UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

6317776406

MATHEMATICS (SYLLABUS D) **4024/21**

Paper 2 **October/November 2013**

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.
Omission of essential working will result in loss of marks.
You are expected to use an electronic calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 100.

This document consists of **24** printed pages.

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Section A [52 marks]

Answer **all** questions in this section.

For Examiner's Use

1 **(a)** The rate of exchange between dollars ($) and pounds (£) is $1.56 = £1.
The rate of exchange between euros (€) and pounds is €1.10 = £1.

(i) Amy changes £300 into dollars.

Calculate how many dollars Amy receives.

Answer $ ..... [1]

(ii) Ben changes €770 into pounds.

Calculate how many pounds Ben receives.

Answer £ ..... [1]

(iii) Chris changes $780 into euros.

Calculate how many euros Chris receives.

Answer € ..... [2]

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(b) Debbie changed some dollars into Japanese yen.
The rate of exchange was 81 dollars = 1 yen.

Emma changed the same number of dollars into yen.
The rate of exchange for Emma was 82 dollars = 1 yen.

Emma received 3 fewer yen than Debbie.

Given that the number of dollars changed each time is x, find x.

For Examiner's Use

Answer ..... [3]

For Examiner's Use

2 **(a)** Construct the triangle ABC in which $B\hat{A}C = 40^\circ$ and $AC = 8$ cm.

C is above the line AB, which is drawn for you.



[2]

(b) Construct the locus of all the points **outside** the triangle that are 2 cm from the perimeter of the triangle. [2]

(c) Find and label the point P, **inside** the triangle, that is 6.5 cm from A and equidistant from B and C. [2]

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3 The line AB joins the point A (–2, 1) to the point B (6, 5).

For Examiner's Use

(a) Find the coordinates of the midpoint of AB.

Answer (..... , ...) [1]

(b) Find the gradient of AB.

Answer ..... [1]

(c) AB intersects the y-axis at the point (0, c).

Find c.

Answer ..... [2]

(d) Express $\overrightarrow{AB}$ as a column vector.

Answer [1]

(e) C is the point (5, 2) and D is the point (h, k).
The lines AB and CD are equal in length and parallel.

Find the coordinates of each of the possible points D.

Answer (..... , ...) and (..... , ...) [3]

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4 The table shows the distribution of the masses of 100 babies at birth.

For Examiner's Use

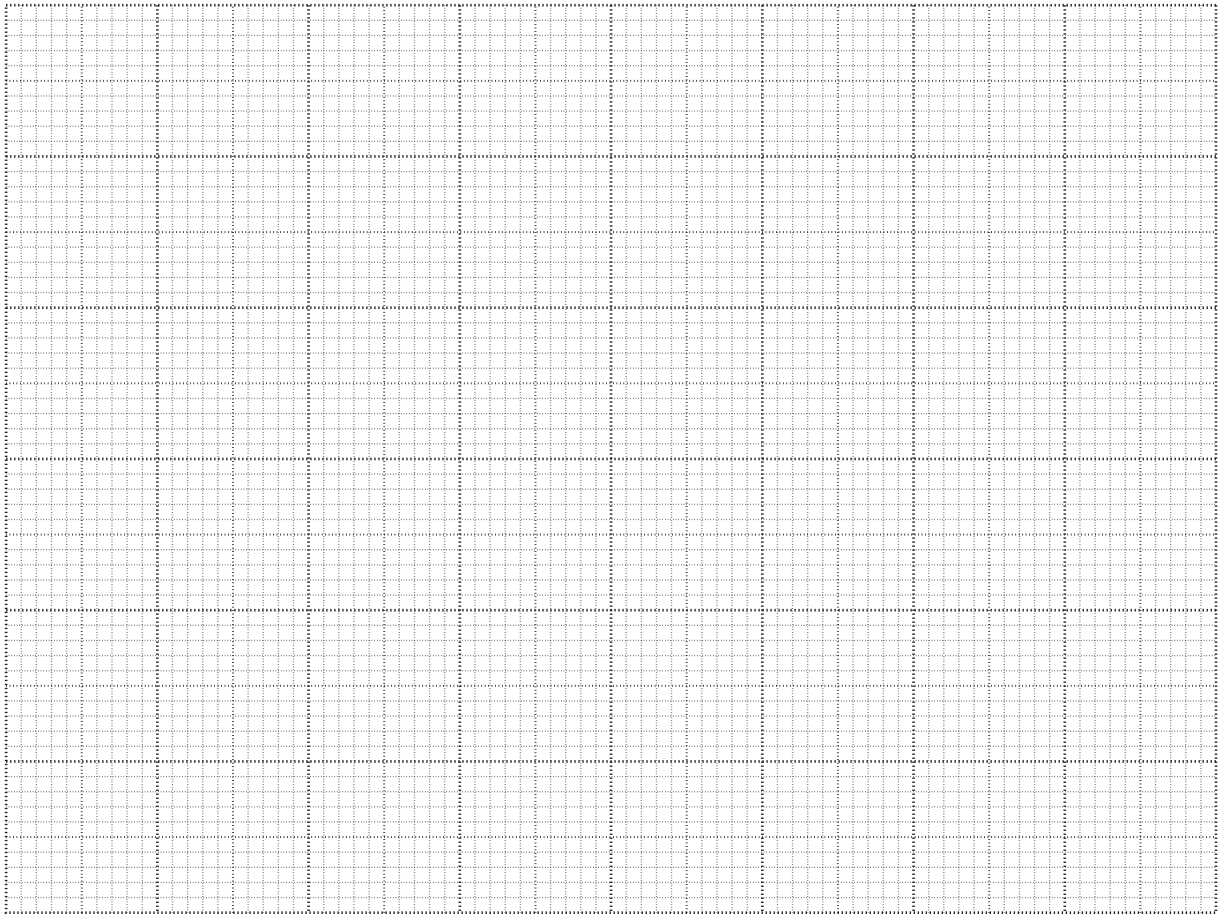
Mass (x kg)	$1.5 < x \leqslant 2$	$2 < x \leqslant 2.5$	$2.5 < x \leqslant 3$	$3 < x \leqslant 3.5$	$3.5 < x \leqslant 4$	$4 < x \leqslant 4.5$	$4.5 < x \leqslant 5$
Number of babies	3	12	20	24	25	14	2

