Name: KEY

Date:

Section C D F

The Masters School DOBBS
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Physics

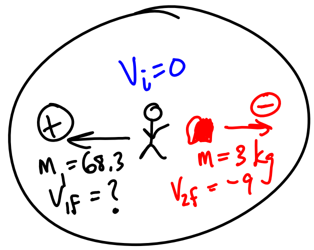
Momentum IV

1. A 670 N student stands in the middle of a frozen pond having a radius of 10.0 m. He cannot move because of a lack of friction between his shoes and the ice. To overcome this difficulty, he throws his 3.0 kg backpack away from him at a speed of 9.0 m/s. Assuming friction is negligible, and he slides with a constant velocity, how long does it take him to slide to shore? *(Hint: This is similar to the astronaut problem. Your answer should be between 22 – 28 seconds.)*

$F_g = 670\ N$

$mg = 670$

$m = \frac{670}{9.81} = 68.30\ kg$



$\cancel{(M_1 + M_2)V_i} = M_1V_{1f} + M_2V_{2f}$

$-(M_2V_{2f}) = M_1V_{1f}$

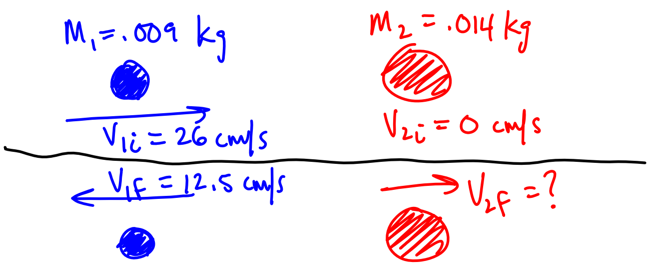
$-(3 \cdot -9) = 68.3\ V_{1f}$

$V_{1f} = .3953$

$V_{1f} = \frac{\Delta x}{\Delta t}$ $\quad \Delta t = \frac{\Delta x}{V} = \frac{10}{.3953}$

$\boxed{\Delta t = 25.30\ sec}$

2. A 9.0 g coin moving to the right at 26.0 cm/s makes an elastic head-on collision with a 14.0 g coin that is initially at rest. After the collision, the 9.0 g coin moves to the left at 12.5 cm/s.
   a. Find the final velocity of the other coin. *(Your answer should be between 23 – 25 cm/s)*



$M_1V_{1i} + \cancel{M_2V_{2i}} = M_1V_{1f} + M_2V_{2f}$

$(.009)(26) = (.009)(-12.5) + (.014)V_{2f}$

$\boxed{V_{2f} = 24.75\ cm/s}$

   b. Find the amount of kinetic energy transferred to the 14.0 g coin. *(Hint: This is an elastic collision, so kinetic energy is conserved. Your answer should be between 3.0 – 4.5 x 10^{-4} Joules)*

3.

$KE_{2i} = 0$, so the amount of KE transferred is simply equal to KE_{2f}.

$KE_{2f} = \frac{1}{2} M_2 V_{2f}^2$

$KE_{2f} = \frac{1}{2}(.014)(.2475)^2$

$\boxed{KE_{2f} = 4.288 \times 10^{-4}\ J}$

A moving object has a kinetic energy of 140 J and a momentum with a magnitude of 33.0 kg•m/s. Determine the mass and speed of the object. *(Your mass should be between 3 – 4 kg, and your speed should be between 8 – 10 m/s.)*

$KE = 140\ J = \frac{1}{2}mv^2$

$p = 33\ kg \cdot m/s = mv$

$33 = m \cdot v$

$\boxed{m = \frac{33}{v}}$

$\frac{1}{2}mv^2 = 140\ J$

$\frac{1}{2}\left(\frac{33}{\cancel{v}}\right)v^{\cancel{2}} = 140\ J$

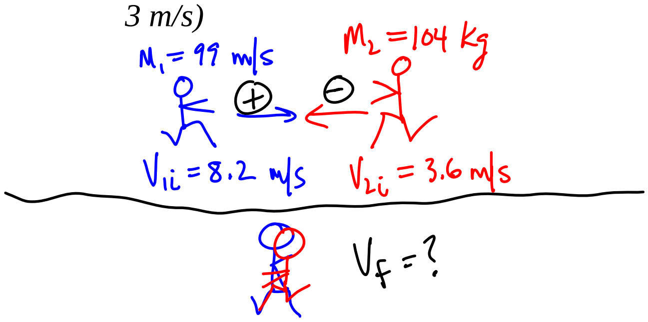
$\frac{33\,v}{2} = 140$

$33\,v = 280$

$\boxed{v = 8.485\ m/s}$

$\boxed{m = \frac{33}{v} = 3.89\ kg}$

4. A 99 kg fullback moving east with a speed of 8.2 m/s is tackled by a 104 kg opponent running west at 3.6 m/s, and the collision is perfectly inelastic.
   a. Calculate the velocity of the players just after the tackle. *(Your answer should be between 2 and 3 m/s)*



$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$

$(99)(8.2) + (104)(-3.6) = (99 + 104)\, v_f$

$437.4 = 203\, v_f$

$\boxed{+2.155\ m/s = v_f \text{ (east)}}$

   b. Calculate the decrease in kinetic energy during the collision. *(Your answer should be between 3,500 and 4,000 Joules)*

$KE_{i,tot} = KE_{1i} + KE_{2i}$

$= \frac{1}{2}m_1 v_{1i}^2 + \frac{1}{2}m_2 v_{2i}^2$

$= \frac{1}{2}(99)(8.2)^2 + \frac{1}{2}(104)(-3.6)^2$

$\boxed{KE_{i,tot} = 4002.3\ J}$

$KE_f = \frac{1}{2}(m_1 + m_2) v_f^2$

$KE_f = \frac{1}{2}(203)(2.155)^2$

$\boxed{KE_f = 471.37\ J}$

$\Delta KE = KE_i - KE_f = \boxed{3530.9\ J}$