2000

10(b) deceleration $= -4e^{\frac{v}{6}} \Rightarrow \boxed{a = -4e^{\frac{v}{6}}}$

$v\frac{dv}{dx} = -4e^{\frac{v}{6}}$ $\quad$ $\frac{dv}{dt} = -4e^{\frac{v}{6}}$

$x=0$	$x=?$
$t=0$	$t=t_1$
$v=6$	$v=3$

(i) linking speed and time $\Rightarrow \frac{dv}{dt} = -4e^{\frac{v}{6}}$ (5)

(5) $\Rightarrow \int_6^3 \frac{1}{e^{\frac{v}{6}}}\,dv = \int_0^{t_1} -4\,dt$

$\Rightarrow \int_6^3 e^{-\frac{1}{6}v}\,dv = \int_0^{t_1} -4\,dt$

$\Rightarrow \frac{e^{-\frac{1}{6}v}}{-\frac{1}{6}}\Big|_6^3 = -4t\Big|_0^{t_1}$

5) $\Rightarrow -6e^{-\frac{1}{6}v}\Big|_6^3 = -4t_1 + 0$

5) $\Rightarrow t_1 = \frac{6}{4}\left[e^{-\frac{1}{2}} - e^{-1}\right] = \frac{3}{2}\left[\frac{1}{\sqrt{e}} - \frac{1}{e}\right]$

(ii) linking speed time again: $\int_6^0 e^{-\frac{v}{6}}\,dv = \int_0^{t_2} -4\,dt$

$-6\left[e^{-\frac{v}{6}}\right]_6^0 = -4t\Big|_0^{t_2}$

5) $-6\left[1 - e^{-1}\right] = -4t_2 + 0$

$\Rightarrow t_2 = \frac{3}{2}\left[1 - \frac{1}{e}\right]$

(i) Algebra! $\frac{t_2 - t_1}{t_1} = \frac{\frac{3}{2}\left[1 - \frac{1}{e}\right] - \frac{3}{2}\left[\frac{1}{\sqrt{e}} - \frac{1}{e}\right]}{\frac{3}{2}\left[\frac{1}{\sqrt{e}} - \frac{1}{e}\right]}$ multiply top & bottom by e

(Early) $= \frac{e - 1 - \sqrt{e} + 1}{\sqrt{e} - 1} = \frac{e - \sqrt{e}}{\sqrt{e} - 1} = \frac{\sqrt{e}}{1}\left(\frac{\sqrt{e} - 1}{\sqrt{e} - 1}\right)$

$= \sqrt{e}$