Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D) **4024/01**

Paper 1

October/November 2006

2 hours

Candidates answer on the Question Paper.
Additional Materials: Geometrical instruments

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.

Answer **all** 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.

NEITHER ELECTRONIC CALCULATORS NOR MATHEMATICAL TABLES MAY BE USED IN THIS PAPER.

At the end of the examination, fasten all your work securely together.
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 80.

For Examiner's Use

This document consists of **16** printed pages.

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NEITHER ELECTRONIC CALCULATORS NOR MATHEMATICAL TABLES MAY BE USED IN THIS PAPER

1 Evaluate

(a) $3 + 2(4 - 5)$,

(b) $1\frac{1}{3} \div 2\frac{1}{2}$.

Answer (a) ....[1]

(b) ....[1]

2 **(a)** An empty tin has a mass of 330 g.
When filled with powder, the total mass is 2.10 kg.
Find the mass, in kilograms, of the powder.

(b) Express 2.45 hours in minutes.

Answer (a) ....kg [1]

(b) ....minutes [1]

3 **(a)** Simplify $25x^2 \div 5x^{-4}$.

(b) Solve $(2x - 3)(x + 2) = 0$.

Answer (a) ....[1]

(b) x = ... or ....[1]

4 In an examination, Alan obtained 32 out of 40 marks. In another examination Ben obtained $\frac{5}{8}$ of the total marks.
Express the mark of each candidate as a percentage.

Answer Alan ....% [1]

Ben ....% [1]

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5 **(a)** Write the following numbers in order of size, starting with the **smallest**.

$$0.7\ ,\quad 0.7^2\ ,\quad \frac{7}{11}\ ,\quad \frac{7}{9}\ .$$

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

(b) In a school election, John received 220 votes.
This was 55% of the total number of votes.
Find the total number of votes.

Answer (b) ....[1]

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6 The temperature at the bottom of a mountain was 8°C.
The temperature at the top was –26°C.
Find

(a) the difference between the two temperatures,

(b) the mean of the two temperatures.

Answer (a) ....°C [1]

(b) ....°C [1]

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7 **(a)** Find the fraction which is exactly halfway between $\frac{5}{9}$ and $\frac{8}{9}$.

(b) **Estimate** the value of $\sqrt{5000}$, giving your answer correct to **one** significant figure.

(c) Evaluate $3^0 \times 4^{\frac{3}{2}}$.

Answer (a) ....[1]

(b) ....[1]

(c) ....[1]

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8 Written as the product of its prime factors, $360 = 2^3 \times 3^2 \times 5$.

(a) Write 108 as the product of its prime factors.

(b) Find the lowest common multiple of 108 and 360.
Give your answer as the product of its prime factors.

(c) Find the smallest positive integer k such that $360k$ is a cube number.

Answer (a) 108 = ...[1]

(b) ....[1]

(c) k = ...[1]

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9 **(a)** Solve $-7 \leqslant 3x - 4 < 2$.

(b) Write down all the integers which satisfy $-7 \leqslant 3x - 4 < 2$.

Answer (a) .... $\leqslant x <$ ....[2]

(b) ....[1]

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10 The distance from the Earth to the Sun is e kilometres, where $e = 1.5 \times 10^8$.
The distance from the Sun to Mercury is m kilometres, where $m = 6 \times 10^7$.

(a) Express $e : m$ as the ratio of two integers in its simplest form.

(b)

The diagram shows when the Earth, the Sun and Mercury are in a straight line, with the Sun between the Earth and Mercury.
Find the distance from the Earth to Mercury.
Give your answer in standard form.

Answer (a) .... : ....[1]

(b) ....km [2]

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11 Ann, Brian and Carol share the cost of a car.
Ann pays $\frac{2}{5}$ of the cost, Brian pays $\frac{1}{3}$ and Carol pays the rest.

