



1. (a) Find the remainder when

$$x^3 - 2x^2 - 4x + 8$$

is divided by

(i)  $x - 3$ ,

(ii)  $x + 2$ .

**(3)**

(b) Hence, or otherwise, find all the solutions to the equation

$$x^3 - 2x^2 - 4x + 8 = 0.$$

**(4)**

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4. (a) Show that the equation

$$3 \sin^2 \theta - 2 \cos^2 \theta = 1$$

can be written as

$$5 \sin^2 \theta = 3. \tag{2}$$

(b) Hence solve, for  $0^\circ \leq \theta < 360^\circ$ , the equation

$$3 \sin^2 \theta - 2 \cos^2 \theta = 1,$$

giving your answers to 1 decimal place. (7)

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**Question 4 continued**

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**(Total 9 marks)**

**Q4**



5. Given that  $a$  and  $b$  are positive constants, solve the simultaneous equations

$$a = 3b,$$

$$\log_3 a + \log_3 b = 2.$$

Give your answers as exact numbers.

(6)

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6.

Figure 1

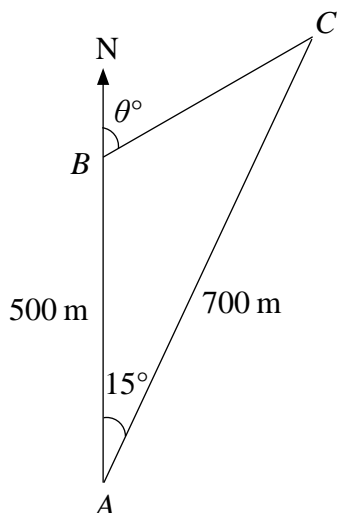


Figure 1 shows 3 yachts  $A$ ,  $B$  and  $C$  which are assumed to be in the same horizontal plane. Yacht  $B$  is 500 m due north of yacht  $A$  and yacht  $C$  is 700 m from  $A$ . The bearing of  $C$  from  $A$  is  $015^\circ$ .

- (a) Calculate the distance between yacht  $B$  and yacht  $C$ , in metres to 3 significant figures. (3)

The bearing of yacht  $C$  from yacht  $B$  is  $\theta^\circ$ , as shown in Figure 1.

- (b) Calculate the value of  $\theta$ . (4)

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**Question 6 continued**

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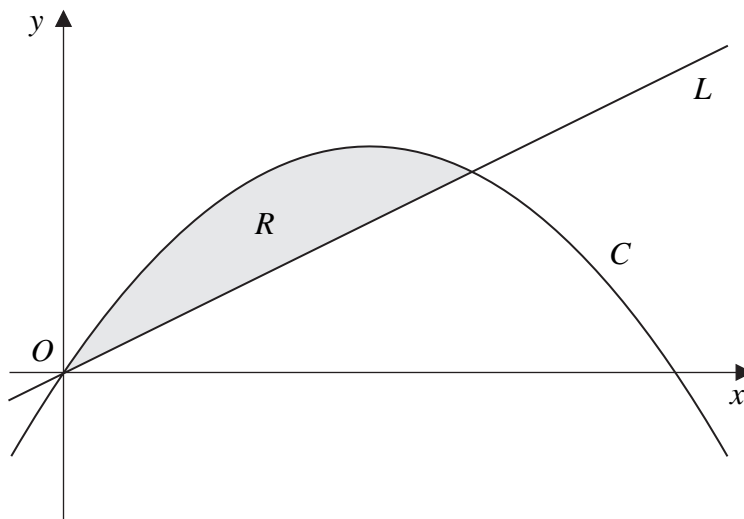
**(Total 7 marks)**

**Q6**



7.

Figure 2



In Figure 2 the curve  $C$  has equation  $y = 6x - x^2$  and the line  $L$  has equation  $y = 2x$ .

(a) Show that the curve  $C$  intersects the  $x$ -axis at  $x = 0$  and  $x = 6$ . (1)

(b) Show that the line  $L$  intersects the curve  $C$  at the points  $(0, 0)$  and  $(4, 8)$ . (3)

The region  $R$ , bounded by the curve  $C$  and the line  $L$ , is shown shaded in Figure 2.

