Core Mathematics C2 Paper K

1. Solve the equation

$$\log_5 (4x + 3) - \log_5 (x - 1) = 2.$$ [4]

2. Find the coefficient of x^2 in the expansion of

$$(1 + x)(1 - x)^6.$$ [5]
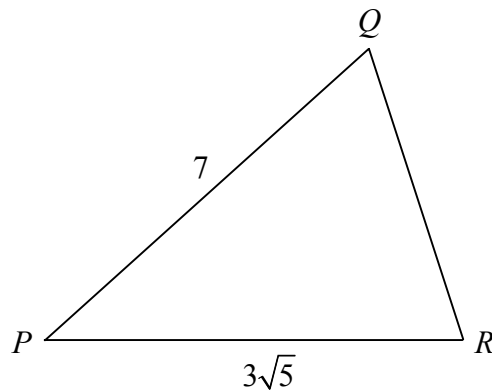
3. *(i)* Evaluate

$$\sum_{r=1}^{50} (80 - 3r).$$ [3]

(ii) Show that

$$\sum_{r=1}^{n} \frac{r + 3}{2} = kn(n + 7),$$

where k is a rational constant to be found. [4]

4.

The diagram shows triangle *PQR* in which $PQ = 7$ and $PR = 3\sqrt{5}$.

Given that $\sin (\angle QPR) = \frac{2}{3}$ and that $\angle QPR$ is acute,

(i) find the exact value of $\cos (\angle QPR)$ in its simplest form, [2]

(ii) show that $QR = 2\sqrt{6}$, [3]

(iii) find $\angle PQR$ in degrees to 1 decimal place. [2]

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5. *(i)* Find

$$\int \left(8x - \frac{2}{x^3}\right) \, dx.$$ [3]

The gradient of a curve is given by

$$\frac{dy}{dx} = 8x - \frac{2}{x^3}, \quad x \neq 0,$$

and the curve passes through the point (1, 1).

(ii) Show that the equation of the curve can be written in the form

$$y = \left(ax + \frac{b}{x}\right)^2,$$

where a and b are integers to be found. [4]

6. Given that

$$f(x) = x^3 + 7x^2 + px - 6,$$

and that $x = -3$ is a solution to the equation $f(x) = 0$,

(i) find the value of the constant p, [2]

(ii) show that when $f(x)$ is divided by $(x - 2)$ there is a remainder of 50, [2]

(iii) find the other solutions to the equation $f(x) = 0$, giving your answers to 2 decimal places. [5]

7. The second and third terms of a geometric series are $\log_3 4$ and $\log_3 16$ respectively.

(i) Find the common ratio of the series. [3]

(ii) Show that the first term of the series is $\log_3 2$. [2]

(iii) Find, to 3 significant figures, the sum of the first six terms of the series. [5]
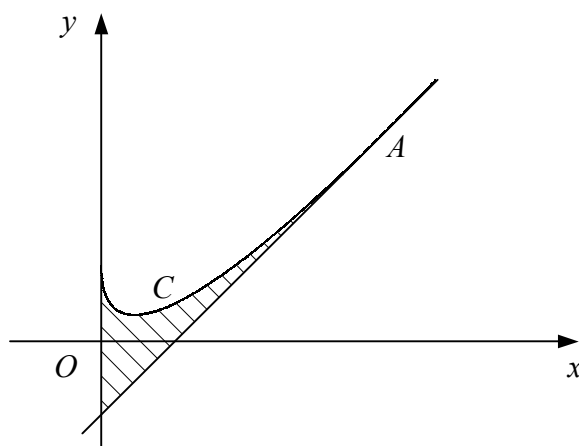
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8. *(i)* Find, to 2 decimal places, the values of x in the interval $0 \le x < \pi$ for which

$$\tan 2x = 3.$$ [4]

(ii) Find, in terms of π, the values of y in the interval $0 \le y < 2\pi$ for which

$$2 \sin y = \tan y.$$ [7]

9.

The diagram shows the curve C with equation $y = 3x - 4\sqrt{x} + 2$ and the tangent to C at the point A.

Given that A has x-coordinate 4,

(i) show that the tangent to C at A has the equation $y = 2x - 2$. [6]

The shaded region is bounded by C, the tangent to C at A and the y-axis.

(ii) Find the area of the shaded region. [6]