

Centre Number	Candidate Number	Name
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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.



**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]

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**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]

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

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

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

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

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- 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  $8^{\circ}\text{C}$ .  
The temperature at the top was  $-26^{\circ}\text{C}$ .  
Find

- (a) the difference between the two temperatures,  
(b) the mean of the two temperatures.

Answer (a) ..... $^{\circ}\text{C}$  [1]

(b) ..... $^{\circ}\text{C}$  [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]

- 
- 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]

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

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

(b) .....[1]

- 
- 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]

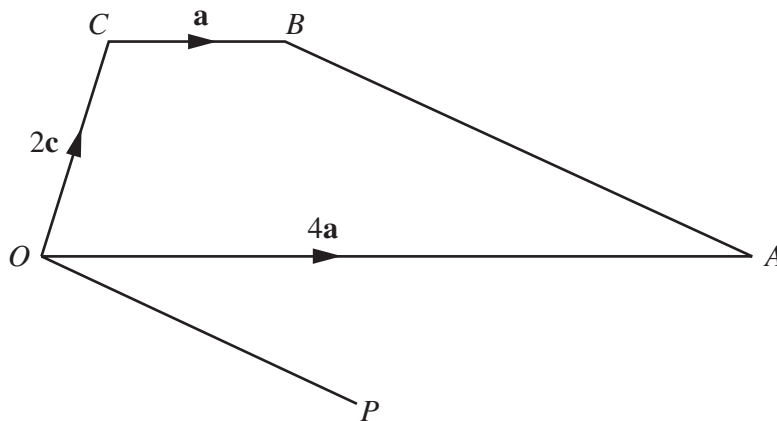
(b) .....km [2]

- 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,  $\vec{OA} = 4\mathbf{a}$ ,  $\vec{OC} = 2\mathbf{c}$  and  $\vec{CB} = \mathbf{a}$ .

- (a) Express  $\vec{BA}$  in terms of  $\mathbf{a}$  and  $\mathbf{c}$ .
- (b)  $\vec{OP} = 2\mathbf{a} - \frac{4}{3}\mathbf{c}$ .

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

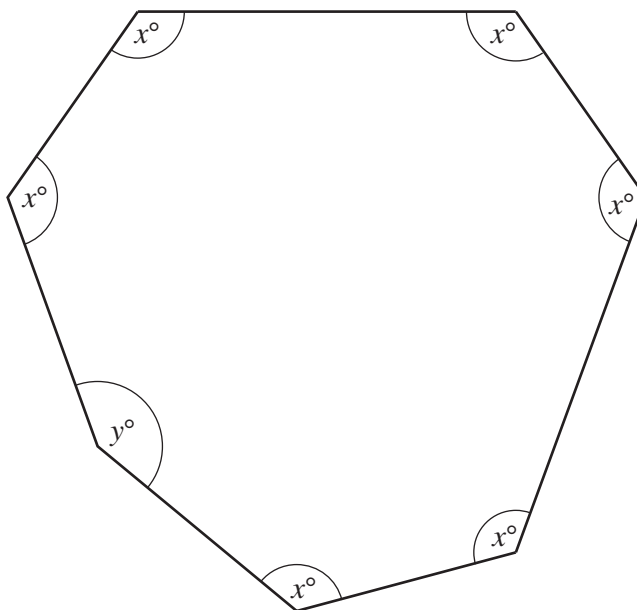
- (c) Find  $\frac{\text{area of triangle } OBA}{\text{area of triangle } OPA}$ .

Answer (a)  $\vec{BA} = \dots\dots\dots$ [1]

Answer (b) .....[1]

Answer (c) .....[1]

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



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

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

Answer (b)  $x = \dots\dots\dots$ [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) .....  $\leq$  distance < .....

