

# MATHEMATICS D

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Paper 4024/01

Paper 1

## General comments

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 - that they should write in dark blue or black pen. Some wrote in pencil and even erased their workings, making it impossible for Examiners to award marks for intermediate steps.

There was a small number of scripts which contained answers only, with no supporting workings. Occasionally workings on separate sheets were inserted in the answer booklet, indicating that some Centres were issuing rough paper. This practice tends to disadvantage candidates as it is not often possible to identify easily which working applies to a particular question and to award marks for appropriate results or working.

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

Candidates seemed to use their time sensibly and there was no evidence that they could not attempt the whole paper in the allotted time.

## Comments on specific questions

### Question 1

- (a) The figures 18 were almost always obtained, though not all candidates positioned the decimal point correctly.
- (b) Well answered, in the expected decimal form. A few candidates gave 3.5, from  $(0.4 + 0.3) \times 5$ , or 0.55 following  $0.3 \times 5 = 0.15$ .

Answer: (a) 0.018, (b) 1.9.

### Question 2

- (a) This was well done.  $\frac{45}{100}$  was written down and simplified correctly by the majority. A few gave  $\frac{9}{50}$ , or converted  $\frac{9}{20}$  to  $2\frac{2}{9}$ .
- (b) Most candidates started correctly with  $\frac{13}{40} \times 100$ . Some could not simplify this expression correctly, or made a slip after getting as far as  $\frac{65}{2}$ . Common wrong answers were 32.2 and 37.5.

Answers: (a)  $\frac{9}{20}$ , (b) 32.5.

### Question 3

- (a) This part was generally well answered, though  $1\frac{3-10}{15}$  was left as  $1-\frac{7}{15}$ , or became  $-1\frac{7}{15}$ . Occasionally  $\frac{8}{15}$  was converted to  $1\frac{7}{8}$ . Inability to deal with subtraction of fractions resulted in  $\frac{16}{5}-\frac{8}{3}$  becoming  $\frac{8}{2}$ .
- (b) Many candidates answered this part correctly, but a significant number could not deal with the fractional index and omitted this part or gave the answer 6. The answer  $2^3$  was not acceptable.

Answers: (a)  $\frac{8}{15}$ , (b) 8.

### Question 4

Very many candidates failed to obey the instruction "By writing each value correct to 1 significant figure" and plunged into complicated, long multiplications which earned no credit. Others wrote some values correct to 2 significant figures.

Candidates were expected to multiply the numbers 10 000, 30 and 20.

Answer: 6 000 000

### Question 5

Nearly all candidates could answer **part (a)** correctly, though a few gave 18. Answers to **part (b)** showed that the median is less well understood. The responses 8.5 from  $\frac{10+7}{2}$ ; 7, 9; 8.8 (the mean); and 88 (the sum) occurred quite often.

Answers: (a) 7, (b) 8.

### Question 6

- (a) This question was answered correctly quite frequently, but suffered through candidates not reading the question carefully, and assuming, in **part (a)**, that it was the total length that was 125 cm. Thus **part (a)** often had an answer that was an attempt to evaluate  $\frac{125}{8}$ .
- (b) Working in this part was often not consistent with the assumptions made in **part (a)**, and sometimes, despite the question asking for metres, and the answer line containing an m, answers were given in centimetres.

Answers: (a) 25 cm, (b) 2 m.

### Question 7

Many candidates are clearly not confident in the use of standard form.

- (a) This part was sometimes answered correctly, but the wrong answers  $700$ ,  $0.7 \times 10^3$ ,  $7 \times 10^3$  or  $6.3 \times 10^2$  were quite common.
- (b) Few candidates could answer this part correctly.
- For  $n^2$ ,  $3^2$  was sometimes evaluated as 6, or left as 3;  $(10^4)^2$  was sometimes given as  $10^6$  or as  $10^{16}$ .

Other mistakes were to write  $9 \times 10^8$  as  $0.9 \times 10^7$ ;  $2.1 \times 10^7$  as  $21 \times 10^8$ ; and to obtain  $11.1 \times 10^{15}$  from  $9 \times 10^8 + 2.1 \times 10^7$ .

Answers: **(a)**  $7 \times 10^2$ , **(b)**  $9.21 \times 10^8$ .

### Question 8

Some Centres seemed to have covered this topic far better than others. It was pleasing to see that, when attempting **part (a)**, most candidates gave their answers as a decimal or as a fraction whose value was between 0 and 1.

