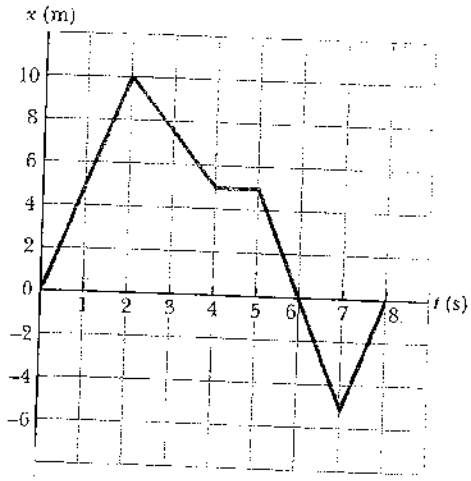
Key

Test 1 **Dr. Weppner**
PH 241 **Oct. 2006**

NAME _____ ☐ Pledged SCORE____ / 100 pts

Remember to get full credit label answers with correct units, show all work, draw diagrams, give axis directions, write all applicable formuli.

1. [8 pts] From the graph shown below calculate the average velocity from
(A) 0 s to 4 s
(B) 0s to 6 s



$$\bar{V} = \frac{\Delta x}{\Delta t}$$

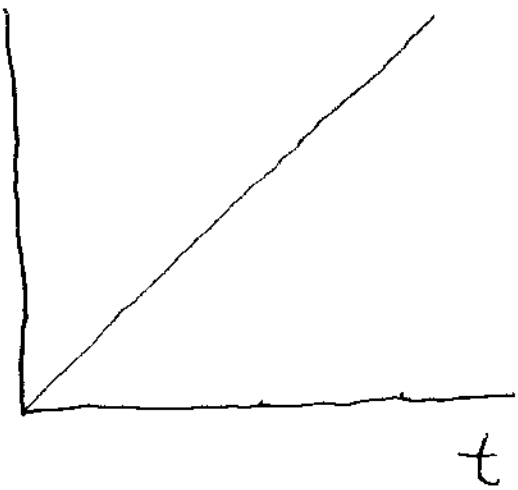
A) $\frac{5m - 0m}{4s} = 1.25\,m/s = \bar{V}$

B) $\frac{0m - 0m}{6s} = 0\,m/s = \bar{V}$

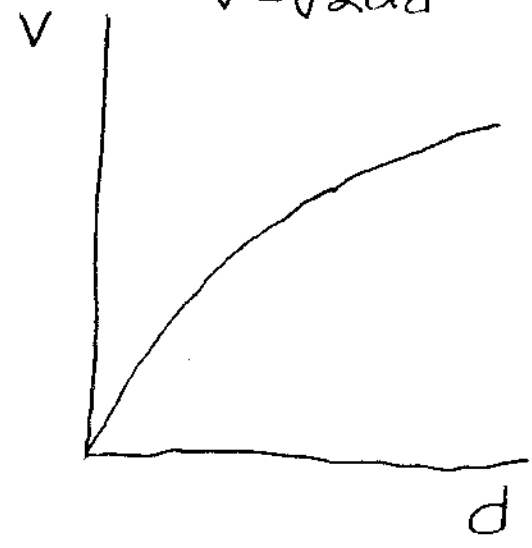
2. [10 pts] An object is dropped from a high tower. Ignoring air resistance make a graph of (a) speed vs. time and (b) speed vs. distance. Draw a picture with coordinate system.

$V = at$

$a = +9.8\,m/s^2$



$V = \sqrt{2ad}$



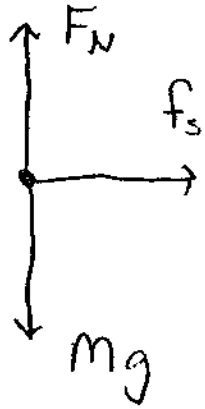
3. [6 pts] Would it be easy to play catch with a large bowing ball in outer space since the ball would have no weight? Explain.

NO. Ball still has mass (inertia) $F=ma$

An object in Motion wants to stay in motion (1st law)
- hard to stop

Every action has an equal but opposite reaction
- When you throw it you will go backwards
- when you catch it you will also go Backwards

4. [13 pts] A coin is at the rim of a rotating turn-table. When the rate of rotation reaches a certain value the coin, why does the coin fly off? Draw a picture and force diagram, and set up the force equation while the coin is still on the turn table.



• center of circle

① $\frac{mv^2}{r} = f_s = \mu_s F_N = \mu_s mg$

② $0N = F_N - mg$

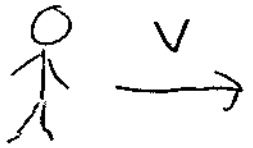
when

so $\downarrow v^2 = \mu_s g r$ coin will slide off

5. [6 pts] When the brakes on a bus are suddenly applied, the passengers are thrown forward. Explain why this happens.

