Question Number	Scheme	Marks
5(a)	$0.5v\dfrac{\mathrm{d}v}{\mathrm{d}x}=-\dfrac{2}{x^3}$	M1
	$\int v\,\mathrm{d}v=\int -\dfrac{4}{x^3}\,\mathrm{d}x$	
	$\dfrac{v^2}{2}=\dfrac{2}{x^2}\quad(+k)$	DM1A1
	$v^2=\dfrac{4}{x^2}+2k$	
	$v=3, x=1\Rightarrow 2k=5$	DM1
	$v^2=\dfrac{4}{x^2}+5$ *	A1 *
		(5)
	Alt for first 2 marks using Energy	
	Use of $W=\int F dx$	M1
	Attempt integration **and** equate to change in KE.	M1
(b)	$\dfrac{\mathrm{d}x}{\mathrm{d}t}=\sqrt{\dfrac{4}{x^2}+5}$	M1
	$\int \dfrac{x}{\sqrt{5x^2+4}}\mathrm{d}x=\int \mathrm{d}t$	M1A1
	$\dfrac{1}{5}\sqrt{5x^2+4}=t\qquad(+k_1)$	DM1A1
	$x=1,\ t=1\Rightarrow k_1=-\dfrac{2}{5}$	DM1
	$t=\dfrac{2+\sqrt{5x^2+4}}{5}$	A1
		(7)

(a)

M1 Dimensionally correct equation of motion. Acceleration must be in form $v\frac{\mathrm{d}v}{\mathrm{d}x}$. Condone missing minus sign.

DM1 Separate variables **and** attempt integration. Condone missing minus sign.

A1 Correct integrals. Condone missing constant.

DM1 Use $v = 3, x = 1$ to find constant of integration. Dependent on both previous M marks.

A1* Reach given result with no errors.

Alt – Definite Integration/Energy Work.

M1 – Equate change in KE to Integral for WD. Integration not needed for this mark and condone inconsistent signs.

$$\frac{1}{2}\times 2v^2 - \frac{1}{2}\times 2\times 3^2 = \int (\pm)\frac{2}{x^3}dx$$

DM1 Attempt integration. Condone inconsistent signs.

A1 Correct integration, with consistent signs for KE and WD.

DM1 Substitute in limits.

A1 Reach given result with no errors.

(b)

M1 Use $v = \frac{\mathrm{d}x}{\mathrm{d}t}$ to form differential equation in x and t.

M1 Separate variables and to produce functions ready to be integrated.

A1 Correct integrands, written in a form that can be integrated.

DM1 Valid attempt to integrate their expression. If they have an incorrect expression, the integration must not be significantly simplified. Dependent on first 2 M marks.

A1 Correct integration. Condone missing constant.

DM1 Use $x = 1, t = 1$ to find constant of integration. Dependent on all 3 M marks.

A1 Correct result. (cso)