**(a) (i)** Quite often correct, with 0.75 a frequent wrong answer.

**(ii)** Quite often correct, or with an answer that was correctly derived from the **part (a)** answer. A few gave 0.4.

**(b)** Responses to this part were very varied. Some answers, for example 16.4, 6.4 from  $0.4 \times 16$ , were not even whole numbers.

Answers: **(a) (i)** 0.25, **(ii)** 0.65, **(b)** 40.

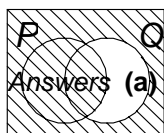
### Question 9

Quite a large number of candidates showed little understanding of Venn diagrams and set notation.

**(a)** This part was seldom answered correctly, with  $P \cup Q$ , or  $Q'$  being the usual wrongly shaded regions.

**(b)** Many attempted to draw an appropriate Venn diagram, but with mixed success. Some candidates used the 3 as the intersection of the two sets. Others started correctly, with an equation like  $(19 - x) + x + (15 - x) + 3 = 27$ , but were unable to obtain  $x = 10$ .

Some correctly obtained the number of children who own a bicycle and a scooter, but gave the answer 5, which is the number of children who own a scooter but not a bicycle. Other common wrong answers were 7 from  $34 - 27$ ; 16 from  $19 - 3$ ; 10.



**(b)** 9.

### Question 10

**(a)** Many candidates did not seem to know what was required to give the formula for  $T$  in terms of  $L$ .

Common answers were  $T = \frac{k}{L^2}$ ;  $T = \left(\frac{1}{L}\right)^2$ ;  $T = 36$ . A surprising number of candidates did not read the question carefully, either not noticing the word “inversely”, “square”, or interpreted “square” to mean “square root”. A few went from  $9 = \frac{k}{4}$  to  $k = 5$ , or to  $k = 13$ .

**(b)** Only a minority could obtain the correct answer. Better attempts stopped at  $\sqrt{\frac{36}{25}}$  or  $\sqrt{1.44}$ , some gave 7.2 from  $25 = \frac{36}{L^2}$ ,  $\therefore 5 = \frac{36}{L}$ .

Normally, when taking the square root of a positive number, candidates are expected to give both the positive and the negative value. On this occasion, with only one mark allocated, the answer  $\frac{6}{5}$ , or its equivalent, was given full credit.

Answers: (a)  $T = \frac{36}{L^2}$ , (b)  $\pm \frac{6}{5}$ .

### Question 11

- (a) The usual errors here were to overlook the 100 boxes, and to fail to convert correctly from cubic centimetres to cubic metres. The most common wrong answer was 1500.
- (b) "Limits of accuracy" continues to be a topic that is not well understood by most candidates. Few realised that the upper bound for 6 is 6.25. Better efforts, in the sense that they used at least one correct upper bound, were 161.5 from  $1.55 \times 100 + 6.5$ ; 7.80 from  $1.55 + 6.25$ ; 780 from  $(1.55 + 6.25) \times 100$ .

Answers: (a)  $0.15 \text{ m}^3$ , (b) 161.25 kg.

### Question 12

- (a) Nearly every candidate could get as far as  $\frac{15}{6}$ , but not all of these went on to simplify this fraction correctly. Answers of  $\frac{5}{3}$ , or  $1\frac{1}{2}$  (from  $\frac{5}{2}$ ) occurred too frequently.
- (b) Some candidates started this part correctly, but could not get further than  $2xy - 4x = 3$ . It was not uncommon to see  $2xy - 4x = 3$  leading to  $2x - 4x = \frac{3}{y}$ . Others started with  $y - 3 = \frac{4x}{2x}$ .

Answers: (a)  $2\frac{1}{2}$ , (b)  $\frac{3}{2x-4}$ .

### Question 13

The response to this question was most disappointing. Though many candidates drew at least part of a circle, centre  $S$ , with radius 4 cm, very few drew the perpendicular bisector of  $MF$ , and so were unable to proceed to the rest of the question.

Many attempts involved triangle  $MSF$ . The most common of these was to construct the median from  $S$  or the bisector of angle  $MSF$ . The region between this line and the line  $MS$ , and within the circle, centre  $S$ , with radius 4 cm was then shaded.

Answers: (a) perpendicular bisector of  $MF$ ; circle, centre  $S$ , radius 4 cm, (b) smaller segment of the circle, centre  $S$ , formed by the perpendicular bisector, (c) approx. 10.2 km.

### Question 14

- (a) This part was often answered correctly. Drawing  $T$  as the reflection of  $Q$  in the  $y$ -axis was a common wrong answer.
- (b) The most popular answer was the incorrect "rotation". Some candidates realised that the transformation is a reflection, but not many mentioned the mirror line, or were able to describe this line in terms of an equation.