.....  $\leq$  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)  $\begin{pmatrix} & \\ & \end{pmatrix}$  [2]

(b)  $\begin{pmatrix} & \\ & \end{pmatrix}$  [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)  $f(-2) = \dots\dots\dots[1]$

(ii)  $p = \dots\dots\dots[1]$

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

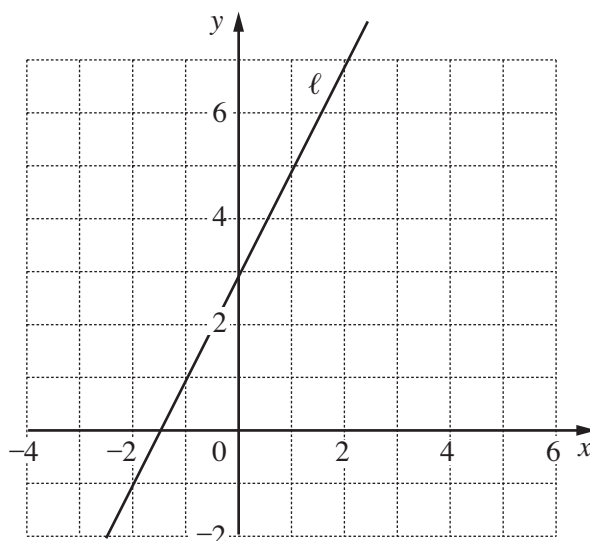
**17** The line  $\ell$  is drawn on the grid in the answer space.

- (a) Write down the equation of the line  $\ell$ .
- (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

$$x \geq 1, y \leq 3 \text{ and } x + y \geq 2.$$

Answer (a)  $\dots\dots\dots[1]$

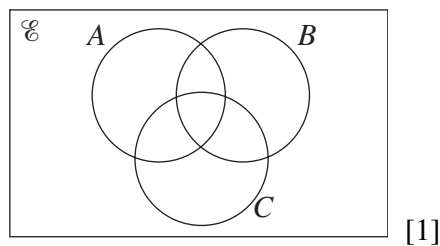
Answer (b)



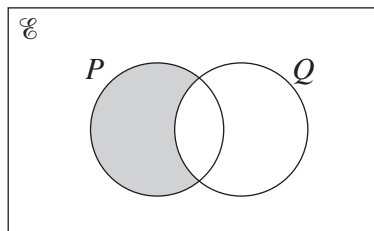
[3]

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

Answer (a)



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

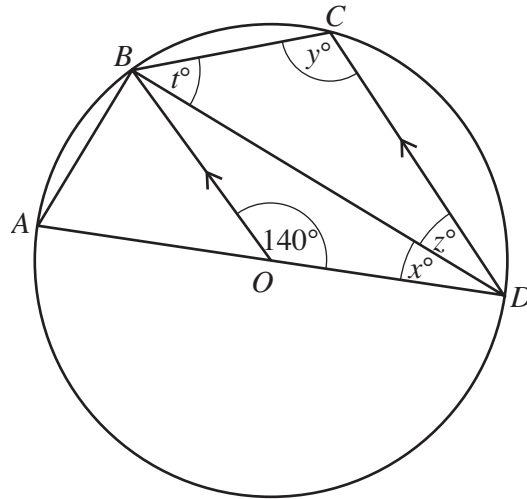


Answer (b) .....[1]

- (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]

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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  $\hat{BOD} = 140^\circ$ . Find

- (a)  $x$ ,
- (b)  $y$ ,
- (c)  $z$ ,
- (d)  $t$ .

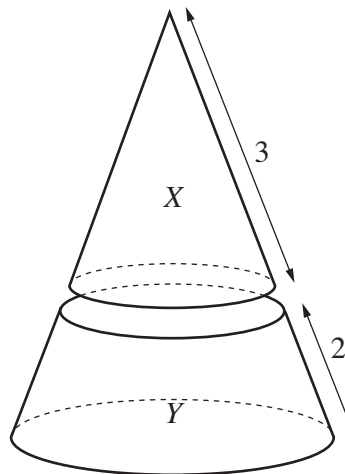
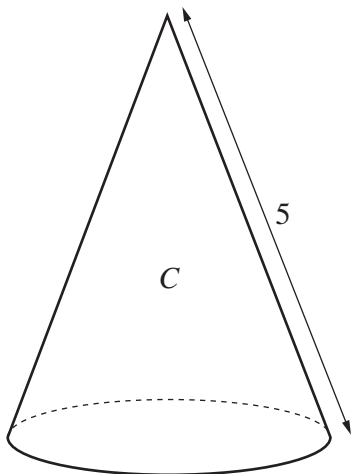
Answer (a)  $x = \dots\dots\dots[1]$

