

# MATHEMATICS D

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Paper 4024/01

Paper 1

## General comments

The overall level of difficulty of the paper compared reasonably closely with that of last year. The questions tested candidates of all abilities.

The questions that proved particularly difficult were **4(a), 10(b)(ii), 14(a), 15(b)(ii), 18(b), 21(b)(ii), 22(b)(ii), 24(b), 25(a)(ii)** and **25(b)**.

The questions that were most accessible to candidates were **1, 2(b), 3, 5(b), 10(a), 12(a), 13(a), 15(a), 19(a)(i), 22(a)** and **23(a)(i)**.

Presentation of the work was often good. However, some scripts were quite disorganised and marks were lost through carelessly planned work and misreading of figures. Many candidates did not heed the instructions on the front page to write in dark blue or black pen. Some wrote the answers in pencil, then wrote over them in ink making a double image which was very difficult to read. Some wrote in pencil and even erased their workings, making it impossible for Examiners to award marks for intermediate steps. Some of these left such a mess of rubber and paper debris from the erasing that it interfered with the clarity of their answers.

There was a small number of scripts that contained answers only, with no supporting workings.

A small minority of candidates wrote all their workings, often in a disorganised form, in the margins reserved "For Examiner's Use".

Candidates should be made aware that only their final answer to each question should be written in the answer space. Alternative offerings and working should not be written there. When an answer is to be changed, it is far better to delete and replace the original one rather than attempt to write over it.

Care should always be taken to ensure that answers obtained in the working are accurately transferred to the answer space.

There were a number of unattempted questions at the end of some scripts. It was not clear whether these arose from lack of time or lack of knowledge and understanding.

## Comments on specific questions

### Question 1

- (a) This question was very well answered on the whole. A few candidates converted  $\frac{2}{21}$  to  $10\frac{1}{2}$ , others gave an answer that involved  $\frac{2}{4}$ .
- (b) This question was well answered, in the expected fractional form. A few candidates converted  $\frac{5}{6}$  to 1.2.

Answers: (a)  $\frac{2}{21}$  (b)  $\frac{5}{6}$

### Question 2

- (a) Many candidates used more than one pair of brackets, though often giving the correct answer in places. Common wrong answers were  $(4 + 6) \times (7 - 5) = 16$  and  $4 + (6 \times 7) - 5 = 16$ .
- (b) Though most candidates obtained the figures 54, many could not position the decimal point correctly. The answer 0.0054 was frequently given. A few could not multiply 27 by 2 correctly.

Answers: (a)  $4 + 6 \times (7 - 5) = 16$  (b) 0.054

### Question 3

Most candidates scored at least one mark by getting at least three of the numbers in the correct order. Only a few converted fractions to decimals, or vice versa, incorrectly, or started with the largest. A surprising number started with  $\frac{2}{5}$ .

Answer: 0.39,  $\frac{2}{5}$ ,  $\frac{9}{20}$ , 46%

### Question 4

- (a) This question showed that many candidates were not comfortable with factors of numbers. Common wrong answers were 392, or 49, or 7, or  $7^2$ .
- (b) Many candidates did not use the given factors of 784, but obtained the correct answer by trial and error. Some, who realised that  $784 = 28 \times 28$ , went on to give the wrong answer  $28^2$ .

Answers: (a) 98 (b) 28

### Question 5

- (a) Only the better candidates reached 08 45. Many gave 22 45 or 10 45 or 09 45.
- (b) Most candidates realised that it was necessary to multiply 250 by 3.10. Of these, the majority obtained the figures 77500 but did not always place the decimal point correctly.

Answers: (a) 08 45 (b) \$775

### Question 6

Many candidates used direct rather than inverse proportion and gave the answer of 5000. Others used  $y = \frac{k}{x^2}$ . Some who started with  $y = \frac{k}{x}$  often transformed it incorrectly. A surprising number could not evaluate  $250 \times 4$  correctly. Others could not evaluate  $\frac{1000}{80}$  to an acceptable form.

Answer:  $12\frac{1}{2}$

### Question 7

Many candidates appeared not to be confident in the use of standard form in this question.

- (a) This part was sometimes answered correctly, but answers seemed to be evenly distributed across the other possibilities.



- (b) On the whole, this part was attempted sensibly, though not all answers were given in standard form or calculated correctly. Common wrong answers involved 9.9, or  $10^{-1}$ , or both 9.9 and  $10^{-1}$ , or  $10^{15}$ .

Answers: (a) China (b)  $1.125 \times 10^8$

### Question 8

Hardly any candidates worked from the result that an angle of  $6^\circ$  represented 1 car. A surprising number, in evaluating an expression such as  $\frac{12}{72} \times 360$ , used long multiplication followed by long division instead of cancelling.