(a) Write down the modal class.

Answer ..... [1]

(b) For this part of the question use the grid below.
Using a scale of 4 cm to represent 1 kg, draw a horizontal x-axis for $1 \leqslant x \leqslant 5$.
Using a scale of 2 cm to represent 5 babies, draw a vertical axis for frequency from 0 to 30.

Using your axes, draw a frequency polygon to represent these results.



[2]

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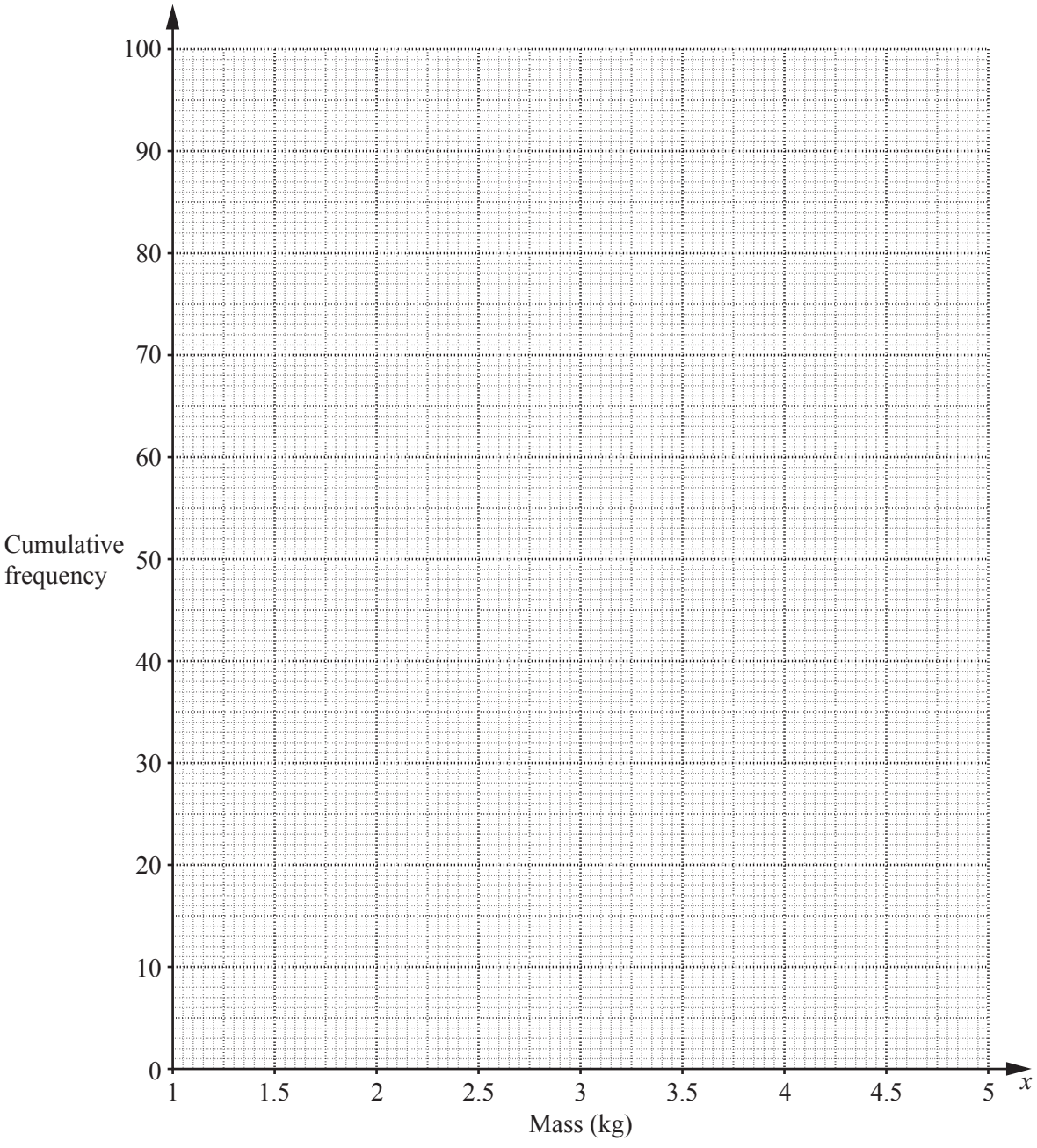
(c) **(i)** Complete the cumulative frequency table below.

