PHY 231C – EXAM 1 **Form 1** **June 17, 2003**

All your answers should appear on the bubble sheets. Please fill in the circles on the sheets using a number 2 pencil. Use the margins or the backs of your exam pages for scratch paper. You may take these exam pages with you when you leave.

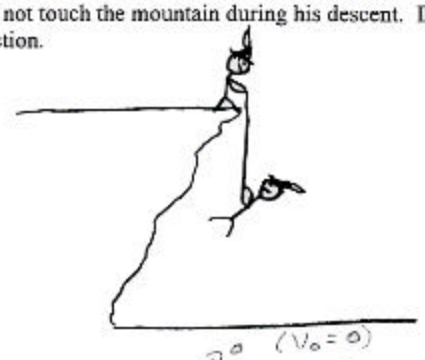
Unless stated otherwise, all mechanics problems below assume the environment is on Earth's surface. Use 10 m/s^2 for the acceleration of gravity.

1. What are the base units of the SI system?
   a. gram, centimeter, second
   b. meter, newton, second
   (c.) meter, kilogram second
   d. gram, meter, second
   e. joule, newton, watt

2. Choose the correct response. Distance divided by acceleration has the following units:
   a. m/s^2
   (b.) s^2
   c. s^2/m^2
   d. s
   e. s/m

$$\frac{d}{a} = \frac{m}{\frac{m}{s^2}} = s^2$$

Problems 3 through 5: A mountain climber uses a massless rope to lower his friend whose mass is 80 kg over the edge of a cliff down to a ledge 20 meters below. The friend starts from rest and accelerates uniformly for ten seconds before reaching the ledge below. The friend does not touch the mountain during his descent. Define upward to be the positive direction.



3. Calculate his acceleration.
   a. -0.20 m/s^2
   (b.) -0.40 m/s^2
   c. 0.40 m/s^2
   d. -2.00 m/s^2
   e. 2.00 m/s^2

$y = V_0 t + \frac{1}{2} a t^2$

$a = \frac{2y}{t^2} = \frac{2(-20m)}{(10sec)^2} = \boxed{-0.40 \frac{m}{s^2}}$

4. Calculate the friend's velocity the instant before he reaches the ledge below.
   a. -2.0 m/s
   b. 2.0 m/s
   c. -0.4 m/s
   d. 4.0 m/s
   (e.) -4.0 m/s

$V = V_0 + at = 0 + (-0.40 \frac{m}{s^2})(10s)$

$V = -4.0 m/s$

5. What is the tension in the rope while the climber's friend is being lowered? (Assume the rope is massless).
   a. 832 N
   b. 800 N
   c. 784 N
   (d.) 768 N
   e. 640 N

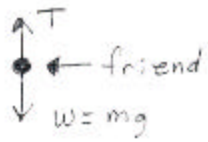
$\Sigma F = ma$

$T - mg = ma$

$T = mg + ma$

$= m(g+a) = 80kg(10 \frac{m}{s^2} - 0.4 \frac{m}{s^2})$

$= 768N$



6. Bullet A is dropped from rest. At the same instant another bullet is fired horizontally from a rifle. If both bullets leave from the same height above ground, then:

   a. The heavier of the two bullets hits the ground first.
   b. Bullet B hits the ground before bullet A
   c. Bullet A hits the ground before bullet B.
   d. The lighter of the two bullets hits the ground first.
   (e.) None of the above are true

7. A ball is thrown with an initial velocity of 20 m/s at an angle of 30° with respect to the horizontal. How long does it take to reach the top of its path?

