Name: Key

Practice - 8.1 Linear Momentum and Force

1. Calculate the momentum of:

A. A 2000-kg elephant charging a hunter at a speed of 7.50 m/s.

$$p = mv = (2000\,kg)\left(7.50\,\frac{m}{s}\right) = \boxed{1.50\times10^{4}\,\frac{kg\,m}{s}}$$

B. A 0.0400-kg tranquilizer dart fired at a speed of 600 m/s.

$$p = mv = (0.0400\,kg)\left(600\,\frac{m}{s}\right) = \boxed{24.0\,\frac{kg\,m}{s}}$$

C. The 90.0-kg hunter running at 7.40 m/s after missing the elephant?

$$p = mv = (90.0\,kg)\left(7.40\,\frac{m}{s}\right) = \boxed{666\,\frac{kg\,m}{s}}$$

2. At what speed would a 2.00×10^4-kg airplane have to fly to have a momentum of 5.40×10^6 kg·m/s?

$$p = mv \Rightarrow v = \frac{p}{m} = \frac{5.40\times10^{6}\,\frac{kg\,m}{s}}{2.00\times10^{4}\,kg} = \boxed{2.70\times10^{2}\,\frac{m}{s}}$$

3. A runaway train car that has a mass of 15,000 kg travels at a speed of 5.4 m/s down a track. Compute the time required for a force of 1500 N to bring the car to rest.

$$F = \frac{\Delta p}{\Delta t} \Rightarrow t = \frac{\Delta p}{F} = \frac{m(v_f - v_i)}{F} = \frac{(15000\,kg)\left(0 - 5.4\,\frac{m}{s}\right)}{-1500\,N} = \boxed{54\,s}$$

4. The mass of Earth is 5.972×10^{24} kg and its orbital radius is an average of 1.496×10^{11} m . Calculate its linear momentum.

$$p = mv = \frac{m\,d}{t} = \frac{m\,2\pi r}{t} = \frac{(5.972\times10^{24}\,kg)\,2\pi\,(1.496\times10^{11}\,m)}{365.25\,d\left(\frac{24\,h}{1\,d}\right)\left(\frac{3600\,s}{1\,h}\right)}$$

$1\,y = 3.16\times10^{7}\,s$

$$= \boxed{1.78\times10^{29}\,\frac{kg\,m}{s}}$$