ABRHS PHYSICS (H) NAME: KEY

Momentum & Recoil

1. A 1.5 kg gun can fire a 0.005 kg bullet with a speed of 500 m/s. What is the "recoil speed" of the gun? $p_1 = p_2$ (= & opposite) → initial total momentum = 0.

$(1.5)v = (.005)(500)$ $\quad \boxed{v = 1.67 \text{ m/s}}$

2. Imagine someone invented a super-light gun that has a mass of only 0.010 kg, yet could still fire a 0.005 kg bullet with a speed of 500 m/s. Why would this gun be really dangerous for the person firing the gun?

recoil speed would be huge.

$(.01)(v) = (.005)(500)$

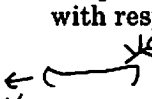
$v = 250 \text{ m/s}$

3. Two astronauts are floating in space. One of them pushes the other, sending astronaut A to the left at 0.5 m/s and the astronaut B to the right at 0.75 m/s. What is the ratio of their masses?

$p_1 = p_2$

$m_A(.5) = m_B(.75)$ $\quad \frac{m_A}{m_B} = \frac{.75}{.5} = \boxed{\frac{3}{2}}$

4. A 70 kg person is at rest in a 40 kg canoe by a dock. In a horrible attempt to get out of the canoe, the person tries to jump forward, sending the canoe backward. If the relative speed of the person with respect to the canoe is 4 m/s, what is the speed of the person with respect to the dock?



using speeds

$m_1v_1 = m_2v_2$ & $v_1 + v_2 = 4$

$\therefore (70)v_1 = (40)v_2 \Rightarrow 70v_1 = 40(4 - v_1)$

$v_2 = 4 - v_1$

$70v_1 = 160 - 40v_1$

$110v_1 = 160$

$\boxed{v_1 = 1.46 \text{ m/s}}$

5. A 7 kg object is sliding along a frictionless surface with an initial speed of 5 m/s. For some reason, it explodes into 2 pieces. A 4 kg piece of it is now only sliding with a speed of 3 m/s. How fast is the other piece traveling?

momentum conserved.

$(7)(5) = (4)(3) + (3)v$

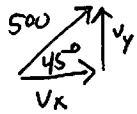
$35 = 12 + 3v$

$23 = 3v$

$\boxed{v = 7.67 \text{ m/s}}$

6. A projectile is fired from a gun at an angle of 45° with the horizontal and with a muzzle velocity of 500 m/sec. At the highest point in its flight, the projectile explodes into two fragments of equal mass. One fragment, whose speed immediately after the explosion is zero, falls vertically down. How far from the gun does the other fragment land, assuming a level terrain and ignoring air resistance?

Momentum! @ top $v = v_x$ b/c $v_y = 0$



$v_x = 500\cos 45 = 353.6 \text{ m/s}$

$v_{y_i} = 500\sin 45 = 353.6 \text{ m/s}$

so $m(353.6) = (\frac{1}{2}m)(0) + (\frac{1}{2}m)v_f$

$v_f = 707 \text{ m/s}$ (= new v_x)

t to top!

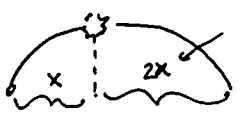
$v_f = at + v_i$

$0 = -10t + 353.6$

$t = 35.36 \text{ s}$

$\therefore x = (353.6)(35.36)$

$x = 12{,}500 \text{ m}$



b/c twice as fast!

$\boxed{\text{Total} = 37{,}500 \text{ m}}$

Answers: 1. 1.7 m/s 2. recoil=250 m/s! 3. A:B = 3:2 4. 1.46 m/s
5. 7.7 m/s 6) 37,500 m