Kinematics 2 Answers

1)	**(i)** (a =) sin (t / 2) × (– 4)	M1 A1
	When $t = 1$, $a \approx -1.92$	A1√
	(ii) (s =) sin (t / 2) × 16	M1 A1
	At P, $v = 0$, $t = \pi$ $\quad OP = \left[16\sin\left(\frac{t}{2}\right)\right]_0^{\pi} = 16$	B1 A1√

2)	6 $v = 6 - 6e^{-3t}$		
	(i) $a = dv/dt = 18e^{-3t}$	M1 A1	Attempt at differentiation. Co.
	$t = \ln 2$ $e^t = 2 \rightarrow e^{-3t} = 1/8$		
	$\rightarrow a = 18/8$ or 2.25	A1 [3]	Co.
	(ii) $s = \int v dt = 6t + 2e^{-3t}$ [+c]	M1 A1	Attempt at integration. Co. (ignore c)
	but t=0 when s=0, $\rightarrow c = -2$	DM1	Don't allow if c automatically = 0.
	Put t = ln2 $\rightarrow$ 2.41	A1 [4]	Co.

3)	**(i)** $v = \frac{1}{t+1}, v_0 = 1$	M1, A1 [2]	M1 for attempt to differentiate
	(ii) $v = \frac{1}{2(t-2)} - \frac{1}{t+1}$	M1	M1 for attempt to differentiate
	$v_4 = \frac{1}{4} - \frac{1}{5}$; $v_4 = \frac{1}{20}$ (0.05)	A1 [2]	
	(iii) $a = -\frac{1}{2(t-2)^2} + \frac{1}{(t+1)^2}$; $a_4 = -\frac{17}{200}$ (–0.085)	M1, A1 [2]	M1 for attempt to differentiate
	(iv) $\frac{1}{2(t-2)} - \frac{1}{t+1} = 0, t = 5$	DM1, A1 [2]	DM1 for equating v to zero
	(v) $s_3 = \ln 4$ (1.386)	M1	M1 for attempt to find s_3 and s_4
	$s_4 = \ln\frac{16\sqrt{2}}{5}$ (1.509)		
	In 4th sec, $s = \ln\frac{4\sqrt{2}}{5}$ (0.123) (allow 0.124)	A1 [2]	

4)

(i) $v = \int a\,dt = t^2 - 9t \ (+c)$	When $t = 0$, $v = 14 \Rightarrow c = 14$	M1 A1
Solve $t^2 - 9t + 14 = 0$	$\Rightarrow$ $A : t = 2, a = -5$; $B : t = 7, a = 5$	M1 A1
(ii) When $a = 0$, $t = 4.5$	$\Rightarrow$ $v = (-)\,6.25$	M1 A1
(iii) $s = \int v\,dt = \frac{t^3}{3} - \frac{9t^2}{2} + 14t \ (+c)$		M1A2,1,0
$s_A = 12\frac{2}{3}$ $s_B = -8\frac{1}{6}$	$\Rightarrow$ Distance $AB = (-)\,20\frac{5}{6}$ (20.8)	A1

5)

$v = pt^2 + qt + 4$		
t=1 → a = 2pt+q → 2p+q=8	M1 A1	Using a=dv/dt Co
t=2 → s = ⅓pt³+½qt²+4t ..(+c) → 8p/3 + 2q + 8 = 22	M1 A1 A1√	Integrating for s . co. Putting t=2 into his s to form linear eqn in p,q.
Sim equations → q=5 and p=1½	DM1 A1 [7]	Soln of equations. Co.