(b)  $y = \dots\dots\dots[1]$

(c)  $z = \dots\dots\dots[1]$

(d)  $t = \dots\dots\dots[1]$

20



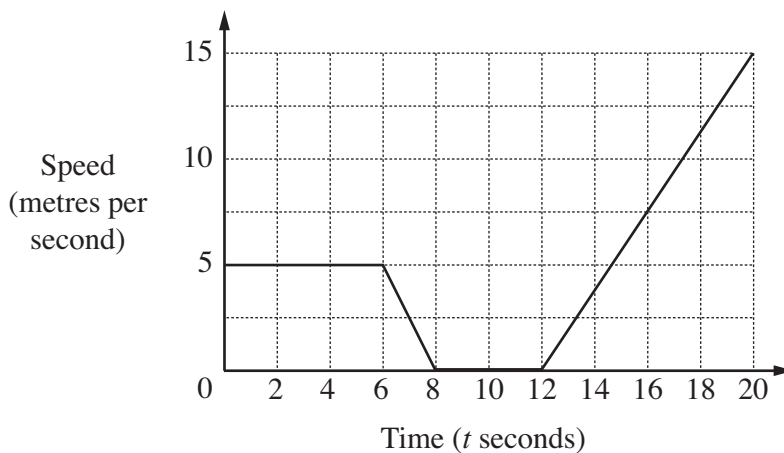
A solid cone,  $C$ , is cut into two parts,  $X$  and  $Y$ , by a plane parallel to the base. The lengths of the sloping edges of the two parts are 3 cm and 2 cm. Find the ratio of

- (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]



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

(a) Find

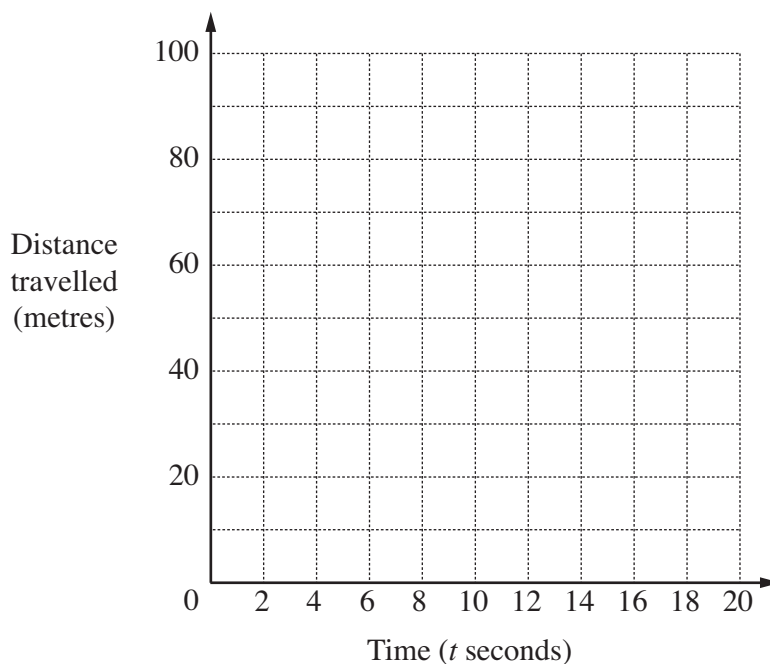
- (i) the acceleration when  $t = 16$ ,
- (ii) the distance travelled in the first 20 seconds.

