

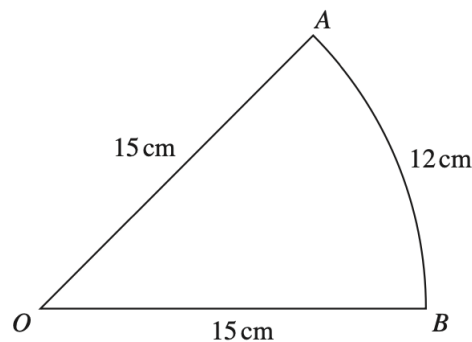
Dr Oliver Mathematics
Cambridge O Level Additional Mathematics
2009 June Paper 1: Calculator
2 hours

The total number of marks available is 80.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

You must write down all the stages in your working.

1. The diagram shows a sector AOB of a circle, centre O , radius 15 cm.



The length of the arc AB is 12 cm.

- (a) Find, in radians, angle AOB . (2)
- (b) Find the area of the sector AOB . (2)
2. The equation of a curve is (4)

$$y = x^3 - 8.$$

Find the equation of the normal to the curve at the point where the curve crosses the x -axis.

3. Show that (4)

$$\frac{1 - \cos^2 \theta}{\sec^2 \theta - 1} \equiv 1 - \sin^2 \theta.$$

4. The line

$$y = 5x - 3$$

is a tangent to the curve

$$y = kx^2 - 3x + 5$$

at the point A .

Find

(a) the value of k , (3)

(b) the coordinates of A . (2)

5. (a) Solve the equation (3)

$$9^{2x-1} = 27^x.$$

(b) Given that (2)

$$\frac{a^{-\frac{1}{2}}b^{\frac{2}{3}}}{\sqrt{a^3b^{-\frac{2}{3}}}} = a^pb^q,$$

find the value of p and of q .

6. Solve the equation (6)

$$2x^3 + 3x^2 - 32x + 15 = 0.$$

7. (a) Find (3)

$$\frac{d}{dx}(xe^{3x} - \frac{1}{3}e^{3x}).$$

(b) Hence find (3)

$$\int xe^{3x} dx.$$

8. A curve has equation

$$y = \frac{2x}{x^2 + 9}.$$

(a) Find the x -coordinate of each of the stationary points of the curve. (4)

(b) Given that x is increasing at the rate of 2 units per second, find the rate of increase of y when $x = 1$. (3)

9. At 1000 hours, a ship P leaves a point A with position vector $(-4\mathbf{i} + 8\mathbf{j})$ km relative to an origin O , where \mathbf{i} is a unit vector due East and \mathbf{j} is a unit vector due North.

The ship sails north-east with a speed of $10\sqrt{2}$ kmh⁻¹.

Find

(a) the velocity vector of P , (2)

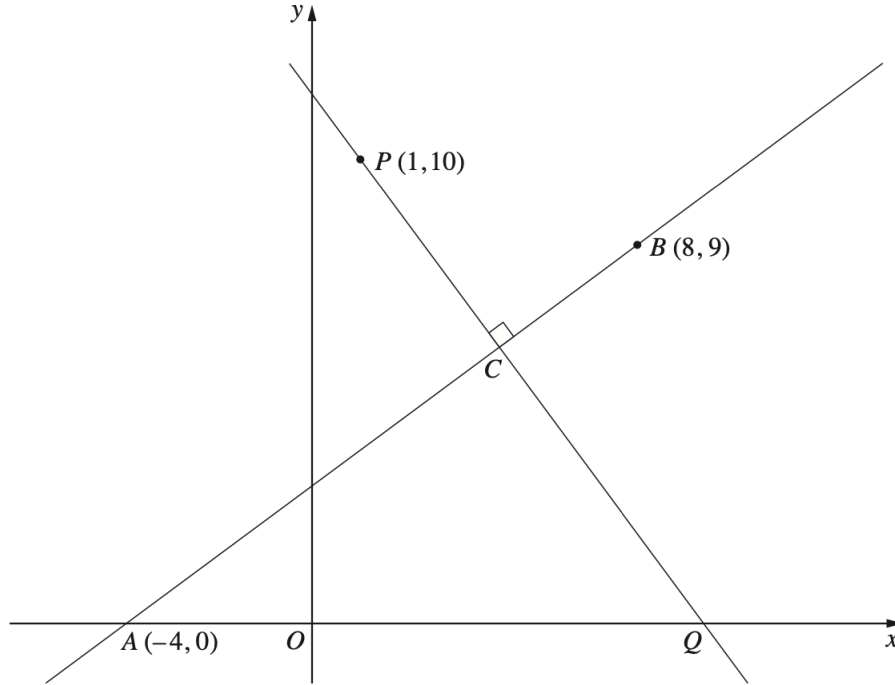
(b) the position vector of P at 1200 hours. (2)