- (a) Responses to this part were very varied; some worked from angles of sectors, others from the number of cars of each colour. Only the better candidates could obtain the correct answer. Common wrong answers were 48 (omitting the 12 blue cars) or 2160 (using  $1^\circ$  to represent 6 cars).
- (b) Some candidates could get no further than  $360 - 120 - 90 - 72$ , not always evaluated correctly. Some gave this angle as the number of red cars.

Answers: (a) 60 (b) 13

### Question 9

- (a) Most candidates could get as far as  $\frac{8}{0.01}$ , but many could not evaluate this expression correctly, with a misplaced decimal point, or merely gave this as their answer.
- (b) This part was quite well done. The usual error was not to factorise  $mv - mu$  and to obtain  $\frac{Ft}{vu}$  or to factorise it as  $m^2(v - u)$  and give  $\sqrt{\frac{Ft}{v - u}}$ . A few substituted numbers from part (a).

Answers: (a) 800 (b)  $\frac{Ft}{v - u}$

### Question 10

- (a) This part was usually answered correctly.
- (b)(i) This part was usually well answered. Common wrong answers were 09 66, 10 04, 10 08, 10 6.
- (ii) This part was rarely answered correctly. Some found a third of 6.36 but failed to subtract 1.53 and so gave 2.12; others subtracted the 2.12 from 6.36 and gave 4.24; some subtracted 1.61 from 2.12 and gave 0.51; others gave 4.83.

Answers: (a) 4.83 m (b)(i) 10 06 (ii) 0.59 m



### Question 11

- (a) Many candidates seemed to have a reasonable idea of the mode. Common wrong answers were 5, 2 and 7.
- (b) Many candidates attempted to find the total number of pets by multiplying the frequencies by the number of pets in each group, though an arithmetic slip or an omission occurred now and then. Some could not evaluate  $\frac{58}{20}$  to an acceptable form. Candidates should be made aware that a mean does not have to be a whole number and the mean of 2.9 should not be rounded to 3. Wrong attempts involved a fraction with a numerator of 28 or a denominator of 7, 8 or 28. A few candidates confused the mean with the median.

Answers: (a) 1 (b) 2.9

### Question 12

- (a) Most candidates answered this part correctly.
- (b) Many candidates could not start this part correctly by writing down the equation  $4p - 7 = p$ . There was much confusion between the use of  $p$ , and  $x$  or even  $y$ . Common wrong answers were  $\frac{7}{4}$  from  $4p - 7 = 0$ ;  $4p - 7$  on its own; 2.3, which is not an acceptable approximation to  $2\frac{1}{3}$ .

Answers: (a) -5 (b)  $2\frac{1}{3}$

### Question 13

- (a) This part was usually well attempted, though a substantial minority showed a lack of knowledge of the basic rules for adding fractions. Common wrong answers were  $\frac{13}{20}$ ,  $\frac{3m}{20}$ ,  $\frac{13m}{5 \times 4}$  and  $\frac{13m^2}{20}$ .
- (b) Most candidates could make a reasonable attempt at this part, though only the better ones could manipulate a negative sign with the inequality. Some candidates did not make use of the  $x$  in the answer space and wrote their answer as  $10 < x$ , or just 10. A few expanded  $5(x + 4)$  incorrectly as  $5x + 4$ .

Answers: (a)  $\frac{13m}{20}$  (b)  $x > 10$

### Question 14

- (a) Few candidates seemed to realise that the point where a line crosses the  $y$ -axis is where the value of  $x$  is zero. Of those who did, a common wrong answer was (0, 15). Other common wrong answers were (3, 2) and (1, 7.5).
- (b)(i) Most candidates could answer this part correctly. The usual wrong answers were 1.5,  $\frac{2}{3}$  and  $-\frac{2}{3}$ .
- (ii) This part was answered quite well. Wrong answers included (2, 14) and (7, 1).

Answers: (a) (0, 7.5) (b)(i) -1.5 (ii) (1, 7)

### Question 15

- (a) The majority of candidates made a good attempt at this question. The usual wrong answers were  $\begin{pmatrix} -1 \\ 10 \end{pmatrix}$  and  $\begin{pmatrix} 1 \\ -10 \end{pmatrix}$ .



- (b)(i)** On the whole, this part was only answered well by good candidates.
- (ii)** Many candidates did not attempt this part. Very good candidates were able to obtain the correct answer, though some gave the answer  $\sqrt{2}$  or  $\sqrt{4}$ , or could not simplify  $\frac{\sqrt{50}}{5}$ .

Answers: **(a)**  $\begin{pmatrix} 1 \\ 10 \end{pmatrix}$     **(b)(i)** 5    **(ii)** 2

### Question 16

- (a)(i)** This part was answered well by the majority. The usual errors were to forget to multiply by 3 and give 8.5; to give 255, sometimes with following zeros; to measure the length of  $FG$  incorrectly.
- (ii)** Many candidates appeared to find the idea of bearings difficult. Good candidates gave good answers, but many either gave an answer close to 067, or to 293, or to 247, or did not attempt this part.
- (b)** Attempts at this part varied. The best answers showed two arcs of radii 6.5 cm and 5 cm centred, respectively, on  $F$  and  $G$ , with  $H$  clearly labelled at their intersection above  $FG$ .