(c) Use calculus to find the area of  $R$ . (6)

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**Question 7 continued**

*[This area contains 30 horizontal lines for writing the answer to Question 7.]*



8. A circle  $C$  has centre  $M (6, 4)$  and radius 3.

(a) Write down the equation of the circle in the form

$$(x - a)^2 + (y - b)^2 = r^2. \tag{2}$$

Figure 3

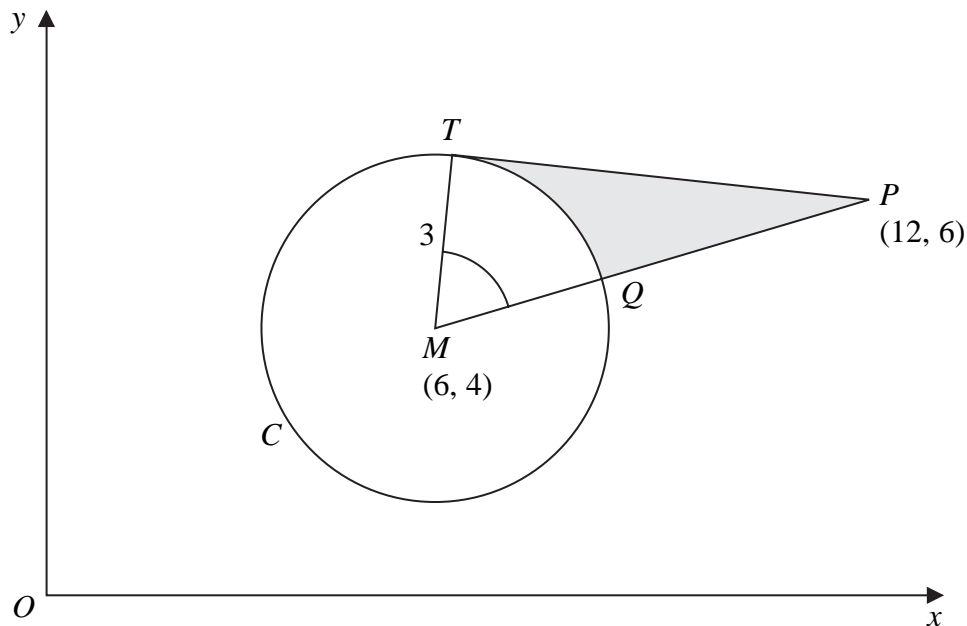


Figure 3 shows the circle  $C$ . The point  $T$  lies on the circle and the tangent at  $T$  passes through the point  $P (12, 6)$ . The line  $MP$  cuts the circle at  $Q$ .

(b) Show that the angle  $TMQ$  is 1.0766 radians to 4 decimal places. (4)

The shaded region  $TPQ$  is bounded by the straight lines  $TP$ ,  $QP$  and the arc  $TQ$ , as shown in Figure 3.

(c) Find the area of the shaded region  $TPQ$ . Give your answer to 3 decimal places. (5)

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9.

**Figure 4**

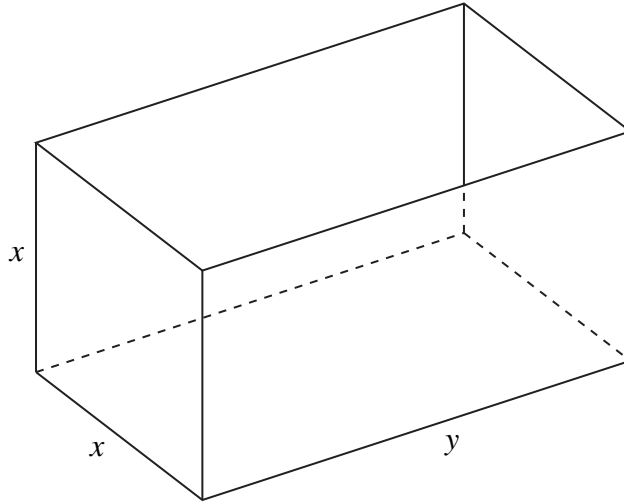


Figure 4 shows an open-topped water tank, in the shape of a cuboid, which is made of sheet metal. The base of the tank is a rectangle  $x$  metres by  $y$  metres. The height of the tank is  $x$  metres.

The capacity of the tank is  $100 \text{ m}^3$ .

(a) Show that the area  $A \text{ m}^2$  of the sheet metal used to make the tank is given by

$$A = \frac{300}{x} + 2x^2. \quad (4)$$

(b) Use calculus to find the value of  $x$  for which  $A$  is stationary. (4)

(c) Prove that this value of  $x$  gives a minimum value of  $A$ . (2)

(d) Calculate the minimum area of sheet metal needed to make the tank. (2)

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**Question 9 continued**

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Q9

(Total 12 marks)

**TOTAL FOR PAPER: 75 MARKS**

**END**

