

# MATHEMATICS D

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Paper 4024/01

Paper 1

## General comments

The overall level of difficulty of the paper compared very closely with that of last year, although there were perhaps fewer parts that provided real tests for the most able candidates. Weak candidates seemed able to find some parts that they could attempt.

Questions which gave the most difficulty were **9(a)**, **(b)(ii)**, **11(a)**, **12(a)**, **13**, **15**, **17(a)(ii)**, **(b)(ii)**, **18(a)**, **19(a)**, **22(a)** and **23(b)**.

Almost all candidates were able to gain marks in **Questions 1(b)**, **2(b)**, **6(a)**, **7** (first rectangle), **14** and **24(a)**. In addition, many were also able to gain marks from among **Questions 2(a)**, **3**, **4(a)**, **10(a)**, **12(b)**, **20(c)**, **21(a)**, **23(a)** and **25(b)**.

Candidates should be urged to read questions carefully, not to miscopy numbers and to take care with basic arithmetical processes.

Presentation of the work was, for the most part, good. However, 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 were a small number of scripts that 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. A small minority of candidates wrote all their workings in the margins instead of the working space provided with each question. Too often calculations were written all over the working space in no logical fashion and with no indication as to which part of the question was being answered.

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, instead of overwriting the original one, it is far better to delete the original and to write the new answer next to it.

Candidates seemed to use their time sensibly, and only very occasionally was the impression gained that they were struggling to finish in the allotted time. Blank pages at the end seemed to come from weak candidates who failed to give answers to other questions too. A substantial number of candidates seemed unprepared for the paper in terms of level of knowledge and understanding.

## Comments on specific questions

### Question 1

(a) This was often answered correctly, though some found it difficult to progress with the simplification

beyond  $\frac{22\frac{1}{2}}{100}$  or  $\frac{45}{200}$ . Others gave the answer 0.225, or  $\frac{45}{2}$ , or  $\frac{0.9}{4}$ , or  $\frac{9}{20}$ .

(b) This was well answered. Occasionally the decimal point was incorrectly positioned.

Answer: (a)  $\frac{9}{40}$  (b) 0.018

## Question 2

- (a) This was well done. Those who noticed that  $2\frac{2}{3} = 2\frac{6}{9}$  usually went on to obtain the correct answer. Those who started with  $\frac{32}{9} - \frac{8}{3}$ , unfortunately sometimes continued with  $\frac{32-8}{9-3}$ . Some left the answer as  $\frac{24}{27}$ , or as  $1\frac{-1}{9}$ .
- (b) This was usually well done, though a few used  $\frac{3}{8} \times \frac{9}{4}$  or evaluated  $\frac{2}{12}$  as 6.

Answer: (a)  $\frac{8}{9}$  (b)  $\frac{1}{6}$

## Question 3

- (a) Provided the units were handled correctly, the correct answer was usually obtained. The most common error was to assume that there are 100 grams in a kilogram and thus obtain the answer 9.9 kg.
- (b) This part was generally well done. Most errors involved the evaluation of  $(-1)^3$  and  $3^{-1}$  as  $-3$ , or  $3^0$  as 0. Only a very small number of candidates did not heed the word "smallest" in the answer space.

Answer: (a) 4.32 kg (b)  $(-1)^3, 3^{-1}, 3^0, 3^1$

## Question 4

- (a) Those who recognised that they needed to use the angle in a semicircle usually answered this part correctly. Common incorrect answers were  $34^\circ$ ;  $73^\circ$ ;  $146^\circ$ .
- (b) Many recognised that  $\angle TAC$  is  $90^\circ$  and used Pythagoras' theorem to obtain  $CA$ . A few of those who used the theorem correctly recorded their answer to the question as 4 cm or as 8 cm. Some, however, used  $CA = \sqrt{5^2 + 3^2}$ , or else calculated  $25 - 9$  as 14, or as 6.

Answer: (a)  $56^\circ$  (b) 2 cm

## Question 5

- (a) Many answered this part correctly. Those who did not usually evaluated  $300 \times 0.8$ . Quite a few wrote down  $\frac{300}{0.8}$  and either stopped, or made an error in the evaluation. The answer 37.5 was seen quite frequently.
- (b) Although the method was understood by most candidates, the answer was too often spoilt either by failing to convert the 18 months to years, thus obtaining 324, or by inaccurate arithmetic.

Answer: (a) 375 (b) \$27

### Question 6

- (a) This part was usually answered correctly. The usual error was to use  $-(-9) = -9$ .
- (b) There were some correct attempts at this question, but some of these made careless slips, such as going from  $2x = 3 - y$  to  $y = 2x - 3$ , or else gave an expression in terms of  $y$  instead of  $x$ . Weak candidates gave  $\frac{2}{3-x}$ , or else substituted  $-1$  for  $x$ .

