

Momentum Review Questions

9. $m = 80 \text{ kg}$ $\Delta v = 33 - 100 = -67 \text{ km/h} \div 3.6 = -18.61 \text{ m/s}$

$\Delta t = 4.0 \text{ s}$

a) $F \Delta t = m \Delta v$ $F = \frac{m \Delta v}{\Delta t} = \frac{(80 \text{ kg})(-18.61 \text{ m/s})}{(4.0 \text{ s})}$

$F = 370 \text{ N}$

b) beyond the scope of instruction

c) beyond the scope of instruction

10. $m = 0.06 \text{ kg}$ $v = 330 \text{ m/s}$ $\Delta t = 330 \text{ m/s}$

a) beyond the scope of instruction

b)

b) $\vec{J} = F \Delta t = m \Delta v = (330 \text{ m/s})(0.06 \text{ kg}) = 19.8 \text{ N}\cdot\text{s}$

c) $19.8 \text{ kg}\cdot\text{m/s} = \vec{p}$

1a $m = 120 \text{ kg}$ $v = 4.0 \text{ m/s}$ $\vec{p} = (120 \text{ kg})(4.0 \text{ m/s})$
 $\vec{p} = 480 \text{ kg}\cdot\text{m/s}$

1b $m = 2.04 \times 10^5 \text{ kg}$ $v = 0.2 \text{ m/s}$ $\vec{p} = (2.04 \times 10^5 \text{ kg})(0.2 \text{ m/s})$
 $\vec{p} = 40,000 \text{ kg}\cdot\text{m/s}$
 or $4.0 \times 10^4 \text{ kg}\cdot\text{m/s}$

1c $m = 60 \text{ g} \times \frac{1 \text{ kg}}{1000 \text{ g}} = 0.060 \text{ kg}$ $v = 140 \text{ km/h} \cdot \frac{1000 \text{ m}}{1 \text{ km}} \cdot \frac{1 \text{ hr}}{3600 \text{ s}}$
 $= 38.89 \text{ m/s}$

$\vec{p} = (0.060 \text{ kg})(38.89 \text{ m/s})$

$\vec{p} = 2.3 \text{ kg}\cdot\text{m/s}$

1d $m = 130 \text{ tonnes} \times \frac{1000 \text{ kg}}{1 \text{ tonne}} = 1.3 \times 10^5 \text{ kg}$ $v = 20 \frac{\text{km}}{\text{h}} \times \frac{1000}{3600}$
 $= 5.56 \text{ m/s}$

$\vec{p} = (1.3 \times 10^5 \text{ kg})(5.56 \text{ m/s})$

$\vec{p} = 7.2 \times 10^5 \text{ kg}\cdot\text{m/s}$

1e) $m = 0.900 \text{ g} \times \frac{1 \text{ kg}}{1000} = 9.0 \times 10^{-4} \text{ kg}$ $v = 29 \frac{\text{km}}{\text{hr}} \times \frac{1000}{3600} = 8.06 \text{ m/s}$

$\vec{p} = (9.0 \times 10^{-4} \text{ kg})(8.06 \text{ m/s}) = 7.2 \times 10^{-3} \text{ kg}\cdot\text{m/s}$

$$2. F = 2200 \text{ N} \quad \Delta t = 1.30 \times 10^{-3} \text{ s}$$

$$\vec{J} = (2200 \text{ N})(1.3 \times 10^{-3} \text{ s})$$

$$\text{a) } \vec{J} = 2.86 \text{ N}\cdot\text{s} \quad \text{b) } \vec{p} = 2.86 \text{ kg}\cdot\text{m/s}$$

$$3. v_i = 22 \text{ m/s} \quad v_f = 26 \text{ m/s} \quad \Delta v = 4 \text{ m/s} \quad m = 1750 \text{ kg}$$

$$\text{a) } \Delta \vec{p} = (1750 \text{ kg})(4 \text{ m/s}) = 7000 \text{ kg}\cdot\text{m/s}$$

$$\text{b) } \vec{J} = 7000 \text{ N}\cdot\text{s}$$

$$4. v_i = -22 \text{ m/s} \quad v_f = 26 \text{ m/s} \quad \Delta v = 26 - (-22) = 48 \text{ m/s}$$

$$m = 1750 \quad \text{a) } \Delta \vec{p} = (1750 \text{ kg})(48 \text{ m/s}) = 84000 \text{ kg}\cdot\text{m/s}$$

$$\text{b) } \vec{J} = 84000 \text{ N}\cdot\text{s}$$

$$5. a = 125 \text{ m/s}^2 \quad \text{b) } \Delta v = 125 \text{ m/s}^2 \times 0.2 \text{ s} = 25 \text{ m/s}$$

