UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

MATHEMATICS (SYLLABUS D) **4024/22**

Paper 2 **October/November 2012**

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.

For Examiner's Use

This document consists of **23** printed pages and **1** blank page.

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Section A [52 marks]

Answer **all** questions in this section.

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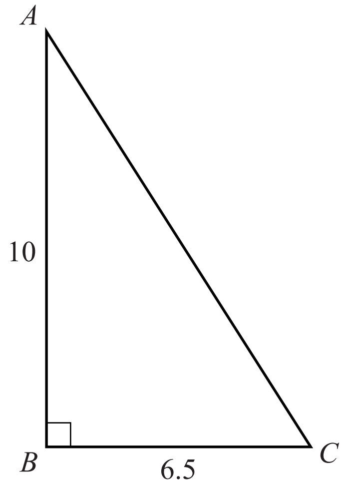
1

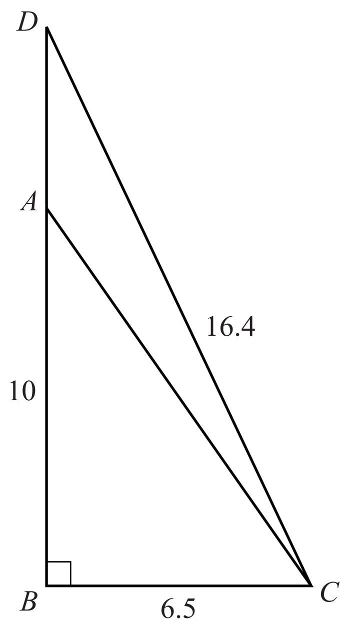


In triangle ABC, $AB = 10\,\text{m}$, $BC = 6.5\,\text{m}$ and $A\hat{B}C = 90°$.

(a) Find $A\hat{C}B$.

Answer .... [2]

(b)



D is the point on BA produced such that $CD = 16.4$ m.

(i) Find AD.
Give your answer in metres and centimetres, correct to the nearest centimetre.

Answer .... m .... cm [3]

(ii) Find $D\hat{C}B$.

Answer .... [2]

2 **(a)** Factorise $4x^2 - 1$.

Answer .... [1]

(b) $P = \dfrac{2Q + R}{R}$

(i) Find P when $R = Q$.

Answer P = ... [1]

(ii) Rearrange the formula to make R the subject.

Answer R = ... [3]

(c) Solve the simultaneous equations.

$$3x + 4y = 17$$
$$2x - 5y = 19$$

Answer x = ...

y = ... [3]

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(d) A shopkeeper sells cartons of milk and bottles of water.
Each carton of milk costs \$2.40, and each bottle of water costs \$0.80.
One day he sells x cartons of milk.
On the same day, he sells 20 more bottles of water than cartons of milk.

(i) Write down an expression, in terms of x, for the number of dollars he receives from the sale of these cartons and bottles.
Simplify your answer.

Answer .... [2]

(ii) The total amount he receives that day from the sale of these cartons and bottles is greater than \$250.

Form an inequality in x and solve it.

Answer .... [2]

(iii) Hence write down the least number of cartons of milk that he sells that day.

Answer .... [1]

3 **(a)** In 2009 the cost of posting a letter was 36 cents.

(i) A company posted 3000 letters and was given a discount of 4%.

Calculate the total discount given.
Give your answer in dollars.

Answer \$ .... [1]

(ii) In 2010, the cost of posting a letter was increased from 36 cents to 45 cents.

Calculate the percentage increase.

Answer ....% [2]

(iii) After the price increase to 45 cents, the cost to the company of posting 3000 letters was \$1302.75.

Calculate the new percentage discount given.

Answer ....% [2]

(b) In 2010, it cost \$5.40 to post a parcel.
This was an increase of $12\frac{1}{2}\%$ on the cost of posting the parcel in 2009.

Calculate the increase in the cost of posting this type of parcel in 2010 compared to 2009.