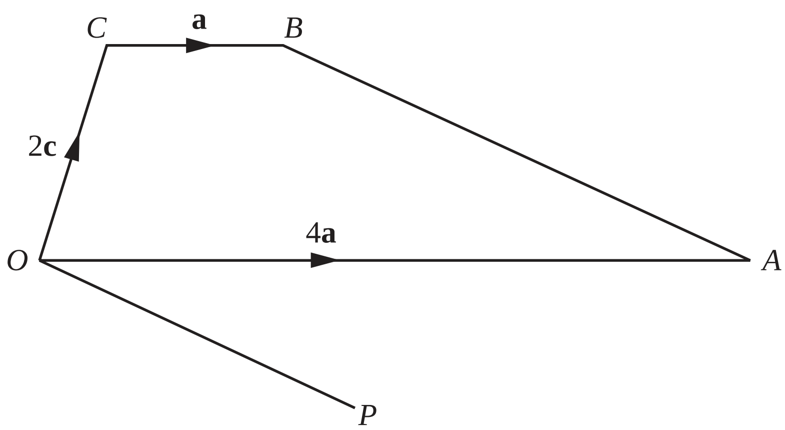
(a) What fraction of the cost does Carol pay?

(b) Ann pays \$1600 more than Brian.
Find the total cost of the car.

Answer (a) ....[1]

(b) \$ ....[2]

12



In the diagram, $\overrightarrow{OA} = 4\mathbf{a}$, $\overrightarrow{OC} = 2\mathbf{c}$ and $\overrightarrow{CB} = \mathbf{a}$.

(a) Express $\overrightarrow{BA}$ in terms of **a** and **c**.

(b) $\overrightarrow{OP} = 2\mathbf{a} - \frac{4}{3}\mathbf{c}$.

Explain why $\overrightarrow{OP}$ is parallel to $\overrightarrow{BA}$.

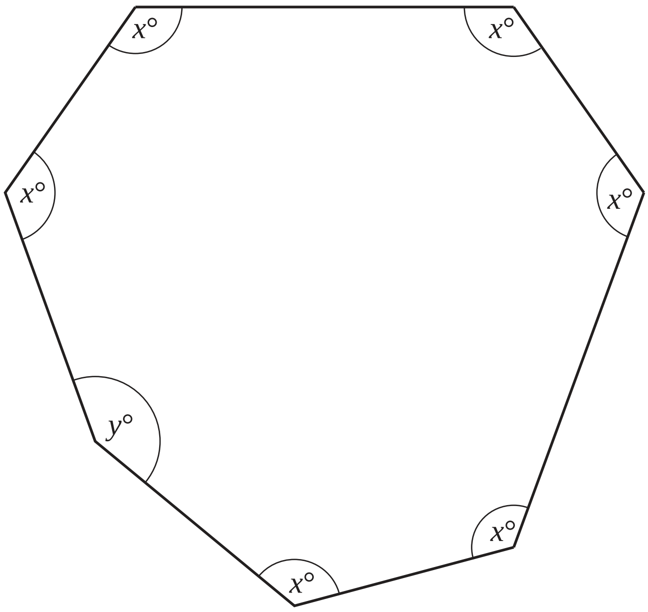
(c) Find $\dfrac{\text{area of triangle } OBA}{\text{area of triangle } OPA}$.

Answer (a) $\overrightarrow{BA} =$ ....[1]

Answer (b) ....[1]

Answer (c) ....[1]

13 The 7 sided polygon in the diagram has 6 angles of $x°$ and one of $y°$.



(a) Draw the line of symmetry on the diagram. [1]

(b) If $y = 126$, calculate the value of x.

Answer (b) $x =$ ....[2]

14 In a race, an athlete runs 1600 m at an average speed of 6 m/s.
The distance is given correct to the nearest 100 m and the speed correct to the nearest metre per second.

(a) Complete the two statements in the answer space.

(b) Calculate the greatest possible time the race could have taken.

Answer (a) .... $\leqslant$ distance < ....

