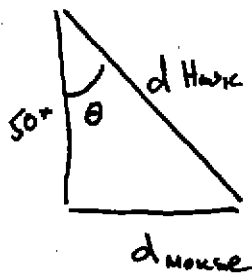
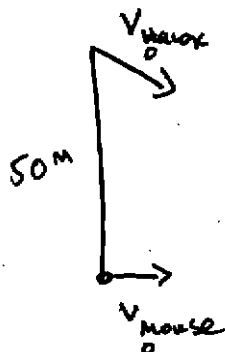


Exam 1 (September 21, 2000)

Please read the problems carefully and answer them in the space provided. Write on the back of the page, if necessary. Show all your work. Partial credit will be given.

Problem 1 (20 pts):

A hawk 50 m above ground sees a mouse directly below running due north at 2.0 m/s. If it reacts immediately, at what angle and speed must the hawk dive in a straight line, keeping a constant velocity, to intercept its prey in 5.0 s?



$a_{mouse} = 0$

$d_{mouse} = v_{mouse} T = (2.0 \text{ m/s})(5.0) = 10 \text{ m}$

$d_{hawk} = v_{hawk} T = v_{hawk} (5)$

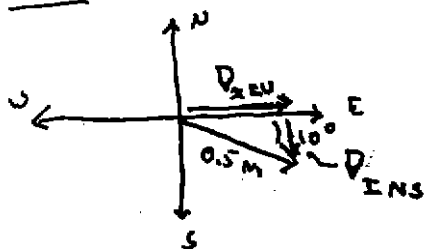
$TAN \theta = \frac{d_{mouse}}{50 \text{ m}} = \frac{10}{50} \Rightarrow \theta = 11.3^\circ$

$0.196 = SIN \theta = \frac{d_{mouse}}{d_{hawk}} = \frac{10 \text{ m}}{v_{hawk} \cdot 5 \text{ s}} \Rightarrow v_{hawk} = 10.2 \text{ m/s}$

Problem 2 (20 pts):

Larry the ladybug fell into a glass of champagne at a wedding reception. After he managed to get out, Larry realized that his wings were sticky and he could not fly. So, he wandered around the table hoping not to get squished. Leaving the champagne glass, Larry walked in a straight line 0.5 meters at an angle 10 degrees south of east. Then he walked 25 degrees north of west for 3 meters. Where did Larry end up with respect to the champagne glass (distance and direction)?

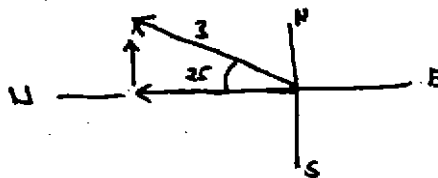
Vector I = \vec{D}_I



$D_{I EW} = D_I \text{ east component} = |\vec{D}_I| \cos 10 = 0.5 \cos 10$

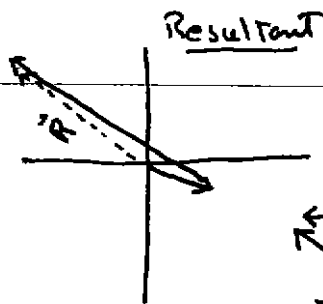
$D_{I NS} = |\vec{D}_I| \sin 10 = -0.085 \text{ m}$

