

# Part 1

①

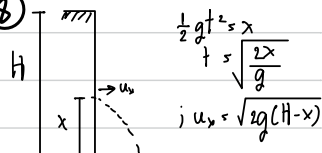
$$t_{\frac{1}{2}} = 100 \text{ s}$$

$$3t_{\frac{1}{2}} = 300 \text{ s}$$

$$1 \text{ g} \xrightarrow{100 \text{ s}} 0.5 \text{ g} \xrightarrow{100 \text{ s}} 0.25 \text{ g} \xrightarrow{100 \text{ s}} 0.125 \text{ g}$$

∴ Mass after A of  $0.125 \text{ g}$  is  $\frac{1}{8} \text{ g}$

⑧



$$s_x = u_x t$$

$$s_x = \sqrt{2g(H-x)} \left( \frac{x}{g} \right) = \sqrt{4x(H-x)} = 2\sqrt{x(H-x)}$$

$$\frac{ds_x}{dx} = 2 \left( \frac{1}{2} \right) \frac{1}{\sqrt{x(H-x)}} (H-2x) = 0$$

$$H = 2x \quad \left| \frac{1}{\sqrt{x(H-x)}} = 0 \right.$$

$$x = \frac{H}{2}$$

③

$$\text{Time } t = \frac{\ln \frac{N_2}{N_1}}{-0.693} \times t_{\frac{1}{2}}$$

$$t = \frac{\ln \frac{40}{100}}{-0.693} \times 5730$$

$$t = \frac{-0.916}{-0.693} \times 5730$$

$$t = 7579 \text{ y} \quad *$$

⑩

$$\text{Then } s_x = u_x t$$

$$5 = 10 \cos 45^\circ t$$

$$5 = 10 \left( \frac{1}{\sqrt{2}} \right) t$$

$$\Rightarrow t = \frac{\sqrt{2}}{2} \text{ unit} \quad \text{--- (1)}$$

Now we find the height of the projectile

$$\text{Then } s_y = u_y t + \frac{1}{2} a_y t^2$$

$$h = 10 \sin 45^\circ t + \frac{1}{2} (-10) t^2 \quad \text{--- (2)}$$

$$\text{In (1) } \text{unit} \Rightarrow h = 10 \sin 45^\circ \left( \frac{\sqrt{2}}{2} \right) + \frac{1}{2} (-10) \left( \frac{\sqrt{2}}{2} \right)^2$$

$$= 10 \left( \frac{1}{\sqrt{2}} \right) \left( \frac{\sqrt{2}}{2} \right) + \frac{1}{2} (-10) \left( \frac{1}{2} \right)$$

$$= 5 - 2.5$$

$$h = 2.5 \text{ m} \quad *$$

④

$$\text{Then } A_1 V_1 = A_2 V_2$$

$$A_1 = \left( \frac{A}{3} \right) (V_2)$$

$$\frac{3}{A} (A) (9) = V_2$$

$$12 \text{ m/s} = V_2$$

$$\text{Then } P_1 + \frac{1}{2} \rho v_1^2 = P_2 + \frac{1}{2} \rho v_2^2$$

$$5 \times 10^5 + (0.5)(1000)(9)^2 = P_2 + 0.5(1000)(12)^2$$

$$5 \times 10^5 + 8 \times 10^3 = P_2 + 7.2 \times 10^4$$

$$(5 \times 10^5 + 8 \times 10^3) - 7.2 \times 10^4 = P_2$$

$$4.36 \times 10^5 = P_2$$

$$P_2 = 4.36 \times 10^5 \text{ N/m}^2$$

⑦

$$\text{Then } \frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$F_1 = \frac{A_1}{A_2} F_2$$

$$F_1 = \frac{\pi r^2}{\pi R^2} (mg) = \left( \frac{r}{R} \right)^2 (120 \text{ kg})(10 \text{ m/s}^2)$$