.... $\leqslant$ speed < ....[2]

(b) ....seconds [1]

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15 **(a)** The matrix **M** satisfies the equation

$$3\mathbf{M} + 4\begin{pmatrix} 2 & -1 \\ 3 & 0 \end{pmatrix} = \mathbf{M}.$$

Find **M**, expressing it in the form $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$.

(b) Find the inverse of the matrix $\begin{pmatrix} 5 & -3 \\ -4 & 2 \end{pmatrix}$.

Answer (a) $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$ [2]

(b) $\begin{pmatrix} \quad & \quad \\ \quad & \quad \end{pmatrix}$ [2]

16 **(a)** Given that $f(x) = x^2 - 2px + 3$, find

(i) f(–2), giving your answer in terms of p,

(ii) the value of p when f(–2) = f(0).

(b) Given that $g(y) = y^2 - 1$, find $g(a - 1)$.
Give your answer in its simplest form.

Answer (a) (i) f(–2) = ...[1]

(ii) p = ...[1]

(b) $g(a - 1)$ = ...[2]

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17 The line ℓ is drawn on the grid in the answer space.

(a) Write down the equation of the line ℓ.

(b) On the grid,

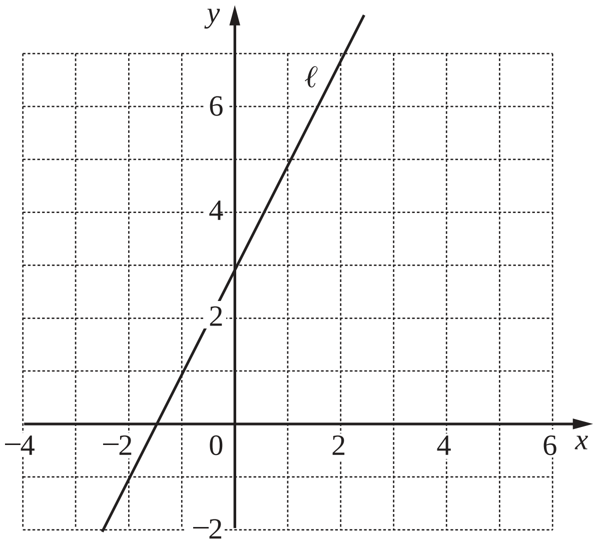
(i) draw and label the lines $x = 1$, $y = 3$ and $x + y = 2$,

(ii) shade the region which satisfies the three inequalities

$$x \geqslant 1, \ y \leqslant 3 \ \text{ and } \ x + y \geqslant 2.$$

Answer (a) ....[1]

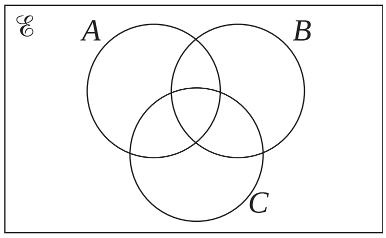
Answer (b)



[3]

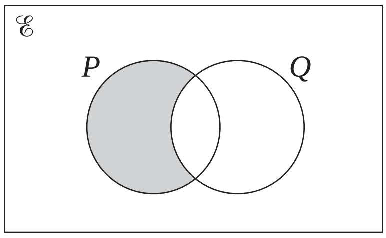
18 **(a)** On the Venn diagram in the answer space, shade the set $A \cup (B \cap C)$.

Answer (a)



[1]

(b) Express in set notation the subset shaded in the Venn diagram.