Answer (a) (i) .....m/s<sup>2</sup> [1]

(ii) .....m [1]

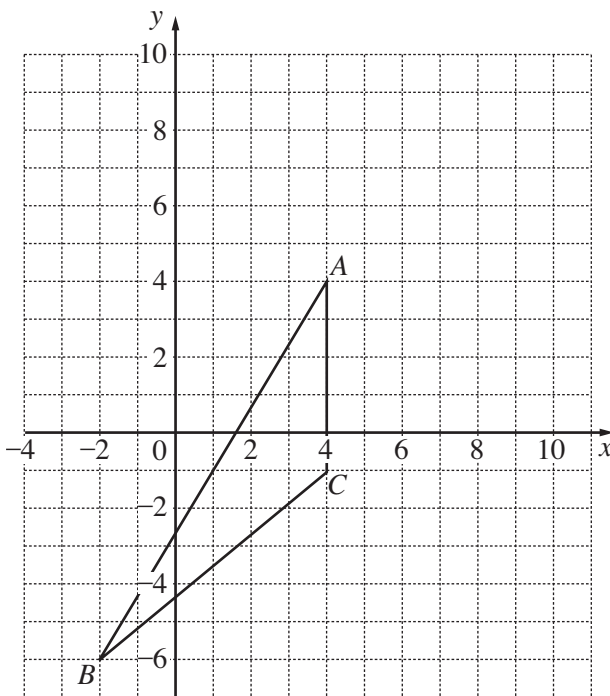
(b) On the grid in the answer space, sketch the distance-time graph for the same journey.

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  $\triangle ABC$ ,
  - (ii) the coordinates of the point  $P$  such that  $ABCP$  is a parallelogram,
  - (iii) the area of the parallelogram  $ABCP$ ,
  - (iv)  $\tan \hat{BAC}$ .
- (b) It is given that the length of  $BC = k$  units.  
Write down  $\cos \hat{BCA}$ , giving your answer in terms of  $k$ .

Answer (a) (i) .....unit<sup>2</sup> [1]

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

(iii) .....unit<sup>2</sup> [1]

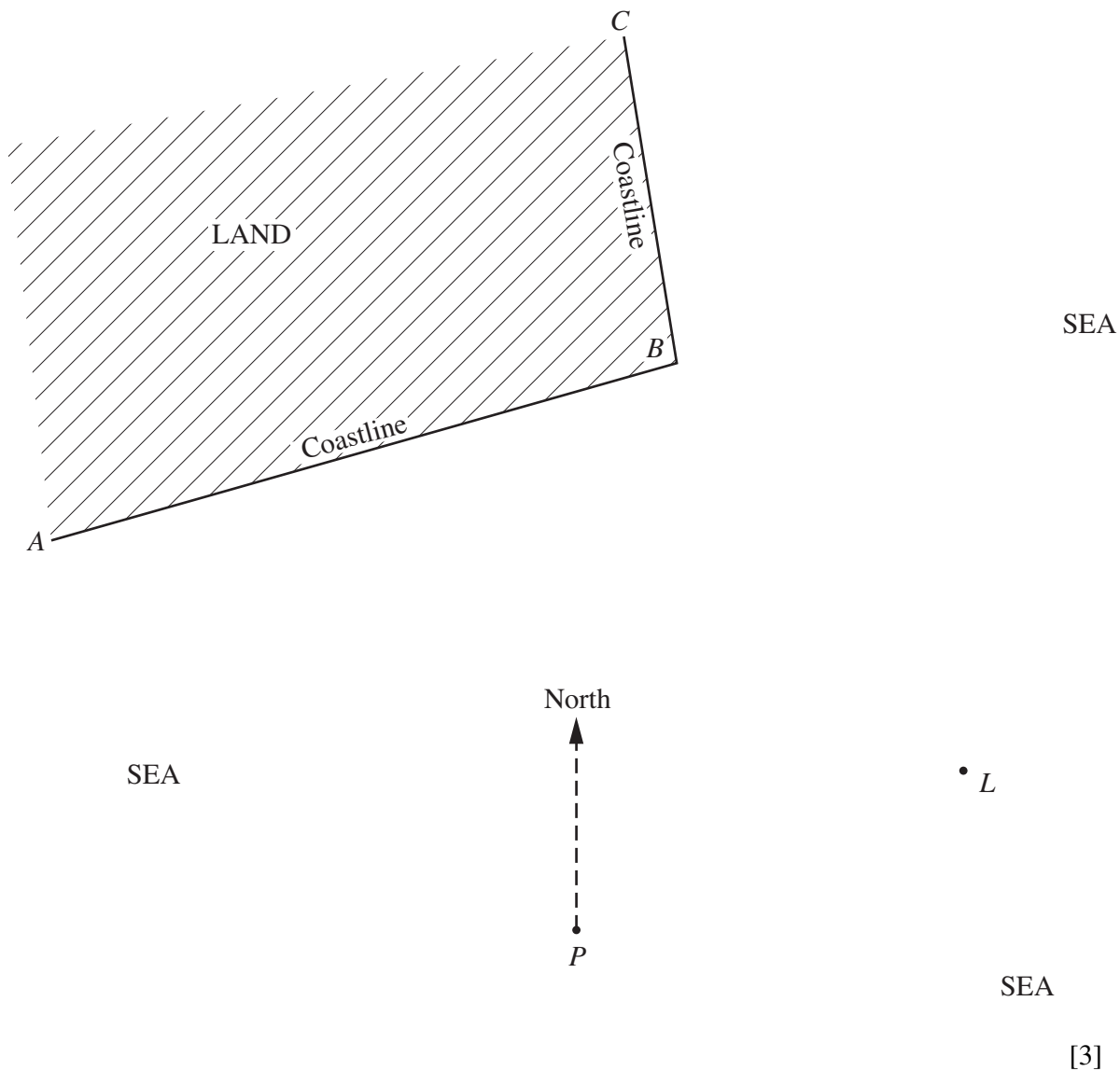
(iv)  $\tan \hat{BAC} = \dots\dots\dots$ [1]