$$= \left( \frac{1}{4} \right)^2 (120 \text{ kg})(10 \text{ m/s}^2)$$

$$= 75 \text{ N} \quad *$$

$$(25) \frac{\text{Loop}}{\text{Length}} \leq \frac{3}{0.6} \leq \frac{2}{\lambda} \rightarrow \lambda = 0.4$$

$$v = f\lambda = 250 \times 0.4 = 100 \text{ m/s} \quad \#$$

$$(24) \quad n\lambda |S_1 P_1 - S_2 P_2| = (n - \frac{1}{2}) \lambda$$

$$|15 - 5| = (2 - \frac{1}{2}) \lambda$$

$$10 = \frac{3}{2} \lambda$$

$$\lambda = \frac{20}{3}$$

$$= 6.67 \lambda$$

$$v = f\lambda$$

$$f = \frac{v}{\lambda}$$

$$f = \frac{50}{6.67}$$

$$f = 7.5 \text{ Hz}$$

$$(22) \quad \frac{dx}{D} \leq n\lambda$$

$$\lambda = \frac{dx}{Dn} = \frac{0.03 \times 10^{-3} \times 4.5 \times 10^{-2}}{4.8}$$

s

$$(20) \quad u_x = 3 \text{ m/s}, u_y = 0 \text{ m/s}, u = 3 \text{ m/s}$$

$$v_x = u_x = 3 \text{ m/s}$$

$$v_y = u \sin \theta + gt$$

$$= 0 \sin \theta + \frac{g}{2} t$$

$$= 10(0.4)$$

$$v_y = 4 \text{ m/s}$$

$$V_{\text{total}} = \sqrt{v_x^2 + v_y^2} = \sqrt{3^2 + 4^2} = \sqrt{25}$$

$$V_{\text{total}} = 5 \text{ m/s} \quad \#$$

$$(19) \quad \frac{v_y}{v_x} = \frac{4}{3} = \tan \theta = \frac{4}{3}$$

$$\theta = \tan^{-1}\left(\frac{4}{3}\right) \quad \#$$

# Part 2

$$(5) P_1 V_1 = 12 \times 10 = 120$$

$$P_2 V_2 = 1.5 \times 0.5 = 0.75$$

$$\frac{P_1 V_1}{P_2 V_2} = \frac{120}{0.75} = 160$$

$$(6) mgh = \frac{1}{2} m u^2$$

$$gl = \frac{1}{4} \times \frac{1}{2} u^2$$

$$u^2 = 8gl$$

$$E_{k2} = E_{k1}$$

$$\frac{1}{2} m v^2 = \frac{1}{4} \times \frac{1}{2} m (8gl)$$

$$v^2 = 2gl$$

$$v = \sqrt{2gl}$$

$$(7) \text{N/A } m_1; \Sigma \vec{F} = ma$$

$$m_1 g \sin 30^\circ + T = ma$$

$$(b) (10)(0.5) + T = 6a$$

$$a = \frac{30 + T}{6} \quad \text{--- (1)}$$

$$\text{N/A } m_2; \Sigma \vec{F} = ma$$

$$mg - T = ma$$

$$4(10) - T = 4a \quad \text{--- (2)}$$

$$\text{N/A (1) \& (2); } 40 - T = 4\left(\frac{30 + T}{6}\right)$$

$$\therefore T = 12 \text{ N}$$

$$(11) m s = \frac{f}{s-f} \rightarrow f = \frac{2}{2-1} = 2$$

$$0.10^4 m s = \frac{2}{1-2}$$

$$= 2 \text{ mm}$$

$$(25) s = 15$$

$$m = 4$$

$$m s = \frac{f}{s-f}$$

$$4(15 - f) = f$$

$$60 - 4f = f$$

$$5f = 60$$

$$f = 12 \text{ cm}$$

$$(16) d_2 : d_3$$

$$\left. \begin{array}{l} \frac{d_1}{2} \\ \frac{2}{3} d_1 \end{array} \right\} \frac{d_1}{2} \times \frac{3}{2} d_1 = \frac{3}{4} d_1$$