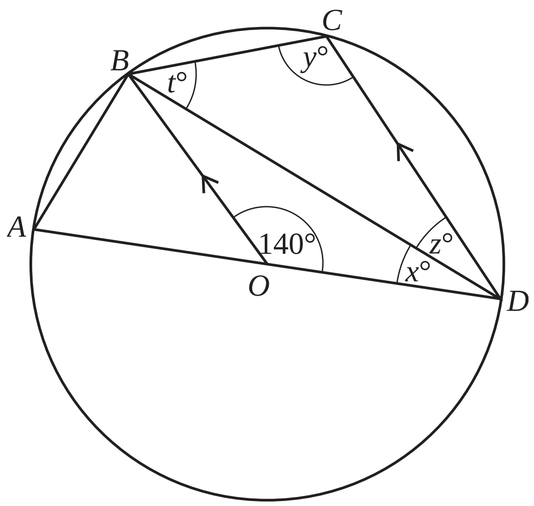


Answer (b) ....[1]

(c) In a class of 36 students, 25 study History, 20 study Geography and 4 study neither History nor Geography.
Find how many students study both History and Geography.

Answer (c) ....[2]

19



In the diagram, the points A, B, C and D lie on a circle, centre O.
AOD is a diameter, OB is parallel to DC and $B\hat{O}D = 140°$.
Find

(a) x,

(b) y,

(c) z,

(d) t.

Answer (a) $x =$ ....[1]

(b) $y =$ ....[1]

(c) $z =$ ....[1]

(d) $t =$ ....[1]

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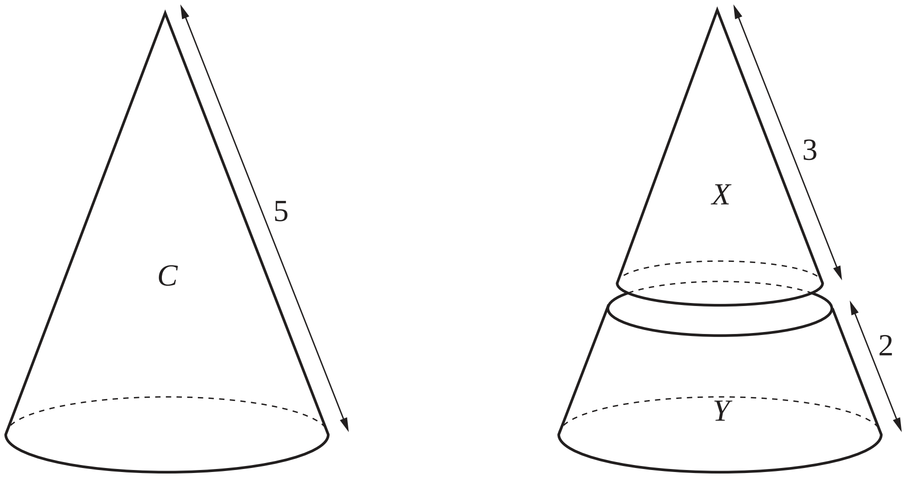


A solid cone, *C*, is cut into two parts, *X* and *Y*, by a plane parallel to the base.
The lengths of the sloping edges of the two parts are 3 cm and 2 cm.
Find the ratio of

(a) the diameters of the bases of *X* and *C*,

(b) the areas of the bases of *X* and *C*,

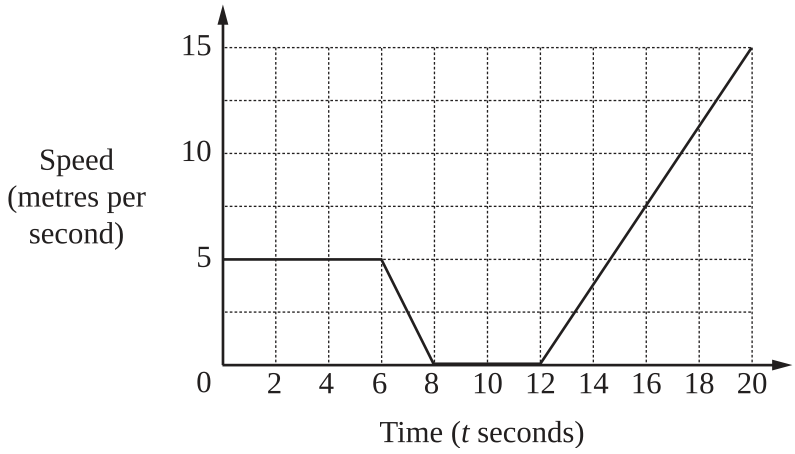
(c) the volumes of *X* and *Y*.

