PRACTICE EXERCISES

Formulas: $\bar{p} = m\bar{v}$ $\bar{F}_{net}t = \Delta\bar{p}$ or $\bar{F}_{net}t = m\Delta\bar{v}$

1. Calculate the momentum of a 4.0 kg object travelling at a velocity of 12.0 m/s east.

$$\vec{p} = m\vec{v}$$
$$= (4)(12)[E]$$
$$= \underline{48}\,kg\frac{m}{s}\,[E]$$ ✓

2. A 5.0 kg object has momentum of 25.0 kg·m/s west. What is its velocity?

$$\vec{v} = \frac{\vec{p}}{m} = \frac{25\,[W]}{5} = \underline{5.0}\,\frac{m}{s}\,[W]$$ ✓

3. An object has a velocity of 8.0 m/s south and a momentum of 36.0 kg·m/s south. What is the mass of the object?

$$m = \frac{\vec{p}}{\vec{v}} = \frac{36\,[S]}{8\,[S]} = \underline{4.5}\,kg$$ ✓

4. An object has a velocity of 2.0 m/s east and momentum of 29 kg·m/s east. What is the magnitude of the weight of the object?

$$M = \frac{\vec{P}}{\vec{V}} = \frac{29\,[E]}{2\,[E]} = 14.5\,kg$$ ← mass

$$F_g = (14.5)(9.81) = \underline{1.4\times10^2}\,N$$ ✓

5. A 6.6 N object is travelling at a velocity of 3.0 m/s north. What is the momentum of the object? (Express answer in kg·m/s.)

$$m = \frac{F}{a} = \frac{6.6}{9.81} = 0.67278\,kg$$

$$\vec{p} = m\vec{v} = (0.67278)(3\,m/s\,[N]) = \underline{2.0}\,kg\frac{m}{s}\,[N]$$ ✓

6. A 7.0 kg object travels 2.6 m west in 1.1 s. If velocity is uniform, what is the momentum of the object?

$\vec{p} = m\vec{v}$ $\quad \vec{v} = \frac{d}{t}$

$= (7kg)\left(\frac{2.6m}{1.1s}\right)[W] = 16.54 = \underline{17\, kg\frac{m}{s}}\ [W]$ ✓

7. A 5.0 kg object is dropped from a height of 2.5 m above the floor. What is the object's momentum after 0.25 s?

$V_i = 0$
$V_f = ?$
$a = -9.81$
$t = 0.25$

$V_f = \overset{0}{\cancel{V_i}} + at$
$= (-9.81)(0.25)$
$= -2.4525\ m/s$

$\vec{p} = m\vec{v}$
$= (5)(-2.4525)$
$= -12.\ kg\ m/s$
$= \underline{12\ kg\ m/s\ [down]}$ ✓

8. An average net force of 17.0 N acts east on an object for 2.5×10^{-2} s.. What is the impulse?

$\text{impulse} = \vec{F}\Delta t$
$= (17N)(2.5\times10^{-2}s)$
$= 0.425 = \underline{0.43\ N\cdot s\ [E]}$ ✓

9. An average net force of 11.2 N acts west on an object producing an impulse of 7.00 N•s west. How long did the force act on the object?

$t = \frac{\vec{imp}}{\vec{F}}$
$= \frac{7N\cdot s\ [W]}{11.2N\ [W]}$
$= \underline{0.625s}$ ✓

10. A 26.3 kg object is travelling at 21.0 m/s north. What average net force is required to bring this object to a stop in 2.60 s?

$imp = \Delta p$
$F_{net}t = \overset{0}{\cancel{P_f}} - P_i$
$F_{net} = \frac{-mv}{t} = \frac{-(26.3)(21.0\ m/s\ [N])}{2.6s} = -212\ N$
$= \underline{212N\ [S]}$ ✓

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11. An average net force of 31.6 N south is used to accelerate a 15.0 kg object uniformly from rest to 10.0 m/s. How long was the acceleration?

$$\vec{imp} = \Delta\vec{p}$$

$$\vec{F}_{net} t = \vec{p}_f - \cancel{\vec{p}_i}^{0}$$

$$t = \frac{\vec{p}_f}{\vec{F}} = \frac{m\vec{v}}{\vec{F}} = \frac{(15)(10)}{31.6} = \underline{4.75 s}$$ ✓

12. An average net force of 25.0 N acts north on an object for 7.20×10^{-1} s. What is the change in momentum of the object?

$$\Delta\vec{p} = imp$$

$$= \vec{F}\Delta t$$

$$= (25N)(7.2 \times 10^{-1})$$

$$= \underline{18.0} \text{ kg} \frac{m}{s} [N]$$ ✓

13. A 5.00 kg object accelerates uniformly from rest to a velocity of 15.0 m/s east. What is the impulse on the object?

$$\vec{imp} = \Delta\vec{p} = \vec{p}_f - \vec{p}_i$$

$$= m\vec{v}_f - \cancel{m\vec{v}_i}^{0}$$

$$= (5)(15) = \underline{75 N \cdot s} [E]$$ ✓

14. An average net force caused an 11.0 kg object to accelerate uniformly from rest. If this object travels 26.3 m west in 3.20 s, what is the change in momentum of the object?