Answer \$ .... [3]

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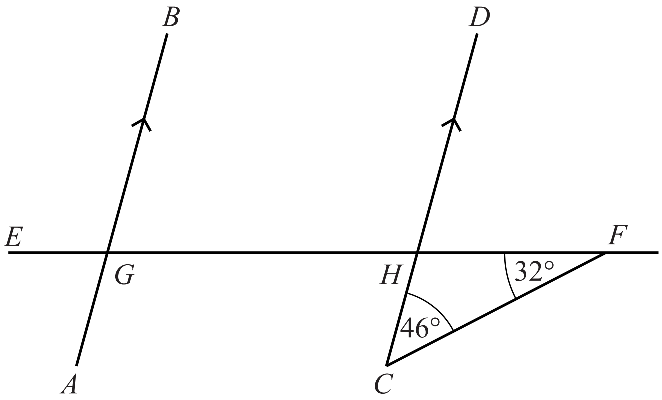
4 **(a)**



AB and *CD* are parallel.
EGHF is a straight line.
$H\hat{C}F = 46°$ and $H\hat{F}C = 32°$.

(i) Find $C\hat{H}F$.

Answer .... [1]

(ii) Find $G\hat{H}D$.

Answer .... [1]

(iii) Find $H\hat{G}B$.

Answer .... [1]

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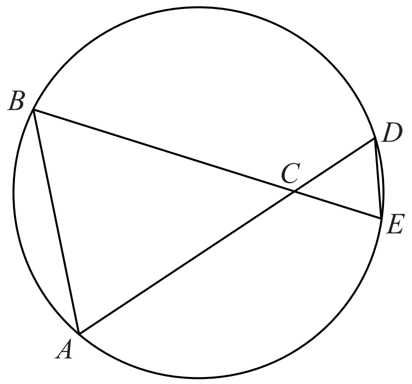
(b) A, B, D and E are points on a circle.



AD and BE intersect at C.

(i) Show that triangles ABC and EDC are similar.
Give your reasons.

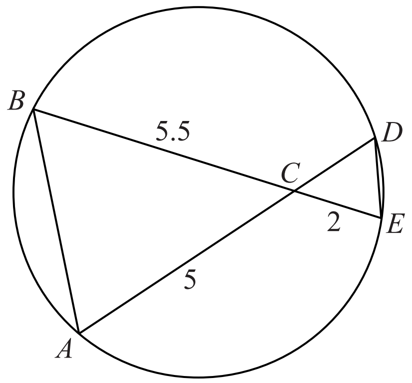
Answer ....

....

....

.... [2]

(ii)



Given that $AC = 5$ cm, $BC = 5.5$ cm and $CE = 2$ cm, find the length of the chord AD.

Answer .... cm [2]

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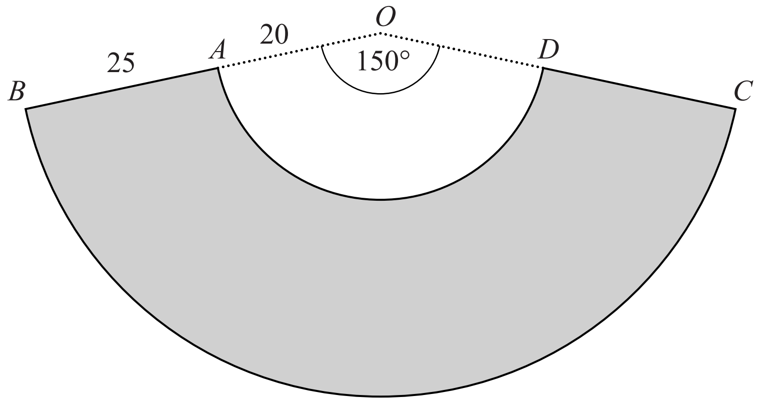

AD and *BC* are arcs of circles with centre *O*.
A is a point on *OB*, and *D* is a point on *OC*.
OA = 20 cm and *AB* = 25 cm.
$A\hat{O}D = 150°$.

(a) Calculate the perimeter of the shaded shape *ABCD*.