Answer (a) .... : ....[1]

(b) .... : ....[1]

(c) .... : ....[2]

21



The diagram is the speed-time graph for the first 20 seconds of a journey.

(a) Find

(i) the acceleration when $t = 16$,

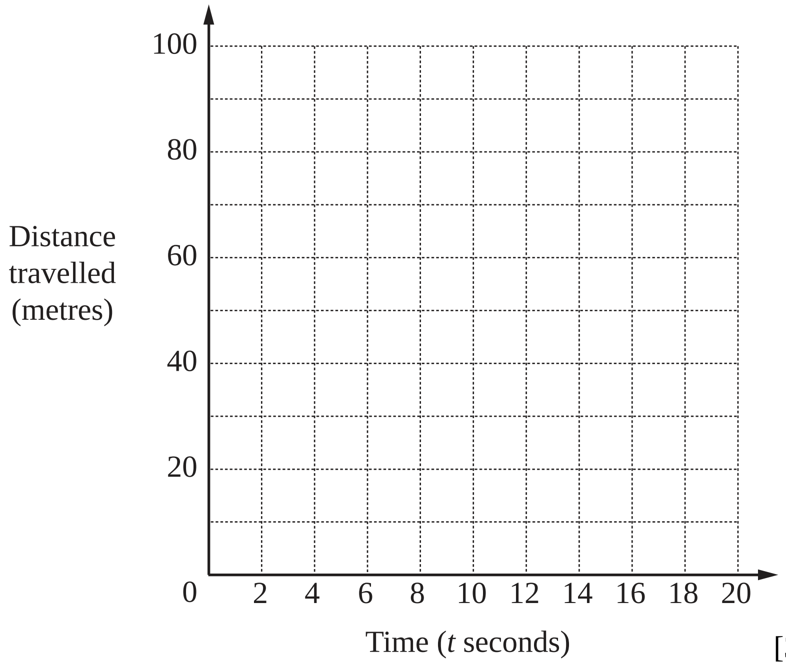
(ii) the distance travelled in the first 20 seconds.

Answer (a) (i) ....m/s^2 [1]

(ii) ....m [1]

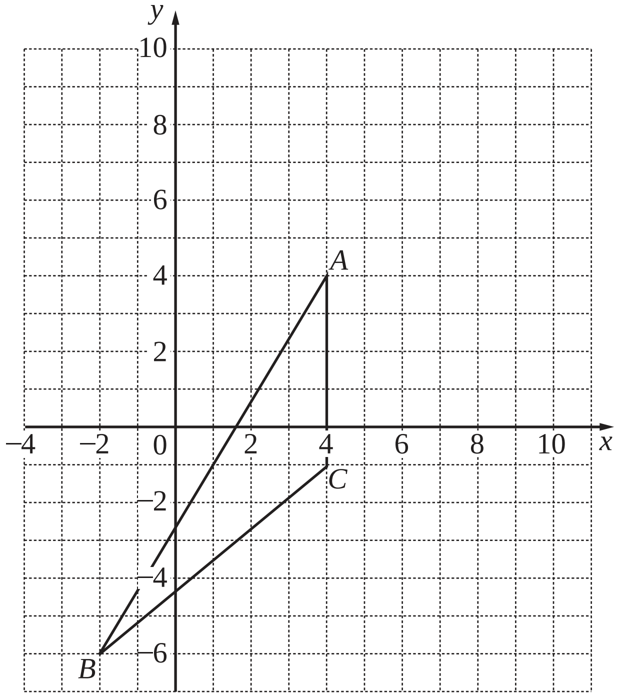
(b) On the grid in the answer space, sketch the distance-time graph for the same journey.