Vector II = \vec{D}_{II}



$D_{II EW} = -|\vec{D}_{II}| \cos 25 = -3 \cos 25$

$D_{II NS} = |\vec{D}_{II}| \sin 25 = 3 \sin 25$



$R_{EW} = 0.5 \cos 10 - 3 \cos 25 = -2.2 \text{ m}$

$R_{NS} = -0.5 \sin 10 + 3 \sin 25 = 1.2 \text{ m}$

$|\vec{R}| = \sqrt{R_{EW}^2 + R_{NS}^2} = 2.5 \text{ m}$

$TAN \theta = \frac{|R_{EW}|}{|R_{NS}|}$

$\theta = 61^\circ \text{ West of North}$

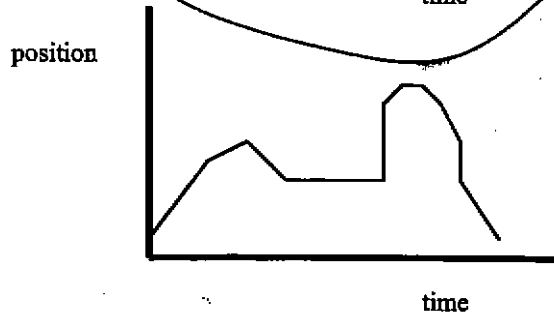
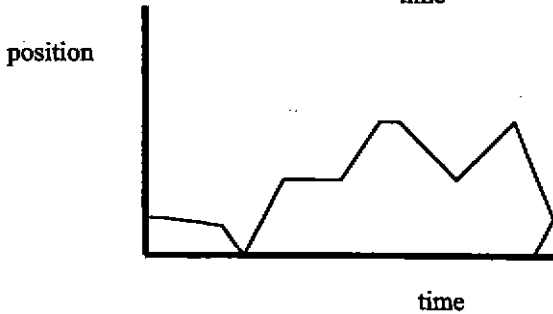
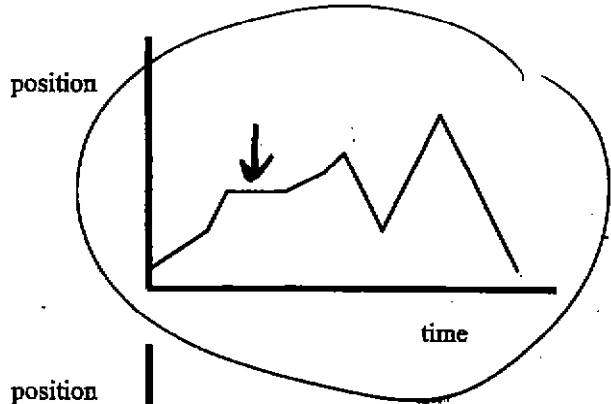
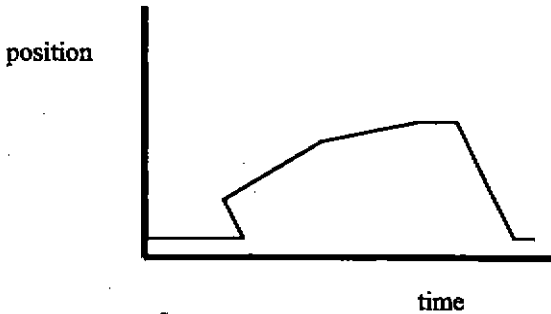
1)	/20
2)	/20
3)	/20
4)	/20
5)	/20

tot **100** /100

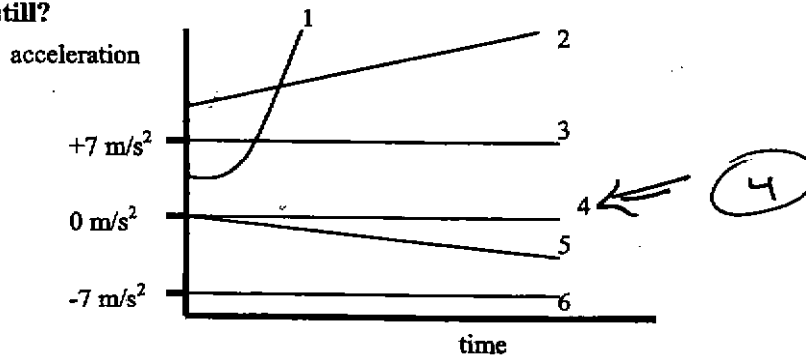
Problem 3 (20 pts):

Joe Sevenio is a cab driver in New York City. Joe decided to take physics one semester so he would have something interesting to chat about with his customers ... like "Yo! Did'ja know it takes 12.2 seconds for somethin' to fall from the top of the Empire State building to the ground? ... Neglecting air friction, of course!" While in the course Joe plotted his position as a function of time as he drove up and down a straight section of Broadway one evening.

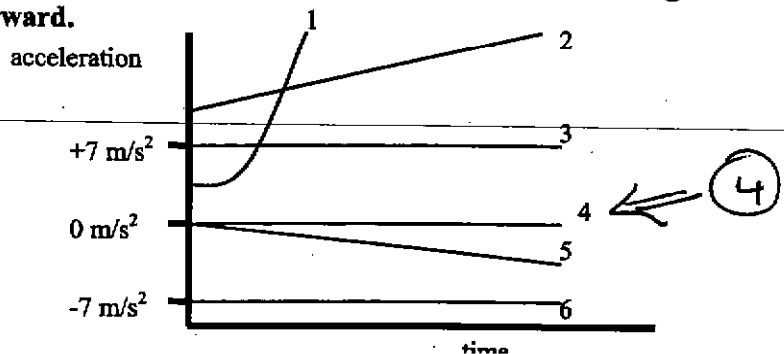
- (a) Which of the following curves describing Joe's motion is possible physically? Circle it.
 (b) Draw an arrow pointing to each segment on the chosen curve where Joe's cab was sitting still for at least a few moments.