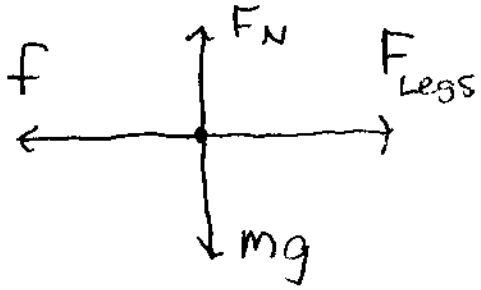
passengers are seated on bus they are moving at constant speed. When Bus brakes they want to continue to move at this const speed while bus slows down underneath them. More appropriatly, the Bus is thrown Backward - Newtons First Law

6. [15 pts] What is the magnitude and direction of the average frictional force on a person who walks at constant velocity? (1 lb = 4.4 N on surface of earth). Draw a force diagram.



$\vec{F}_{TOT} = 0$

(Legs push on ground, ground Pushes back)



(1) $0N = F_{Legs} - f$ $\quad F_{Legs} = f = \mu mg$

(2) $0N = F_N - mg$ $\quad F_N = mg$

$$f = \mu mg = (.3)(70Kg)(10m/s^2)$$

$$\approx 230N$$

7. [25 pts] A medieval catapult could project a 75 kg stone at 50m/s at 30° above the horizontal. Suppose the target is a fortress wall of height 12 m at a horizontal distance of 200 meters. Would the stone hit the wall? If so at what height?

$\Delta X = 200m$ $\quad a = -9.8 m/s^2$ $\quad V_{ox} = V_0 \cos 30^\circ = 43 m/s$

$\Delta Y = 12m$ $\quad V_{oy} = V_0 \sin 30^\circ = 25 m/s$

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① $\Delta x = V_{ox} t$ ① $200m = (43 m/s)\, t$

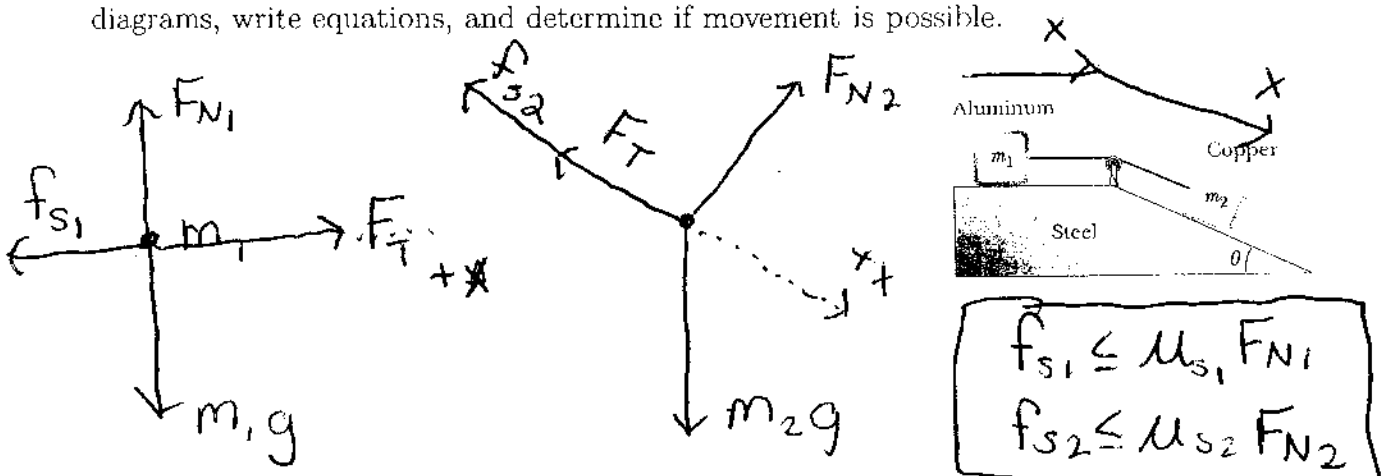
$t = 4.65$ sec to go over wall

$\Delta y = (25 m/s)(4.65s) - \frac{1}{2}(9.81 m/s^2)(4.65s)^2$

at 4.65s $\quad \Delta y = 116m - 106m$

$\Delta y \sim 10m$ (just hits top of wall)

8. [25 pts] Look at the pulley-mass system below. Assume $m_1 = 2.0kg, m_2 = 6.0kg, \theta = 20^0, \mu_{s-Al} = .65, \mu_{s-Cu} = .50$. Will this system move? Please draw appropriate force diagrams, write equations, and determine if movement is possible.



$f_{s_1} \leq \mu_{s_1} F_{N_1}$

$f_{s_2} \leq \mu_{s_2} F_{N_2}$

(X) $ON = F_T - f_{s_1}$ (1)

(Y) $ON = F_{N_1} - m_1 g$ (2)

(X) $ON = m_2 g \sin\theta - F_T - f_{s_2}$ (3)

(Y) $ON = F_{N_2} - m_2 g \cos\theta$ (4)

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(1) $F_T = f_{s_1}$

(4) $F_{N_2} = m_2 g \cos\theta$

(2) $F_{N_1} = m_1 g$

so (3) $ON = m_2 g \sin\theta - f_{s_1} - f_{s_2}$

so $f_{TOT} = (f_{s_1} + f_{s_2}) = m_2 g \sin\theta$

$= 20.1\ N$

movement will occur at critical value

$f_{s_1} + f_{s_2} = \mu_{s_1} F_{N_1} + \mu_{s_2} F_{N_2}$

$(.65)(2kg)(9.8 m/s^2) + (.50)(6kg)(9.8 m/s^2)\cos 20^\circ$

$= 40.4\ N$

No Movement!