

$$\Rightarrow \frac{dx}{dt} = \frac{t^2}{16}$$

$$\Rightarrow \int_0^x dx = \frac{1}{16} \int_0^t t^2 dt$$

$$\Rightarrow x = \frac{t^3}{48} \dots \textcircled{2}$$

From $\textcircled{1}$ $t = 4v^{\frac{1}{2}}$

From $\textcircled{2}$ $x = \left(\frac{4v^{\frac{1}{2}}}{48}\right)^3$

$$\Rightarrow x = \frac{64v^{\frac{3}{2}}}{48}$$

$$\Rightarrow x = \frac{4v^{\frac{3}{2}}}{3}$$

$$\Rightarrow 3x = 4v^{\frac{3}{2}}$$

$$9x^2 = 16v^3$$

Exercise 12J

Q. 1.



$$P = Fv$$

$$\Rightarrow F = \frac{P}{v}$$

NZL: $\Sigma F = ma$

$$\rightarrow \frac{25m}{v} = m \frac{dv}{dt}$$

$$\Rightarrow \int_1^3 v dv = 25 \int_0^t dt$$

$$\Rightarrow 25t = \frac{1}{2} [v^2]_1^3$$

$$\Rightarrow t = \frac{1}{50} [9 - 1]$$

$$\Rightarrow t = \frac{4}{25}$$

$$\Rightarrow t = 0.16$$

Q. 2. $F = \frac{P}{v} = \frac{25km u_0^2}{v}$



NZL: $\Sigma F = ma$

$$\rightarrow \frac{25 km u_0^2}{v} = mv \frac{dv}{ds}$$

(i) $\Rightarrow v^2 dv = 25k u_0^2 ds$ QED

(ii) $\int_{u_0}^{4u_0} v^2 dv = 25k u_0^2 \int_0^s ds$

$$\Rightarrow \frac{1}{3} [v^3]_{u_0}^{4u_0} = 25k u_0^2 s$$

$$\Rightarrow \frac{1}{3} [64u_0^3 - u_0^3] = 25k u_0^2 s$$

$$\Rightarrow 21u_0^3 = 25k u_0^2 s$$

$$\Rightarrow s = \frac{21u_0}{25k} \text{ QED}$$

Q. 3. $F = \frac{P}{v} = \frac{75,000}{v}$



NZL: $\Sigma F = ma$

$$\rightarrow \frac{75,000}{v} = 1,000a$$

(i) $\Rightarrow a = \frac{75}{v} \dots \textcircled{1}$

$$\Rightarrow \frac{dv}{dt} = \frac{75}{v}$$

(ii) $\Rightarrow \int_5^{25} v dv = 75 \int_0^t dt$

$$\Rightarrow \frac{1}{2} [v^2]_5^{25} = 75t$$

$$\Rightarrow \frac{1}{2} [625 - 25] = 75t$$

$$\Rightarrow t = \frac{600}{150}$$

$$\Rightarrow t = 4 \text{ s}$$

(iii) From $\textcircled{1}$

$$v \frac{dv}{dx} = \frac{75}{v}$$

$$\Rightarrow \int_5^{25} v^2 dv = 75 \int_0^x dx$$

$$\Rightarrow \frac{1}{3} [v^3]_5^{25} = 75x$$

$$\Rightarrow x = \frac{1}{225} [25^3 - 5^3]$$

$$\Rightarrow x = \frac{620}{9}$$

$$\Rightarrow x = 68.89 \text{ m}$$