- (c) Only a small minority answered this part correctly. Many gave their answer as a  $2 \times 3$  or as a  $2 \times 1$  matrix. Quite frequent wrong answers were  $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ ;  $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ .

Answers: (a) Triangle with vertices at  $(-1,3)$ ,  $(1,3)$  and  $(1,4)$ , (b) reflection in  $y = -x$ ,  
 (c)  $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ .

### Question 15

- (a) The majority of candidates seemed to know what was required in this part, but arithmetic errors were quite common. A few gave  $\begin{pmatrix} 8 & 3 \\ 1 & 0 \end{pmatrix}$  from  $\begin{pmatrix} 2 \times 4 & (-1) \times (-3) \\ 1 \times 1 & 3 \times 0 \end{pmatrix}$ .
- (b) This part was also usually attempted correctly, though the value of the determinant of **B** was sometimes calculated as  $-3$  or as  $+7$ .

Answers: (a)  $\begin{pmatrix} 7 & -6 \\ 7 & -3 \end{pmatrix}$ , (b)  $\begin{pmatrix} 0 & 1 \\ -\frac{1}{3} & 1\frac{1}{3} \end{pmatrix}$ .

### Question 16

- (a) This part was answered well by a minority. Although the result  $-2x < 2$  was often seen in the working, it usually led to a final answer of  $x < -1$ ,  $x > 1$ ,  $-1$ ,  $x > 4$ , or  $x < 4$ .
- (b) Most candidates removed the brackets correctly, (though  $2(2y - 7) + y$  sometimes became  $4y - 14 + 2y$ ), and many went on to obtain the correct answer. However, many others made errors like  $-14 - 6 = -8$ ;  $-14 - 6 = +20$ ;  $3y - y - 4y = -8y$ ;  $4y - 3y = -1y$ .

Answers: (a)  $x > -1$ , (b)  $y = 10$ .

### Question 17

- (a) Few candidates realised that it was necessary to find the  $x$ -coordinate of the point where the curve crosses the  $x$ -axis. Some gave  $2.1$ , from the intersection of the line  $y = 5$  with the curve.
- (b)(i) Most of the more able candidates could draw the line that passes through  $(0, 15)$  and  $(3, 0)$ . Other candidates drew a different line, or a curve, or omitted this part.
- (ii) Those who drew a graph in **part (b)(i)** usually made a good attempt to read the scales correctly, (though  $0.45$  was sometimes given for  $4.5$ ), and to write down the coordinates of the point of intersection.
- (iii) Very few candidates realised that it was necessary to equate  $x^3 - 5$  to  $15 - 5x$ , then to rearrange this equation, and finally to read off the values of  $a$  and  $b$ .

Answers: (a) approx.  $1.7$ , (b) (i) st. line through  $(0, 15)$  and  $(3, 0)$ , (ii) approx.  $(2.1, 4.5)$ ,  
 (iii)  $a = 20$  and  $b = -5$ .

### Question 18

- (a) This part revealed that there are many candidates who do not understand bearings and the idea of clockwise angle.

In (i), common, incorrect answers were  $127^\circ$  (measuring anticlockwise);  $53^\circ$  (from  $180^\circ - 127^\circ$ ).

In (ii), common, incorrect answers were  $235^\circ$  (from  $127^\circ + 108^\circ$ );  $125^\circ$  (the bearing of  $B$  from  $H$ );  $55^\circ$  (from  $180^\circ - 125^\circ$ ).

- (b) The majority of candidates realised that it was necessary to divide the distance by the speed.

Many went on to obtain 2.8 hours, but this was very frequently converted to 2 hours and 80 minutes, 3 hours 20 minutes or 2 hours 8 minutes.

Some candidates did not attempt to add the time of travel to the 7 30 a.m. given in the question. A few gave 10 30 a.m. from  $7.5 + 2.8 = 10.3$ .

Answers: (a)(i)  $233^\circ$ , (ii)  $305^\circ$ , (b) 10 18 a.m.

### Question 19

- (a)(i) Many candidates noted where the line met the vertical axis. Common wrong answers were 3600, 3800, or 4000.

- (ii) Some candidates seemed to recognise that  $m$  is related to the gradient of the line, but calculations like  $\frac{4000}{15000}$ ,  $\frac{3600}{5000} \times 100$  and  $\frac{3600 - 3400}{3600} \times 100$  were common. Others gave 1000, or 200.