Answer (b)



[3]

22



The triangle with vertices $A(4, 4)$, $B(–2, –6)$ and $C(4, –1)$ is shown in the diagram.
Find

(a) **(i)** the area of ΔABC,

(ii) the coordinates of the point P such that $ABCP$ is a parallelogram,

(iii) the area of the parallelogram $ABCP$,

(iv) tan $B\hat{A}C$.

(b) It is given that the length of $BC = k$ units.
Write down cos $B\hat{C}A$, giving your answer in terms of k.

Answer (a) (i) ....unit^2 [1]

(ii) (............ , ...) [1]

(iii) ....unit^2 [1]

(iv) tan $B\hat{A}C$ = ...[1]

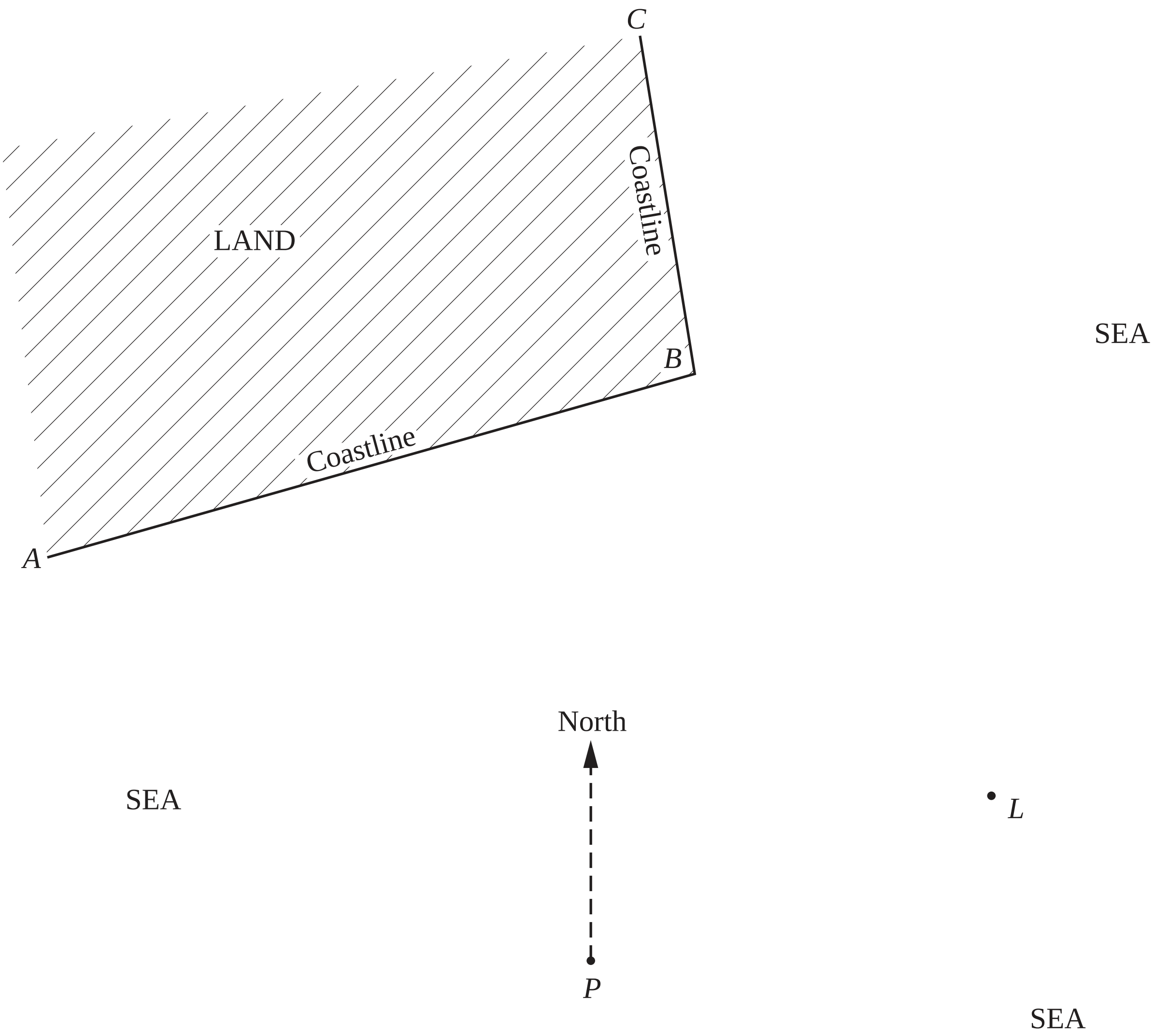
(b) cos $B\hat{C}A$ = ...[1]