$$t = 0.2 \text{ s}$$

$$m = 60 \text{ kg}$$

$$\text{a) } \vec{J} = (60 \text{ kg})(25 \text{ m/s}) = 1500 \text{ N}\cdot\text{s}$$



$$F = ma \rightarrow F = (60 \text{ kg})(125 \text{ m/s}^2) = 7500 \text{ N}$$

$$\text{a) } F \Delta t = (7500 \text{ N})(0.2 \text{ s}) = 1500 \text{ N}\cdot\text{s}$$

$$(1500 \text{ N}\cdot\text{s}) = (60 \text{ kg})(\Delta v)$$

$$\text{b) } 25 \text{ m/s} = \Delta v$$

$$6. m_g = 45 \text{ g} \times \frac{1 \text{ kg}}{1000 \text{ g}} = 0.045 \text{ kg}$$

$$m_p = 4 \text{ g} \div 1000 = 0.004 \text{ kg} \quad v = 8.1 \times 10^3 \text{ m/s}$$

$$\vec{p}_p = (0.004)(8.1 \times 10^3 \text{ m/s})$$

$$\vec{p}_p = 32.4 = m_g v_g = (0.045 \text{ kg})(v_g)$$

$$\div 0.045 \text{ kg} \quad \div 0.045 \text{ kg}$$

$$720 \text{ m/s} = v_g = 720 \text{ m/s} \times \frac{3600 \text{ s}}{1 \text{ hr}} \times \frac{1 \text{ km}}{1000 \text{ m}} = 2592 \text{ km/hr}$$

$$7. m_c = 2000 \text{ kg}$$

$$m_o = 2.0 \text{ lb} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} = 0.91 \text{ kg}$$

$$v_o = 4.5 \text{ mi/s} \times \frac{5280 \text{ ft}}{1 \text{ mi}} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{1 \text{ m}}{100 \text{ cm}}$$

$$= 7242.048 \text{ m/s}$$

$$\vec{p}_o = (0.91 \text{ kg})(7242.048 \text{ m/s})$$

$$\vec{p}_A = 6590.26 = m_c v_c = (2000 \text{ kg})(v_c)$$

$$\div 2000 \text{ kg} \quad \div 2000 \text{ kg}$$

$$3.3 \text{ m/s} = v_c$$

$$8. F \Delta t = mv \quad m = 0.142 \text{ kg} \quad v = 60 \text{ km/h} \cdot \frac{10}{36} = 44.4 \text{ m/s}$$

$$\text{a) } 320 \text{ N}$$

$$\text{a) } \Delta t = 0.02 \text{ s} \quad \frac{mv}{\Delta t} = 316 \text{ N}$$

