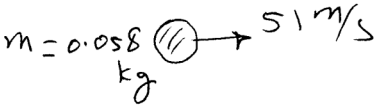
MCQ - Chapter 7

Solutions

Question 1



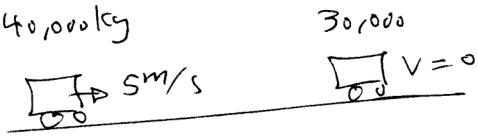
$$\vec{\Delta P} = \vec{P}_f - \vec{P}_i$$

$\vec{P}_i = 0$ (no horizontal component)

(C)

$$\Delta P = (0.058 \times 51) \simeq 3.0 \text{ kg.m/s}$$

Question 2



$$P_i = 40{,}000 \times 5 + 0 = 200{,}000 \text{ kg.m/s}$$

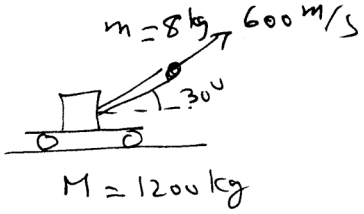
$$P_f = (\underbrace{40{,}000 + 30{,}000}_{70{,}000})\,\bar{V} \quad \text{(They couple)}$$

(B)

$$P_i = P_f \rightarrow 200{,}000 = 70{,}000\,\bar{V}$$

$$\bar{V} = \frac{20}{7} = 2.9 \text{ m/s}$$

Question 3



The horizontal component of momentum is conserved.

$$P_{i_x} = P_{f_x}$$

$P_{i_x} = 0$

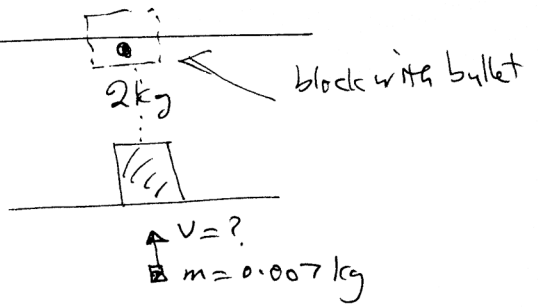
$$0 = (8 \times 600)\cos 30^\circ + (1200 - 8)\vec{V}$$

$$0 = 4800\cos 30^\circ + 1192\vec{V}$$

(C)

$$\boxed{V = -3.5 \text{ m/s}}$$

Question 4



$$K_i + U_i = K_f + U_f$$

$U_i = 0$, $K_f = 0$

$$\frac{1}{2}(M+m)V_i^2 = (M+m)gy_f$$

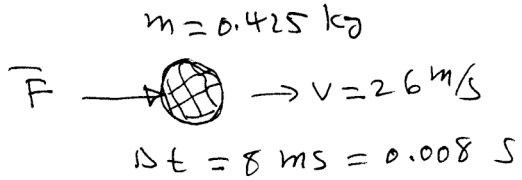
$$V_i = \sqrt{2gy_f} = \sqrt{2 \times 9.8 \times 0.25} = 2.2 \text{ m/s} = \text{speed after}$$

Now apply $P_i = P_f \rightarrow mv = (m+M)V$

$$v = \frac{m+M}{m}V = \frac{0.007 + 2}{0.007}(2.2) = 631 \text{ m/s}$$

(B)

Question 5



(A) $\bar{F}\,\Delta t = \Delta P$

$$\bar{F} = \frac{\Delta P}{\Delta t} = \frac{0.425 \times 26}{0.008} = 1381\ N \simeq 1.4\ kN$$

Question 6 $m = 2 \times 10^5$ kg

a) To be able to rise, the thrust must be (at least) equal to mg (or pull of gravity)

(B) $F_{thrust} = mg = (2 \times 10^5)(9.8) \simeq 20 \times 10^5\ N$

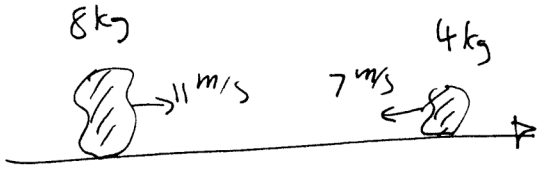
b) $F\Delta t = \Delta P$

$(20 \times 10^5)(1) = (20\ kg)V \rightarrow V = 10^4\ m/s$

$= 100\ km/s$

(1 second)

Quest 7



(A)

$$P_i = 8 \times 11 - 7 \times 4 = 60 \text{ kg.m/s}$$

$$P_f = (8+4)V = 12V$$

$$60 = 12V \rightarrow \boxed{V = 5 \text{ m/s}}$$

Quest 8

a) $P_i = P_f$

$$(0.005 \times 150) + 0 = (0.005 + 2)V$$

$$\Rightarrow \boxed{V = 0.37 \text{ m/s}}$$

b) Apply energy conservation:

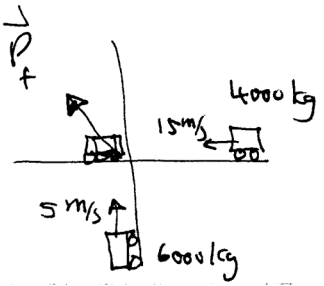
(C)

$$K_i + U_i + W_{nc} = K_f + U_f$$

$$\frac{1}{2}(0.005+2)(0.37)^2 + 0 + (f)(2.7)(-1) = 0 + 0$$

$$\Rightarrow \boxed{f = 0.052 \text{ N}}$$

Quest 9



$$\vec{P}_i = \vec{P}_f \Rightarrow$$

$$\begin{cases} P_{ix} = P_{fx} \\ P_{iy} = P_{fy} \end{cases} \Rightarrow$$

$$\begin{cases} -4000 \times 15 = P_{fx} \\ 6000 \times 5 = P_{fy} \end{cases} \rightarrow \quad P_{fx} = -60{,}000 \ kg\cdot m/s$$

$$P_{fy} = 30{,}000 \ kg\cdot m/s$$

(B)

$$P_f = \sqrt{P_{fx}^2 + P_{fy}^2} = 67082 \ kg\cdot m/s$$

but $P_f = (6000 + 4000) V_f \rightarrow \boxed{V_f = 6.7 \ m/s}$

$$\theta = \tan^{-1} \frac{P_{fy}}{P_{fx}} = \dots = -27^\circ$$

Question 10 a) $0.09 \times 1 + 0 = (0.09 + 0.01)V$

$\Rightarrow V = 0.9\ m/s = 90\ cm/s$

b) $\begin{cases} 0.09 \times 1 + 0 = 0.09\, v_1' + 0.01\, v_2' \\ \frac{1}{2}(0.09)(1)^2 = \frac{1}{2}(0.09)v_1'^2 + \frac{1}{2}(0.01)v_2'^2 \end{cases}$

Simplify equations $\Rightarrow \begin{cases} 9v_1' + v_2' = 9 \rightarrow v_2' = 9 - 9v_1' \\ 9v_1'^2 + v_2'^2 = 9 \end{cases}$

(A)

$9v_1'^2 + (9 - 9v_1')^2 = 9 \Rightarrow$

$90v_1'^2 - 162v_1' + 72 = 0$

$v_1' = 0.8\ m/s$

$v_2' = 1.8\ m/s$

Question 11 + 12

For questions 11 and 12, do the same as part (b) of 10:

$\begin{cases} P_i = P_f \\ K_i = K_f \end{cases}$

Answers: 11 (C)

12 (C)