Answers: **(a)(i)** 24.9 to 26.1 km inclusive    **(ii)**  $111^\circ$  to  $115^\circ$  inclusive  
**(b)**  $H$  marked 6.5 cm from  $F$  and 5 cm from  $G$

### Question 17

This question revealed a poor understanding of frequency density. Relatively few candidates realised that the numbers of cars were given by the areas of the rectangles in the histogram and could give good answers.

- (a)** Only the better candidates answered this part correctly. Some gave the answer 24, or 7, whereas others showed convoluted working that lead nowhere.
- (b)** Most of the candidates who attempted this part drew rectangles with the correct bases but whose heights varied a great deal.

Answers: **(a)** 6    **(b)** rectangle, base 3 to 3.5, height 16; rectangle, base 3.5 to 4.5, height 4

### Question 18

- (a)** Many candidates found this part difficult. A common error was not to use the angle of  $117^\circ$  but to assume that triangle  $PQR$  is isosceles with angle  $PRQ$  equal to  $48^\circ$  and to calculate angle  $QPR$  to be  $84^\circ$ . Some of those who used the correct method made careless arithmetic errors.
- (b)(i)** Few candidates could answer this part correctly. The usual wrong answers were 3 : 1 and 1 : 2, or else to include  $PU$  or  $PV$ . A common misconception was to use angles.
- (ii)** Most candidates omitted this part or could do little of value. Very few candidates realised that it was necessary to find the ratio of the areas of the two similar triangles  $PST$  and  $PQR$  and to involve the area of the trapezium  $STRQ$  by subtracting these two areas. A common wrong answer was 9 : 4.

Answers: **(a)**  $69^\circ$     **(b)(i)** 1 : 3    **(ii)** 9 : 8

### Question 19

- (a)(i)** This part was generally well answered. Wrong answers were more often slips rather than a lack of understanding of factorising.
- (ii)** This part was generally attempted sensibly and answered fairly successfully. Common wrong answers only factorised the first two terms or placed 3 and 40 in the brackets.



- (b) It was fairly common for candidates to substitute  $y = 3$  into the quadratic and to reach  $k = 3$ , though mistakes like  $2(3)^2 = 6^2$ , or to obtain  $k = 6$  from  $3k = 9$ , occasionally occurred. Not many went on to find the other solution to the equation correctly and very few realised that  $y = 3$  being a solution implied that  $y - 3$  is a factor of the quadratic. Those who made an error in later working often gave the answer  $4\frac{1}{2}$ . A common wrong answer was  $\frac{27}{y + 2k}$ .

Answers: (a)(i)  $7a(3a - 2)$  (ii)  $(x - 8)(x + 5)$  (b)  $-4\frac{1}{2}$

### Question 20

- (a) Only the better candidates were able to establish that angle  $AOE$  is  $70^\circ$  and then to go on to find angle  $ADO$ . Poor arithmetic let some candidates down. Wrong answers were very variable and included  $70^\circ$ ,  $55^\circ$  and  $45^\circ$ .
- (b)(i) This part was the one most successfully answered in this question. Many candidates marked the two lines as intersecting at right angles and tried to calculate angle  $BAD$ , but few used symmetry to write down angle  $BAD$  as  $55^\circ$ .
- (ii) Few seemed to recognise that angles  $BAD$  and  $BCD$  were opposite angles of the cyclic quadrilateral  $ABCD$  and so were supplementary. Common wrong answers were  $110^\circ$  or  $(90^\circ - \text{angle } BAD)$ .

Answers: (a)  $35^\circ$  (b)(i)  $55^\circ$  (ii)  $125^\circ$

### Question 21

- (a) The answers to this part were very varied, but more often correct. Errors included reversing the answers, using  $\frac{4}{7}$  and  $\frac{3}{7}$ ;  $\frac{2}{7}$  and  $\frac{1}{7}$ ; or to work in eighths or sixths.
- (b)(i) More able candidates knew which fractions to multiply together and were usually successful in doing this.
- (ii) There was confusion over which fractions to multiply and which to add. The majority of those who attempted this part sensibly, overlooked the possibility of two boys and so gave the answer  $\frac{15}{28}$ .

Answers: (a)  $\frac{5}{7}$ ,  $\frac{2}{7}$  correctly placed (b)(i)  $\frac{5}{14}$  (ii)  $\frac{25}{28}$

### Question 22

- (a) This part was answered well by almost all candidates. Common wrong answers were 35 for 36; 14 for 15; 55 25 20 from adding the numbers in each row.
- (b)(i) Only the more able candidates were able to answer this part correctly. Most gave spurious, numerical answers, or made no attempt.
- (ii) Only the most able candidates were able to answer this part correctly. Most gave spurious, numerical answers, or made no attempt.

