

Revision Questions – 16 May 2026

1.

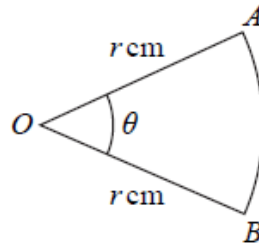
**Figure 1**

Figure 1 shows a sector AOB of a circle with centre O and radius r cm.

The angle AOB is θ radians.

The area of the sector AOB is 11 cm^2

Given that the perimeter of the sector is 4 times the length of the arc AB , find the exact value of r .

(4)

2.

The depth of water, D metres, in a harbour on a particular day is modelled by the formula

$$D = 5 + 2 \sin(30t)^\circ \quad 0 \leq t < 24$$

where t is the number of hours after midnight.

A boat enters the harbour at 6:30 am and it takes 2 hours to load its cargo.

The boat requires the depth of water to be at least 3.8 metres before it can leave the harbour.

(a) Find the depth of the water in the harbour when the boat enters the harbour.

(1)

(b) Find, to the nearest minute, the earliest time the boat can leave the harbour.

(Solutions based entirely on graphical or numerical methods are not acceptable.)

(4)

3.

The height above ground, H metres, of a passenger on a roller coaster can be modelled by the differential equation

$$\frac{dH}{dt} = \frac{H \cos(0.25t)}{40}$$

where t is the time, in seconds, from the start of the ride.

Given that the passenger is 5 m above the ground at the start of the ride,

(a) show that $H = 5e^{0.1 \sin(0.25t)}$ (5)

(b) State the maximum height of the passenger above the ground. (1)

The passenger reaches the maximum height, for the second time, T seconds after the start of the ride.

(c) Find the value of T . (2)

4.

The value, $\pounds V$, of a vintage car t years after it was first valued on 1st January 2001, is modelled by the equation

$$V = Ap^t \quad \text{where } A \text{ and } p \text{ are constants}$$

Given that the value of the car was $\pounds 32\,000$ on 1st January 2005 and $\pounds 50\,000$ on 1st January 2012

(a) (i) find p to 4 decimal places,
(ii) show that A is approximately 24 800 (4)

(b) With reference to the model, interpret
(i) the value of the constant A ,
(ii) the value of the constant p . (2)

Using the model,

(c) find the year during which the value of the car first exceeds $\pounds 100\,000$ (4)

5.

Relative to a fixed origin O ,

the point A has position vector $(2\mathbf{i} + 3\mathbf{j} - 4\mathbf{k})$,

the point B has position vector $(4\mathbf{i} - 2\mathbf{j} + 3\mathbf{k})$,

and the point C has position vector $(a\mathbf{i} + 5\mathbf{j} - 2\mathbf{k})$, where a is a constant and $a < 0$

D is the point such that $\overrightarrow{AB} = \overrightarrow{BD}$.

(a) Find the position vector of D . (2)

Given $|\overrightarrow{AC}| = 4$

(b) find the value of a . (3)

6.

$$f(x) = -3x^3 + 8x^2 - 9x + 10, \quad x \in \mathbb{R}$$

- (a) (i) Calculate $f(2)$
- (ii) Write $f(x)$ as a product of two algebraic factors. (3)

Using the answer to (a)(ii),

(b) prove that there are exactly two real solutions to the equation

$$-3y^6 + 8y^4 - 9y^2 + 10 = 0 \quad (2)$$

(c) deduce the number of real solutions, for $7\pi \leq \theta < 10\pi$, to the equation

$$3 \tan^3 \theta - 8 \tan^2 \theta + 9 \tan \theta - 10 = 0 \quad (1)$$