Answer: (a) 6 (b)  $3 - 2x$

### Question 7

The first rectangle was nearly always drawn correctly. Some candidates also drew the second one correctly, but many had an incorrect height of 15. A few candidates drew the second rectangle on a base from 5 to 6.

Answer: rectangle from 4 to 5, height 20 ; rectangle from 5 to 8, height 5

### Question 8

- (a) There was a mixed response to this part. Some had difficulty in finding the equations of the lines  $AB$  and  $AC$ . Most who obtained the correct equations went on to give the correct inequalities, but some gave equations and a smaller number reversed one or both inequalities. Weak candidates offered an inequality, such as  $x + y < 2\frac{1}{2}$ , or  $x > 1$ .
- (b) This was often answered correctly, though some included the points on the lines  $AB$  and  $AC$ . Others gave the answer 5.

Answer: (a)  $y > 1, y < 2x$  (b) 3

### Question 9

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

- (a) Many candidates did not attempt this part sensibly, and only the most able could answer it correctly. Some seemed to recognise that the answer involved the intersection of sets  $B$  and  $C$ , and the complement of set  $A$ , but often gave an answer that included a union.
- (b) Some attempted to draw an appropriate Venn diagram, but with mixed success. A few did not seem to know that  $n(P)$  denotes the number of elements in set  $P$ . Common answers were: (i) 45, 38; (ii) 2, or 33 from  $40 - n(P \cap Q)$ .

Answer: (a)  $B \cap C \cap A'$  (b)(i) 31 (ii) 9

### Question 10

There were many correct attempts to part (a) and to part (b). Answers were often correct, but sometimes spoiled by a simple arithmetic error.

Part (c) was sometimes answered correctly, but usually from basics rather than realising that, from part (b),  $\mathbf{A}^{-1}$  must be a multiple of  $\mathbf{B}$ . Valid methods were sometimes spoiled by the use of  $\det \mathbf{A} = -3$  or  $\det \mathbf{A} = 7$ .

Answer: (a)  $\begin{pmatrix} 8 & -3 \\ 9 & -4 \end{pmatrix}$  (b)  $\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$  (c)  $\begin{pmatrix} 0 & \frac{1}{3} \\ -1 & 1\frac{1}{3} \end{pmatrix}$

### Question 11

- (a) "Limits of accuracy" seems to be a topic that is not well understood by most candidates. There was a variety of incorrect answers, the commonest involving 5.3 and 5.5; 4.9 and 5.9; 0.4 and 10.4; 80 and 90; 84.5 and 85.5.
- (b) Some candidates seemed to know how to attempt this part. Many, however, seemed to have no idea, or else merely calculated  $85 + 20 \times 5.4$ , and then gave the answer 194.5. Others calculated  $20 \times$ (their 5.35) only, or  $20 \times$  (their 82.5) or else evaluated  $20 \times 5.35$  as 1070.

Answer: (a) 5.35 5.45, 82.5 87.5 (b) 189.5 g

### Question 12

- (a) Most did not realise that, with a square relationship, multiplying the independent variable by 2 results in multiplying the dependent variable by  $2^2$  (i.e. 4). The usual wrong answer was 60 newtons, though 900, 30 and  $30\sqrt{2}$  were also quite common.
- (b) Most who attempted this routine question knew what they were doing and obtained the correct answer. A few, however, did not notice that the question involved inverse proportion, and obtained the answer 4.5, or else misread the question and gave  $y$  inversely proportional to the square, cube or cube root of  $x$ .

Answer: (a) 120 newtons (b) 8

### Question 13

Many candidates did not answer this question correctly, but could make a reasonable attempt. Most assumed that the depth, and not the volume, of the water increased at a constant rate, and did not compare the volumes of the cylinders. A few were inconsistent in their understanding of the depth of water when the container was full.

Some reasoned, incorrectly, that since the radii were in the ratio 1:2 and the heights in the ratio 2:1 then, overall, the ratio was 1:1.

Of those who did compare volumes, a common error was to use  $(2r)^2 = 2r^2$  and hence a belief that the two cylinders were of equal volume.

- (a) Not many candidates obtained the correct answer. An answer of 8 minutes, or of 6 minutes, was quite common and, occasionally, 9.6 minutes.
- (b) It was pleasing to see that most graphs started at (0,0) and finished at (12, 3h). However, some graphs did not use the value found in part (a), or else contained a curve.