Answer .... cm [3]

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(b) Calculate the area of the shaded shape *ABCD*.

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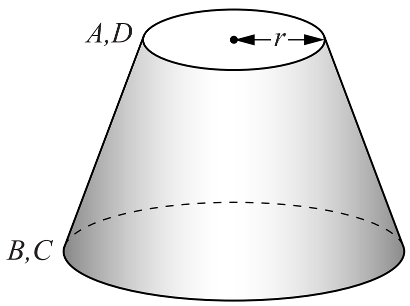
Answer .... cm^2 [3]

(c) The shape *ABCD* is used to make a lampshade by joining *AB* and *DC*.



Calculate the radius, r cm, of the circular top of the lampshade.

Answer .... cm [2]

6 The heights of 150 children are measured.
The results are summarised in the table.

Height (h cm)	$130 < h \leqslant 140$	$140 < h \leqslant 150$	$150 < h \leqslant 155$	$155 < h \leqslant 160$	$160 < h \leqslant 170$	$170 < h \leqslant 190$
Frequency	10	30	20	30	35	25

(a) Calculate an estimate of the mean height.

Answer .... cm [3]

(b) **(i)** One child is chosen at random.

Find the probability that this child has a height greater than 160 cm.

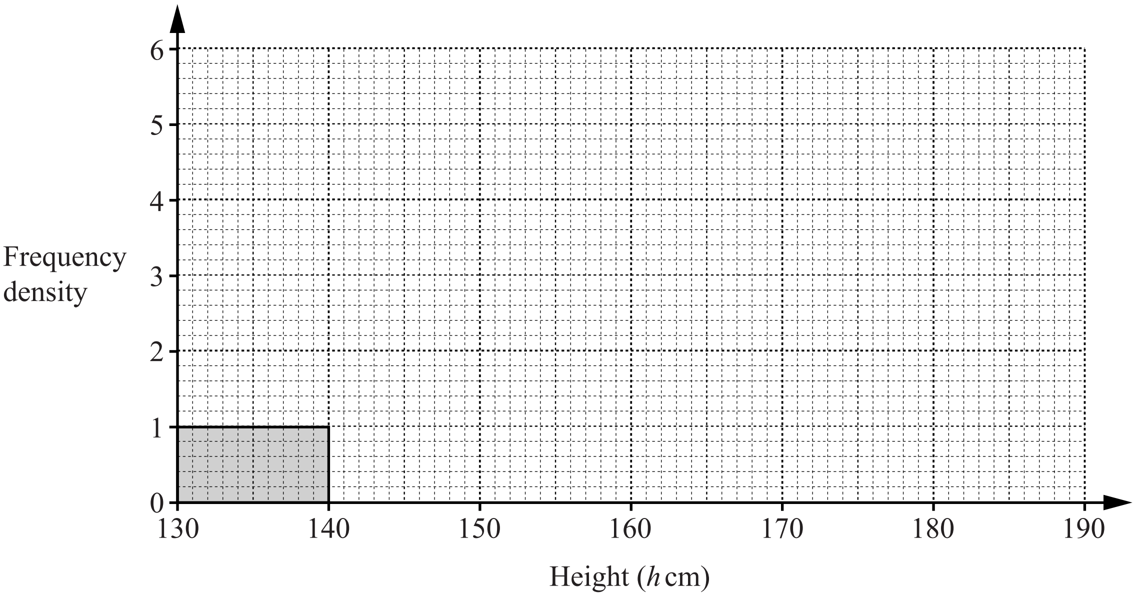
Answer .... [1]

(ii) Two children are chosen at random without replacement.

Find the probability that the height of one child is greater than 160 cm and the height of the other is 150 cm or less.

Answer .... [2]

(c) Complete the histogram to represent the information in the table.



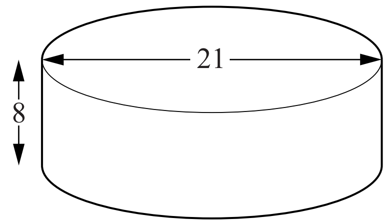
[3]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7 A cylindrical, **open** container has a diameter of 21 cm and height of 8 cm.