Answers: (a) 36, 11, 15 (b)(i)  $n^2$  (ii)  $2n - 1$

### Question 23

- (a) (i) This part was usually answered correctly, but arithmetic slips, or not including both adults and all three children, occurred quite often.
- (ii) Many candidates started, correctly, with  $\frac{17.50}{25} \times 100$ , but a surprising number made mistakes in its evaluation. Others calculated  $\frac{7.50}{25} \times 100$  or  $\frac{3 \times 17.5}{2 \times 25} \times 100$  or  $\frac{17.50 \times 25}{100}$  or used a denominator of 52.50.
- (b) Many candidates started from the incorrect expression  $\frac{60}{100} \times 12$  instead of the correct  $\frac{12}{60} \times 100$  or its equivalent from the unitary method. A common error was to add 12 to the result obtained.

Answers: (a)(i) 102.5 (ii) 70 (b) 20

### Question 24

- (a) Most candidates made a good attempt at solving the simultaneous equations, but only the better ones were able to do so correctly. Fewer attempted to use the substitution method which, on the whole, was more successful. Careless slips occurred very frequently. Some candidates did not realise the link between their solutions and the coordinates of  $L$ .
- (b) Only very good candidates scored full marks in this part. The usual mistakes were to use the equation  $x = -2$  instead of  $y = -2$ , the equation  $2y = 3x + 5$  instead of  $x + 4y = 24$ , or the wrong inequalities.

Answers: (a) (2, 5.5) (b)  $y > -2$ ,  $x + 4y < 24$

### Question 25

- (a) (i) Most candidates made a reasonable attempt at this part. The usual errors were to give the wrong sign with one or more components; or to reverse the components; or count 7 squares instead of 8.
- (ii) Only the better candidates were able to answer this part correctly. The usual wrong answers were 2,  $\frac{1}{3}$  and  $-3$ , though others gave coordinates, a vector, a matrix or a ratio.
- (b) (i) Of those who attempted this part, many realised that the transformation is a reflection, but the correct mirror line was not mentioned. The usual wrong answer was "rotation".
- (ii) Few could answer this part correctly. Some did manage to draw the reflection of triangle  $A$  in the line  $x = -1$ , but could not find the centre of rotation. A few reflected triangle  $A$  in the line  $y = -1$ , but many did not make a serious attempt.

Answers: (a)(i)  $\begin{pmatrix} -8 \\ 2 \end{pmatrix}$  (ii) 3 (b)(i) reflection in  $y = -x$  (ii)  $(-1, 1)$

# MATHEMATICS D (CALCULATOR VERSION)

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Paper 4024/02

Paper 2

## General comments

The scripts seen this year covered the full range of marks available. There were many that were extremely well presented, each question being set out on a full page, neatly and clearly, making it straightforward for Examiners to read and follow, the questions in each section being fully completed before moving on to another question. However, there are still a number of candidates who divide each page into multiple columns and others who tackle parts of questions in a random order. Some of these scripts become very untidy and consequently difficult to read and follow, although in every case, candidates are given the full credit for what they have earned.

There were very few scripts infringing the rubric. The instruction to present only 4 **section B** questions was largely adhered to. There were still a number of candidates who had their calculators set in the wrong mode. More marks, however, were lost by those candidates who continue to work throughout in fewer figures than required to achieve the 3 significant figure accuracy expected.

In **section A**, good marks were obtained in the algebra and trigonometry questions, and in **section B**, candidates at all levels did well with most aspects of the graphical questions. In **section A**, a wide range of candidates had difficulty with the geometrical reasoning, aspects of the question dealing with the theory of sets, and in the arithmetic question, understanding the implications of upper bound. In **section B**, the extended question on distance and time proved a challenge. Marks would be greatly improved if mistakes in basic arithmetic could be reduced, and a disappointing feature of the response of candidates this year was the loss of marks that resulted from inaccuracies in the handling of basic formulae.

## Comments on specific questions

### **Section A**

#### **Question 1**

- (a) Generally well answered. The statement  $2^3 = 8$  was accepted for this mark. The common error was the answer 4; less common, the answer 6, both being inappropriate combinations of the numbers 2 and 8.
- (b) Care was needed here in removing the brackets. Those not attaining full marks usually gained the method mark for going about this in the right way, Examiners allowing one error. However,  $6(p - 3)$  could not be given any credit. Care was also needed later when moving terms to different sides of the equation.
- (c) Many candidates did very well in combining the algebraic fractions on the left hand side of the equation given, and thus gained the method marks available. However, a surprising number then lost sight of the fact that they were dealing with an equation, offering no final solution. There were a good number of 6's as the answer, but full marks were obtained only by those candidates reaching  $\pm 6$ .