$$\text{b) } \Delta t = 0.2 \text{ s}$$

$$\frac{mv}{\Delta t} = 31.6 \text{ N}$$

$$mv = 6.311 \text{ kg}\cdot\text{m/s}$$

$$\text{b) } 32 \text{ N}$$

$$16. m_1 v_1 = m_2 v_2 \quad v_1 = v_2$$

$$v_a + v_b = v_c + v_d$$

$$v_a + 2.2 \text{ m/s} = 0.8 \text{ m/s} + 4.5 \text{ m/s}$$

$$v_a + 2.2 \text{ m/s} = 5.3 \text{ m/s}$$

$$\boxed{v_a = 3.1 \text{ m/s}}$$

$$17. v_1 = v_2$$

$$v_a + v_b = v_c + v_d$$

$$v_a = 7.6 \text{ m/s} \rightarrow$$

$$v_b = -4.5 \text{ m/s} \leftarrow$$

$$v_c = ?$$

$$v_d = 2.5 \text{ m/s} \rightarrow$$

$$7.6 \text{ m/s} - 4.5 \text{ m/s} = v_c + 2.5 \text{ m/s}$$

$$3.1 \text{ m/s} = v_c + 2.5 \text{ m/s}$$

$$\boxed{0.6 \text{ m/s} = v_c}$$

$$18. m_1 v_1 + m_2 v_2 = m_3 v_3$$

$$m_1 = 0.040 \text{ kg}$$

$$v_1 = 0.25 \text{ m/s}$$

$$m_3 = 0.040 \text{ kg} + 0.050 \text{ kg}$$

$$= 0.090 \text{ kg}$$

$$(0.040 \text{ kg})(0.25 \text{ m/s}) = (0.090 \text{ kg})(v_3)$$

$$0.01 \text{ kg} \cdot \text{m/s} = (0.090 \text{ kg})(v_3)$$

$$\boxed{0.11 \text{ m/s} = v_3}$$

$$19. m_1 v_1 + m_2 v_2 = m_3 v_3$$

$$(2200)(11.11) + (1800)(5.56) = (4000)(v_3)$$

$$24442 + 10008 = (4000)(v_3)$$

$$34450 = (4000)(v_3)$$

$$\boxed{8.6 \text{ m/s} = v_3}$$

$$m_1 = 2200 \text{ kg}$$

$$v_2 = 40 \text{ km/h} \div 3.6 = 11.11 \text{ m/s}$$

$$m_2 = 1800 \text{ kg}$$

$$v_2 = 20 \text{ km/hr} \div 3.6 = 5.56 \text{ m/s}$$

$$m_3 = 2200 \text{ kg} + 1800 \text{ kg}$$

$$= 4000 \text{ kg}$$

$$v_3 = ?$$

$$20. m_1 v_1 = m_2 v_2 + m_3 v_3$$

$$-m_2 v_2 = m_3 v_3$$

$$(0.120 \text{ kg})(220 \text{ m/s}) = (0.180 \text{ kg})(v_3)$$

$$26.4 \text{ kg} \cdot \text{m/s} = (0.180 \text{ kg})(v_3)$$

$$\boxed{147 \text{ m/s} = v_3}$$

$$m_1 = 0.300 \text{ kg}$$

$$m_2 = 0.120 \text{ kg}$$

$$m_3 = 0.300 - 0.120 = 0.180 \text{ kg}$$

$$v_1 = 0$$

$$v_2 = 220 \text{ m/s}$$

$$v_3 = ?$$

~~21. Removed~~

~~22. Removed~~

$$11. F \Delta t = m \Delta v$$

$$m = 0.060 \text{ kg}$$

$$\Delta v = -70 \text{ m/s}$$

$$\Delta t = 0.025 \text{ s}$$

$$F = \frac{m \Delta v}{\Delta t} = \frac{(0.060 \text{ kg})(-70 \text{ m/s})}{(0.025 \text{ s})} = -4.2 / 0.025$$

$$a) F = -168 \text{ N}$$

$$b) F = ma \quad F = 168 \text{ N}$$

$$m = 0.060 \text{ kg}$$

$$\frac{F}{m} = a$$

$$\frac{168 \text{ N}}{0.060 \text{ kg}}$$

$$b) = 2800 \text{ m/s}^2 = a$$

$$12. m = 120 \text{ kg} \quad v = 15 \text{ km/hr} = 3.6 = 4.17 \text{ m/s}$$

$$a) \vec{p} = mv = (120 \text{ kg})(4.17 \text{ m/s})$$

$$\vec{p} = 500 \text{ kg} \cdot \text{m/s}$$

$$b) F \Delta t = mv = -500 \text{ N} \cdot \text{s}$$

$$c) F \Delta t = mv$$

$$\Delta t = 1.10 \text{ s}$$

$$F = \frac{mv}{\Delta t}$$

$$\frac{-500 \text{ N} \cdot \text{s}}{1.10 \text{ s}} = -455 \text{ N}$$

d) beyond the scope

$$13) m_1 v_1 + m_2 v_2 = m_3 v_3 + m_4 v_4 \quad \text{or} \quad m_1 v_1 = m_2 v_2$$

$$m_1 = 0.165 \text{ kg}$$

$$v_1 = 8.2 \text{ m/s}$$

$$m_3 = 0.165 \text{ kg}$$

$$v_3 = 3.0 \text{ m/s}$$

$$v_1 = v_2$$

$$m_1 v_1 = 1.353 \text{ kg} \cdot \text{m/s}$$

$$m_3 v_3 = 0.495 \text{ kg} \cdot \text{m/s}$$

$$m_1 v_1 - m_3 v_3 = 0.858 \text{ kg} \cdot \text{m/s} = m_4 v_4$$

$$m_4 = 0.165$$

$$v_4 = ?$$

$$\frac{0.858 \text{ kg} \cdot \text{m/s}}{0.165} = (0.165 \text{ kg})(v_4)$$

$$5.2 \text{ m/s} = v_4$$

$$8.2 - 3.0 \text{ m/s} = 5.2 \text{ m/s}$$

$$14) m_1 v_1 = m_2 v_2$$

$$v_1 = v_2$$

$$v_2 = v_a + v_b$$

$$v_a = -1.2 \text{ m/s}$$

$$v_1 = 8.2 \text{ m/s} = -1.2 \text{ m/s} + v_b$$

$$8.2 + 1.2 = v_b$$

$$9.4 \text{ m/s} = v_b$$

$$15) m_1 v_1 = m_2 v_2$$

$$v_1 = v_2$$

$$v_1 = v_a + v_b = v_c + v_d$$

$$8.2 \text{ m/s} + 2.0 \text{ m/s} = 3.0 \text{ m/s} + v_d$$

$$10.2 \text{ m/s} = 3.0 \text{ m/s} + v_d$$

$$7.2 \text{ m/s} = v_d$$