

- 1** Expand $(3+x)(1-2x)^{\frac{1}{2}}$ in ascending powers of x , up to and including the term in x^2 , simplifying the coefficients. [4]

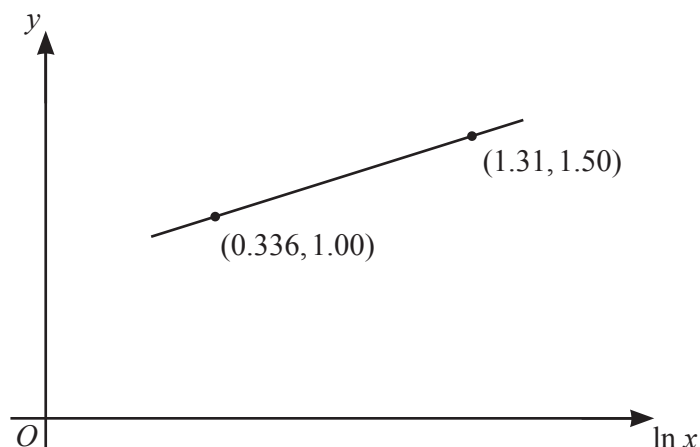
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- 2 Solve the equation $\ln(x-5) = 7 - \ln x$. Give your answer correct to 2 decimal places. [4]

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The variables x and y satisfy the equation $a^y = bx$, where a and b are constants. The graph of y against $\ln x$ is a straight line passing through the points $(0.336, 1.00)$ and $(1.31, 1.50)$, as shown in the diagram.

Find the values of a and b . Give each value correct to the nearest integer. [4]

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4 The complex number u is given by $u = -1 - i\sqrt{3}$.

- (a) Express u in the form $r(\cos \theta + i \sin \theta)$, where $r > 0$ and $-\pi < \theta \leq \pi$. Give the exact values of r and θ . [2]

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The complex number v is given by $v = 5\left(\cos \frac{1}{6}\pi + i \sin \frac{1}{6}\pi\right)$.

- (b) Express the complex number $\frac{v}{u}$ in the form $re^{i\theta}$ where $r > 0$ and $-\pi < \theta \leq \pi$. [2]

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- 5** The equation of a curve is $y = \frac{e^{\sin x}}{\cos^2 x}$ for $0 \leq x \leq 2\pi$.

Find $\frac{dy}{dx}$ and hence find the x -coordinates of the stationary points of the curve. [7]

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- (b) Verify by calculation that α lies between 1 and 2.
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- [illegible]

converges, then it converges to α . [1]

[illegible]

- (d) Use this iterative formula with an initial value of 1.4 to determine α correct to 2 decimal places. Give the result of each iteration to 4 decimal places. [3]

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- (e) State the minimum number of calculated iterations needed with this initial value to determine α correct to 2 decimal places. [1]

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- (a) On a single Argand diagram sketch the loci given by the equations $|z - 3 + 2i| = 2$ and $|w - 3 + 2i| = |w + 3 - 4i|$ where z and w are complex numbers. [4]

- (b) Hence find the least value of $|z - w|$ for points on these loci. Give your answer in an exact form. [2]

[illegible]

Use the substitution $u = 1 - \sin x$ to find the exact value of

$$\int_{\pi}^{\frac{3}{2}\pi} \frac{\sin 2x}{\sqrt{1-\sin x}} dx.$$

Give your answer in the form $a + b\sqrt{2}$ where a and b are rational numbers to be determined.

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- 9 The equations of two straight lines l_1 and l_2 are

$$l_1: \mathbf{r} = \mathbf{i} - 2\mathbf{j} + 3\mathbf{k} + \lambda(2\mathbf{i} - \mathbf{j} + a\mathbf{k}) \quad \text{and} \quad l_2: \mathbf{r} = -\mathbf{i} - \mathbf{j} - \mathbf{k} + \mu(3\mathbf{i} - 2\mathbf{j} - 2\mathbf{k}),$$

where a is a constant.

The lines l_1 and l_2 are perpendicular.

- (a) Show that $a = 4$. [1]

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The lines l_1 and l_2 also intersect.

- (b) Find the position vector of the point of intersection. [4]

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The point A has position vector $-5\mathbf{i} + \mathbf{j} - 9\mathbf{k}$.

- (c) Show that A lies on l_1 . [2]

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The point B is the image of A after a reflection in the line l_2 .

- (d) Find the position vector of B . [2]

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- 10 (a)** Given that $2x = \tan y$, show that $\frac{dy}{dx} = \frac{2}{1+4x^2}$. [3]

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- (b) Hence find the exact value of $\int_{\frac{1}{2}}^{\frac{\sqrt{3}}{2}} x \tan^{-1}(2x) dx$. [7]

This image shows a blank sheet of white paper with horizontal dotted lines for writing. The lines are evenly spaced and run across the width of the page. There is a faint watermark in the top left corner that reads "Kambor ka".

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- 11** In a field there are 300 plants of a certain species, all of which can be infected by a particular disease. At time t after the first plant is infected there are x infected plants. The rate of change of x is proportional to the product of the number of plants infected and the number of plants that are **not** yet infected. The variables x and t are treated as continuous, and it is given that $\frac{dx}{dt} = 0.2$ and $x = 1$ when $t = 0$.

(a) Show that x and t satisfy the differential equation

$$1495 \frac{dx}{dt} = x(300 - x). \quad [2]$$

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- (b)** Using partial fractions, solve the differential equation and obtain an expression for t in terms of a single logarithm involving x . [9]

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