

GCE Examinations
Advanced Subsidiary

Core Mathematics C4

Paper E

Time: 1 hour 30 minutes

Instructions and Information

Candidates may use any calculator EXCEPT those with the facility for symbolic algebra, differentiation and/or integration.

Full marks may be obtained for answers to ALL questions.

Mathematical formulae and statistical tables are available.

This paper has eight questions.

Advice to Candidates

You must show sufficient working to make your methods clear to an examiner.
Answers without working may gain no credit.



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1. Find

$$\int \cot^2 2x \, dx. \quad (4)$$

2. A curve has the equation

$$4 \cos x + 2 \sin y = 3.$$

- (a) Show that $\frac{dy}{dx} = 2 \sin x \sec y$. (5)

- (b) Find an equation for the tangent to the curve at the point $(\frac{\pi}{3}, \frac{\pi}{6})$, giving your answer in the form $ax + by = c$, where a and b are integers. (3)

3. continued

$$\mathbf{r} = (6\mathbf{i} + a\mathbf{j} + b\mathbf{k}) + \mu(\mathbf{i} + 4\mathbf{j} - \mathbf{k})$$

(b) Find the values of the constants a and b . (3)

(c) Find, in degrees to 1 decimal place, the acute angle between lines l_1 and l_2 . (4)

4. continued

5. At time $t = 0$, a tank of height 2 metres is completely filled with water. Water then leaks from a hole in the side of the tank such that the depth of water in the tank, y metres, after t hours satisfies the differential equation

$$\frac{dy}{dt} = -ke^{-0.2t},$$

where k is a positive constant,

- (a) Find an expression for y in terms of k and t . (4)

Given that two hours after being filled the depth of water in the tank is 1.6 metres,

- (b) find the value of k to 4 significant figures. (3)

Given also that the hole in the tank is h cm above the base of the tank,

- (c) show that $h = 79$ to 2 significant figures. (3)

5. continued


$$x = 2 - t^2, \quad y = t(t + 1), \quad t \geq 0.$$

6. continued

7. (a) Prove that

$$\frac{d}{dx}(a^x) = a^x \ln a. \quad (3)$$

A curve has the equation $y = 4^x - 2^{x-1} + 1$.

(b) Show that the tangent to the curve at the point where it crosses the y -axis has the equation

$$3x \ln 2 - 2y + 3 = 0. \quad (5)$$

(c) Find the exact coordinates of the stationary point of the curve. (4)

7. continued



The shaded region is bounded by the curve, the x -axis and the line $x = 3$.

- The shaded region is rotated through 2π radians about the x -axis.

8. continued

8. continued

END