- (b) This part was generally answered well, though some stopped after calculating 5% of \$12 000, or went on to calculate  $12\ 000 - 600$ ,  $12\ 000 + 600$ , or  $3500 - 600$ . Others calculated 5% of \$3500, or  $\frac{12000}{3500} \times 100$ .

A surprising number misread \$12 000 as \$1200 and obtained the answer \$3560.

Answers: (a)(i) \$3400, (ii) 4, (b) \$4100.

### Question 20

- (a) Most candidates were well acquainted with the properties of parallel lines and an isosceles triangle and were able to answer all parts correctly. The values  $112^\circ$ ,  $68^\circ$  and  $44^\circ$  were regularly seen but sometimes in the wrong place, or with one value missing and replaced with a repetition of one of the other two. A few responses were marred by arithmetic slips and the sets of answers  $68^\circ$ ,  $44^\circ$ ,  $112^\circ$  and  $68^\circ$ ,  $68^\circ$ ,  $68^\circ$  occurred every so often.

- (b) Few candidates calculated the height of the trapezium to be 4 cm, from a 3, 4, 5 Pythagorean triangle. The majority assumed, incorrectly, that the height of the trapezium was 5 cm, and usually, but by no means always, went on to calculate the area to be  $65\text{ cm}^2$ .

Answers: (a)(i)  $112^\circ$ , (ii)  $44^\circ$ , (iii)  $68^\circ$ , (b)  $52\text{ cm}^2$ .

### Question 21

- (a) The brackets were usually expanded correctly and the correct answer was often obtained. The common mistakes were to include the quantities  $+20$ ,  $+p$ ,  $-9p$ , or to re-factorise and give  $(p - 5)(p + 4)$  as the answer. A tiny minority gave "solutions", such as 5 and -4.

- (b)(i) Few could answer this part correctly. Most made a half-hearted attempt or offered an expression like  $(2x - 3y)(2x + 3y) + 12xy$ ,  $4x^2 + 3y(4x + 3y)$ ,  $(4x + 3y)(x + 3y)$ .

- (ii) Many obtained the result  $3(m^2 - 16)$ , but did not recognise that  $m^2 - 16$  is the difference of two squares. Some divided by 3 and gave the answer  $(m - 4)(m + 4)$ . Others gave  $3m(m - 16)$ ,  $3(m - 4)^2$  or gave the "solutions" 4 and -4.

Answers: (a)  $p^2 - p - 20$ , (b)(i)  $(2x + 3y)^2$  or  $(2x + 3y)(3x + 3y)$ , (ii)  $3(m - 4)(m + 4)$ .

## Question 22

Gradients and equations of straight lines do not seem to be well understood by many candidates, some of whom, in addition, confuse the use of  $x$  and  $y$ .

- (a) Sometimes correct, but 1, -1, 2, -2,  $\frac{-x}{2}$  or a blank space were too frequent.
- (b) There seemed to be some lack of realisation that, in this situation, the equation of a line involves the use of  $x$ ,  $y$ , numbers and an equals sign. Statements such as  $c = 5$  are not sufficient. When an equation was given, it frequently did not have a gradient that matched the answer given in **part (a)**, nor was it parallel to  $x + 2y = -1$ .

Careless slips were quite frequent. For example,  $y - 5 = -\frac{1}{2}(x - 0)$  sometimes became  $y - 5 = \frac{1}{2}x$ .

- (c) (i) Many candidates drew the line  $y = -2$  correctly, though  $x = -2$  was often drawn instead.
- (ii) This part was very badly answered. Most candidates shaded the triangle formed by the three lines. In most cases, candidates obeyed the instruction to shade and label with the letter R, a region. However, many shaded out the unwanted regions. Both methods of shading are recognised conventions, but candidates should make it clear which system is being used and to make sure that the label is written inside the intended region.

Answers: (a) -0.5, (b)  $x + 2y = 10$ , (c)(i)  $y = -2$  drawn, (ii) region enclosed by the lines joining the points  $(-4, -2)$ ,  $(-1.5, -2)$ ,  $(-0.6, -0.2)$  and  $(-4, 1.5)$ .

## Question 23

Some Centres clearly need to pay more attention to the topics assessed in **(a)(ii)** and **(b)**.

A few candidates disregarded the hint in the answer spaces that the expected units were minutes and tried, with variable success, to convert to seconds, or to a combination of minutes and seconds.