$\vec{p}_i = 0$

$$\Delta\vec{p} = \vec{p}_f - \cancel{\vec{p}_i}^{0}$$

$$= m\vec{v}_f$$

$$= (11 kg)(16.4375 m/s)$$

$$= \underline{181} \text{ kgm/s [West]}$$ ✓

$v_f = ?$
$t = 3.2$
$d = 26.3 [W]$
$v_i = 0$

$$d = v_{avg} t$$

$$= \left(\frac{v_f - \cancel{v_i}^{0}}{2}\right) t$$

$$v_f = \frac{2d}{t} = \frac{2(26.3)}{3.2} = 16.4375$$

15. A 3.0 kg object is dropped from a height of 6.5 m. How far has the object fallen when its momentum is 6.0 kg·m/s down?

$$\Delta\vec{p} = \vec{p}_f - \cancel{\vec{p}_i}^{0}$$

$$= m\vec{v}_f$$

$$v_f = \frac{\Delta\vec{p}}{m}$$

$$= \frac{6}{3} = 2 m/s [down]$$

$d = ?$
$v_f = -2 m/s$
$a = -9.81 m/s^2$
$v_i = 0$

$$v_f^2 = \cancel{v_i^2}^{0} + 2ad$$

$$(-2)^2 = 2(-9.81)d$$

$$d = -0.203 m$$

$$= \underline{0.20 m [down]}$$ ✓

16. A 1.0 kg ball hits the floor with a velocity of 2.0 m/s. If this ball bounces up with a velocity of 1.6 m/s, what is the ball's change in momentum?

$$\Delta\vec{p} = \vec{p}_f - \vec{p}_i$$
$$= m\vec{v}_f - m\vec{v}_i$$
$$= (1\text{kg})(1.6\ \text{m/s up}) + (1\text{kg})(2\ \text{m/s}\ \overset{\text{up}}{\cancel{\text{down}}})$$
$$= \underline{3.6\ \text{kg m/s [up]}}\ ✓$$

17. A rocket at rest with a mass of 9.5×10^3 kg. is acted on by an average net force of 1.5×10^5 N up for 15 s. What is the final velocity of the rocket?

$$\vec{Imp} = \vec{F}\Delta t = \Delta\vec{p} = \vec{p}_f - \overset{0}{\cancel{\vec{p}_i}}$$
$$\vec{F}\Delta t = m\vec{v}_f$$
$$(1.5\times10^5\ \text{N}_{\text{up}})(15\text{s}) = 9.5\times10^3\text{kg}\ \vec{v}_f$$
$$v_f = \underline{2.4\times10^2\ \text{m/s [up]}}\ ✓$$

18. Without finding the acceleration, calculate the average net force that is required to accelerate a 5.4 kg ball from rest to 3.0 m/s east in a time of 0.75 s.

$$\vec{F}\Delta t = \vec{p}_f - \overset{0}{\cancel{\vec{p}_i}}$$
$$F = \frac{\vec{p}_f}{\Delta t} = \frac{m\vec{v}_f}{t}$$
$$= \frac{(5.4\text{kg})(3\ \text{m/s [E]})}{0.75\text{s}} = 21.6 = \underline{22\ \text{N [E]}}\ ✓$$

19. Without finding the acceleration, calculate the time an average net force of 225 N must act on a 1.0 × 103 kg object to change its velocity from 2.0 m/s east to 5.0 m/s east.

$$\vec{F}\Delta t = \vec{p}_f - \vec{p}_i$$
$$t = \frac{m\vec{v}_f - m\vec{v}_i}{F}$$
$$t = \frac{(1000)(5[E]) - 1000(2[E])}{225\text{N}} = \underline{13\ \text{s}}\ ✓$$

20. Without finding the acceleration, calculate the change in velocity of a 15 kg object when an average net force of 95 N north acts on the object for 1.6 s.

$$\vec{F}\Delta t = m\Delta\vec{v}$$
$$\Delta\vec{v} = \frac{F\Delta t}{m}$$
$$= \frac{(95\text{N}_{\text{North}})(1.6\text{s})}{15\text{kg}} = \underline{10\ \text{m/s [North]}}\ ✓$$