- (d) Many candidates used the formula for solving a quadratic equation confidently, and scored well in this question. Examiners must see that the candidate is using a fraction of the form  $\frac{p \pm \sqrt{q}}{r}$  before marks can be given. One mark was given for both  $p = -1$  and  $r = 10$ , and another for  $q = 141$ . Common errors were to give  $p = 1$ , or  $q = 139$ , both of which lose at least 3 marks in this question. Some candidates lost a mark because they did not correct their answers to 2 decimal places as required. There were a significant number of weaker candidates who appeared not to know the formula at all and who attempted false algebraic manipulation in their efforts to reach a solution.

Answers: (a)  $y = 3$  (b)  $p = 2$  (c)  $q = \pm 6$  (d)  $x = -1.29$  or  $1.09$

## Question 2

Reasoning applied to Geometry continues to be a difficulty for the vast majority of candidates.

- (a)(i) Examiners were looking for a convincing argument using the equality of the relevant sides of the rectangle and the information given in the question. Some candidates achieved this. No credit could be given, however, for such as  $AP = CR$ ,  $QC = SA$  therefore  $PB = RD$ , or for arriving at this conclusion on the basis that  $AB$  and  $CD$  were parallel, where in both cases, there is no indication that  $AB = CD$ .
- (ii) There were a pleasing, if small, number of correct, concise arguments gaining full marks. Examiners needed to see all the facts on which the claim for congruency was being based. It was expected that candidates would state the result of part (a)(i) and  $BQ = DS$ , for one mark, and that the angles at  $B$  and  $D$  were equal for another mark. The conclusion that the triangles were congruent was then accepted for the final mark. Quite a number of candidates achieved one or both of these method marks. If, however, as was often the case, there were other, additional facts stated, the final mark was awarded only if the case of congruency was identified accurately, and, if this depended on any of the additional facts, that the appropriate facts had been justified. For example, using  $PQ = RS$  together with  $PB = RD$  and angle  $B =$  angle  $D$ , would require the justification that  $PQ = RS$  and reference to the right angle, hypotenuse, side case of congruency.
- (iii) A full method required at least two steps, such as stating the equal angles at  $P$  and  $R$  from the congruent triangles in part (a)(ii), and the equal angles at  $P$  and  $R$  from the parallel lines  $AB$  and  $CD$ , followed by a convincing conclusion. Very few candidates managed this. If neither of the two method marks was obtained, a special case was given to those candidates who stated, but did not prove, that  $PQ$  was parallel to  $SR$  and that the given angles were then alternate angles.
- (b) Despite a large number of guesses, such as kite and rhombus and some speculative shapes such as triangular quadrilateral, a lot of candidates anticipated what was happening and gained this mark.

Answers: (a)(i)  $AB = CD$ ,  $AP = CR$ , therefore  $AB - AP = CD - CR$  (ii)  $PB = RD$ ,  $BQ = DS$ ,  $\hat{P}BQ = \hat{S}DR$ , therefore triangles  $PBQ$  and  $RDS$  are congruent (iii)  $\hat{B}PQ = \hat{D}RS$ ,  $\hat{R}PB = \hat{P}RD$ , therefore  $\hat{R}PB - \hat{B}PQ = \hat{P}RD - \hat{D}RS$  (b) Parallelogram

## Question 3

Candidates generally scored well on this question. The methods used were usually those appropriate for right angled triangles. A significant number of candidates continue to lose marks in this type of question, however, by working in fewer than the 3 significant figures required. Also, a few candidates continue to be penalised because their calculators are set in Radian or Grad mode.

- (a) The sine ratio was usually used directly in this part. Some candidates used the tan ratio in error.
- (b) Again, quite well done. However, after a correct start, a number of candidates transposed incorrectly, losing the second method mark available. There are also still some candidates who have an unsure grasp of something like  $\sin 15$ . The "sin" and the "15" become detached from each other as transposition takes place. Solutions, seen on a few scripts, using part (a) and similar triangles were accepted.



- (c)(i)** A pleasing number of candidates got this correct, realising that  $\hat{B}CM = 90^\circ$ . There were the occasional long winded methods involving the calculation of other lengths, perhaps using Pythagoras. Candidates were not penalised if they worked sufficiently accurately. This part was difficult for weaker candidates, with answers of  $75^\circ$ ,  $45^\circ$ ,  $90^\circ$  and even  $7.5^\circ$  seen. There was some concern that perhaps some of these candidates were unclear as to which angle was meant by  $\hat{B}MC$ .
- (ii)** Again, quite well done. Candidates were given full credit for evaluating 10 costheir **(c)(i)**, but no credit was given if this final calculation did not use a right angled triangle.

Answers: **(a)** 12.9 m **(b)** 38.6 m **(c)(i)**  $15^\circ$  **(ii)** 9.66 m

#### Question 4

Not many completely correct solutions to this question. Generally, part **(a)** produced better marks than part **(b)**. In part **(b)**, the expected expressions and equation in  $x$  were seen from a number of candidates, but all too often, there were intrusive  $p$ 's and  $q$ 's present.