- (a) (i) This part was usually answered correctly, though 4.5, or 4.36 were sometimes offered.
- (ii) Some candidates had the correct idea, but answers were sometimes spoilt by misreading the horizontal scale (for example, 5.5 instead of 5.05), or by arithmetic slips, for example, obtaining 1.05 from  $5.05 - 4.1$ .

Many, though, merely used  $60 - 20 = 40$ , and gave an answer of 40, or of 4.6. A few added the two quartiles.

- (b) Many candidates clearly did not know that, with a grouped frequency distribution, a calculation of an estimate of the mean is obtained by firstly calculating the sum of the products of each frequency multiplied by the mid-value of its associated group, and then dividing this sum by the sum of the frequencies.

Instead of the mid-interval values, (3, 4, 5 and 6), candidates used the class width (1), or 0.5, or the sum of the bounds (6, 8, 10, 12), or the upper, or the lower, bound.

A few tried to calculate  $2.5 \times 3.5 + 3.5 \times 4.5$  etc.

Even when the correct products of 15, 120, 250 and 90 were obtained, errors in addition, such as 270 from  $15 + 120$ , were made because the numbers to be added were not placed in their correct hundreds, tens and units columns.

Despite the question stating that there were 100 tracks, some candidates obtained a total frequency of 110, 80 or 90 from  $5 + 30 + 50 + 15$ .

Some candidates used 4 as the sum of the frequencies.

Finally, when calculating an estimate of a mean it is expected that the answer will be given in its simplest form (for example 4.75 instead of  $\frac{475}{100}$ ), and that the answer will not be rounded ( for example 4.75 will not be rounded to 4.8, or to 5).

*Answers:* **(a)(i)** 4.55 to 4.65 minutes, **(ii)** 0.9 to 1 minutes, **(b)** 4.75 minutes.



# MATHEMATICS D

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Paper 4024/02

Paper 2

## General comments

There were many well presented scripts again this year.

Candidates at all levels scored well on questions dealing with standard results such as the solution of the quadratic equation in **Question 7** and the use of the sine and cosine rules in **Question 8**.

However, they were less confident with those questions such as **3(c)** and **9(b)(ii)**, where the strategies required had to be thought out using their understanding of basic principles in algebra and trigonometry.

There were marks available throughout the paper that weaker candidates managed to pick up, and challenges to which the more able responded with some well thought out solutions.

Many candidates, particularly the weaker ones, continue to lose marks in numerical calculations by approximating too early. It then becomes impossible to achieve the 3 significant figure accuracy that is usually required.

There was some evidence, such as in the evaluation of expressions in trigonometry, that a minority of candidates were less than confident in their use of a calculator.

Also, it continues to be disappointing when some candidates lose marks in trigonometry because their calculators are set in the wrong mode. Working in grads, for example, can result in losing at least 3 marks in total in a paper.

Again this year, the standard of plotting and drawing in the graph question in **Section B** was most pleasing. Candidates picked up useful marks for these skills. The question was designed for centimetre graph paper, however, so the few Centres not using this size may have slightly disadvantaged their candidates. One candidate, for example, carefully drew centimetre scales on  $\frac{1}{2}$  inch graph paper. This would take up valuable time.

## Comments on specific questions

### **Section A**

#### **Question 1**

**(a) (i)** The answer here was frequently left as 16.3 instead of the 16 whole litres expected. Other wrong answers involved wrong combinations of 91.8 and 15, such as 13.77 from multiplication.

**(ii)(a)** It was hoped to see  $\frac{4}{91.8} \times 100$  correctly evaluated, and candidates using this method usually did

well. However, a popular starting point was  $\frac{95.8}{91.8} \times 100$ , evaluated as 104 instead of 104.36,

leading to 4% instead of 4.36%. This method had the additional problem for weaker candidates of having to add 91.8 cents and 4 cents. Typical attempts at this addition were 92.2 and 91.84.

**(b)** Again, it was hoped to see  $\frac{19200}{21} \times 4$  cents rounded to the nearest dollar. The rounding in this part of the question was better understood, and candidates using this approach usually did well. However, many candidates chose to work out the total costs for each year and subtract. This

method was unnecessarily long and prone to error. Some misunderstandings were apparent here, such as giving the answer as the total cost for 2007, or working with 19200 instead of  $19200 \div 21$ .

(iii) Many candidates were unaware that this was a reverse percentage requiring  $\frac{100}{90} \times 91.8$ , not 10% or even 110% of 91.8.

(b)(i) Well done.

(ii) Generally well done. A number of candidates did not proceed beyond  $\frac{2}{3}$  of 54 000, for which some credit was given.

