PHYS 101: General Physics KOÇ UNIVERSITY Fall Semester 2015

College of Arts and Sciences

Quiz - Ch.8

Closed book. No calculators are to be used for this quiz.

Name: Student ID: Signature:

Two sisters with mass m each stand on top of a crate also with mass m, all at rest on a frozen pond (i.e., no friction). Each jumps horizontally eastward, with a speed v relative to the crate. What is the final speed of the crate if one jumps few seconds after the other?

$$0 = m(V_{c,1} + v) + 2mV_{c,1}$$

$$\Rightarrow V_{c,1} = -\frac{1}{3}v$$ (after the first sistor jump).

$$0 = m(V_{c,1} + V) + m(V_{c,2} + V) + mV_{c,2}.$$

$$\Rightarrow V_{c,2} = -\frac{m(V_{c,1} + 2V)}{2m} = -\frac{5}{6}V$$ (after the second sis jump)

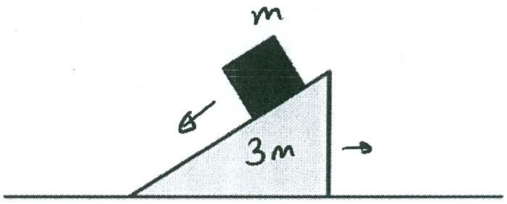
The final speed of crate

$$\boxed{V_{c,2} = -\frac{5}{6}V}$$

PHYS 101: General Physics KOÇ UNIVERSITY Fall Semester 2015
College of Arts and Sciences
Quiz - Ch.8

Closed book. No calculators are to be used for this quiz.
Name: Student ID: Signature:

On a frictionless floor, a brick with mass m slides down a wedge with mass $3m$ as shown in the figure. Both the wedge and the brick are initially at rest. After the brick reaches the floor, both continue moving horizontally in opposite directions. Find the ratio of their final kinetic energies, K_b/K_w.



The horizontal component of force due to gravity = 0.

$\Rightarrow$ horizontal component of total Momentum = 0.

The final speed V_w and V_b respectively satisfy

$$3m \cdot V_w = m \cdot V_b$$

$$\Rightarrow K_b = \frac{m}{2} V_b^2 = \frac{m}{2} 9 V_w^2 = 3 K_w.$$

$$\Rightarrow \boxed{\frac{K_b}{K_w} = 3}$$

PHYS 101: General Physics KOÇ UNIVERSITY Fall Semester 2015
College of Arts and Sciences
Quiz - Ch.8

Closed book. No calculators are to be used for this quiz.
Name: Student ID: Signature:

An object with mass m and speed v approaches a stationary second object with mass $2m$. After the (inelastic) collision, half of the initial kinetic energy is lost as heat. What is the final *relative* speed of the objects if all velocities are all along the x-axis?

By Conservation of Momentum.

$$mv = mv' + 2m(v' + v_r).$$

$$\Rightarrow \quad v' + v_r = \frac{v - v'}{2} \quad — \quad (1)$$

Here v, v' and v_r are the velocity of the first mass (before & after) and the relative velocity in $+x$ direction, respectively. The K.Es before and after the collision satisfy

$$\frac{1}{2}mv^2 = mv'^2 + 2m(v' + v_r)^2. \quad — (2)$$

Substituting Eq(1) above, we obtain.

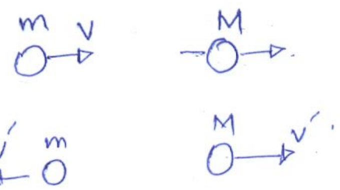
$$\frac{1}{2}v^2 - v'^2 = \frac{1}{2}(v - v')^2 \Rightarrow v' = \frac{2}{3}v,$$ and using Eq(1) again, $v_r = -\frac{1}{2}v$.

After the collision, the mass m takes over the mass $2m$ with an absolute speed $\frac{2v}{3}$ and relative speed $\frac{v}{2}$.

PHYS 101: General Physics KOÇ UNIVERSITY Fall Semester 2015
College of Arts and Sciences
Quiz - Ch.8

Closed book. No calculators are to be used for this quiz.
Name: Student ID: Signature:

An object with mass m moving at speed v approaches another stationary object with mass M. The objects collide elastically and depart with the same final speed v' *in opposite directions.* What is the ratio m/M?



K.E before collision.

$$= \frac{1}{2} m V^2 + 0 .$$

K.E after collision.

$$= \frac{1}{2} m(v')^2 + \frac{1}{2} M(v')^2 .$$

$$= \frac{1}{2} v'^2 [m + M] .$$

for Elastic collision.

$$K.E_{before} = K.E_{after}.$$

$$\cancel{\frac{1}{2}} m v^2 = \cancel{\frac{1}{2}} v'^2 (m + M) .$$

$$\frac{v^2}{v'^2} = 1 + \frac{M}{m} \Rightarrow \frac{M}{m} = \frac{v^2}{v'^2} - 1 .$$

$$= \frac{v^2 - v'^2}{v'^2} .$$

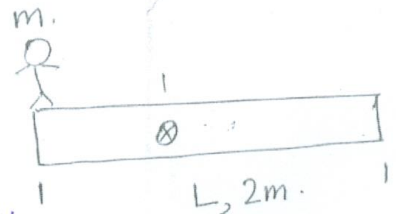
$$\Rightarrow \boxed{\frac{m}{M} = \frac{v'^2}{v^2 - v'^2}}$$

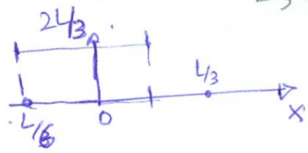
PHYS 101: General Physics KOÇ UNIVERSITY Fall Semester 2015
College of Arts and Sciences
Quiz - Ch.8

Closed book. No calculators are to be used for this quiz.

Name: Student ID: Signature:

A man with mass m stands up at the front end of a canoe with length L and mass $2m$ which is initially at rest and floating on water (with negligible resistance to motion). The center of mass of the canoe is at a distance $L/3$ from the front end. If the man walks all the way to the back of the canoe, how far has he moved relative to the ground?





$m v_m + 2m V_c = 0.$

To find the position

$m\int_0^L V_m \cdot dt + 2m\int_{L/3}^{X} V_c \cdot dt = 0.$

$m\, x_m \Big|_0^L + 2m \cdot x_c \Big|_{L/3}^{x} = 0.$

$mL + 2m[x_c - L/3] = 0.$

$\Rightarrow \quad mL - \frac{2mL}{3} + 2m x_c = 0.$

$\frac{3mL - 2mL}{3} + 2m x_c = 0$

$\Rightarrow \quad 2\cancel{m}\, x_c = -\frac{\cancel{m}L}{3}.$

$x_c = \frac{-L}{6}.$

Distance of Canyon w.r.t ground

$\boxed{x_c = \frac{-L}{6}}$

The Distance of man w.r.t Canyon

$= L - \frac{L}{3} = \frac{2L}{3}.$

Distance of Man w.r.t ground

$= \frac{2L}{3} - \frac{L}{6}$

$= \frac{4L - L}{6} = \frac{3L}{6} = \frac{L}{3}.$

$\boxed{x_m = \frac{L}{3}}$