23 The diagram below is a map showing a coastline *ABC*, a lighthouse *L* and a point *P*.
The map is drawn to a scale of 1 cm to 100 m.
Ships must not sail within 200 m of the coastline nor within 200 m of the lighthouse.

(a) Construct the locus of points 200 m from the lighthouse *L*.

(b) Construct the locus of points 200 m from the coastline *ABC*.

Answer (a) (b)



[3]

(c) A ship sailed from the point *P* on a bearing of θ°.
It passed between *B* and *L*.
Complete the statement in the answer space.

Answer (c) .... < θ < ....[2]

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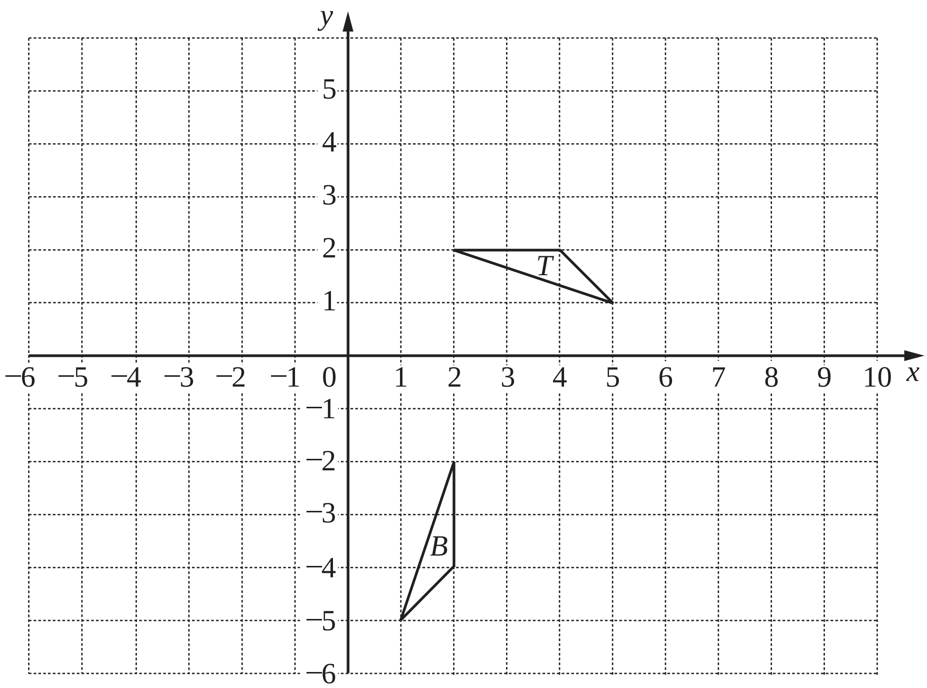

[3]

The diagram shows triangles T and B.

(a) The enlargement, with centre (0, 0) and scale factor 2, maps ΔT onto ΔA.
Draw ΔA on the diagram above.

(b) Describe fully the **single** transformation which maps ΔT onto ΔB.

Answer (b) ....[2]

(c) A transformation is represented by the matrix $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$.

This transformation maps ΔT onto ΔC.
Draw ΔC on the diagram above.