PH141 **Exam 2** **Fall 2009**

Name: _____ **October 22, 2009**

Student Number: _____ **Section Number:** _____ **(51 or 52)**

Fill out all information above.
Present neat and orderly answers for each question.
Clearly indicate your method of solution for each problem, including equations used.
Use separate Sheet of Paper if you need more Room
Include appropriate units.
Show all work.

(6pts each)

1. For each, determine weather the work done is *Positive*, *Negative* or *Zero*

   (a) A bowler throws the ball down the lane (work done by bowler)
   (b) A dart lands in a dartboard (work done by dartboard)
   (c) A fisherman casts a line out to fish (work done by fisherman)
   (d) A student slips on a banana peal (work done by student)

a) V↑ +
c) V↑ +
b) V↓ −
d) V↑ +

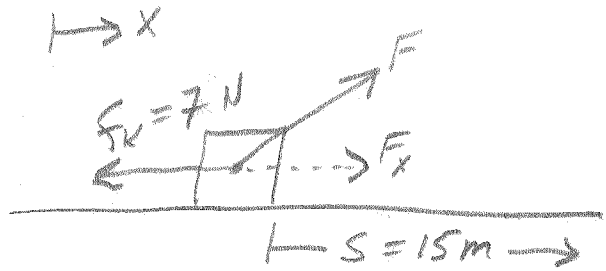
2. A box is being pulled across the floor at a constant speed (with only friction and the applied force acting). The frictional force has a magnitude of 7 N. If the box was pulled a distance of 15 m…

   (a) How much work was done by friction?
   (b) If the student is applying a 10 N force, at what angle (with respect to the displacement vector) must the force be applied?

a) $W = F s \cos\theta$

$W = (7)(15)\cos 180$

$\boxed{W = -105\ J}$



b) $F_x = f_k$, $F_x = F\cos\theta$ → $\cos\theta = \frac{f_k}{F} = \frac{7}{10}$

$\boxed{\theta = 44.4^\circ}$ 1 + or −

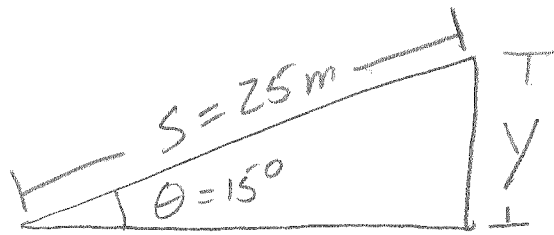
3. A 65 kg Student walks 25 m up a ramp at a 15° incline. Determine…

   (a) The Magnitude of the vertical displacement.
   (b) What was the students change in gravitational potential energy?

a) $y = S \sin\theta$

$y = 25 \sin 15$

$\boxed{y = 6.5\ m}$



b) $\Delta PE = mg\Delta H = (65)(9.8)(6.5)$

$\boxed{\Delta PE = 4122\ J}$

4. A hang glider, with total mass of 175 kg, is traveling with a speed of 50 m/s at a height of 100 m above the ground. Determine the total mechanical energy of the system if it is pointing 20°…

   (a) Above the horizontal.
   (b) Bellow the horizontal.

a) $E_T = KE + PE$

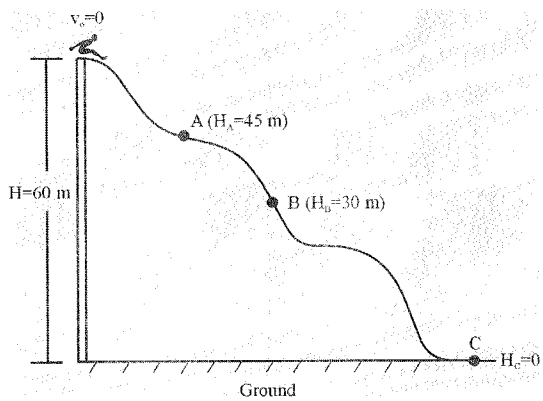
$E_T = \frac{1}{2}mv^2 + mgH$

$E_T = (0.5)(175)(50)^2 + (175)(9.8)(100)$

$\boxed{E_T = 390,250\ J}$

b) Same →

5. A Student is at a water park enjoying his spring break. The water slide he is about to ride is 60 m tall at the top where the student enters the slide with an initial velocity of zero at H = 60 m. How fast is the student going at each of the positions bellow (assuming total mechanical energy is conserved)?



(a) What is the magnitude of the velocity at A (45 m above the ground)?
(b) What is the magnitude of the velocity at B (30 m above the ground)?
(c) What is the magnitude of the velocity at C (0 m above the ground)?

a) $E_T = mgH_{60} + 0 \rightarrow KE$

$mgH_{60} = mgH_A + \frac{1}{2}mV_A^2$

$gH_{60} = gH_A + \frac{V_A^2}{2} \rightarrow \boxed{V_A = \sqrt{2g(H_{60} - H_A)}}$

a) $V_A = \sqrt{2(9.8)(60-45)}$

$\boxed{V_A = 17\ m/s}$

b) $V_B = \sqrt{2(9.8)(60-30)}$

$\boxed{V_B = 24.25\ m/s}$

c) $\boxed{V_c = 34.3\ m/s}$

6. A pinball machine launches a ball from rest, at a velocity of 8 m/s. If the plunger and the ball are in contact for 0.3 s and the average force on the ball is 4.8 N, then what is the mass of the ball?

