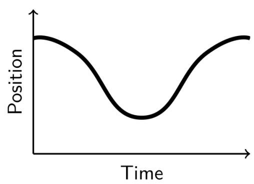
Physics 131-01 Test 1

I pledge that I have neither given nor received unauthorized assistance during the completion of this work.

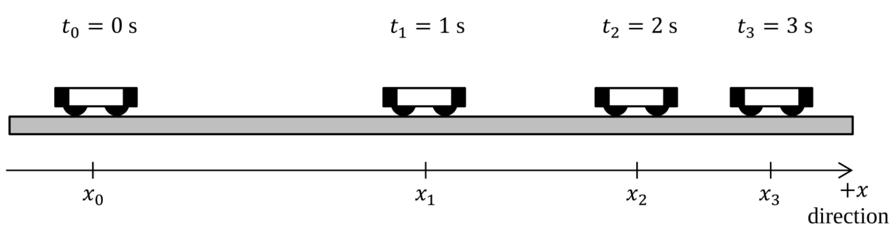
Signature ______________________________

Questions (8 pts. apiece) Answer in complete, well-written sentences WITHIN the spaces provided.

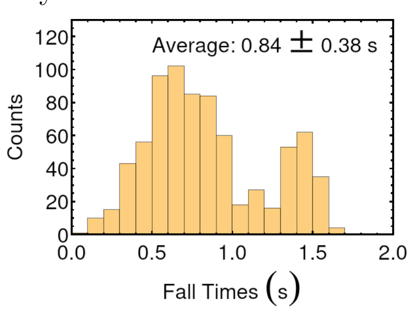
1. How do you walk to create a U-shaped graph?



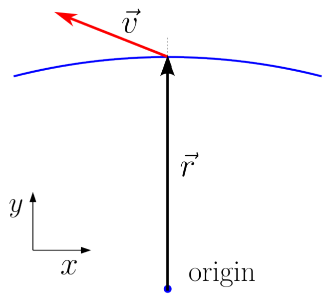
2. The diagram shows the positions of a cart at equal time intervals. At each indicated time, sketch, and label, a vector above the cart to represent the velocity of the cart at that time while it is moving in the positive direction and slowing down. Using these vectors how would you find the vector representing the change in velocity between the times $t_1 = 1$ s and $t_2 = 2$ s? What is the sign of the acceleration? Explain.



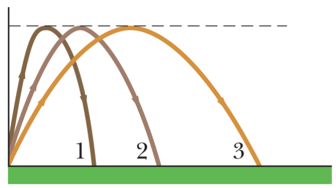
3. Consider the histogram shown below for possible fall times of a ball. The average and standard deviation of the data is shown. How many peaks are in this histogram? Do the average and standard deviation capture the full description of the data? Why or why not.



4. Consider the figure shown below for an object undergoing uniform circular motion. Is anything wrong with this picture? Justify your statements and reasoning.



5. The figure below shows three paths for a ball kicked from ground level. Ignoring the effects of air, rank the paths according to initial speed, greatest first. Explain your reasoning.



Problems. Clearly show all reasoning for full credit. Use a separate sheet to show your work.

Note: Derivatives should be calculated using the the definition in terms of a limit.

1. 14 pts. A fish swimming in a horizontal plane has velocity $v_i = (3.0\,\hat{i} + 1.5\,\hat{j}\,)\ m/s$ at a point in the ocean where the position relative to a certain rock is $\vec{r}_i = (8.0\,\hat{i} - 3.0\,\hat{j}\,)\ m$. After the fish swims with constant acceleration for 10.0 s, its velocity is $\vec{v}_f = (20.0\,\hat{i} - 5.0\,\hat{j}\,)\ m/s$. (a) What are the components of the acceleration? (b) What is the direction of the acceleration with respect to unit vector $\hat{i}$?

2. 20 pts. The current world record in the long jump is held by Galina Chistyakova of the former Soviet Union. She jumped a distance $d = 7.52\ m$ horizontally on June 11, 1988. Assuming her take-off speed was $v_0 = 8.6\ m/s$ and she jumped at an angle $\theta = 45°$, how close was she to the maximum possible distance? What was her flight time?

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3. 26 pts. A Ferris wheel has a radius of $r = 17\ m$ and completes a full turn in $\Delta t = 15\ s$ moving at a constant speed. The acceleration of each passenger is caused by the vector sum of the acceleration of gravity and the acceleration created by the Ferris wheel. (a) Draw a vector diagram of the accelerations acting on a passenger at the highest point on the Ferris wheel. (b) What is the speed of a passenger? (c) What is the acceleration created by the Ferris wheel on the passenger at the highest point?

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Physics 131-01 Constants

Speed of Light (c)	$2.9979 \times 10^8\ m/s$	proton/neutron mass	$1.67 \times 10^{-27}\ kg$
R	$8.31 J/K - mole$	g	$9.8\ m/s^2$
Gravitation constant	$6.67 \times 10^{-11}\ N - m^2/kg^2$	Earth's radius	$6.37 \times 10^6\ m$
Earth-Moon distance	$3.84 \times 10^8\ m$	Electron mass	$9.11 \times 10^{-31}\ kg$

Physics 131-01 Equations

$$\Delta x = x_{finish} - x_{start} \qquad \Delta\vec{r} = \vec{r}_{finish} - \vec{r}_{start} \quad \Delta\vec{v} = \vec{v}_{finish} - \vec{v}_{start}$$

$$\bar{v} = \langle v \rangle = \frac{\Delta x}{\Delta t} \quad v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \lim_{\Delta t \to 0} \frac{x(t+\Delta t) - x(t)}{\Delta t} = \frac{dx}{dt}$$

$$\bar{a} = \langle a \rangle = \frac{\Delta v}{\Delta t} \quad a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \lim_{\Delta t \to 0} \frac{v(t+\Delta t) - v(t)}{\Delta t} = \frac{dv}{dt}$$

$$x = \frac{1}{2}at^2 + v_i t + x_i \qquad v = at + v_i \qquad a_g = -g$$

$$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k} \quad \vec{A} + \vec{B} = (A_x + B_x)\hat{i} + (A_y + B_y)\hat{i} + (A_z + B_z)\hat{i}$$

$$a_c = \frac{v^2}{r} \qquad \vec{v} \perp \vec{r} \qquad \vec{v} \perp \vec{a}_c \qquad v = \frac{2\pi r}{T}$$

$$\vec{v} = \frac{d\vec{r}}{dt} = \frac{dx}{dt}\hat{i} + \frac{dy}{dt}\hat{j} + \frac{dz}{dt}\hat{k} \qquad \vec{a} = \frac{d\vec{v}}{dt} = \frac{dv_x}{dt}\hat{i} + \frac{dv_y}{dt}\hat{j} + \frac{dv_z}{dt}\hat{k}$$

$$\theta = \frac{s}{r} \quad \sin\theta = \frac{opp}{hyp} \quad \cos\theta = \frac{adj}{hyp} \quad \tan\theta = \frac{opp}{adj} \quad \cos^2\theta + \sin^2\theta = 1 \quad x^2 + y^2 + z^2 = R^2$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad \text{C} = 2\pi r \quad \text{Area} = \pi r^2 \quad \text{Area} = \frac{1}{2}bh \quad \text{Area} = 4\pi r^2 \quad \text{Volume} = \frac{4}{3}\pi r^3$$

$\text{Volume} = \pi r^2 l$ ratio of sides of similar triangles $\dfrac{\sin A}{a} = \dfrac{\sin B}{b} = \dfrac{\sin C}{c}$ $c^2 = a^2 + b^2 - 2ab\cos C$