A1: Correct derivative.

M1: Uses implicit differentiation to find $\frac{\mathrm{d}S}{\mathrm{d}t}$ in terms of $\frac{\mathrm{d}r}{\mathrm{d}t}$ and $\frac{\mathrm{d}l}{\mathrm{d}t}$.

A1: As main scheme.

Question	Scheme	Marks
5(a)	$\int x^2 \cos 2x \,\mathrm{d}x = x^2.\frac{1}{2}\sin 2x - \int 2x.\frac{1}{2}\sin 2x \,\mathrm{d}x$	**M1 A1**
	$= x^2.\frac{1}{2}\sin 2x - \left(-\frac{1}{2}x\cos 2x - \int -\frac{1}{2}\cos 2x \,\mathrm{d}x\right)$	**M1**
	$= \frac{1}{2}x^2 \sin 2x + \frac{1}{2}x\cos 2x - \frac{1}{4}\sin 2x \ (+c)$	**A1**
		(4)
(b)	$\frac{\mathrm{d}y}{\mathrm{d}t} = \frac{t^2\cos^2 t}{y^2} \Rightarrow$ e.g. $\int y^2 \frac{\mathrm{d}y}{\mathrm{d}t}\mathrm{d}t$ or $\int y^2 \,\mathrm{d}y = \int t^2\cos^2 t \,\mathrm{d}t$	**B1**
	$\Rightarrow \frac{y^3}{3} = \ldots \quad ; \quad \ldots = \frac{1}{2}\int t^2 + t^2\cos 2t \,\mathrm{d}t$	**M1 ; M1**
	$\ldots = \frac{1}{6}t^3 + \frac{1}{2}\left(\frac{1}{2}t^2\sin 2t + \frac{1}{2}t\cos 2t - \frac{1}{4}\sin 2t\right) \quad (+c)$	**M1**
	$\Rightarrow y^3 = \frac{1}{2}t^3 + \frac{3}{4}t^2\sin 2t + \frac{3}{4}t\cos 2t - \frac{3}{8}\sin 2t + c$	**A1ft**
		(5)
		(9 marks)

Notes:

(a)

M1: Attempts parts in the correct direction – look for $Ax^2\sin 2x \pm \int Bx\sin 2x \,\mathrm{d}x$ unless they explicitly state an incorrect formula (in which case it is M0).

A1: Correct first application of parts.

M1: Attempts parts again in the same direction. $\int x\sin 2x \,\mathrm{d}x \to Kx\cos 2x \pm L\int \cos 2x \,\mathrm{d}x$

A1: Correct answer with or without constant of integration. ISW after a correct answer.

(b)

Note: accept use of x in place of t (or even mixed x's and t's) for the method marks if the intention is clear, but the final A mark needs to be correct in terms of t.

B1: Correct separation of variables with indication to integrate (e.g. statement as shown in scheme, or an attempt to integrate one side).

M1: For $y^n \to \ldots y^{n+1}$ on the left hand side.

M1: Applies double angle formula to right hand side. Accept $\cos^2 t \to \frac{1}{2}(\pm 1 \pm \cos 2t)$ for this mark.

M1: Applies their result from (a) (allow with *t* or *x* here) or redoes integration by parts and reaches the correct form or same form as their (a), and integrates the *t*"2" term (no need for +*c*)

A1ft: Achieves the correct result, accepting equivalent forms, but must include a constant of integration (+ *c* or other labelling is fine). Follow through on their answer to (a) *providing* isw was not applied. So for $y^3 = \frac{1}{2}t^3 + \frac{3}{2} \times$ their answer to (a) $+ c$

5(a) By DI method

S	*D*	*I*
+	x^2	$\cos 2x$
-	$2x$	$\frac{1}{2}\sin 2x$
+	2	$-\frac{1}{4}\cos 2x$
-	0	$-\frac{1}{8}\sin 2x$

M1 A1

$$\int x^2 \cos 2x \, dx = x^2 \times \frac{1}{2}\sin 2x - 2x \times -\frac{1}{4}\cos 2x + 2 \times -\frac{1}{8}\sin 2x$$ **M1**

$$= \frac{1}{2}x^2 \sin 2x + \frac{1}{2}x\cos 2x - \frac{1}{4}\sin 2x \ (+c)$$ **A1**

Notes

M1: Sets up a correct table or equivalent method with x^2 and cos *x* as the leads.