Answer: (a) 4 minutes (b) straight line from (0,0) to (4, 2h); straight line from (4, 2h) to (12, 3h)

### Question 14

- (a) This part was well answered by the majority, though a few went from  $24 = x - 4$  to  $x = 20$ , or to  $x = 6$ .
- (b) Those who removed the brackets correctly were usually successful. The most common errors were to simplify the left-hand side of the equation to  $50 - 10y$  from  $10(5 - y)$ , or to  $2 - 2y$  from  $12 - 10 - 2y$  or else to go from  $2 = 3y$  to  $y = \frac{3}{2}$  or to  $y = 6$  or to  $y = 1$ .

Answer: (a)  $x = 28$  (b)  $y = \frac{2}{3}$

### Question 15

The response to this question was disappointing. Many candidates did not make any attempt, or else just wrote down a few spurious values. Only a few candidates seemed to grasp fully what was involved, and were able to produce a table of correct values that led to the correct answers. A few came close, but used length plus width equals 39 m instead of length plus twice the width. Very few did not realise that width and length values had to be whole numbers because the fence panels were each 1 metre long.

Answer: Length = 19 m; Area = 190 m<sup>2</sup>

### Question 16

The majority knew how to set about solving the simultaneous equations. However, solutions were sometimes spoilt by a failure to multiply all of the terms in an equation by a constant, or by sign errors, or by poor arithmetic, or by carelessness.

Answer:  $x = 7$ ;  $y = -2$

### Question 17

(a) Many coped fairly well with this part, though not all obeyed the instruction to express answers in standard form, and so forfeited the mark(s). Common wrong answers were

in part (i)  $\frac{1}{20}$ ,  $\frac{1}{2} \times 10^{-1}$ ;  $0.5 \times 10^{-3}$

in part (ii) 200,  $8 \times 10^2$ ,  $2 \times 10^3$ ,  $2 \times 10^6$

(b)(i) Many attempted this part, sometimes successfully, by the 'factor ladder'. The best solutions combined the factors of 10 with the given factors of 225, though some of these went on to give the answer  $3^2 \times 5^2 \times 10$ .

(ii) As 225 had been given in the form  $3^2 \times 5^2$ , it can be seen that extra factors  $2^2 \times 3$  converted 225 to  $2^2 \times 3^3 \times 5^2$ , which is a multiple of 540.

Many could not interpret the question in this way and did much unnecessary work, not all of which was relevant or successful. Some merely divided 540 by 225 giving the answer 2.4, or else gave an answer of 2.

Answer: (a)(i)  $5 \times 10^{-2}$  (ii)  $2 \times 10^2$  (b)(i)  $2 \times 3^2 \times 5^3$  (ii)  $n = 12$

### Question 18

The response to this question was disappointing. The properties of the angles of polygons were not as well known as had been anticipated.

(a) Although there were some correct answers, surprisingly few divided the exterior angle of  $15^\circ$  into  $360^\circ$  to find the number of sides. When using the formula for the angle sum of a polygon,  $165$  was frequently used in place of  $165n$ , leading to an impossible answer.

(b) This part was less well done. Some attempts started with  $\frac{360}{12}$  (but not always evaluated correctly), and then either added the exterior  $15^\circ$  angle of polygon  $ABCD$ , or used a calculated  $\angle ABP$  and the property that the angles at a point add up to  $360^\circ$ . Other attempts assumed that  $\angle ABP = 165^\circ$  and obtained the answer  $30^\circ$ . Occasionally  $360 - 165 - 150$  was evaluated as 35 or as 55.

Answer: (a) 24 (b) 45

### Question 19

(a) Many candidates seemed unaware of the technique of estimation, and to realise that to obtain an answer correct to one significant figure it is usually only necessary to work to two significant figures. Some good attempts were seen. Of these, most realised that the numerator was approximately  $16 \times 30$ . Finding an approximation to  $\sqrt{150}$  troubled most candidates, with values such as 14 (from  $\sqrt{200}$ , or from  $\sqrt{3} \times \sqrt{50} = 2 \times 7$ ), 10 (from  $\sqrt{100}$ ),  $5\sqrt{6}$ . Those who used the expected value of 12 usually went on to find the correct answer. Errors included writing  $4^2$  as 8, 29.88 as 3 to 1 significant figure and similarly 4 from a correctly estimated answer of 40.

(b) Attempts at this part were very varied. Though most knew how to convert from metres to kilometres few could convert from seconds to hours correctly: 12 seconds being  $\frac{12}{60}$  or  $12 \times 60$  or  $12 \times 60 \times 60$  hours were very common incorrect conversions. Others seemed to have little idea of “average speed”.  $8\frac{1}{3}$  was a common wrong answer.

