For clicker question,

$W = 2{,}000\,N \Rightarrow m = 200\ kg$

$F = W = -kx$, $k = 2{,}000\ N/m$

then $x = 1\ m$

$U = \frac{1}{2}kx^2 = 1{,}000\ J$

Then if we launch mass, use cons. of energy $\frac{1}{2}kx^2 = \frac{1}{2}mv^2$

$v = \sqrt{\frac{kx^2}{m}} = \sqrt{10\ \frac{m^2}{s^2}} \simeq 3.2\ m/s$

Oct 24-9:36 AM

ETA problem 9.4.22

asteroid
$m = 5 \times 10^{12}\ kg$
$v = 15\ km/s$

moon
$m = 7.36 \times 10^{22}\ kg$

(a) momentum is conserved, $p_1 = p_2$

p_1 = momentum before collision

p_2 = momentum after collision

$p_1 = m_a v_a + m_m v_{m1}$ ($v_{m1} \to 0$)

$p_2 = (m_m + m_a) v_{m2}$

$v_{m2} = \frac{m_a v_a}{m_m + m_a} \simeq \frac{m_a}{m_m} v_a$

$= 1 \times 10^{-8}\ m/s$

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$$KE_1 = \frac{1}{2} m_a v_a^2 = 5 \times 10^{20}\ J$$

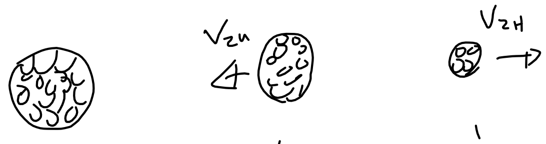
$$KE_2 = \frac{1}{2} m_m v_{m2}^2 \simeq 4 \times 10^{10}\ J$$

$$\Delta KE \simeq 5 \times 10^{20}\ J$$

(a lot of energy!)

Oct 24-10:06 AM

ETA p.5



$V_1 = 0$ $\quad$ $V_{2u} = ?$ $\quad$ $V_{2H} = ?$

$m_{U238} = ?$ $\quad$ $m_{U235} = 235\ au$ $\quad$ $m_H = 4\ au$

Let p_1 = momentum before decay = 0

p_2 = " after " $= -m_{U235} V_{2u} + m_H V_{2H}$ ✓

Since $p_1 = p_2$, $\boxed{m_{U235} V_{2u} = m_H V_{2H}}$

Now $KE_1 = \emptyset$

So KE_2 = energy released in decay

$= U = 8.4 \times 10^{-13}\ J$

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$$\text{So} \quad \frac{1}{2} m_{U235} v_{U2}^2 + \frac{1}{2} m_H v_{H2}^2 = U \checkmark$$

We have 2 equations & 2 unknowns

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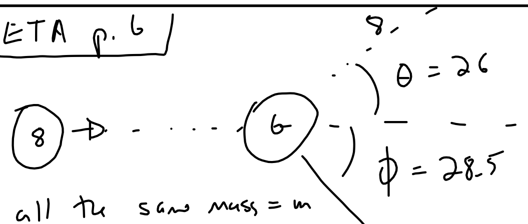
ETA p. 6



all the same mass = m

Cons. of momentum in x-direction,

$$p_{xi} = p_{xf}$$

$$m v_{8i} + m v_{6i}^{\,0} = m v_{8f} \cos\theta + m v_{6f} \cos\phi$$

$$\boxed{v_{8i} = v_{8f} \cos\theta + v_{6f} \cos\phi}$$

Cons. of momentum in y-direction

$$p_{yi} = p_{yf}$$

$$0 = m v_{8f} \sin\theta - m v_{6f} \sin\phi$$

$$\boxed{v_{8f} \sin\theta = v_{6f} \sin\phi}$$

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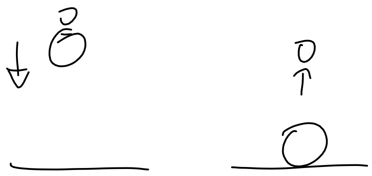
Basketball + lacrosse ball



Analysis, let "1" be before collison
"2" be after collision

$p_1 = p_2$ $\quad (m_B - m_L)V_1 = m_L V_2$

$KE_1 = KE_2$ $\quad \frac{1}{2} m_B v_1^2 + \frac{1}{2} m_L v_1^2 = \frac{1}{2} m_L v_2^2$

With algebra,

$$m_B = 3 m_L$$

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