- (a)(i)(a)** Generally well done. A common error was to include 1 in this set. A number of candidates gave the answer  $\{6,12\}$ , clearly labelled  $L \cap M$ .
- (b)** Again, generally well done, but also again, the answer  $\{3, 9, 15\}$  was given by some candidates, clearly labelled  $L' \cap M$ .
- (ii)** The correct answer was seen in a number of scripts, but sometimes, only a whole number was given.
- (b)(i)(a)** When attempted, a common error here was  $p = \frac{x}{4}$ . Many candidates produced a statement containing  $x$ ,  $p$  and  $q$ . Some candidates simply gave a number for  $p$ .
- (b)** The answer  $q + 4x = 66$  was accepted. Again, mixtures of  $x$ 's,  $p$ 's,  $q$ 's and numbers were common.
- (ii)(a)** The attempt to form an equation here defeated many candidates. Examiners often saw a mixture of numbers,  $x$ 's,  $p$ 's and  $q$ 's for which no credit could be given. The correct answer of 13 was relatively rare.
- (b)** As well as the correct answer, credit was given at this stage for  $77 +$  their  $x$ . Common wrong answers were 93, from  $66 + 27$ , and 104, from  $66 + 27 + 11$ .

Answers: **(a)(i)(a)**  $\{3, 9, 15\}$  **(b)**  $\{6, 12\}$  **(ii)**  $\frac{10}{15}$  **(b)(i)(a)**  $4x$  **(b)**  $66 - 4x$  **(ii)(a)** 13 **(b)** 90

#### Question 5

Candidates generally scored marks in this question.

- (a)(i)** This needed care, especially with signs, in order to reach the correct answer. When an incorrect answer was reached, usually involving  $-6$ , credit was given for using either of the scalars 3 and 2 correctly.
- (ii)** A good number of correct matrix multiplications were seen, reaching the correct shape of 1 row and 2 columns. A consolation mark was given for 2 rows and 1 column. Clearly, some candidates had no idea of what sort of shape to expect. A  $3 \times 2$  product was a common error.



- (b)(i)** Often well done. Credit was given for  $\begin{pmatrix} 1 & 3 \\ 0 & 2 \end{pmatrix}$  or for  $\det A = 2$ .  $\det A = 5$  was sometimes seen.
- (ii)** This part was well done by some, but without much success elsewhere. No credit was given for either a correct  $h$  or a correct  $k$  obtained fortuitously. Examiners expected to see a correct matrix multiplication, either  $\begin{pmatrix} 2 & -3 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} h \\ k \end{pmatrix} = \begin{pmatrix} 10 \\ 2 \end{pmatrix}$  or their **(b)(i)**  $\times \begin{pmatrix} 10 \\ 2 \end{pmatrix}$ . When attempted, most candidates seemed to prefer the first approach, although some candidates used the inverse matrix successfully. The usual error was the order of multiplication in the first method, with  $\begin{pmatrix} h \\ k \end{pmatrix}$  on the wrong side of  $\begin{pmatrix} 2 & -3 \\ 0 & 1 \end{pmatrix}$ .

Answers: **(a)(i)**  $\begin{pmatrix} 4 \\ 0 \\ 6 \end{pmatrix}$  **(ii)** (29 7) **(b)(i)**  $\frac{1}{2} \begin{pmatrix} 1 & 3 \\ 0 & 2 \end{pmatrix}$  **(ii)**  $h = 8, k = 2$

### Question 6

- (a)** The idea of ratio was usually understood, but many candidates failed to appreciate the instruction to express their answer using integers. The ratio was often left as 0.9 : 25. Those giving the answer 1 : 3600 were clearly confused.
- (b)(i)** This part was very well answered.
- (ii)(a)** Many candidates saw the 0.3% immediately, but many resorted to a fairly lengthy calculation to reach this point. They clearly felt the need to involve 210 in the calculation. 3% and 30% were common wrong answers.
- (b)** Many candidates found this difficult. The whole tin contained  $0.3 \times 2.1$  grams of fat, and this amount was required as a percentage of 70 g. So Examiners expected to see  $0.63 \times 100$  followed by division by 70. Often what was seen was division by 0.63, if the 210 had not been forgotten, and/or multiplication by 70.
- (iii)** This was very poorly handled. Only rarely was the correct answer seen, and only rarely was the consolation mark awarded for 1.05 seen in the working.
- (c)** This part was much better, but again, candidates were apt to multiply by 8.3 (finding 8.3% of 166) instead of dividing.

Answers: **(a)** 9 : 250 **(b)(i)** 9.45 g **(ii)(a)** 0.3% **(b)** 0.9% **(iii)** 2.205 g **(c)** 2000

### Section B

#### Question 7

A popular choice of question. It is expected that candidates know how to calculate the volume of a cylinder. This formula is not given in questions. This was one of the factors preventing high scores on this question.

