

Name: _____

Key

Notes - 8.1 Linear Momentum and Force

1. Momentum, like energy, is important because it is conserved.

2. Write the equation for momentum. $\vec{p} = m\vec{v}$

3. What are the units for momentum? $\frac{\text{kgm}}{\text{s}}$

4. Calculate the momentum of a 110-kg football player running at 8.00 m/s.

$$p = mv = (110 \text{ kg}) \left(8.00 \frac{\text{m}}{\text{s}} \right) = \boxed{880 \frac{\text{kgm}}{\text{s}}}$$

5. Write Newton's 2nd law of Motion in terms of momentum.

$$F_{\text{NET}} = \frac{\Delta p}{\Delta t}$$

$$\vec{F} = \frac{d\vec{p}}{dt}$$

6. During the 2007 French Open, Venus Williams hit the fastest recorded serve in a premier women's match, reaching a speed of 58 m/s (209 km/h). What is the average force exerted on the 0.057-kg tennis ball by Venus Williams' racquet, assuming that the ball's speed just after impact is 58 m/s, that the initial horizontal component of the velocity before impact is negligible, and that the ball remained in contact with the racquet for 5.0 ms (milliseconds)? Show your work.

$$\begin{aligned} F_{\text{AVG}} &= \frac{\Delta p}{\Delta t} = \frac{mv_f - mv_i}{\Delta t} \\ &= \frac{0.057 \text{ kg} \left(58 - 0 \frac{\text{m}}{\text{s}} \right)}{5.0 \times 10^{-3} \text{ s}} \\ &= \boxed{660 \text{ N}} \\ &\quad 661 \text{ N} \end{aligned}$$