- (c) Which of the following curves describes Joe's acceleration versus time if he is sitting still?



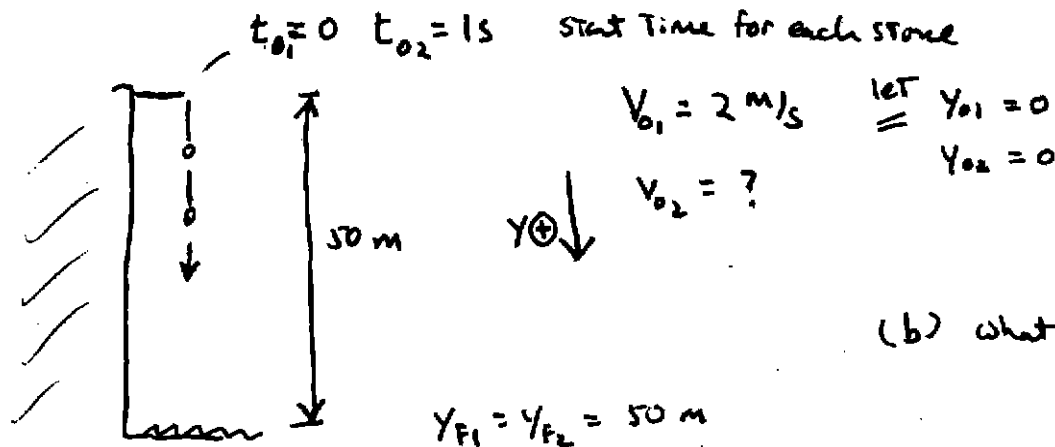
- (d) Which of the following curves describes Joe's acceleration versus time if he is driving at a constant velocity of 7 m/s forward.



Problem 4 (20 pts):

A very inquisitive, rock-climbing P113 student takes a hike in Stony Brook State Park. The student climbs a 50-m cliff that overhangs a pool of calm water. He throws two stones vertically downward 1 s apart and observes that they cause a single splash. The first stone has an initial velocity of 2 m/s. (a) At what time after release of the first stone will the two stones hit the water? (b) What initial velocity must the second stone have if they are to hit simultaneously?

Const. Acceleration equations are valid



(a) What is flight time of 1st stone

$$y = y_0 + v_{0y}t + \frac{1}{2}at^2$$

$$50 = 0 + 2t + \frac{9.8}{2}t^2$$

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$a = 4.9$
 $b = 2$
 $c = -50$

$$t = \frac{-2 \pm \sqrt{4 - 4(4.9)(-50)}}{2(4.9)} = \frac{-2 \pm 31.3}{9.8}$$

(a) time = 3 seconds

(b) what must initial velocity of stone 2 be if it hits water at $t = 3$ seconds

TOTAL flight time for stone 2 = 2 seconds because it starts at $t = 1$ second

$$y = y_0 + v_{0y}t + \frac{1}{2}at^2$$

$$50 = v_{0y}(2) + \frac{1}{2}(9.8)(2)^2$$

$$\frac{50 - 19.6}{2} = v_{0y@}$$

$v_{0y@} = 15.2 \text{ m/s}$
downward

2 roots
 $\left\{ \begin{array}{l} 3s \\ -3.4s \end{array} \right.$
 negative time unphysical for this problem

Problem 5 (20 pts)::

A cat hears its person (owner) opening a can of tuna and takes off at a run from its favorite sleeping spot on the couch. The magnitude of the velocity of the cat is given by Ct^2 , where $C = 2 \text{ m/s}^3$. Assuming the cat runs in a straight line, how far does the cat run in two seconds?

$$x - x_0 = \int_{t_0}^t v dt \quad \leftarrow \text{comes from } \frac{dx}{dt} = v$$

define x_0 and t_0 to be zero

$$x = \int_0^2 v dt = \int_0^2 Ct^2 dt = C \int_0^2 t^2 dt = C \left[\frac{t^3}{3} \right]_0^2$$

$$x = C \frac{8}{3} = \frac{2(8) \text{ m}}{3} = \frac{16}{3} \text{ m}$$

The cat travels $\frac{16}{3}$ meters in 2 seconds