- (a)(i)** Most candidates attempting this question managed to convert the 25 000 litres to  $25 \text{ m}^3$  thus gaining one of the method marks available. Examiners then looked for an appropriate equation with consistent units of volume, and this gained another method mark. Full credit for method depended on the use of the correct formula for the volume of a cylinder. Unfortunately, a number of candidates thought that the volume of a cylinder was  $2\pi r^2 h$ . Those candidates who got confused with surface area and included such as  $\pi r^2$  in the formula for the volume produced an equation where the units were not consistently those of volume, so no credit was given at that stage.
- (ii) (a)** This was generally well done.

- (b) Candidates generally used an appropriate strategy based on the areas of a sector and triangle and so gained the available method marks. Care was needed with the area of triangle OCD, however, with mistakes seen in both the use of the sine formula and the use of  $\frac{1}{2}bh$ . Some candidates worked to fewer than 3 significant figures at this stage, so failed to gain the final accuracy mark. A number of candidates thought that the area of the segment could be calculated directly. The "method" seemed to be to find  $ED$ , and to use this value in the formula for the area of a sector.
- (c) It was expected that candidates would use their result from part (ii)(b) and form the product with their result from part (a)(i), thus finding the volume of a prism. This was very poorly handled. One of the common errors in this part was to think that the result from part (ii)(b) could be converted directly into litres.
- (b) Candidates working efficiently, and economically, readily came up with the correct answer of 5 m. Others were allowed to reach a number rounding to 5.00. Some candidates remained confused concerning radius/diameter, and some were using  $\frac{4}{3}\pi r^3$  as the volume of a hemisphere, so some credit was given for an answer of 10 m when this arose from a correctly formed equation. Sadly, a number of candidates allocated the factor of 10 to the wrong side of their equation.

Answers: (a)(i) 9.82 m (ii)(a)  $\cos \hat{EOD} = \frac{0.45}{0.9}$  leading to  $\hat{EOD} = 60^\circ$  (b) 0.497 or 0.498 m<sup>2</sup>  
(c) 4880 or 4890 litres (b) 5 m

### Question 8

A popular question, with candidates scoring good marks, especially in part (a).

- (a)(i) Usually correctly calculated. Candidates sometimes gave  $p$  as 6, possibly trying to spot a pattern in the table.
- (ii) Plotting and drawing were generally good across the whole ability range. Care was needed, however, in plotting (3.5,21). It was seen a number of times plotted at either (4,21), or (3.5,23). The drawing mark was lost when the points (0.5,6) and (1, 6), or the points (2, 0) and (2.5, 0) were joined by a straight line.
- (iii) Candidates usually managed the first value of  $x$ , and so understood the need to read the graph in the right way. Credit was given for this, but for full marks, all three values of  $x$  were required.
- (b)(i) Some candidates struggled with this, but many succeeded.
- (ii) A good number of accurate derivations. Weaker candidates produced numerical work of some kind at this point.
- (iii) The significance of this was realised by only a few of the more able candidates. It was hoped that candidates would reject their value of  $x$  from part (a)(iii) that was greater than 2.
- (iv)(a) A few correct answers here and in the next part. 6 was accepted from those candidates who had a straight line at this point.
- (b) Again, a few correct answers. Usually the response to part (a) was 21 and the response to part (b) 3.5.

Answers: (a)(i)  $p = 21$  (ii) plotting all 8 points correctly, and joining with a smooth curve (iii)  $x = 0.2$  to 0.35, 1.3 to 1.4 and 2.8 to 2.95 (b)(i)  $5 - 2x$  and  $4 - 2x$  (ii)  $V = x(5 - 2x)(4 - 2x)$  leading to  $V = 4x^3 - 18x^2 + 20x$  (iii)  $x = 2.8$  to 2.95 (iv)(a) their maximum value of  $y$  between  $x = 0$  and 2  
(b) 0.7 to 0.8 cm

### Question 9

A good response was made to part **(a)**. Weaker candidates tended to omit part **(b)**. Perhaps they did not realise that parts **(b)(iii)** and **(iv)** were just the cosine and sine rules, usually popular choices.

- (a) (i)** If full marks were not obtained for a correct diagram, credit was given for right angles at *A* and *E*, and further credit was given for *C* correctly placed in relation to *B* and *D*. Examiners checked that  $BC : CD = 3 : 2$ .
- (ii)** This part was well answered apart from those reading the wrong part of their protractor and coming up with  $45^\circ$ . Some candidates did not attempt to measure the angle, possibly because they didn't have protractors available?
- (b) (i)** Many more candidates than those gaining this mark understood the mathematics of the situation. However, Examiners expected to see a specific reference using *DE* and *ST*. General statements such as "all the sides are not in the same ratio" were not given any credit. Some candidates seemed to think that "similar" meant "identical".
- (ii)** Examiners expected to see  $QS^2 = 5^2 + 14^2 = 221$ , from Pythagoras in the right angled triangle formed by drawing a line through *Q* parallel to *PT*. If this was not seen, credit was given for (12 – 7) and 14 seen as possible sides of a right angled triangle. Full credit was given for genuine long (some very long!) methods reaching numbers rounding to 221, such as 220.7. A common error was to assume that triangle *QRS* had a right angle at *R*, and then try to obtain 221 from  $10.5^2 + 7^2$ . No credit was given at this stage for using  $QS^2 = 221$  to find  $\hat{QRS}$ , and then using the cosine rule to get back to  $QS^2 = 221$ .
- (iii)** Having been given  $QS^2 = 221$ , candidates could now use the cosine rule in triangle *QRS* to find the angle at *R*. Answers rounding to  $115^\circ$  were accepted, to allow candidates to use their 221.
- (iv)** Candidates usually switched to the use of the sine rule at this point, as hoped, and generally used it correctly. A fairly wide range of answers was accepted to allow for variations in methods.