For Examiner's Use

Mass (x kg)	$x \leqslant 2$	$x \leqslant 2.5$	$x \leqslant 3$	$x \leqslant 3.5$	$x \leqslant 4$	$x \leqslant 4.5$	$x \leqslant 5$
Cumulative frequency	3	15					100

[1]

(ii) On the grid below draw a smooth cumulative frequency curve to represent these results.



[2]

(d) Use your curve to estimate

(i) the median mass,

Answer .....kg [1]

(ii) the 10th percentile.

Answer .....kg [1]

For Examiner's Use

5 **(a)** Solve $\frac{2}{3-x} = 1$.

Answer .....[1]

(b) Factorise

(i) $5x + 5y$,

Answer .....[1]

(ii) $9x^2 - 16$.

Answer .....[1]

(c) **(i)** Factorise $2x^2 + 5x - 12$.

Answer .....[1]

(ii) Use your answer to **part (c)(i)** to solve the equation $2x^2 + 5x - 12 = 0$.

Answer $x =$ ..... or ..... [1]

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(d) A source of light is observed from a distance of d metres.
The amount of light received, L units, is inversely proportional to the square of the distance.

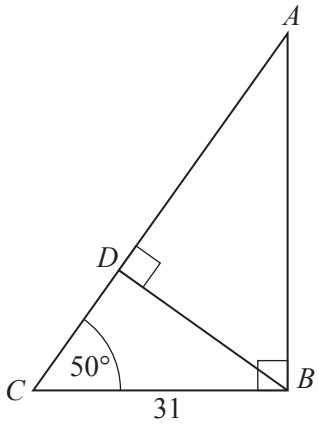
Given that $L = 9$ when $d = 2$, find the value of L when $d = 3$.

For Examiner's Use

Answer ..... [2]

6 (a)

For Examiner's Use



In the triangle ABC, $A\hat{B}C = 90°$, $A\hat{C}B = 50°$ and $BC = 31$ m.
D is the point on AC such that $B\hat{D}A = 90°$.

(i) Show that $CD = 19.93$ m, correct to 2 decimal places.