$\bar{F}\Delta t = mV_f - mV_o^{\,0}$

$m = \frac{\bar{F}\Delta t}{V_f} = \frac{(4.8)(0.3)}{8}$

$\boxed{m = 0.18\ kg}$

7. A 2 kg soccer ball is kicked at 15 m/s into a wall. If the collision is 100% elastic, and the collision took 0.15 s, then what was the average force exerted on the ball.

$F\Delta t = m v_f - m v_0$

$F = \frac{m(v_f - v_0)}{\Delta t}$

$F = \frac{2(15-(-15))}{0.15}$

$\boxed{F = 400\ N}$

$\rightarrow x$

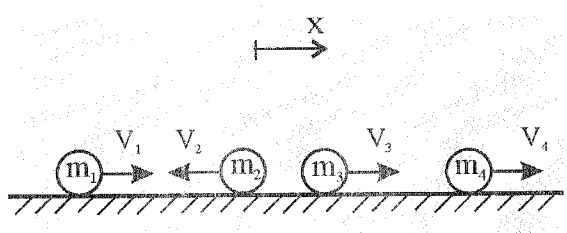
$0 \rightarrow v_0$

$v_f \leftarrow 0$

Elastic

$|v_0| = |v_f|$

8. Using the information bellow, what must m_3 be to make the total momentum of the system equal to zero?



No Friction

$m_1 = 4$ kg	$v_1 = 1$ m/s
$m_2 = 3$ kg	$v_2 = -4$ m/s
$m_3 = ?$	$v_3 = 5$ m/s
$m_4 = 1$ kg	$v_4 = 4$ m/s

$Net\ P = \sum P_i, \quad i=4$

$m_1 v_1 + m_2 v_2 + m_3 v_3 + m_4 v_4 = 0$

$(4)(1) + (3)(-4) + m_3(5) + (1)(4) = 0$

$4 - 12 + 5m_3 + 4 = 0$

$5m_3 = 12 - 8 = 4$

$\boxed{m_3 = 0.8\ kg}$

9. (a) Two apples, each 1.5 kg, are rolling towards each other. If the initial velocity of each apple is 5 m/s and –3 m/s respectively, and the final velocity of one of the apples is –1 m/s, find the velocity of the second apple after the collision.

(b) Repeat the problem assuming Carmel apples are used (and stick together). All initial conditions are the same. What is the final velocity of the two apples after they have stuck together?

Before $m_1 = 1.5$ kg, $m_2 = 1.5$ kg, $V_1 = 5$ m/s, $V_2 = -3$ m/s

a) $m_1V_1 + m_2V_2 = m_1V_1 + m_2V_2$

$(1.5)(5) + (1.5)(-3) = (1.5)(-1) + (1.5)V_2$

$7.5 - 4.5 = -1.5 + 1.5V_2$

$3 + 1.5 = 1.5V_2 \rightarrow V_2 = \frac{4.5}{1.5}$

$\boxed{V_2 = 3 \text{ m/s}}$

After a) $m_1 = m_2 = 1.5$ kg, $V_1 = -1$ m/s, $V_2 = ?$

b) $m_1V_1 + m_2V_2 = (m_1 + m_2)V$

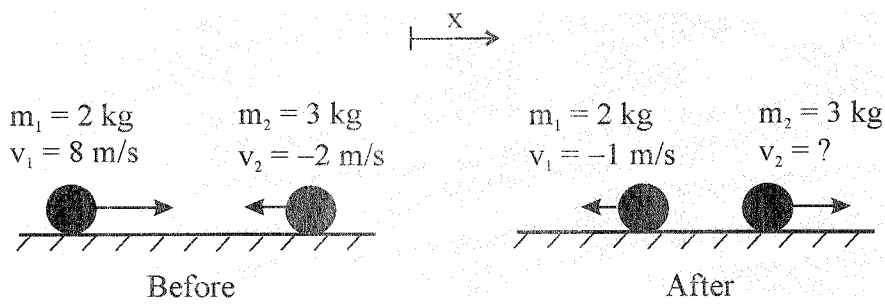
$1.5(5 + (-3)) = 3V$

$3 = 3V$

$\boxed{V = 1 \text{ m/s}}$

After b) $m_1 = m_2 = 1.5$ kg, $V = ?$

10. Using conservation of momentum determine the velocity of ball 2 after the collision.



What is v_2 (final)? $m_1V_1 + m_2V_2 = m_1V_1 + m_2V_2$

$(2)(8) + (3)(-2) = (2)(-1) + (3)V_2$

$16 - 6 = -2 + 3V_2$

$10 + 2 = 3V_2$

$V_2 = \frac{12}{3} \rightarrow \boxed{V_2 = 4 \text{ m/s}}$