Answers: **(a)(i)** Accurate scale drawing of *ABCDE* of the correct size **(ii)**  $135^\circ$  **(b)(i)**  $DE : ST \neq 1 : 3.5$   
**(ii)**  $QS^2 = (12 - 7)^2 + 14^2$  **(iii)**  $115^\circ$  **(iv)** 25.1 to  $25.5^\circ$

### Question 10

Again, a good standard of plotting and drawing by candidates across the ability range. A popular choice of question, with candidates picking up good marks.

- (a)** This part was usually answered correctly.
- (b)** Generally well plotted and carefully drawn.
- (c) (i)** Well answered. The relationship between median and cumulative frequency was well understood. Care was needed, however, in reading the graph scales accurately.
- (ii)** Quite a number of candidates were uncertain about this. A common error was to take the 10<sup>th</sup> percentile to be 10 instead of 8
- (d)** Full marks were given for plotting and joining the relevant points. The three points (50,3), (250,40) and (275,60) were found and plotted accurately by most candidates. (200,20) and (350,80) were the difficult points to find and plot. Instead of using the interquartile range, some candidates plotted (75,20), and a common error was to plot (350,0). Some weaker candidates omitted this part.



- (e)(i)** Well answered, since this involved only the first cumulative frequency curve.
- (ii)** This mark was usually earned by only the more able candidates. Unfortunately, a number of candidates gave values at 250 hours.
- (f)** There were some correct answers with appropriate justification. The correct answer supported, for example, by reference to the medians was not accepted. Examiners expected to see evidence based on reading both curves at 250 hours, using numbers such as 11 and 40. For example, the probability that bulbs A last longer than 250 hours is  $\frac{11}{80}$ , while the probability that bulbs B last longer than 250 hours is  $\frac{40}{80}$ . Some candidates used values at 260 hours, and quite a number chose A incorrectly.

Answers: **(a)** 9 43 69 77 79 **(b)** All 8 points plotted and joined with a smooth curve **(c)(i)** 192 to 198 hours **(ii)** 142 to 148 hours **(d)** the points (50,3), (200,20), (250,40), (275,60) and (350,80) plotted **(e)(i)** 71 or 72 bulbs **(ii)** 47, 48 or 49 bulbs **(f)** B with evidence of reading both graphs at 250 hours

### Question 11

This question proved to be difficult for most candidates. Not many answers scored high marks. Less able candidates struggled to score any marks at all in this question.

- (a)(i)** Usually understood by those attempting this question, and quite well done. A common wrong answer, showing misunderstanding, was to give the gradient of  $4 \text{ (ms}^{-2}\text{)}$  as the distance travelled by object B.
- (ii)** This needed careful thought to gain full marks. Some candidates recovered a method mark here after a wrong answer in part **(a)(i)**, by correctly adding  $20 \times 5$  to find the total distance travelled, and then dividing by 10. Many candidates, however, confused the “average” of average speed, with the average obtained by adding two numbers and dividing by two.
- (iii)** Candidates regularly managed the correct answer here, often apparently without requiring any working.
- (iv)** This part was very poorly done. The mark available for understanding the connection between area and distance was sometimes earned, but usually Examiners were unable to give any credit for the work shown. Again, basics, such as the formula for the area of a triangle, need care.
- (b)(i)** Reasonably well done by a minority of candidates. Candidates were given credit here if they worked correctly from errors made in parts **(a)(i)** and **(ii)**. Many candidates gave answers which bore no relation to their previous work, however.
- (ii)** Well answered. “Speed” was accepted, but, for example, “increasing speed” was not.
- (iii)** A few correct answers from candidates who had got this far.
- (c)** Not many correct answers. Credit was gained by a minority of candidates for using the retardation of  $\frac{12}{9} \text{ ms}^{-2}$ . A common wrong answer was 19 seconds.

Answers: **(a)(i)** 50 m **(ii)**  $15 \text{ ms}^{-1}$  **(iii)** 3 seconds **(iv)** 6.25 seconds **(b)(i)** 50 m and 150 m **(ii)** the constant speed of object B, **(iii)**  $10 \text{ ms}^{-1}$ , **(c)** 25 seconds.