[2]

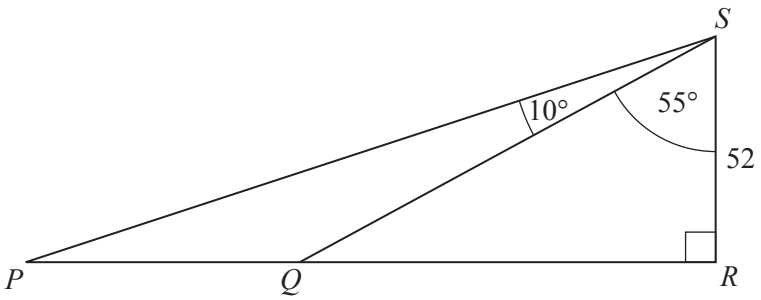
(ii) Calculate AD.

Answer ..... m [3]

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(b)

For Examiner's Use



Two boats are at the points P and Q .
RS is a vertical cliff of height 52 m.
$P\hat{S}Q = 10°$ and $Q\hat{S}R = 55°$.

(i) State the angle of depression of P from S.

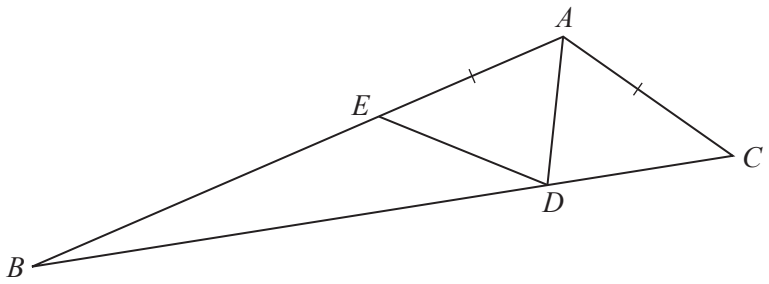
Answer .....[1]

(ii) Calculate the distance, PQ, between the boats.

Answer .....m [3]

7 (a)

For Examiner's Use



In triangle ABC, D is the point on BC such that AD bisects $B\hat{A}C$ and E is the point on AB such that $AE = AC$.

(i) Show that triangles AED and ACD are congruent.

[3]

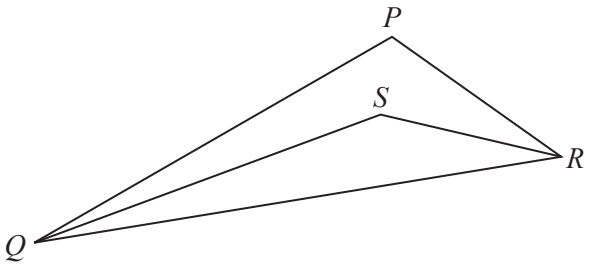
(ii) Given that $A\hat{B}D = x°$, $E\hat{D}B = y°$ and $A\hat{C}B = z°$, find x in terms of y and z.

Answer $x =$ ..... [2]

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(b)

For Examiner's Use



In triangle PQR, QS bisects $P\hat{Q}R$ and RS bisects $P\hat{R}Q$.
$P\hat{Q}R = 42^\circ$ and $P\hat{R}Q = 54^\circ$.

Find reflex angle QSR.

Answer ..... [2]

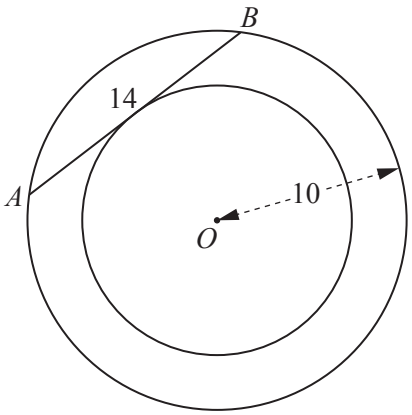
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

For Examiner's Use

8 (a)

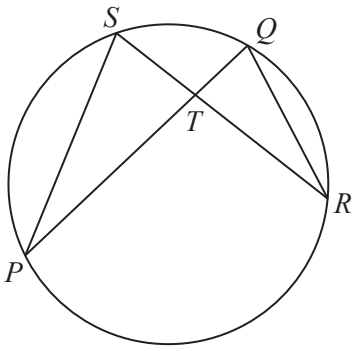


In the diagram, the circles each have centre O.
AB is a chord of the larger circle and also a tangent to the smaller circle.
$AB = 14$ cm and the radius of the larger circle is 10 cm.

Find the radius of the smaller circle.

