## Momentum Quiz Review Key

Instructions: Show your work completely in your journal when answering the following questions.

1. If a 3.0 kg object moves 10 . meters in 2.0 seconds, what is its average momentum?

$$
\begin{aligned}
\bar{v}=\frac{d}{t}= & \frac{10 \mathrm{~m}}{2.0 \mathrm{~s}}=5.0 \mathrm{~m} / \mathrm{s} \\
p=m v & =(3.0 \mathrm{~kg})(5.0 \mathrm{~m} / \mathrm{s}) \\
\boldsymbol{p} & =15 \mathrm{~N} \cdot \mathbf{s}
\end{aligned}
$$

2. An impulse of $30.0 \mathrm{~N} \cdot \mathrm{~s}$ is applied to a 5.00 kg mass. If the mass had a speed of $100 \mathrm{~m} / \mathrm{s}$ before the impulse, what would its speed be after the impulse?

$$
\begin{gathered}
I=m \cdot \Delta v=m\left(v_{2}-v_{1}\right) \leadsto v_{2}=\frac{I}{m}+v_{1}=\frac{30.0 \mathrm{~N} \cdot \mathrm{~s}}{5.00 \mathrm{~kg}}+100 \mathrm{~m} / \mathrm{s} \\
\boldsymbol{v}_{2}=\mathbf{1 0 6} \mathbf{~ m} / \mathbf{s}
\end{gathered}
$$

3. A 15 N force acts on an object in a direction due east for 3.0 seconds. What will be the change in momentum of the object?

$$
\begin{gathered}
I=F \cdot \Delta t=(15 \mathrm{~N})(3.0 \mathrm{~s}) \\
\boldsymbol{I}=\Delta \boldsymbol{p}=45 \mathbf{N} \cdot \mathbf{s}
\end{gathered}
$$

4. A 1.0 kg mass changes speed from $2.0 \mathrm{~m} / \mathrm{s}$ to $5.0 \mathrm{~m} / \mathrm{s}$. What is the change in the object's momentum?

$$
\begin{gathered}
\Delta p=m \cdot \Delta v=m\left(v_{2}-v_{1}\right)=(1.0 \mathrm{~kg})(5.0 \mathrm{~m} / \mathrm{s}-2.0 \mathrm{~m} / \mathrm{s}) \\
\Delta \boldsymbol{p}=\mathbf{3 . 0 ~ N} \cdot \mathbf{s}
\end{gathered}
$$

5. A net force of 12 Newtons acting North on an object for 4.0 seconds will produce an impulse of what?

$$
\begin{gathered}
I=F \cdot \Delta t=(12 \mathrm{~N})(4.0 \mathrm{~s}) \\
\boldsymbol{I}=\mathbf{4 8} \mathbf{N} \cdot \mathbf{s}
\end{gathered}
$$

6. A ping-pong gun originally at rest fires a ball. What is the sum of the gun's and ball's momenta after the shot?

$$
p_{\text {before }}=p_{\text {after }}^{\prime}=0 \mathrm{~N} \cdot \mathrm{~s}
$$

7. A moving freight car runs into an identical car at rest on the track. The cars couple together. Compared to the velocity of the first car before the collision, what is the velocity of the combined cars after the collision?

$$
\begin{gathered}
p_{\text {before }}=p_{\text {after }}^{\prime} \\
m_{1} v_{1}+m_{2} v_{2}=\left(m_{1}+m_{2}\right) v^{\prime} \leadsto m v_{1}+0=(2 m) v^{\prime} \leadsto v^{\prime}=\frac{\mathbf{1}}{\mathbf{2}} \boldsymbol{v}_{\mathbf{1}}
\end{gathered}
$$

8. If a $54 \mathrm{~N} \cdot \mathrm{~s}$ impulse is given to a 6.0 kg object, what is the object's change in momentum?

$$
I=\Delta p=54 \mathrm{~N} \cdot \mathrm{~s}
$$

9. Which quantities do not always occur in equal and opposite pairs when and interaction takes place within a system?
a. Impulses

TRUE
b. Accelerations

FALSE
c. Forces

TRUE
d. Momenta changes TRUE
10. Object A has a momentum of $60.0 \mathrm{~N} \cdot \mathrm{~s}$. Object B , which has the same mass, is standing motionless. Object A strikes object B and stops. If the mass of object B is 6.0 kg , what is the velocity of object $B$ after the collision?

$$
\begin{gathered}
p_{\text {before }}=p^{\prime}{ }_{\text {after }} \\
m_{1} v_{1}+m_{2} v_{2}=m_{1} v^{\prime}{ }_{1}+m_{2} v^{\prime}{ }_{2} \leadsto 60 \mathrm{~N} \cdot \mathrm{~s}+0=0+(6.0 \mathrm{~kg}) v^{\prime}{ }_{2} \\
{v^{\prime}}_{\mathbf{2}}=\mathbf{1 0} \mathbf{. m}^{\mathbf{m}} \mathbf{s}
\end{gathered}
$$