The best solutions either used  $\frac{100}{12} \times \frac{60 \times 60}{1000}$  or noticed that Sam ran 500 metres in 1 minute.

Answer: (a) 40 (b) 30 km/h

### Question 20

There were many reasonable to good attempts at this question, and most candidates earned something. Many candidates could handle the more familiar part (c) better than the first two parts.

Common errors were, in (a), not to extract the full  $3a^2$ ; in (b), not to recognise that it was a “difference of squares”,  $1^2 - (4b)^2$ , or to give  $(1 - 16b)(1 + 16b)$ , or to give  $(1 - 4b)(1 - 4b)$ ; in (c), to give a partially factorised answer, such as  $3c(2x - y) - d(2x - y)$ , or to make a sign error, such as  $3c(2x - y) - d(2x + y)$ , sometimes then going on to give  $(3c - d)(2x + y)(2x - y)$ .

Answer: (a)  $3a^2(5 + 4a)$  (b)  $(1 - 4b)(1 + 4b)$  (c)  $(3c - d)(2x - y)$

### Question 21

Some candidates did not attempt this question. Of those who did make an attempt, many gave correct answers to most, if not all, parts. It was pleasing to note that candidates expressed their answers as a number, although a tiny minority did state “impossible” in part (b)(ii). It was a little surprising to note how many candidates were happy to give probability values in excess of 1 and, in part (b), the number of candidates who failed to realise that the probabilities in the branches had to be multiplied to give the probability of the appropriate combined event. There was a wide variety of wrong answers to all parts.

The most frequent wrong answer was in part (b)(iii) where candidates did not consider the two possibilities of blue-red and red-blue, and just gave the answer  $\frac{1}{20}$ .

Answer: (a)  $h = \frac{1}{4}$  (b)(i)  $\frac{3}{10}$  (ii) 0 (iii)  $\frac{1}{10}$

### Question 22

(a) Few candidates seemed to know that the area under a speed-time graph is a measure of distance travelled. Even fewer could negotiate all the steps involved to obtain the final correct answer. Some did not read the speed of 12 m/s correctly; others subtracted the distance covered in the first 30 seconds from the given 300 m, but then did not divide this value by 12. Others gave this result as their final answer, forgetting to add the 30 s.

The majority of attempts were incorrect – finding  $\frac{300}{12}$ ; or finding  $\frac{300}{10}$ ; or using uniform rate reasoning such as 180 m takes 30 s, therefore 300 m takes  $\frac{300 \times 30}{180} = 50$  s; or using distance travelled in the first 30 s is 360 m, therefore the time taken to travel 300 m is 25 s. A few, inappropriately, tried to use constant acceleration formulae.

- (b) Some drew a reasonable tangent, with a ruled straight line, touching the curve at the correct point. Others drew a good tangent, but at the wrong point – typically at  $t = 57$  or so, or at  $t = 60$ . Only a very few tried to get away with a freehand line.

Those who drew a reasonable tangent usually went on to calculate the gradient correctly as a single number (decimal or fraction). A few, however, overlooked the fact that the axes had different scales, or made a careless arithmetic slip, like  $10.5 - 12.5 = 2.5$ , or calculated (horizontal step)/(vertical step).

Because the question asked for the retardation of the cyclist, a positive value was expected. Candidates who expressed this positive retardation as an equivalent negative acceleration were not penalised.

Many candidates did not seem to realise that, when finding the gradient of a line, it is best to use a horizontal step, such as 10 or 20, that is easy to divide by.

The most common error was to calculate the gradient of the line joining (0,0) to (55,11.5).

Answer: (a) 40 seconds (b) 0.12 to 0.24 (+ or –)

### Question 23

- (a) Almost all candidates answered this part correctly. Some gave  $12^\circ\text{C}$  and a small minority did not offer an answer.
- (b) There was a varied response to the questions in this part, and only very strong candidates obtained a full set of correct answers. The working here was often very muddled and difficult to follow.

A very common error in part (i) was to reason as follows:

the temp. at 3000 is  $-4^\circ\text{C}$ , therefore the temp. at 1800 m is  $-4 \times \frac{1800}{3000} = -2.4^\circ\text{C}$ .

Candidates who reasoned like this usually tried to do the same in part (ii), obtaining answers, such as 0 m, that must have confused.

In part (iii) only a small number were able to identify correctly the drop in temperature in terms of  $x$ , and most of those failed to subtract it from 16. The most common wrong answer was  $\frac{x}{750}$ .

