Momentum – *warm-up*

Name: _____ Date: _____

Write the equation for **momentum** & **kinetic energy**:

$\vec{p} = m\vec{v}$ units: $kg \cdot m/s$

Write the units for **momentum** & **kinetic energy**:

$E_k = \frac{mv^2}{2}$ units: $kg \cdot \frac{m^2}{s^2} = J$ (joule)

Questions:

1. Calculate the momentum of an electron (m= 9.1×10^{-31} kg) moving at 2.18×10^{6} m/s.

$p = 1.98 \times 10^{-24}\ kg \cdot m/s$.

2. Calculate the mass of a professional fullback running across the line at 9.2 m/s if he has a momentum of 1012 kg•m/s.

$m = 110\ kg$

3. A bicycle has a momentum of 24 kg•m/s. What momentum would the bicycle have if it had:

a) twice the mass and was moving at the same speed?

$2 \times 24 = 48\ kg \cdot m/s$

b) the same mass and was moving with twice the speed?

$2 \times 24 = 48\ kg \cdot m/s$

c) one-half the mass and was moving with twice the speed?

$\frac{1}{2} \times 2 \times 24 = 24\ kg \cdot m/s$

d) the same mass and was moving with one-half the speed?

$\frac{1}{2} 24 = 12\ kg \cdot m/s$

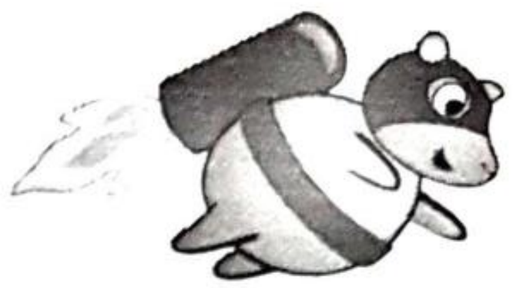
e) three times the mass and was moving with one-half the speed?

$3 \times \frac{1}{2} \times 24 = 36\ kg \cdot m/s$

f) three times the mass and was moving with twice the speed?

$3 \times 2 \times 24 = 144\ kg \cdot m/s$

4. *Rocket Mouse* is in outer-space chasing the *Intergalactic Cat Burglar*. Calculate the following:



a) Calculate the mass of *RM* (and his rocket engine) if he is travelling at 200 km/h and has a momentum of 1111.1 kg m/s.

$v = 200\ \frac{km}{h} = 55.55\ m/s$

$p = 1111.1\ kg \cdot m/s$

$m = ?$

$m = \frac{p}{v}$

$= \frac{1111.1}{55.555}$

$m = 20\ kg$

b) *RM* realizes he is travelling too slowly to catch *ICB* and triples his kinetic energy. Calculate his new momentum at this speed.

① $E_K = \frac{mv^2}{2} = \frac{(20)(55.55)^2}{2} = 30864.19752$

triples this $E_k \Rightarrow 92592.59257 = \frac{mv^2}{2}$ find new v...

$v = \sqrt{\frac{2(92592.59257)}{20}^2} = 96.225$

$p = (20)(\quad) = 1924.5\ kg \cdot m/s$

c) An observer watching through a telescope from Earth is able to remotely calculate the ICB is travelling with double the momentum of RM (from part b) and knows he has a mass of 50kg. Will RM be able to catch up with ICB? Calculate and explain.

ICB: $2 \times 1924.5 = 3849\ kg \cdot m/s$.

$v = \frac{p}{m} = \frac{3849}{50} = 76.98\ m/s$

$v_{ICB} \simeq 77\ m/s$

yes, he would catch up.