(a) **(i)** Calculate the **total** external surface area of this container.

Answer .... cm^2 [3]

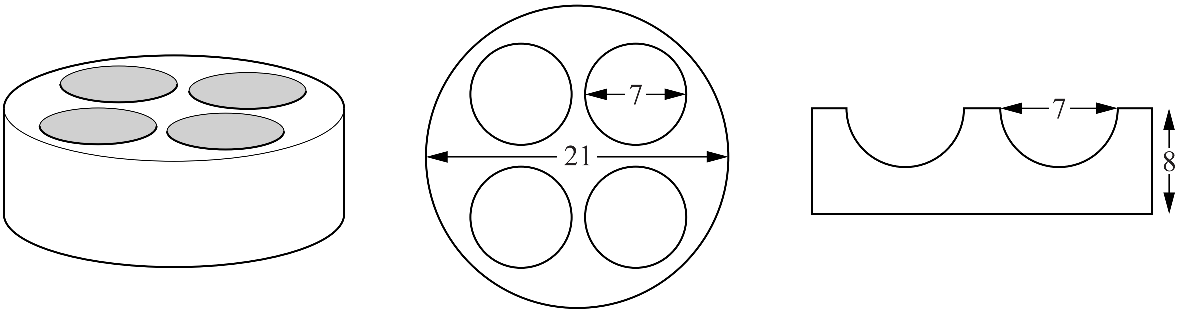
(ii) A manufacturer receives an order for 30 000 containers.
He needs an extra 150 cm^2 of material for each container to cover wastage.

Calculate the area of material needed to make these containers.
Give your answer in square metres.

Answer .... m^2 [2]

[The Surface area of a sphere is $4\pi r^2$] [The Volume of a sphere is $\frac{4}{3}\pi r^3$]

(b) A circular top that can hold 4 hemispherical bowls can be placed on the container.



Container and Top **Top** **Cross-section**

The top is a circle of diameter 21 cm with four circular holes of diameter 7 cm.
A hemispherical bowl of diameter 7 cm fits into each hole.
The cross-section shows two of these bowls.

(i) Calculate the inside curved surface area of one of these hemispherical bowls.

Answer .... cm^2 [1]

(ii) Calculate the total surface area of the top of the container, including the inside curved surface area of each bowl.

Answer .... cm^2 [3]

(iii) With the top and the 4 bowls in place, calculate the volume of water required to fill the container.

Answer ....cm^3 [3]

8 The variables x and y are connected by the equation

$$y = 1 + 2x^2 - x^3.$$

The table below shows some values of x, and the corresponding values of y, correct to 1 decimal place where appropriate.

x	–1	–0.5	0	0.5	1	1.5	2	2.5
y	4	1.6	1	1.4	2	2.1	1	p

(a) Calculate p.
Give your answer correct to 1 decimal place.

Answer $p =$ .... [1]

(b) On the graph paper opposite, using a scale of 2 cm to represent 1 unit on both axes,
draw a horizontal x-axis for $-2 \leqslant x \leqslant 3$, and
draw a vertical y-axis for $-3 \leqslant y \leqslant 5$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) Use your graph to find all the solutions of $1 + 2x^2 - x^3 = 2$.

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

(d) By drawing a tangent, find the gradient of the curve at the point where $x = -0.5$.

Answer .... [2]

(e) By drawing an appropriate straight line on the grid, solve the equation $1 + 2x^2 - x^3 = x$.

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

(f) Find the range of values of k such that $1 + 2x^2 - x^3 = k$ has 3 solutions.