Answer: (a)  $20^\circ\text{C}$  (b)(i)  $4^\circ\text{C}$  (ii) 2400 m (iii)  $16 - \frac{x}{150}$

### Question 24

- (a) This part was usually answered correctly.
- (b) Some candidates gave correct expressions for  $x$  and  $y$ , but very few could give a correct expression for  $z$ , with  $n \times n - 1$  coming close. Algebraic answers were often in the form  $n + (\text{a constant})$ . Some gave a set of numbers, such as the sum of the first four columns. Others did not attempt this part.

Answer: (a) (4), 8, 16, 12 (b)  $x = 2n$ ;  $y = n^2$ ;  $z = n^2 - n$

### Question 25

- (a) Most seemed to measure  $\angle ACB$  correctly, but many of these did not to know what a reflex angle is, and offered the value of  $\angle ACB$ , or the value of  $180^\circ - \angle ACB$ . Arithmetic slips, like  $360 - 66 = 284$ , were not uncommon.
- (b) The triangle  $ACD$  was usually constructed reasonably accurately, but not all candidates showed both construction arcs clearly. Some candidates constructed  $D$ , incorrectly, on the same side of  $AC$  as  $B$ .
- (c) Better candidates knew which loci were required and drew them accurately. Most, however, found this part difficult, particularly in understanding the locus of points which were 5 cm from  $AB$ . A few, in attempting to draw the perpendicular bisector of  $AC$ , were sometimes careless in joining the intersections of the correct pairs of arcs, or else the arcs touched each other at the midpoint of  $AC$ .
- (d) Candidates who drew the two loci correctly, usually went on to mark  $P$  at the intersection of the loci, and to give an acceptable answer for the length of  $CP$ .

Answer: (a)  $293^\circ$  to  $295^\circ$  (b) completed  $\triangle ACD$

(c)(i) perp. bisector of  $AC$  (ii) line parallel to  $AB$ , 5 cm above  $AB$  (d) 6.3 to 6.7 cm

# MATHEMATICS D

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Paper 4024/02

Paper 2

## General comments

Scripts were seen covering a wide range of the marks available. Many were extremely well presented, particularly those in the upper mark range. Standards vary from those who have a strong grasp of all aspects of the syllabus, to those who are ill equipped to succeed at this level.

The majority of candidates show their working, and in particular, there was a positive response to the request that all working should be shown in part **(a)(ii)** of **Question 7**.

In **Section A**, candidates gained good marks in trigonometry and in the numerical aspects of other questions. There were instances when candidates accepted unreasonable answers, however, so perhaps these marks would have been improved by a more disciplined approach in the use of the calculator, where answers could be checked against an estimate of what to expect. The algebraic manipulation and the work on the inequality in **Question 2** proved more troublesome, as did the geometrical reasoning required in **Question 3**.

In **Section B**, the graphical questions proved popular, with candidates gaining good marks for plotting and drawing. One part of **Question 8**, however, where the graph had to be interpreted, proved difficult. In **Question 10**, many candidates who knew the formula for the calculation of the mean showed that they did not understand what this formula represents.

## Comments on specific questions

### **Section A**

#### **Question 1**

It was expected that candidates would use the trigonometry of the right angled triangle throughout parts **(a)** and **(b)(ii)** of this question, using the ratios suggested by the diagrams. Many candidates did so successfully. There were many, however, who embarked on Pythagoras unnecessarily, and others who used methods more appropriate for general triangles, making their methods long winded and creating more opportunities for error.

On the whole, candidates scored reasonably well on this question.

- (a)** Candidates were expected to work to 3 sig. fig. accuracy, so the answer  $71.9^\circ$  was not accepted. A common error led to the answer  $18^\circ$ .
- (b)(i)** Although most candidates knew that distance divided by speed was required, there was considerable doubt about the units of the time obtained. Credit was given at this stage for appreciating that it was a time of 0.15 hours or 9 minutes. Where other times were offered, credit was given for a final correct follow through addition using 22 56.

- (ii) Here, candidates were expected to identify clearly which angles they were evaluating before any credit was given. Method and accuracy marks were available for the angle at  $R$  or the angle at  $S$ . But if for example  $x$  was used for one of these angles, followed by a bearing of  $360 - x$ , then it was impossible to decide which angle had been represented by  $x$ . It was clear that many candidates were uneasy with the concept of bearing.

Answers: (a)  $72.0^\circ$ , (b)(i) 23 05, (ii)  $114^\circ$ .

