of trial and error with correct values of *p* and *q* were also seen; this approach is not encouraged.

Question 4

(a) The majority of candidates obtained a correct answer to this part.

(b) Most candidates plotted the points correctly and joined them with an acceptable smooth curve. The point $(-1,1.2)$ was often plotted at $(-1,1.4)$ due to a misinterpretation of the scale.

(c) A tangent drawn at the correct point was usually accompanied by the correct calculation of the gradient. There were some correct answers that came from close attempts at drawing the tangent; better responses showed no daylight between the tangent and the curve. In some cases, the tangent was calculated from a chord rather than a tangent; in these cases only one mark could be earned.

(d) (i) Many candidates were able to calculate the coordinates of two points on the given line and correctly draw a ruled line. Some did not earn full credit as their line was not long enough to cross the curve three times.

(ii) This part was correctly answered by a majority of candidates who attempted **part (d)(i)**. They were able to read off values in the given range, or earn 'follow through' marks for readings from their graph.

(iii) Most of the candidates found this part of the question challenging and the correct result was rarely seen. Only a few candidates knew that they had to equate the equations of the line and the curve to be successful. It was very common to see candidates replacing the *x*-values of **part (d)(ii)** in the equation $2x^3 + Ax + B = 0$, obtaining two equations in *A* and *B* and then solving them simultaneously, resulting in non-integer values.

Question 5

(a) (i) Many partially correct Venn diagrams were seen. In some cases the elements 3, 7, 11, 13 and 15 were omitted and, in others, elements were often placed in more than one position.

(ii) This part was successfully answered by a large number of candidates who used their diagram to find the number of elements in the required set.

(iii) This part was also well answered by many candidates, who again used their diagram to identify the elements in the correct subset.

(b) (i) A minority of candidates gave the correct answer. An incorrect probability of $\frac{8}{16} = \frac{1}{2}$ was very common which was obtained by considering only odd numbers instead of both odd and square numbers.

(ii) This part was answered correctly by those few candidates who were able to identify the correct probabilities to multiply and gave an answer that followed through correctly from their Venn diagram. Others did not recognise that it was a non-replacement case and went on to calculate $\frac{3}{16} \times \frac{3}{16}$ or $\frac{3}{16} \times \frac{3}{16} \times 2$. It was also common to see candidates adding, rather than multiplying, probabilities.

Question 6

Almost all candidates attempted this question.

(a) This part was generally well done as many candidates recognised that the first step in the rearrangement was to eliminate the fraction and this was often done correctly.

(b) Many candidates knew that they needed to use the common denominator $(2x-5)(x-6)$ and showed the correct numerator of $x(x-6)+3(2x-5)$. They expanded both brackets and successfully simplified the expression to $x^2 - 15$. However, a small number of candidates attempted to cancel the terms in the numerator and denominator or unnecessarily expand the brackets in the denominator, introducing a sign error (leading to $2x^2 - 17x - 30$ instead of $2x^2 - 17x + 30$).

(c) In this part, many correct answers were seen. Candidates successfully carried out cross-multiplication and isolation of terms.

(d) This part was also well answered. Many candidates were able to expand both brackets and to transfer the terms, obtaining the correct quadratic equation. It was very common to see candidates solving the equation using the quadratic formula rather than by factorisation.

Question 7

(a) Many candidates recognised that trigonometry was required here and most were correct in reaching an acceptable value for angle *SPR*. Successful candidates then went on to add 42° to angle *SPR*, obtaining the correct final answer. A common error seen was to not add the 42° angle, resulting in the angle *SPR* rather than the bearing of *R* from *P*.

(b) (i) The need to use the cosine rule here was recognised by the vast majority of candidates and many responses showed the value of 201.5… which was required as evidence that a correct intermediate step was performed. A few candidates misquoted the rule, either through putting a '+' where the '–' should be or omitting the '2' from the product '$2ab\cos\theta$'. Some candidates reached the stage $\sqrt{2025\cos 38}$ when simplifying.

(ii) Few candidates answered this part correctly. Many candidates knew that they had to use the formula $Time = \frac{Distance}{Speed}$. However, the majority went on to divide the distance *QR* in metres by the given speed of 5.5 in kilometres per hour, reaching a duration of 36.727… minutes. It was also common to see that the few candidates who performed the calculation with the proper conversions gave answers such as 2 minutes 20 seconds (from $\frac{202}{1000\times 5.5}\times 60$) or 2 minutes 12.2 seconds (from $\frac{202}{1000\times 5.5}\times 3600$) when they were requested to give the answer correct to the nearest second. The correct answer 2 minutes 12 seconds was very rarely seen.

Question 8

(a) Many candidates answered this question correctly, using the formula given within the question. Most of them recognised that the volume of the bowl had to be the difference between the volume of the larger and the smaller cone. A minority of candidates wrongly used 15 cm as *h* in the formula $\frac{1}{3}\pi r^2 h$.

(b) Many candidates answered this question well. Candidates showed evidence of correct evaluation by writing 46.57…. and then rounded the figure to 46.6.

(c) The key to success in this part was to find the slant height of the larger cone which was recognised by only a few candidates. The vast majority of candidates wrongly worked with 60 cm and 45 cm as the slant height of the larger and smaller cones respectively to calculate the curved surface area. It was common to see that candidates either added the areas of both the circular base and the top of the bowl or subtracted the area of the circular base from the curved surface area. Some responses reached the intermediate step of 452.38… from $\pi 12^2$, which is the area of the shaded region in the diagram, but did not make further progress.

Question 9

(a) (i) The majority of candidates obtained the correct expression for *AR*.

(ii) The expression for *AP* was also found by many candidates.

(b) Almost all candidates who gave correct expressions for *AR* and *AP* in **(a)** went on successfully to obtain the required quadratic equation successfully.

(c) Many candidates attempted this part using the quadratic formula. Some substituted 22 for *b* instead of -22, while others did not extend the division line under the first term or used a short square root. Also, many candidates overlooked the instruction to give the answers to 2 decimal places,

quoting to 3 significant figures instead. It was common to see 1.46 and 20.5 as final answers instead of 1.46 and 20.54. Some quoted the quadratic formula incorrectly.

(d) Most candidates attempted this part but many incorrect responses were seen. Some attempted to use the smaller of the two solutions obtained in **part (c)** to find the area of rectangles *APYR* and *YSCQ*, suggesting that they did not appreciate which value defined the shaded area and which defined the unshaded area. Others gave the area as an expression in terms of x.

Question 10

(a) This was a challenging question and was not attempted by many. Among those who attempted this part, very few were able to complete it successfully. Many were able to identify two or three correct pairings, but they often omitted reasons, did not give sufficient detail, or did not use the correct terminology as stated in the syllabus. In most attempts, the congruence condition used was not stated. It was also common to see that candidates showed three pairs of equal angles which cannot be accepted to establish congruence.

(b) (i) The vast majority of candidates answered this part question correctly.

(ii) Many candidates found this part very demanding and it was often only partially attempted. Many gained at least one mark for calculating the area of sector *COD*. Those few candidates who attempted the question realised that they had to use trigonometry to calculate *DT*. Then they used *OT,* being a line of symmetry, to find the area of kite *OCTD* which was twice the area of triangle *ODT*. However, many incorrect answers were seen coming from wrong use of angle *OTD* as 31° or *OD* as 8 cm. Some attempts at finding the shaded area as the area of triangle *CTD* minus the area of segment in sector *COD* were also seen but were not always completely correct.