Answers: (a)(i) 16 litres, (ii)(a) 4.36%, (b) \$ 37, (iii) 102 cents, (b)(i) 13 500 litres,  
(ii) 4 500 litres.

### Question 2

(a)(i) Reasonably well done, with many candidates preferring to use the sine rule, rather than  $\frac{5}{AB} = \cos 65^\circ$ . One of the wrong answers seen was  $AB = 10$ , usually from a circular argument using the sine rule with angle  $ABC = 65^\circ$ . These candidates had missed the significance of the symmetry.

(ii) The method here was usually correct, using a version of  $\frac{1}{2}ab \sin C$ , although a common wrong method was  $\frac{1}{2} \times 10 \times AB$ . Was this an attempt at  $\frac{1}{2}$  base  $\times$  height, or simply forgetting the  $\sin 65^\circ$ ?

(iii) This was often well done, and candidates were allowed to recover in full after a previous error. Where methods were incomplete, credit was given for using the square of area  $100 \text{ m}^2$ . A common misunderstanding, however, was to use 8 triangles.

(b)(i) A good number of correct responses here. In other cases, credit was given for the answer  $220^\circ$  or when  $90^\circ$  was used in the working.

(ii) Fewer correct responses here. Since the angle required involved  $BC$  produced, the successful candidates were those who supported their work with clear diagrams. Others seemed to guess, either repeating their answer to (i), or giving the answer  $140^\circ$  derived from  $220^\circ$ .

Answers: (a)(i) 11.8, (ii) 53.3 to 53.7, (iii) 313.2 to 314.5, (b)(i)  $140^\circ$ , (ii)  $40^\circ$ .

### Question 3

(a) Candidates usually had the right ideas about dealing with the fractions, but only the more able candidates made the correct adjustment to the 1 to keep their equation accurate and score full marks. Having gained the method mark for clearing the fractional terms, most candidates were able to go on and solve their linear equation, thus gaining useful marks in this question.

(b) A good number of fully correct solutions. Candidates continue to lose marks, however, often after correct work, for false cancelling. Marks were awarded for correctly factorising the numerator and denominator of the given fraction, so that generally, candidates scored quite well here.

(c)(i) A very poor response. Only the most able candidates succeeded here.

To begin earning marks, candidates had to construct the equation  $(10y + x) - (10x + y) = 63$ , and then correctly reduce it to the given  $y - x = 7$ . There were some attempts incorporating  $10x + y = 56$ , and some vague numerical statements, but very few purposeful attempts.

(ii)(a) Again, a very poor response. The mark here depended on constructing  $(10x + y) + (10y + x) = 99$ .

- (b) At this point, many candidates did not seem to realise that the simultaneous equations to be solved were written into the question, thus losing the opportunity to score a possible two marks.

Answers: (a)  $p = -5$ , (b)  $\frac{2}{v+1}$ , (c)(i)  $(10y + x) - (10x + y) = 63$  seen, leading to  $y - x = 7$ ,  
(ii)(a)  $(10x + y) + (10y + x) = 99$  seen, leading to  $x + y = 9$ , (b)  $x = 1, y = 8$ .

#### Question 4

- (a) There were some very well drawn histograms from many Centres.

Common errors were the wrong area for the interval  $160 < h \leq 180$ , and the use of frequencies instead of frequency densities on the vertical scale. However, the marking scheme allowed these candidates to be given some credit.

- (b) A variety of answers were given here, with 10 a popular estimate, so it was clear that many candidates were unsure of the ideas here. The expected answer was 5, but 4 was also accepted.
- (c) Well done, with the instruction to give the answer in its lowest terms well observed.
- (d) A good response from many candidates, with the general ideas of combined events well understood. Common errors included using addition instead of multiplication.

Answers: (a) Histogram, correct column widths, frequency densities 3,4,5,6,4,0.5, (b) 5, (c)  $\frac{1}{8}$ ,  
(d)  $\frac{870}{14280}$  or equivalent.

#### Question 5

- (a)(i) It was essential to mention both **tangent** and **radius** to score this mark. On the whole, the response was disappointing. Candidates usually mentioned *tangent*, but after that, explanations tended to be imprecise.
- (ii) Quite well done.
- (b)(i) Again, quite well done.
- (ii) Poor. Answer often thought to be  $\frac{1}{2}$  of 100.
- (iii) Generally poorly done. The orientation of the triangles led to some use of 20:3 instead of 20:4. Other common errors were to bring in  $CD = 17$ , whereas this was not a side of any triangle, or 21, from  $CD + AE$ .