### Question 2

- (a)(i) This was generally well understood. A common error seemed to be to forget to take the square root. Whatever the final answer, credit was given when it was seen to have been corrected to 2 decimal places. It was essential that candidates continued to work with sufficient figures in the steps leading up to this point. Occasionally, there appeared to be some confusion between 2 decimal places and 2 significant figures.
- (ii) Equivalent forms of the final answer were accepted, and candidates were not penalised for omitting  $\pm$ . Many candidates failing to reach the final answer obtained method marks, but candidates who attempted to square before rearranging made little progress in this part of the question. Weaker candidates continued to work numerically at this stage.
- (b)(i) Equivalent forms of  $8x - 27$  were accepted. Where candidates had difficulty in arriving at this expression, some credit was given if it was clear that  $5x$  was involved. A common error was to interpret "9 more pens than pencils" as  $9 + x$ . A number of candidates introduced the variable  $y$ , but generally failed to resolve this satisfactorily.
- (ii) Some good solutions were seen, but generally candidates found this difficult. However, credit was given for using a strictly less than inequality in their expression in  $x$ .
- (iii) The need to round down their previous answer to the next whole number was not always appreciated, but credit was given when this was done.

Answers: (a)(i) 2.71, (ii)  $\pm\sqrt{x^2 - 2ax}$ , (b)(i)  $8x - 27$ , (ii)  $8x - 27 < 300$ ,  $x < 40.875$ , (iii) 40.

### Question 3

Candidates scored well in the numerical parts of this question. Convincing demonstrations of the similarity of the triangles were less frequent, however.

- (a)(i) This was well answered.
- (ii) This was generally good. Wrong answers seen included  $124^\circ$  and  $62^\circ$  (MR did not bisect angle QMN).
- (b)(i) Many candidates scored at least one mark here for correctly stating that angle  $WXV = \text{angle} YXZ$  or angle  $VWX = \text{angle} XZY$ . Full marks were available, however, only when this step was justified by stating vertically opposite angles or that the lines  $WV$  and  $YZ$  were parallel, as appropriate. All three pairs of equal angles stated, with one of the above justifications for the appropriate pair of angles, was accepted as a complete solution. Two pairs of equal angles stated, again with one of the above justifications, was accepted as a complete solution provided that the conclusion that therefore the given triangles were similar was included. Some candidates attempted solutions based on the ratios of sides, using trigonometry and Pythagoras to calculate lengths in order to show the ratio 1:4. Some of these, however, assumed that the triangles were already similar and so were invalid. At some stage, this ratio method still needed the equal angles given above to be stated and justified.
- (ii) This was well done, usually in the expected way. Candidates who used trigonometry here were not penalised provided that they realised that their final answer had to be exactly 100.

Answers: (a)(i)  $56^\circ$ , (ii)  $68^\circ$ , (b)(i) See above (ii) 100 m.

#### Question 4

This was generally well understood, with candidates of all abilities able to pick up marks at all stages of the question.

- (a) Some candidates went on to evaluate  $\$336 - \$13.44$  and seemed to think that this is what was meant by “total discount”.
- (b) The common error here was to use 35 instead of 28 in the denominator.
- (c) Weaker candidates were still using data from part (a) at this stage.
- (d) Although still a difficult concept, there seemed to be a significant improvement in reverse percentages in some Centres.

Answers: (a) \$13.44, (b) 25%, (c) 5%, (d) \$4.

#### Question 5

Good marks were scored here, with candidates generally able to recognise and apply the relevant trigonometrical formulae for general triangles. Weaker candidates used “Pythagoras” to find  $AD$ , and  $\frac{1}{2}$  base $\times$ “height” for the area.

- (a)(i) The correct form of the cosine rule was generally seen. Some candidates apparently replaced 112 by its supplement without adjusting the sign, reaching  $AD = 23.3$ .
  - (ii) Again, the sine rule generally was recognised and applied successfully. Some candidates mixed up the data from the two triangles shown on the diagram. Weaker candidates tried to use the trigonometry of the right-angled triangle, and others merely added or subtracted angles and sides.
  - (iii) Again, in many cases this was well done using the sine formula. A common wrong answer was 192.
- (b) Care was needed here to convert to exactly 60 km. Perhaps this was the least well done part of the whole question. Some candidates seemed quite happy to accept completely unrealistic answers. A number of answers merely used the figures 24.

Answers: (a)(i) 33.5 cm, (ii)  $47.9^\circ$ , (iii)  $178 \text{ cm}^2$ , (b) 60.

