

$$\begin{aligned}
 13. \text{ Impulse} &= m\Delta\vec{v} \\
 &= (5.00 \text{ kg})(15.0 \text{ m/s east}) \\
 &= 75.0 \text{ kg} \cdot \text{m/s east}
 \end{aligned}$$

$$\begin{aligned}
 14. \quad \vec{v}_{\text{av}} &= \frac{\vec{d}}{t} \\
 &= \frac{26.3 \text{ m west}}{3.2 \text{ s}} \\
 &= 8.22 \text{ m/s west} \\
 \vec{v}_{\text{av}} &= \frac{\vec{v} - \vec{v}_0}{2} \\
 8.22 \text{ m/s west} &= \frac{\vec{v} - 0}{2} \\
 \vec{v} &= 16.4 \text{ m/s west}
 \end{aligned}$$

$$\begin{aligned}
 \Delta\vec{p} &= m\Delta\vec{v} \\
 &= (11.0 \text{ kg})(16.4 \text{ m/s west}) \\
 &= 181 \text{ kg} \cdot \text{m/s west}
 \end{aligned}$$

15. The magnitude of momentum

$$\begin{aligned}
 p &= mv \\
 v &= \frac{p}{m} \\
 &= \frac{6.0 \text{ kg} \cdot \text{m/s}}{3.0 \text{ kg}} \\
 &= 2.0 \text{ m/s} \\
 v^2 &= v_0^2 + 2ad \\
 (2.0 \text{ m/s})^2 &= 2(9.81 \text{ m/s}^2)d \\
 d &= 0.20 \text{ m}
 \end{aligned}$$

$$\begin{aligned}
 16. \quad \vec{p}_1 &= m\vec{v}_1 \\
 &= (1.0 \text{ kg})(-2.0 \text{ m/s}) \\
 &= -2.0 \text{ kg} \cdot \text{m/s} \\
 \vec{p}_2 &= m\vec{v}_2 \\
 &= (1.0 \text{ kg})(1.6 \text{ m/s}) \\
 &= 1.6 \text{ kg} \cdot \text{m/s} \\
 \Delta\vec{p} &= \vec{p}_2 - \vec{p}_1 \\
 &= 1.6 \text{ kg} \cdot \text{m/s} - (-2.0 \text{ kg} \cdot \text{m/s}) \\
 &= 3.6 \text{ kg} \cdot \text{m/s upward}
 \end{aligned}$$

17. Consider up as positive,

$$\begin{aligned}
 \vec{F}_{\text{net}} &= m\vec{a} \\
 \vec{a} &= \frac{\vec{F}_{\text{net}}}{m} \\
 &= \frac{1.5 \times 10^5 \text{ N}}{9.5 \times 10^3 \text{ kg}} \\
 &= 15.8 \text{ m/s}^2 \\
 \vec{a} &= \frac{\vec{v} - \vec{v}_0}{t} \\
 15.8 \text{ m/s}^2 &= \frac{\vec{v} - 0}{15 \text{ s}} \\
 \vec{v} &= 2.4 \times 10^2 \text{ m/s}
 \end{aligned}$$

or

$$\begin{aligned}
 \vec{F}_{\text{net}}t &= m\Delta\vec{v} \\
 (1.5 \times 10^5 \text{ N})(15 \text{ s}) &= (9.5 \times 10^3 \text{ kg})\vec{v} \\
 \vec{v} &= 2.4 \times 10^2 \text{ m/s}
 \end{aligned}$$

$$\begin{aligned}
 18. \quad \vec{F}_{\text{net}}t &= m\Delta\vec{v} \\
 \vec{F}_{\text{net}}(0.75 \text{ s}) &= (5.4 \text{ kg})(3.0 \text{ m/s east}) \\
 \vec{F}_{\text{net}} &= 22 \text{ N east}
 \end{aligned}$$

19. The magnitude of impulse

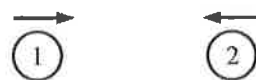
$$\begin{aligned}
 F_{\text{net}}t &= m\Delta v \\
 (225 \text{ N})t &= (1.0 \times 10^3 \text{ kg})(5.0 \text{ m/s} - 2.0 \text{ m/s}) \\
 t &= 13 \text{ s}
 \end{aligned}$$

$$\begin{aligned}
 20. \quad \vec{F}_{\text{net}}t &= m\Delta\vec{v} \\
 (95 \text{ N north})(1.65 \text{ s}) &= (15 \text{ kg})(\Delta v) \\
 \Delta v &= 1.0 \times 10^1 \text{ m/s north}
 \end{aligned}$$

Lesson 2—Conservation of Momentum (Linear Interactions)

PRACTICE EXERCISES ANSWERS AND SOLUTIONS

1. before collision



Consider right as positive and left as negative

$$\begin{aligned}
 m_1 &= 30.0 \text{ kg} & m_2 &= 20.0 \text{ kg} \\
 \vec{v}_1 &= 1.00 \text{ m/s} & \vec{v}_2 &= -5.00 \text{ m/s} \\
 \vec{p}_1 &= 30.0 \text{ kg} \cdot \text{m/s} & \vec{p}_2 &= -100 \text{ kg} \cdot \text{m/s}
 \end{aligned}$$

$$\therefore \vec{p}_{\text{sys}(\text{before})} = \vec{p}_1 + \vec{p}_2 = -70.0 \text{ kg} \cdot \text{m/s}$$