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- 1 Find the quotient and remainder when $x^4 - 3x^3 + 9x^2 - 12x + 27$ is divided by $x^2 + 5$. [3]

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- 2 (a)** Find the coefficient of x^2 in the expansion of $(2x-5)\sqrt{4-x}$. [4]

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- (b)** State the set of values of x for which the expansion in part **(a)** is valid. [1]

[illegible]

3 It is given that $z = -\sqrt{3} + i$.

- (a) Express z^2 in the form $re^{i\theta}$, where $r > 0$ and $-\pi < \theta \leq \pi$. [3]

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- (b) The complex number ω is such that $z^2\omega$ is real and $\left|\frac{z^2}{\omega}\right| = 12$.

Find the two possible values of ω , giving your answers in the form $Re^{i\alpha}$, where $R > 0$ and $-\pi < \alpha \leq \pi$. [3]

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$$\ln\left(\frac{p}{q}\right) = a \quad \text{and} \quad \ln(q^2 p) = b.$$

Express $\ln(p^7q)$ in terms of a and b .

[4]

- 5 (a)** On a sketch of an Argand diagram, shade the region whose points represent complex numbers z satisfying the inequalities $|z - 4 - 2i| \leq 3$ and $|z| \geq |10 - z|$. [4]

- (b) Find the greatest value of $\arg z$ for points in this region. [2]

[illegible]

6 The equation of a curve is $2y^2 + 3xy + x = x^2$.

(a) Show that $\frac{dy}{dx} = \frac{2x-3y-1}{4y+3x}$. [4]

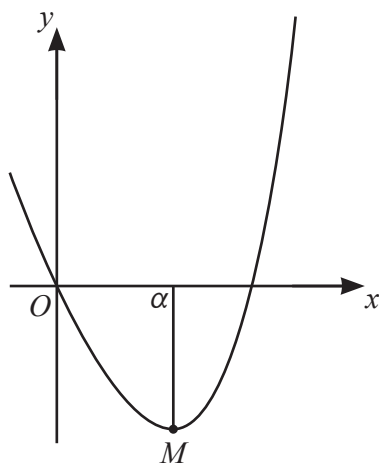
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[3]

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(a) Show that α satisfies the equation $\alpha = \frac{1}{2} \ln\left(\frac{5}{1+2\alpha}\right)$. [3]

[illegible]

- (b)** Verify by calculation that α lies between 0.4 and 0.5 . [2]

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- (c) Use an iterative formula based on the equation in part (a) to determine α correct to 2 decimal places. Give the result of each iteration to 4 decimal places. [3]

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- 8 (a)** Express $3 \sin x + 2\sqrt{2} \cos\left(x + \frac{1}{4}\pi\right)$ in the form $R \sin(x + \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. State the exact value of R and give α correct to 3 decimal places. [4]

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(b) Hence solve the equation

$$6 \sin \frac{1}{2} \theta + 4 \sqrt{2} \cos \left(\frac{1}{2} \theta + \frac{1}{4} \pi \right) = 3$$

for $-4\pi < \theta < 4\pi$.

[5]

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- 9 Relative to the origin O , the position vectors of the points A , B and C are given by

$$\overrightarrow{OA} = 5\mathbf{i} - 2\mathbf{j} + \mathbf{k}, \quad \overrightarrow{OB} = 8\mathbf{i} + 2\mathbf{j} - 6\mathbf{k} \quad \text{and} \quad \overrightarrow{OC} = 3\mathbf{i} + 4\mathbf{j} - 7\mathbf{k}.$$

- (a) Show that $OABC$ is a rectangle.

[4]

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- [4]

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10 Let $f(x) = \frac{36a^2}{(2a+x)(2a-x)(5a-2x)}$, where a is a positive constant.

(a) Express $f(x)$ in partial fractions.

[5]

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- (b) Hence find the exact value of $\int_{-a}^a f(x) dx$, giving your answer in the form $p \ln q + r \ln s$ where p and r are integers and q and s are prime numbers. [5]

[5]

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