#### Question 6

- (a)(i) Many candidates gained this mark, although there was a wide selection of answers, ranging from 2 or 3 to infinity. Explanations in support of the answer 6 showed that this idea was not well understood. In particular the word “order” seemed to cause confusion.
  - (ii) This was generally well done. There was not too much diameter/radius confusion, but weaker candidates struggled to find the radius of the larger circle, and some thought the area formula was  $2\pi r^2$ .
- (b) It was expected that this would follow on from the previous part with the subtraction of the areas of 7 small circles, followed by division by 6. Many candidates managed this. Common errors were to subtract only 5 or 6, however, even though 7 was stated in the question, or to omit the final division by 6.

A number of very good candidates ignored the structure of the question, using the result of part (b)(i) at this stage to work out the shaded area using the sectors of the large and small circles. Although successful, some of these solutions were long and complicated, and clearly time consuming.

- (b)(i)** The value of this angle was seen by many candidates. Sometimes it was calculated correctly. If calculations went wrong, or an incorrect value was stated, subsequent method marks were awarded if used correctly.
- (ii)** Method marks were available for identifying the components of the required perimeter, such as the lengths of the arcs of the large and small sectors and the small semicircles, and these were obtained by a good number of candidates. A common error was to combine them incorrectly, often addition and subtraction being confused. Weaker candidates continued to use area formulae at this stage.

Answers: **(a)(i)** 6, **(ii)(a)** 707 cm<sup>2</sup>, **(b)** 26.2 cm<sup>2</sup>, **(b)(i)** 60°, **(ii)** 54.2 cm.

## Section B

### Question 7

- (a)(i)** This was generally well done.
- (ii)** Candidates followed the instruction to show all their working. It was expected to see all the numbers necessary to make the decision, such as 40, 35 and 36 cents per litre. A variety of valid methods were seen. In some cases, after correct work, candidates chose the most expensive bag. Candidates were not given any credit if their decision was made with insufficient evidence shown, for example if only the 25 and 75 litre bags were compared.
- (b)(i)** This was generally well done, although a significant number of candidates did not seem to realise that “base area” meant the area of a circle. Some candidates were unsure how to convert to litres. Some forgot to do so, but gained credit if they adjusted at the next stage.
- (ii)** Again this was quite well done, although some candidates failed to round their answer down. Weaker candidates divided by 75 at this stage.
- (iii)** It was expected that candidates would use the ratio of the volumes of the similar figures to find 8 times as many smaller pots as larger pots. There were some good solutions using this method. A common error was simply to double the number of large pots, however. Some candidates preferred to calculate the volume of the smaller pot. This long method was rarely completely successful, but candidates were given credit if the dimensions used were consistent with the similarity.

Answers: **(a)(i)** 25, **(ii)** 25 litre bag, **(b)(i)** 2.20, **(ii)** 34, **(iii)** 272.

### Question 8

- (a)** This was often well done. Candidates in some Centres had difficulty in adapting the usual formula to the expression as given, however. Candidates who rearranged the expression incorrectly, but went on to factorise or use the formula, were given some credit. Errors in this part of the question did not seem to affect later work.
- (b)(i)** Plotting and drawing were generally very good.
- (ii)** Wrong answers in **(a)** were usually ignored here, with the curve completed as expected. This part of the question was often not attempted.
- (iii)** Candidates usually realised that this could be calculated. A tolerance of  $\pm 0.5$  was accepted from use of the graph.
- (iv)** This was very poorly done. Not many candidates appreciated that readings were required at  $y = 30$ . If attempted at all, a value using  $y = 6$  was usually given, or 48, the value of  $y$  at  $x = 6$ .

**(c)(i)** A common mistake here was to expand  $(x-5)^2$  as  $x^2 - 5^2$ , thus leaving  $p$  as an expression in  $x$ .

**(ii) (a) and (b)** A number of correct answers were seen. Although this part of the question was independent of the graph, the graph probably helped some candidates to reach these answers. A number of attempts at the greatest height were just off the exact value required.

Answers: **(a)** 12 or  $-2$ , **(b)(i)** plotting all six points correctly and joining with a smooth curve, **(ii)** curve drawn to  $(12,0)$ , **(iii)** 45 m, **(iv)** 8.5 to 8.9 m, **(c)(i)** 49, **(ii)(a)** 49 m, **(b)** 5 m.

### Question 9

Many candidates seemed to understand the basic ideas of vectors, although more care was required over signs. Also, many candidates were familiar with the relevant geometrical results, even if there was some difficulty in describing them fully.

**(a)** This was well answered, and almost always written as a proper column vector. A common mistake was to omit  $\overline{OR}$ , leading to the answer  $\begin{pmatrix} -1 \\ -2 \end{pmatrix}$ .