   (a.) 1.0 seconds
   b. 1.2 seconds
   c. 1.7 seconds
   d. 2.0 seconds
   e. not enough information is given

$V_{oy} = 20\frac{m}{s}\sin 30^\circ = 10\ m/s$

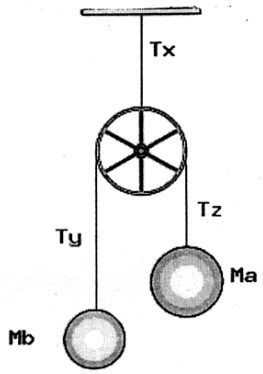
$V_y = V_{oy} - gt$ (at the top, $V_y = 0$)

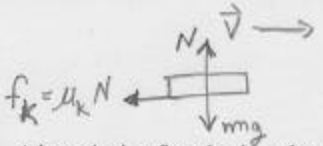
$-V_{oy} = -gt$

OR $t = \frac{V_{oy}}{g} = \frac{10\ m/s}{10\ m/s^2} = 1.0s$

8. A frictionless, massless pulley is attached to the ceiling in a gravity field g = 10 m/ s^2. Mass M_a is greater than mass M_b. The tensions T_x, T_y, T_z and the constant g are magnitudes. Which statement is FALSE?

   a. $(M_b) \times g < T_y$
   b. $(M_a) \times g > T_z$
   c. $T_z = T_y$
   (d.) $(M_b)g + (Ma)g = T_x$
   e. The center of mass of M_b and M_a accelerates





$\Sigma F_y = 0$ $\quad N - mg = 0$ $\quad N = mg$

$\Sigma F_x = ma_x$ $\quad -\mu_k N = ma_x$ $\quad -\mu_k mg = ma_x$ $\quad a_x = -\mu_k g$

9. A boy playing floor hockey shoots a 0.3 kg puck with an initial speed of 5 m/s on a flat horizontal surface. 2.0 seconds later the puck enters the goal. The coefficient of kinetic friction between the puck and the floor is 0.15. Calculate the work done on the puck by the frictional force.

a. 3.15 J
(b.) -3.15 J
c. 3.75 J
d. -3.75 J
e. zero

$V_x = V_{x0} + a_x t$

$= V_{x0} - \mu_k g t$

$= 5\frac{m}{s} - (.15)(10\frac{m}{s^2})(2s)$

$= 2\frac{m}{s}$

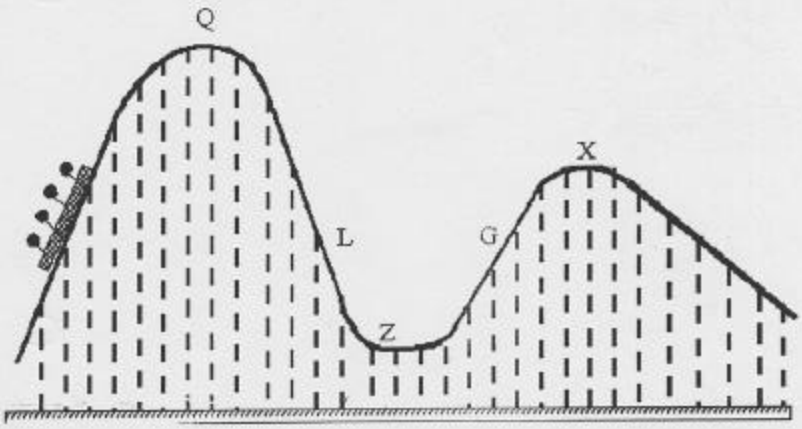
$W = \Delta KE$

$= \frac{1}{2} m V_x^2 - \frac{1}{2} m V_{x0}^2$

$= \frac{1}{2} m (V_x^2 - V_{x0}^2)$

$= \frac{1}{2}(0.3kg)\left[(2\frac{m}{s})^2 - (5\frac{m}{s})^2\right] = \boxed{-3.15J}$

10. Given the diagram of a roller coaster below and ignoring friction, which statement is incorrect?



a. The potential energy of the car at L is equal to the potential energy of the car at G
(b.) The total energy of the car at Z is less than the total energy of the car at X.
c. The speed of the car at L is greater than the speed of the car at X.
d. The kinetic energy of the car at Q is less than the kinetic energy of the car at X.
e. The kinetic energy at Q is positive.