A1: Correct tables of derivatives and integrals.

M1: Extracts the answer from the table achieving the correct form.

A1: Correct answer.

Note an answer of the form $Ax^2 \sin 2x + Bx\cos 2x + C\sin 2x$ with no incorrect working seen can score M1A0M1A0 if the coefficients are incorrect.

Question	Scheme	Marks
6(a)	$\left(3\mathbf{i}+p\mathbf{j}+7\mathbf{k}\right)+\lambda\left(2\mathbf{i}-5\mathbf{j}+4\mathbf{k}\right)=\left(8\mathbf{i}-2\mathbf{j}+5\mathbf{k}\right)+\mu\left(4\mathbf{i}+\mathbf{j}+2\mathbf{k}\right)$ $3+2\lambda=8+4\mu$ (1) $\Rightarrow p-5\lambda=-2+\mu$ (2) $7+4\lambda=5+2\mu$ (3)	**M1**
	e.g. $(3)-2\times(1):1=-11-6\mu\Rightarrow\mu=-2$ $\left(\text{or } \lambda=-\frac{3}{2}\right)$	**M1**
	$\mu=-2$, $\lambda=-\frac{3}{2}\Rightarrow p=-2-2-\frac{15}{2}=...$	**M1**
	$p=-\frac{23}{2}$	**A1**
		(4)
(b)	Intersect at $\left(8\mathbf{i}-2\mathbf{j}+5\mathbf{k}\right)+-2\left(4\mathbf{i}+\mathbf{j}+2\mathbf{k}\right)=..$	**M1**
	$=-4\mathbf{j}+\mathbf{k}$	**A1**
		(2)
(c)	$\left(2\mathbf{i}-5\mathbf{j}+4\mathbf{k}\right).\left(4\mathbf{i}+\mathbf{j}+2\mathbf{k}\right)=2\times4-5\times1+4\times2=...$	**M1**
	$\cos\theta=\frac{"11"}{\sqrt{2^2+5^2+4^2}\sqrt{4^2+1^2+2^2}}=...\left(=\frac{11}{3\sqrt{105}}=0.3578...\right)$	**M1**
	$\theta=\cos^{-1}\frac{11}{3\sqrt{105}}=69.0°$	**A1**
		(3)
(d)	$\lambda=2\Rightarrow\overrightarrow{OA}=\left(7\mathbf{i}-\frac{43}{2}\mathbf{j}+15\mathbf{k}\right)$	**B1ft**
	$\overrightarrow{AB}=\pm\left(\left(8\mathbf{i}-2\mathbf{j}+5\mathbf{k}\right)+\mu\left(4\mathbf{i}+\mathbf{j}+2\mathbf{k}\right)-\left(7\mathbf{i}-\frac{43}{2}\mathbf{j}+15\mathbf{k}\right)\right)$ $=\pm\left(\left(1+4\mu\right)\mathbf{i}+\left(\frac{39}{2}+\mu\right)\mathbf{j}+\left(-10+2\mu\right)\mathbf{k}\right)$	**M1**
	$\left(\left(1+4\mu\right)\mathbf{i}+\left(\frac{39}{2}+\mu\right)\mathbf{j}+\left(-10+2\mu\right)\mathbf{k}\right).\left(4\mathbf{i}+\mathbf{j}+2\mathbf{k}\right)=0\Rightarrow\mu=..\left(=-\frac{1}{6}\right)$	**M1**
	$\overrightarrow{OB}=\left(8\mathbf{i}-2\mathbf{j}+5\mathbf{k}\right)+"-\frac{1}{6}"\left(4\mathbf{i}+\mathbf{j}+2\mathbf{k}\right)=...$	**dM1**
	$=\frac{22}{3}\mathbf{i}-\frac{13}{6}\mathbf{j}+\frac{14}{3}\mathbf{k}$ or $\left(\frac{22}{3},-\frac{13}{6},\frac{14}{3}\right)$	**A1**
		(5)
		(14 marks)