Answers: (a)(i) An angle between a tangent and a radius (ii)  $140^\circ$ , (b)(i)  $40^\circ$ , (ii)  $60^\circ$ , (iii) 11.

#### Question 6

Candidates usually managed to negotiate their way through most of this question and score a good number of marks.

The weakest candidates avoided the algebra. The very weakest had difficulty in counting the dots in the given diagrams so did not score at all well.

**Parts (a) and (b)** were generally well done, with only a minority of candidates not spotting the pattern of square numbers,  $n^2$ .

- (c)(i) These evaluations were usually correct. After earlier errors, credit was given here for correctly following through.
- (ii) This part seemed to defeat many candidates.

- (iii) There were a pleasing number of candidates who reached the correct answer here using the steps completed in earlier parts of the question, and a number who gained credit here for a logical follow through of their earlier work. It was surprising, however, that a number of candidates who gave no response to **part (c)(ii)**, came up with the correct expression here.

Answers: **(a)(i)** 19, **(ii)** 29, **(b)(i)** 16, **(ii)** 25, **(iii)**  $n^2$ , **(c)(i)** 3,4, **(ii)**  $n - 1$ ,  
**(iii)**  $n^2 + n - 1$ .

## Section B

### Question 7

**(a) (i) and (ii)** These two parts were generally well done.

**(b)** There were a good number of attempts at this part, with a pleasing number of genuine derivations of the given equation. However, many candidates did not progress any further than the first M1 stage, which was awarded for the idea that the difference of the expressions in **part (a)** was  $\frac{1}{2}$  an hour, however expressed, e.g. 30 (mins) being accepted at this stage. This part was often completely omitted by weaker candidates.

**(c)** Candidates obtained good marks here. It was expected that candidates would use the formula for the solution of a quadratic equation. Many did so successfully, although there are still candidates who lose marks for using such as  $\frac{-b\sqrt{b^2 - 4ac}}{2a}$  or  $-b \pm \frac{\sqrt{b^2 - 4ac}}{2a}$ . Before marks can be awarded, the basic shape  $\frac{p \pm \sqrt{q}}{r}$  must be clear. At this stage of the question, both roots were required in order to obtain full marks. A minority of candidates gave the positive root only. Some candidates obtained successful solutions by factorisation.

**(d)(i)** Well done. Candidates knew how to use the positive root they had calculated.

**(ii)** A good number of candidates succeeded here, full credit being given for correct work using the time calculated in **part (d)(i)**. However, many candidates simply worked out the average of the speeds of the two flights.

Answers: **(a)(i)**  $\frac{1080}{x}$ , **(ii)**  $\frac{1080}{x+30}$ , **(b)** The given equation correctly obtained, **(c)** 240 and -270, **(d)(i)** 4.5, **(ii)** 254.

### Question 8

Using standard procedures in trigonometry is an obvious strength of many candidates, who scored well in this question.

**(a) (i)** A number of correct solutions, but by no means obvious to many candidates. On the whole, this part was poorly done.  $75^\circ$  and  $105^\circ$  were common wrong answers.

**(ii)** Candidates realised that the cosine rule was appropriate here, and many applied it accurately, leading to the square root of 402.6.

Some marks were lost, however, for inaccuracies such as a final answer of 20, or confusion with -ve signs leading to the square root of 247.35. There are still a number of candidates who evaluate  $a^2 + b^2 - 2ab$  separately, leading in this case to  $25\cos 105^\circ$  and losing 3 marks in the process.

There were a number of interesting solutions using an alternative method based on right-angled triangles.

**(b)** Again, the correct rule was spotted, the sine rule, and generally used accurately. However, in a surprising number of solutions, a correct expression for  $\sin \hat{A}DB$  was incorrectly evaluated.

**(c)(i)** Candidates saw that Pythagoras could be applied here, and many worked to a successful conclusion.

**(ii)** A pleasing number of correct solutions.

Answers: **(a)(i)**  $15^\circ$ , **(ii)** 20.1 **(b)**  $28.9^\circ$ , **(c)(i)** 10.2, **(ii)**  $33.7^\circ$ .

### Question 9

This was probably the least popular question in this section. Most candidates who attempted it scored very few marks, gaining little beyond **parts (a)(i) and (ii)**.

**(a)(i)** Reasonably well done. Weaker candidates seemed to realise that  $\pi r^2$  was relevant, but failed to realise that the difference of two terms was required, and hence did not score any marks. The use of  $r = 20, 30$  or  $40$  was seen in attempts to express the area of cross – section in a single term.