(b)  $\cos \hat{BCA} = \dots\dots\dots$ [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  $ABC$ .

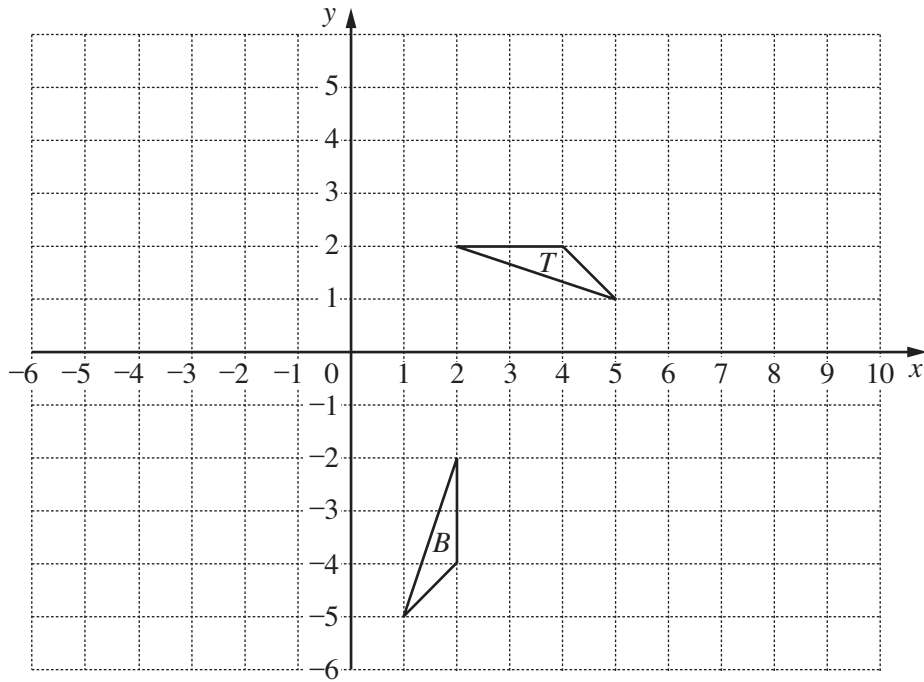
Answer (a) (b)



- (c) A ship sailed from the point  $P$  on a bearing of  $\theta^\circ$ .  
It passed between  $B$  and  $L$ .  
Complete the statement in the answer space.

Answer (c) .....  $< \theta <$  ..... [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  $\Delta T$  onto  $\Delta A$ . Draw  $\Delta A$  on the diagram above.
- (b) Describe fully the **single** transformation which maps  $\Delta T$  onto  $\Delta B$ .

Answer (b) .....[2]

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

This transformation maps  $\Delta T$  onto  $\Delta C$ .  
Draw  $\Delta C$  on the diagram above.