Answer .... [2]

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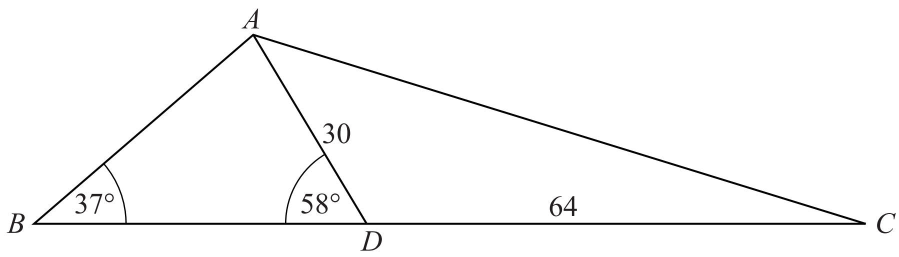

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A, B, C and D are four points on level ground.
BDC is a straight line.
$AD = 30$ m and $DC = 64$ m.
$A\hat{B}D = 37°$ and $A\hat{D}B = 58°$.

(a) Calculate AB.

Answer .... m [3]

(b) Calculate AC.

Answer .... m [4]

(c) Calculate the area of triangle *ADC*.

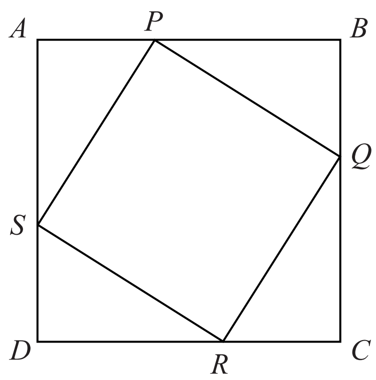
Answer .... m^2 [2]

(d) A vertical tower stands at *A*.
P is the point on the line *BC* such that the angle of depression from the top of the tower to the line *BC* is greatest.

Given that this angle of depression is 34°, calculate the height of the tower.

Answer .... m [3]

10



ABCD is a square.
$AP = BQ = CR = DS$.

(a) Giving reasons, show that triangles *PAS* and *QBP* are congruent.

Answer ....

....

....

.... [3]

(b) The length of a side of the square *ABCD* is 40 cm and $AP = x$ cm.

(i) Write down an expression for *PB* in terms of x.

Answer .... cm [1]

(ii) Show that the area, $y\,\text{cm}^2$, of *PQRS* is given by $y = 1600 - 80x + 2x^2$.

[2]

(c) **(i)** When $y = 1100$, show that $x^2 - 40x + 250 = 0$.

[1]

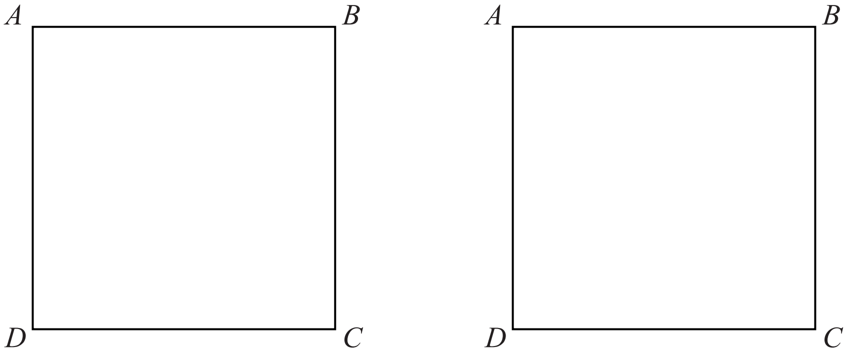
(ii) Solve the equation $x^2 - 40x + 250 = 0$.
Give each answer correct to 1 decimal place.

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

(d) Two outlines of *ABCD* are drawn to scale in the answer space below.
The scale is 1 : 10.

