Name: KEY

Date:

Section C D F

The Masters School
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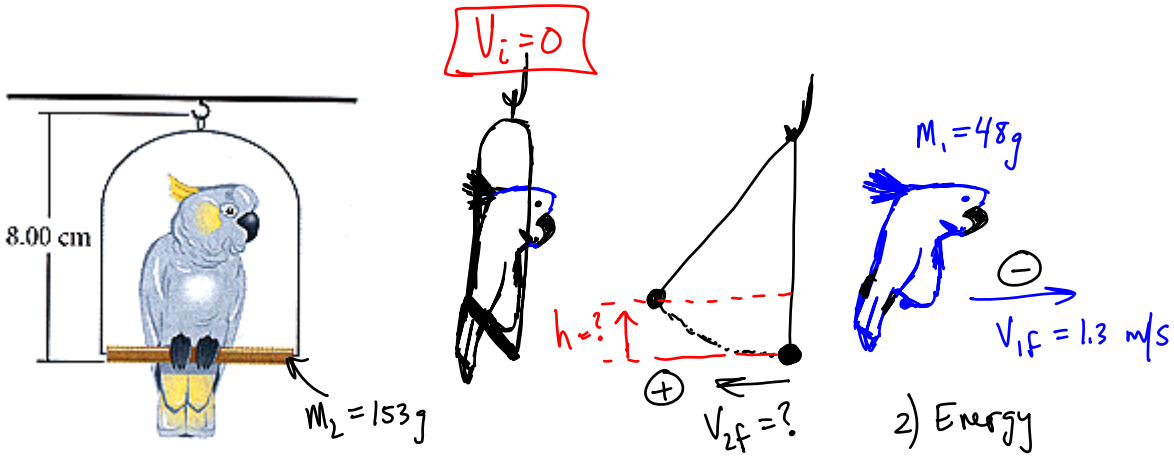
Physics

Momentum V

1. The bird perched on the swing below has a mass of 48.0 g, and the base of the swing has a mass of 153 g. The swing and bird are originally at rest, and then the bird takes off horizontally at 1.30 m/s. How high will the base of the swing rise above its original level? *(Hint: This is a pendulum /"Tarzan" energy question, alongside a momentum question. Your answer should be between .0081 - .011 m)*



1) Momentum

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

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

$-(48)(-1.3) = (153)V_{2f}$

$V_{2f} = .4078$ m/s

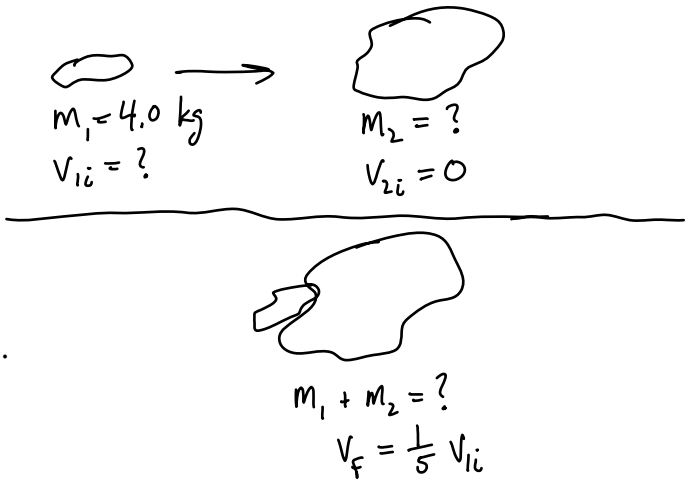
2) Energy

$KE_i = PE_f$

$\frac{1}{2}mV^2 = mgh$

$h = .00848$ m

2. A 4.00 kg mud ball has a perfectly inelastic collision with a second mud ball that is initially at rest. The composite system moves with a speed equal to one-fifth the original speed of the 4.00 kg mud ball. What is the mass of the second mud ball? *(Your answer should be between 15 – 22 kg.)*



$M_1V_{1i} + M_2V_{2i} = (M_1 + M_2)V_f$

$M_1V_{1i} = (M_1 + M_2)(V_i)(\frac{1}{5})$

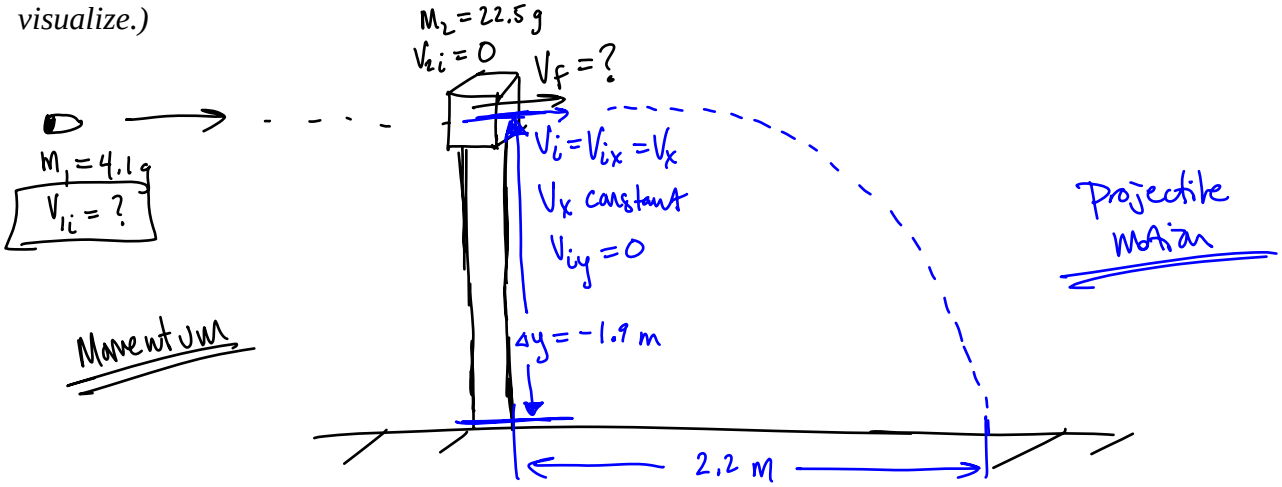
$5m_1V_{1i} = m_1V_i + m_2V_i$

$4m_1 = m_2$

$m_2 = 16$ kg

3.

A 4.1 g bullet is fired into a block of wood with a mass of 22.5 g. The wood block is initially at rest on a 1.9 m tall post. After the collision, the wood block and bullet land 2.2 m from the base of the post. Find the initial speed of the bullet. *(Hint: This is a horizontal projectile problem, connected with a momentum problem. Your answer should be between 20 – 25 m/s. Draw a good diagram to help you visualize.)*



① Projectile motion

$$\Delta y = V_{iy}\Delta t - \frac{1}{2}g\Delta t^2$$

$$\frac{-2\Delta y}{g} = \Delta t^2$$

$$\Delta t^2 = \frac{-2(-1.9)}{9.81}$$

$$\Delta t^2 = .387$$

$$\Delta t = .6223$$

$$\Delta x = V_x \Delta t$$

$$V_x = \frac{\Delta x}{\Delta t}$$

$$V_x = \frac{2.2}{\Delta t}$$

$$V_x = 3.535\ m/s$$

$$V_i = V_x = V_{f,\,momentum} = 3.535\ m/s$$

② Momentum

$$M_1 V_{1i} + M_2 V_{2i} = (M_1 + M_2) V_f$$

$$(4.1) V_{1i} = (4.1 + 22.5)(3.535)$$

$$4.1\, V_{1i} = 94.026$$

$$V_{1i} = 22.933\ m/s$$