Answer ..... cm [3]

(b)



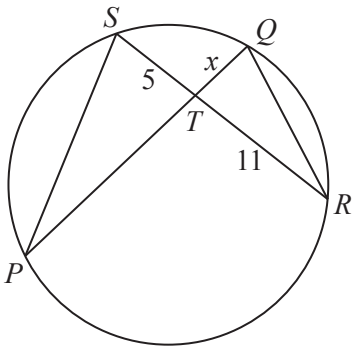
In the diagram, PQ and RS are chords of a circle that intersect at T.

(i) Show that triangles PST and RQT are similar.

[3]

(ii)

For Examiner's Use



$ST = 5$ cm, $TR = 11$ cm and $TQ = x$ cm.

Given that $PQ = 18$ cm, show that x satisfies the equation

$$x^2 - 18x + 55 = 0.$$

[2]

(iii) Solve the equation $x^2 - 18x + 55 = 0$.
Give each solution correct to 1 decimal place.

Answer $x =$ ..... or ..... [3]

(iv) Find the difference between the lengths of PT and TQ.

Answer ..... cm [1]

For Examiner's Use

9 The number of bacteria in a colony **trebles** every hour.
The colony starts with 50 bacteria.
The table below shows the number of bacteria (y) in the colony after t hours.

Time (t hours)	0	1	2	2.5	3	3.5	4
Number of bacteria (y)	50	150	450	780	1350	2340	

(a) Complete the table. [1]

(b) On the grid on the opposite page plot the points in the table, and join them with a smooth curve. [3]

(c) Use your graph to find the number of bacteria in the colony when $t = 3.2$.

Answer ..... [1]

(d) **(i)** By drawing a tangent, estimate the gradient of the curve when $t = 2.5$.

Answer ..... [2]

(ii) What does this gradient represent?

Answer .....

..... [1]

(e) Given that the equation of the graph is $y = ka^t$, find k and a.

Answer $k =$ ..... $a =$ ..... [1]

(f) The number of bacteria in another colony is given by the equation $y = 500 + 500t$.

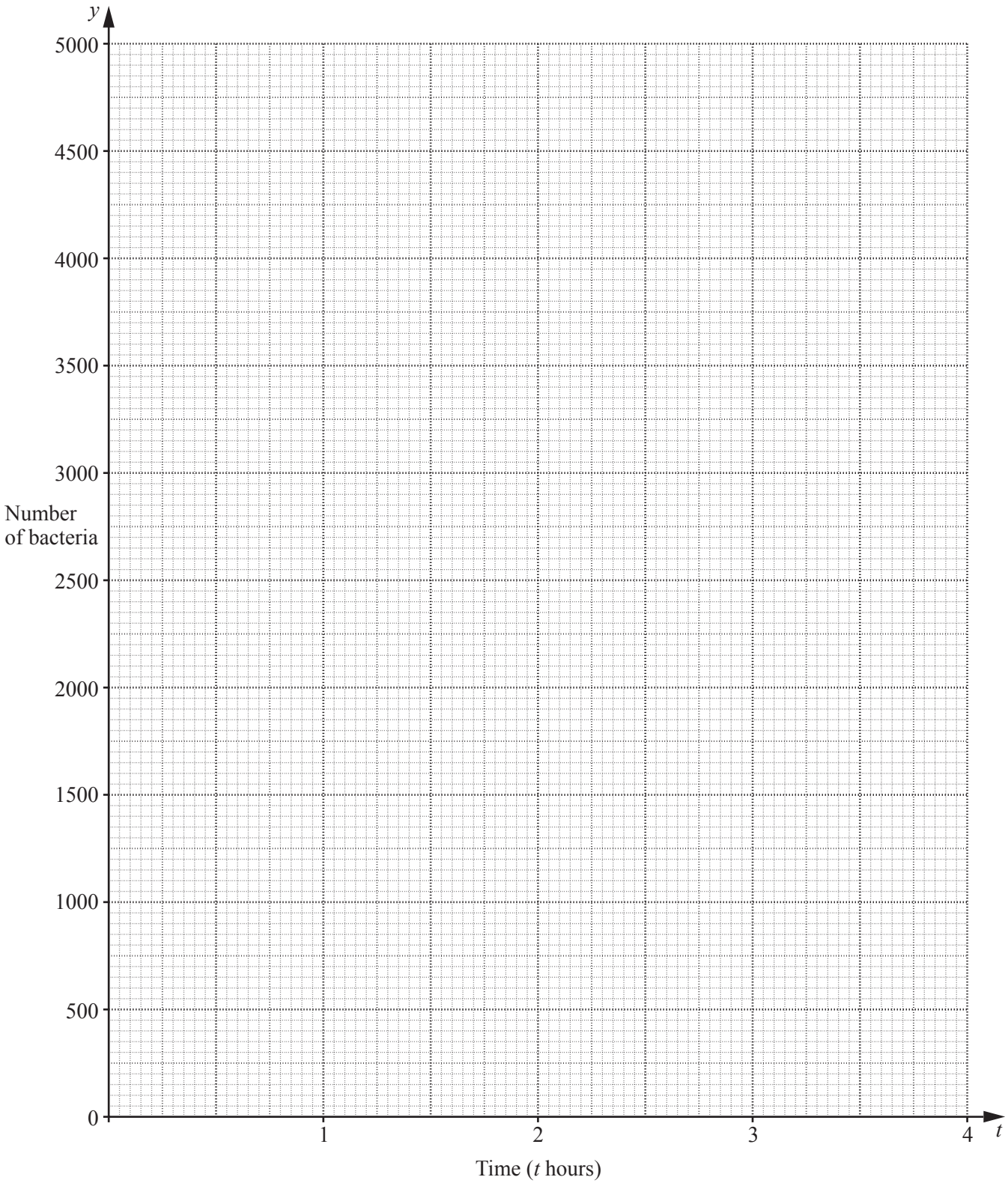
(i) On the same axes, draw a graph to represent the number of bacteria in this colony.