**(b)(i) (a)** The answer **b** was a common error.

**(b)** This was often correct.

**(c) and (d)** These often contained  $kb$  because of following through, for which credit was given. Equally, some candidates recovered at this point and arrived at the correct answers.

**(ii)(a)** Many candidates guessed that the quadrilateral was a trapezium, with  $BC$  parallel to  $AD$ , but this conclusion was expected to be justified by a correct vector for  $BC$ .

**(b)** This was understood by a good number of candidates.

**(c)** There were a good number of correct angles here, but all four reasons given in full were rarely seen. Usually, the maximum mark here was 3. A common error occurred in part **(iv)** with unjustified reference to the isosceles triangle  $CFD$ .

Answers: **(a)**  $\begin{pmatrix} 0 \\ -2 \end{pmatrix}$ , **(b)(i)(a)**  $-b$ , **(b)**  $2b - 2a$ , **(c)**  $2a$ , **(d)**  $a$ , **(ii)(a)** Trapezium,  $AD \parallel BC$ , **(b)** 1:2:3,

**(c)(i)**  $146^\circ$ , angles in the same segment are equal, **(ii)**  $73^\circ$ , angle at the centre of a circle is twice the angle at the circumference, **(iii)**  $34^\circ$ , angles in opposite segments are supplementary, **(iv)**  $73^\circ$ , angle sum of a triangle.

### Question 10

**(a)** Many candidates did not realise that parts **(i)** and **(ii)** were steps in the calculation of the mean. It was expected that the usual numerator in this calculation would be evaluated in part **(i)**. Candidates did not understand that this was the estimate of the total mass required. Some credit was given for the full calculation of the mean presented as the solution to part **(ii)**. One of the common errors was using the interval width of 50 g in part **(i)**. Division by 260 then produced the answer 50 g in part **(ii)**, which was accepted as a correct follow through.

**(b)(i)** Usually correct.

**(ii)** Generally good plotting and drawing.

**(iii)** The basic ideas here were understood by many candidates, and there were some good solutions. Work in both parts was sometimes spoilt by relating the median and quartiles to an incorrect total frequency, such as 300 or 350. A common error in presenting the interquartile range was to subtract frequencies rather than the related masses.

- (b)** It was expected that candidates would subtract 144 from 260, having got this value from one of the tables. A pleasing number of candidates achieved this. Care was required however with the final division, and the subsequent rounding, in this case up.

Answers: **(a)(i)** 50300 g, **(ii)** 193, **(b)(i)** 144 220 256, **(ii)** All seven points plotted and joined with a smooth curve, **(iii)(a)** 190.0 to 197.5 g, **(b)** 72.5 to 82.5 g, **(c)** 5.

### Question 11

- (a)(i)** This was generally well understood. Answers left as  $\sqrt{13}$  or truncated to 3.6 did not score the accuracy mark, however.
- (ii)** Again, this was well done by many candidates. Most candidates knew how to evaluate at least the gradient. Quite a number achieved this but then did not go on to evaluate the constant term.
- (b)(i)** This matrix was known by a lot of candidates. However, those who did not know it often did a huge amount of work trying to find it. This was usually unsuccessful. In this part of the question, there was no credit given for simply describing the transformation.
- (ii)** This was well understood by many candidates, although a few thought that a rotation was involved.
- (iii)(a)** This was well answered.

**(b)**  $\begin{pmatrix} -k \\ h \end{pmatrix}$  had to be seen to come from a correct matrix multiplication, and this had to be followed by the addition of  $\begin{pmatrix} -3 \\ -3 \end{pmatrix}$ . This mark therefore was dependent on the previous result. A number of good candidates scored this mark. There were many attempts reaching the correct conclusion, however, which could not be accepted.

**(c)** Although this was independent of the candidates' previous work since the required simultaneous equations could be deduced from the question, surprisingly few candidates managed to find the equations and hence the values of  $h$  and  $k$ .

**(d)** A few candidates managed to solve this apparently independently of the previous steps. The relevance of  $(h,k)$  did not seem to be grasped, although if their  $(h,k)$  had been stated, credit would have been given. A common wrong answer was  $(0,0)$ .

Answers: **(a)(i)** 3.61, **(ii)**  $3x + 2y = 24$ , **(b)(i)**  $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ , **(ii)** Reflection in the line  $y = x$ , **(iii)(a)**  $\begin{pmatrix} -3 \\ -3 \end{pmatrix}$ ,

**(b)**  $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} h \\ k \end{pmatrix} + \begin{pmatrix} -3 \\ -3 \end{pmatrix}$  seen, **(c)**  $h = 0$ ,  $k = -3$ , **(d)**  $(0,-3)$ .