Chapter 3 Dynamics Notes Answers

Check Your Understanding 1

1. (a) $v^2 = u^2 + 2as = 0 + 2(9.81)5 \rightarrow v = 9.9 \text{ m s}^{-1}$

   (b) $F_{ave} = \frac{\Delta p}{t} = \frac{m\Delta v}{t} = \frac{50(9.9)}{0.1} = 4950 \text{ N}$

   (c) $F_{ave} = \frac{\Delta p}{t} = \frac{m\Delta v}{t} = \frac{50(9.9)}{1} = 495 \text{ N}$

2. tension provides acceleration for wagon 4 and 5
   $T = 2ma = 2 \times (1.0 \times 10^4) \times 1.0 = 2.0 \times 10^4 \text{ N}$

3. tension acts against friction to provide acceleration for wagon 4 and 5
   $T - 2f = 2ma \rightarrow T = 2(5000) + 2 \times (1.0 \times 10^4)(1.0) = 3.0 \times 10^4 \text{ N}$

4. consider bottom block: $mg\sin\theta - f - T = ma \rightarrow 2(9.81)\sin 30 - 5 - T = 2a$
   consider top block: $mg\sin\theta + T - f = ma \rightarrow 2(9.81)\sin 30 + T - 10 = 2a$
   solve simultaneously: T = 2.5 N

5. Impulse = Area under graph from 75 – 150 ms =
   $\left(\frac{60+80}{2}\right)25 \times 10^{-3} + \left(\frac{80+40}{2}\right)50 \times 10^{-3} = 4.75 \text{ Ns}$
   final p = initial p + impulse = $0.2 \times 15 + 4.75 = 7.75 \text{ Ns}$
   final vel = $\frac{7.75}{0.2} = 38.8 \text{ ms}^{-1}$

6. (a) $\frac{m}{t} = \frac{\rho Vol}{t} = \rho Av$
   since final velocity is zero, $\Delta v = v$
   $F = \frac{m}{t}\Delta v = \rho Av^2$

   (b) $\Delta v = 0.5v - (-v) = 1.5v$
   $F = \frac{m}{t}\Delta v = 1.5\rho Av^2$

Check Your Understanding 2

1. (a) The principle of **Conservation of Linear Momentum** states that the total linear momentum of a system is constant provided no net external force acts on the system.

   (b) In both cases, total linear momentum/total energy is conserved. For elastic collision, total kinetic energy is conserved whereas for inelastic collision, total kinetic energy is decreased.

2. By COLM, $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

   $1(2) + 2(-2) = 1(-3) + 2v \rightarrow v = 0.5 \text{ m s}^{-1}\text{(right)}$

3. By COLM, $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

   $10(30) + 15(10) = 10v_1 + 15v_2$

   By rsa = rss, $u_1 - u_2 = v_2 - v_1$

   $30 - 10 = v_2 - v_1$

   solving, simultaneously, $v_1 = 6$, $v_2 = 26$

4. (a) Sphere A will become stationary, while sphere B will move at 5.0 m s^{-1} in the original direction that sphere A was moving.

   (b) $F = \dfrac{\Delta p}{t} = \dfrac{0.20(5.0 - 0)}{0.04} = 25 \text{ N}$

5. By COLM, $m_1u_1 + m_2u_2 = (m_1 + m_2)v$

   $6(6) + 10(-2) = (6 + 10)v \rightarrow v = 1.0 \text{ m s}^{-1}$ (right)

   $F = \dfrac{\Delta p}{t} = \dfrac{10(1 - (-2))}{0.20} = 150 \text{ N}$