At 1200 hours, a second ship Q leaves a point B with position vector $(19\mathbf{i} + 34\mathbf{j})$ km travelling with velocity vector $(8\mathbf{i} + 6\mathbf{j})$ kmh⁻¹.

(c) Find the velocity of P relative to Q . (2)

- (d) Hence, or otherwise, find the time at which P and Q meet and the position vector of the point where this happens. (3)

10. The diagram shows the line AB passing through the points $A(-4, 0)$ and $B(8, 9)$.



The line through the point $P(1, 10)$, perpendicular to AB , meets AB at C and the x -axis at Q .

Find

- (a) the coordinates of C and of Q , (7)
- (b) the area of triangle ACQ . (2)

11. The table shows experimental values of variables s and t .

t	5	15	30	70	100
s	1305	349	152	55	36

- (a) By plotting a suitable straight line graph, show that s and t are related by the equation (4)

$$s = kt^n,$$

where k and n are constants.

(b) Use your graph to find the value of k and of n . (4)

(c) Estimate the value of s when $t = 50$. (2)

EITHER

12. (a) State the amplitude of (1)

$$1 + \sin \frac{1}{3}x.$$

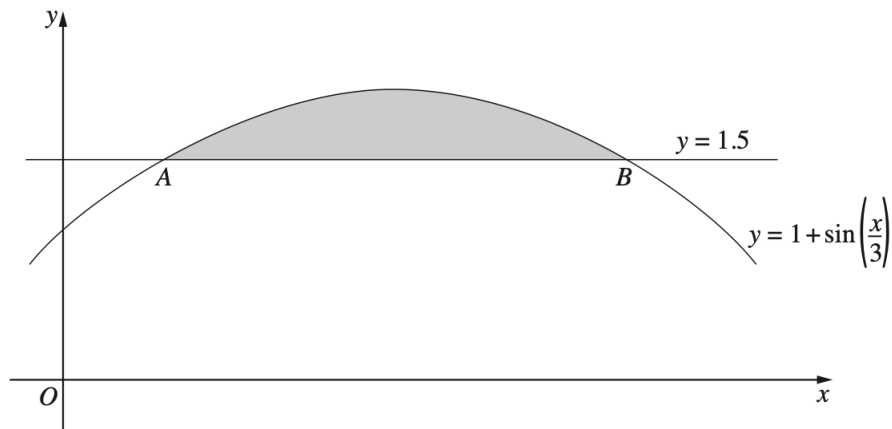
(b) State, in radians, the period of (1)

$$1 + \sin \frac{1}{3}x.$$

The diagram shows the curve

$$y = 1 + \sin \frac{1}{3}x,$$

meeting the line $y = 1.5$ at points A and B .



Find

(c) the x -coordinate of A and of B , (3)

(d) the area of the shaded region. (6)

OR

13. A particle moves in a straight line such that t s after passing through a fixed point O , its velocity, $v \text{ ms}^{-1}$, is given by

$$v = k \cos 4t,$$

where k is a positive constant.

Find

(a) the value of t when the particle is first instantaneously at rest, (1)

(b) an expression for the acceleration of the particle t s after passing through O . (2)

Given that the acceleration of the particle is 12 ms^{-2} when $t = \frac{3}{8}\pi$,

(c) find the value of k . (2)

Using your value for k ,

(d) sketch the velocity-time curve for the particle for $0 \leq t \leq \pi$, (2)

(e) find the displacement of the particle from O when $t = \frac{1}{24}\pi$. (4)

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