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

14.
$$\vec{v}_{av} = \frac{\vec{d}}{t}$$
$$= \frac{26.3\text{ m west}}{3.2\text{ s}}$$
$$= 8.22\text{ m/s west}$$
$$\vec{v}_{av} = \frac{\vec{v} - \vec{v}_0}{2}$$
$$8.22\text{ m/s west} = \frac{\vec{v} - 0}{2}$$
$$\vec{v} = 16.4\text{ m/s west}$$
$$\Delta\vec{p} = m\Delta\vec{v}$$
$$= (11.0\text{ kg})(16.4\text{ m/s west})$$
$$= 181\text{ kg}\cdot\text{m/s west}$$

15. The magnitude of momentum
$$p = mv$$
$$v = \frac{p}{m}$$
$$= \frac{6.0\text{ kg}\cdot\text{m/s}}{3.0\text{ kg}}$$
$$= 2.0\text{ m/s}$$
$$v^2 = v_0^2 + 2ad$$
$$(2.0\text{ m/s})^2 = 2(9.81\text{ m/s}^2)d$$
$$d = 0.20\text{ m}$$

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

17. Consider up as positive,
$$\vec{F}_{net} = m\vec{a}$$
$$\vec{a} = \frac{\vec{F}_{net}}{m}$$
$$= \frac{1.5\times10^5\text{ N}}{9.5\times10^3\text{ kg}}$$
$$= 15.8\text{ m/s}^2$$
$$\vec{a} = \frac{\vec{v} - \vec{v}_0}{t}$$
$$15.8\text{ m/s}^2 = \frac{\vec{v} - 0}{15\text{ s}}$$
$$\vec{v} = 2.4\times10^2\text{ m/s}$$

or
$$\vec{F}_{net}t = m\Delta\vec{v}$$
$$(1.5\times10^5\text{ N})(15\text{ s}) = (9.5\times10^3\text{ kg})\vec{v}$$
$$\vec{v} = 2.4\times10^2\text{ m/s}$$

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

19. The magnitude of impulse
$$F_{net}t = m\Delta v$$
$$(225\text{ N})t = (1.0\times10^3\text{ kg})(5.0\text{ m/s} - 2.0\text{ m/s})$$
$$t = 13\text{ s}$$

20.
$$\vec{F}_{net}t = m\Delta\vec{v}$$
$$(95\text{ N north})(1.65\text{ s}) = (15\text{ kg})(\Delta v)$$
$$\Delta v = 1.0\times10^1\text{ m/s north}$$

Lesson 2—Conservation of Momentum (Linear Interactions)

PRACTICE EXERCISES ANSWERS AND SOLUTIONS

1. before collision

Consider right as positive and left as negative

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

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