Kinematics 1 Answers

1)

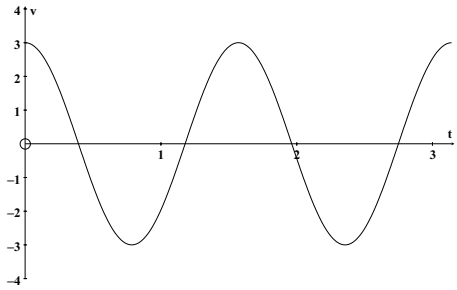
10	**(i)** $t = \sqrt{e^5 - 1}$ or $t^2 + 1 = e^5$ $t = 12.1$	B1 B1 [2]	
	(ii) distance = ln 10 – ln 5 = ln 2 or 0.693	M1 A1 [2]	M1 for $s_3 - s_2$
	(iii) $v = \dfrac{2t}{t^2+1}$, $v = 0.8$	M1, A1 [2]	M1 for attempt to differentiate
	(iv) $a = \dfrac{(t^2+1)2 - 2t(2t)}{(t^2+1)^2}$	M1, A1	M1 for attempt to differentiate a product or quotient
	When $t = 2, a = -\dfrac{6}{25}$, or –0.24	A1 [3]	A1 all correct, allow unsimplified

2)

(i) 4	B1
(ii) Differentiate v to find an expression for a	M1
$6 - 8 \sin 2t$	A1
Substitute $t = 5$	DM1
10.3 to 10.4	A1
(iii) 14	B1
(iv) Integrate v to find an expression for s	M1
$s = 3t^2 + 2 \sin 2t$	A1
Use limits 4 and 5	DM1
23.9	A1
	[10]

3)

(i)	1.25	B1
(ii)	$a = \dfrac{dv}{dt} = \dfrac{-80}{(2t+4)^3}$	M1
	Substitute 3 into $\dfrac{dv}{dt}$	DM1
	-0.08	A1
(iii)	$s = \int v\,dt$	M1
	$\dfrac{-10}{2t+4}$	A1
	Uses limits	M1
	2	A1
		8

4)	**(i)** $48 = 12 \ln(2t + 3)$ $2t + 3 = e^4$ $t = 25.8$	M1 DM1 A1 [3]	M1 for attempt to deal with logs DM1 for attempt to solve
	(ii) $x = 12 \ln(2t + 3)$ $v = \dfrac{24}{2t+3}$ when $t = 1$, $v = 4.8$	B1 B1 B1 [3]	B1 $\dfrac{1}{2t+3}$ B1 24 B1 for 4.8
	(iii) $a = -\dfrac{48}{(2t+3)^2}$ when $t = 1$, $a = -1.92$	B1 √B1 B1 [3]	B1 for $\dfrac{1}{(2t+3)^2}$ √B1 on '24' B1 for –1.92
5)	**(i)** $t = \dfrac{\pi}{8}$	B1 [1]	
	(ii) $a = -4k \sin 4t$	M1, A1 [2]	M1 for attempt to differentiate
	(iii) $12 = -4k \sin \dfrac{3\pi}{2}$ leading to $k = 3$	M1 A1 [2]	M1 for attempt to substitute into their acceleration equation
	(iv) 	B1 √ B1 [2]	B1 for correct shape B1 ft on their value for k
	(v) $s = \displaystyle\int_0^{\frac{\pi}{24}} 3\cos 4t . dt$ $= \left[\dfrac{3}{4}\sin 4t\right]_0^{\frac{\pi}{24}}$ leading to $\dfrac{3}{8}$	M1, √ A1 DM1, A1 [4]	M1 for attempt to integrate Ft on their value for k DM1 for application of limits or equivalent

6)	**(i)** $2t^2 - 12t + 16$	B1+B1+B1
	equate to 0 and solve quadratic for 2 values	M1
	2 and 4	A1
	(ii) $s = \int v \, dt$	M1
	$\dfrac{2}{3}t^3 - 6t^2 + 16t$	A 2, 1, 0√
	use limits and subtract	DM1
	$2\dfrac{2}{3}$ or 2.67	A1

[10]