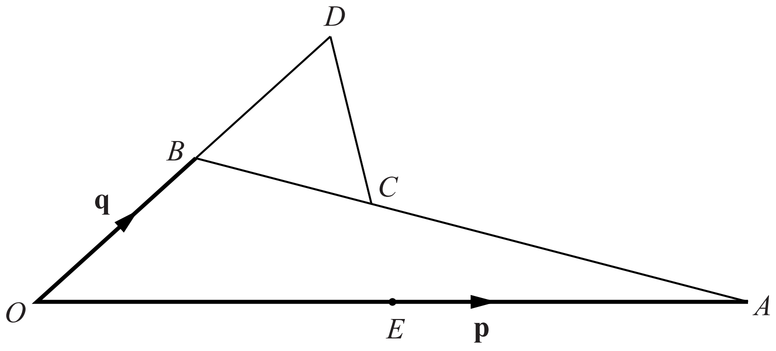
Draw accurately the quadrilateral *PQRS* corresponding to each value of x found above.

Answer



[2]

11 (a)



B is the midpoint of OD and E is the midpoint of OA.
C is the point on AB such that $AC : CB = 2 : 1$.
$\overrightarrow{OA} = \mathbf{p}$ and $\overrightarrow{OB} = \mathbf{q}$.

(i) Find, in terms of $\mathbf{p}$ and $\mathbf{q}$,

(a) $\overrightarrow{AB}$,

Answer .... [1]

(b) $\overrightarrow{CD}$,

Answer .... [1]

(c) $\overrightarrow{ED}$.

Answer .... [1]

(ii) Use your answers to parts **(i)(b)** and **(i)(c)** to make two statements about the points E, C and D.

Answer ....

.... [2]

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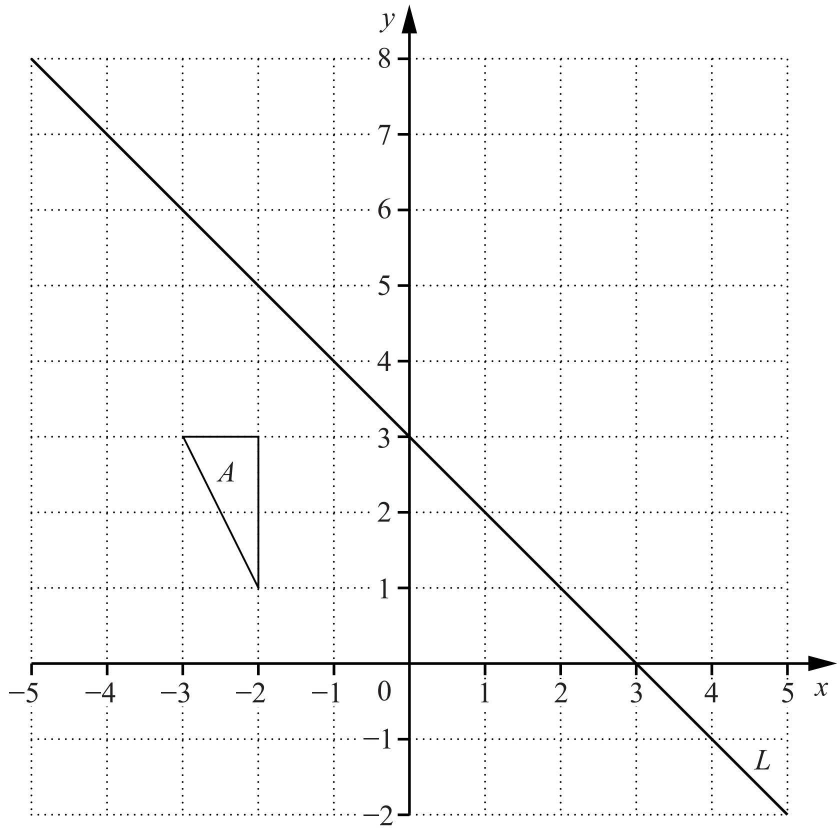
(b)



The diagram shows triangle A and line L.

(i) Triangle A is mapped onto triangle B by a reflection in line L.

Draw and label triangle B. [2]

(ii) Triangle A is mapped onto triangle C by an anticlockwise rotation of 90°, centre $(0, 3)$.

Draw and label triangle C. [2]

(iii) Triangle C is mapped onto triangle D by a reflection in line L.

Describe the single transformation that maps triangle B onto triangle D.

Answer ....

.... [3]

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