[2]

(ii) State the value of t when the number of bacteria in each colony is the same.

Answer ..... [1]

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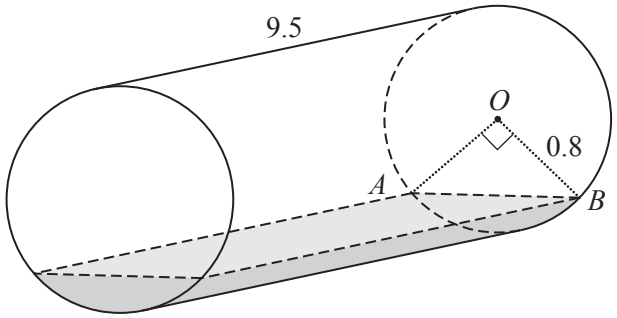


For Examiner's Use

10 A fuel tanker delivers fuel in a cylindrical container of length 9.5 m and radius 0.8 m.

For Examiner's Use

(a) After several deliveries, the fuel remaining in the container is shown in the diagram.



AB is horizontal, O is the centre of the circular cross-section and $A\hat{O}B = 90^\circ$.

(i) Calculate the curved surface area of the container that is in contact with the fuel.

Answer ..... m^2 [2]

(ii) Calculate the volume of fuel remaining in the container.

Answer ..... m^3 [4]

(iii) Calculate this volume remaining as a percentage of the volume of the whole container.

Answer .....% [2]

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(b) The fuel is pumped through a cylindrical pipe of radius 4.5 cm at a rate of 300 cm/s.

For Examiner's Use

(i) Calculate the volume pumped in 1 second.

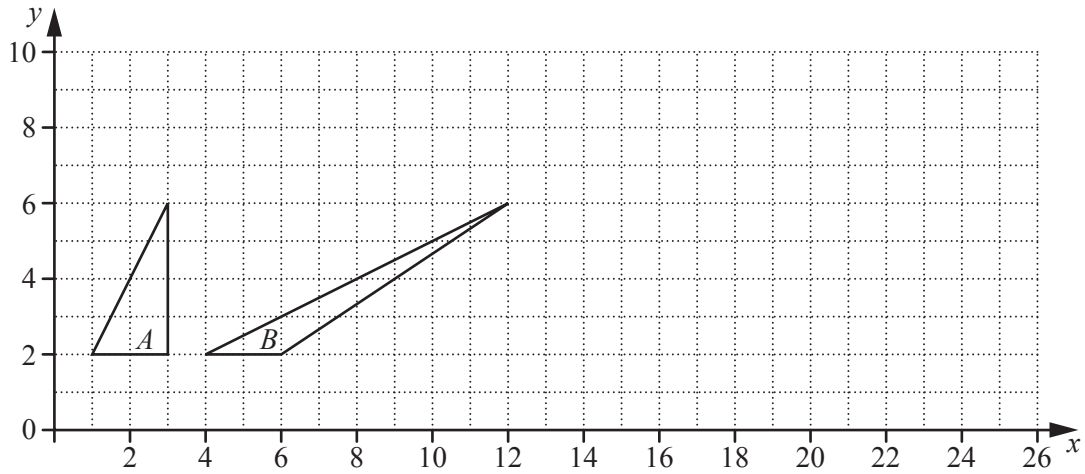
Answer ..... cm^3 [1]

(ii) Calculate the time taken, in minutes, to pump 25 000 litres of fuel.
Give your answer correct to the nearest minute.