**(ii)** Again reasonably well done. The formula for the volume of a cylinder is well known. Establishing the units asked for in the question challenged a good number of candidates, however.

**(iii)** Poorly done. Candidates often did not seem to see any link between this part and the previous two parts.

**(b)(i)** There were good attempts at this from more able candidates, but on the whole, very few convincing demonstrations were seen. It was hoped to see the circumference of the base of the cone (or its curved surface area) linked to the arc length of the sector (or the area of the sector). Thus  $\theta$  could be calculated, or  $210$  could be used to confirm results. Both approaches were seen, but not in any great number.

**(ii)** Very few candidates scored in this part of the question. It was hoped that candidates would find  $3\cos 75^\circ$  and then the smallest whole number bigger than  $3\cos 75^\circ + 3$ . However, the link with the trigonometry of the right angle triangle remained undiscovered by most candidates who attempted this question.

Answers: **(a)(i)**  $2510 \text{ cm}^2$ , **(ii)**  $0.503 \text{ m}^3$ , **(iii)**  $1.68 \text{ mm}$ , **(b)(i)**  $2\pi \frac{3.5}{2}$  and  $\frac{\theta}{360} \times 2\pi 3$  (or

equivalents) seen and used to find or confirm  $\theta = 210$ , **(ii)** 4.

### Question 10

**(a)** This part was generally well done. The vast majority of candidates used the scales given. Plots were accurate, and curves neatly drawn.

**(b)** Care was needed on the time scale in locating 2.75. This part was usually well done.

**(c)(i)** When attempted, the correct tangent was usually well drawn, and there was a fair degree of success getting the value of the gradient within an acceptable range. The method mark here is dependent on an attempt at evaluating  $\frac{\Delta y}{\Delta x}$ , as well as drawing the tangent, so it is important to show all the numerical working at this point in order to gain the mark.

**(ii)** Not well done. The idea of **rate** of change was usually missing from the explanations given. Most candidates who attempted this part seemed to concentrate solely on the idea of the **number** of bacteria present at this particular time. This part of the question was often omitted.

**(d)(i)** A lot of correct, straight lines. Some were freehand, joining several plotted points. Perhaps these candidates did not recognise that the given equation would be represented by a straight line. In graph questions, it is expected that straight lines will be ruled.

**(ii)** Again, care was needed in reading the time axis. A lot of candidates lost this mark, reading 3.05 as 3.1, an error of more than  $\frac{1}{2}$  a square for the scale given. Where either one or both graphs had been drawn incorrectly, credit was given for stating the  $x$  value of their point of intersection.

**(e) (i) and (ii)** A pleasing number of correct responses here, mostly restricted to the better candidates.

Answers: **(a)** All points plotted and a smooth curve drawn, **(b)** 2200 to 2400, **(c)(i)** 1800 to 2800, **(ii)** Rate of change of the number of bacteria per hour, **(d)(i)** Correct, ruled straight line, cutting the curve, **(ii)** 3.025 to 3.075, **(e)(i)** 50, **(ii)** 4.

### Question 11

**(a)(i)(a)** A fair degree of success here. Clearly the notation confused some candidates.

**(b)** Quite well done.

**(ii)** Again, reasonably well done. Candidates were given credit for methods using  $\overrightarrow{QT} = \begin{pmatrix} 2 \\ 7 \end{pmatrix}$ .

**(iii)** This proved to be a difficult part. Where candidates were unsuccessful, credit was given when a candidate showed that they understood that  $\overrightarrow{RS} = \overrightarrow{QP}$ .

**(b)(i)** The base and/or the height of this triangle seemed to be easily misjudged, with answers such as 3 or  $4\frac{1}{2}$  quite common.

**(ii)(a)** Poor. Very few attempts, but some correct answers.

**(b)** Again poor. 4 times **(b)(i)** was a popular misconception.

**(iii)(a)** Some correct answers, with quite a number of candidates picking up the consolation mark for realising that the  $y$  coordinate must be 1. (7,1) was the popular choice here.

**(b)** Most candidates who got this far realised that the area of this triangle was the same as the area of the triangle in **part (b)(i)**, thus gaining the follow through mark.

Answers: **(a)(i)(a)** 37, **(b)**  $\begin{pmatrix} 16 \\ -21 \end{pmatrix}$ , **(ii)**  $\begin{pmatrix} 14 \\ -28 \end{pmatrix}$ , **(iii)** (-6,51) **(b)(i)** 2, **(ii)(a)** (-2,3),  
**(b)** 32, **(iii)(a)** (3,1), **(b)** 2.