5. (a) Find $\int x^2 \cos 2x \, \mathrm{d}x$

(4)

(b) Hence solve the differential equation

$$\frac{\mathrm{d}y}{\mathrm{d}t} = \left(\frac{t \cos t}{y} \right)^2$$

giving your answer in the form $y^n = \mathrm{f}(t)$ where n is an integer.

(5)

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Question 5 continued

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Question 5 continued

(Total for Question 5 is 9 marks)

6. Relative to a fixed origin O, the lines l_1 and l_2 are given by the equations

$$l_1 : \mathbf{r} = (3\mathbf{i} + p\mathbf{j} + 7\mathbf{k}) + \lambda(2\mathbf{i} - 5\mathbf{j} + 4\mathbf{k})$$

$$l_2 : \mathbf{r} = (8\mathbf{i} - 2\mathbf{j} + 5\mathbf{k}) + \mu(4\mathbf{i} + \mathbf{j} + 2\mathbf{k})$$

where λ and μ are scalar parameters and p is a constant.

Given that l_1 and l_2 intersect,

(a) find the value of p,

(4)

(b) find the position vector of the point of intersection.

(2)

(c) Find the acute angle between l_1 and l_2

Give your answer in degrees to one decimal place.

(3)

The point A lies on l_1 with parameter $\lambda = 2$

The point B lies on l_2 with $\overrightarrow{AB}$ perpendicular to l_2

(d) Find the coordinates of B

(5)

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