Answer ..... minutes [3]

11 The diagram shows triangles A and B.

For Examiner's Use



(a) (i) Describe fully the **single** transformation that maps triangle A onto triangle B.

Answer .....

..... [2]

(ii) Find the matrix that represents this transformation.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) Triangle B is mapped onto triangle C by the transformation represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$.

(i) On the grid above, draw and label triangle C. [2]

(ii) Give the name of this transformation.

Answer ..... [1]

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(iii) Find the matrix that represents the inverse transformation that maps triangle C onto triangle B.

For Examiner's Use

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(iv) Find the ratio area of triangle C : area of triangle B.

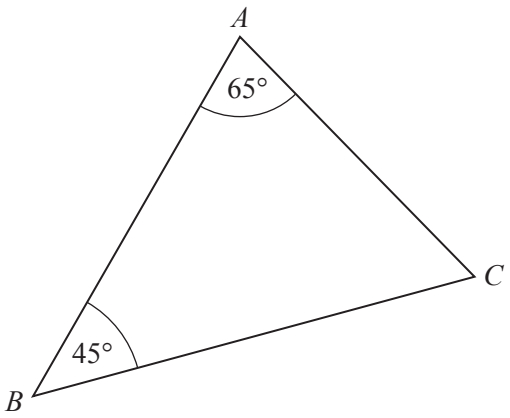
Answer ..... : ..... [1]

(c) Find the matrix that represents the **single** transformation that maps triangle A onto triangle C.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

12 (a)

For Examiner's Use



In triangle ABC, $A\hat{B}C = 45^\circ$ and $B\hat{A}C = 65^\circ$.
AC is 5 cm shorter than BC.

(i) Show that $BC = \dfrac{5\sin 65}{\sin 65 - \sin 45}$.

[3]

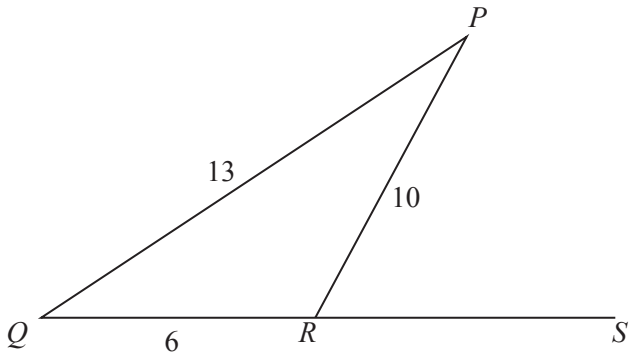
(ii) Find the length of BC.

Answer ..... cm [1]

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(b)

For Examiner's Use



In triangle PQR, $PQ = 13$ cm, $QR = 6$ cm and $RP = 10$ cm.
QR is produced to S.

(i) Find the value of $\cos P\hat{R}Q$, giving your answer as a fraction in its lowest terms.

Answer ..... [3]

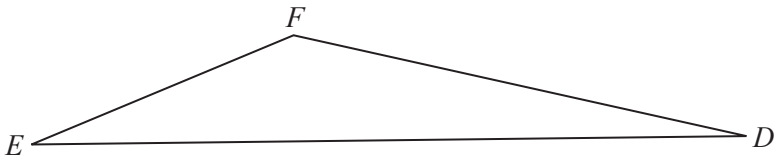
(ii) Hence write down the value of $\cos P\hat{R}S$.

Answer ..... [1]

TURN OVER FOR THE REST OF THIS QUESTION

(c)

For Examiner's Use



Triangle *DEG* has the same area as triangle *DEF*, but is not congruent to triangle *DEF*. The point *G* is lower than *DE* and *GE* = *EF*.

Draw the triangle *DEG* in the diagram above. [1]

(d) In triangle *LMN*, $L\hat{M}N = 30°$ and *ML* = 2*MN*.

When the area of triangle *LMN* is 18 cm^2, calculate *MN*.

Answer ..... cm [3]

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