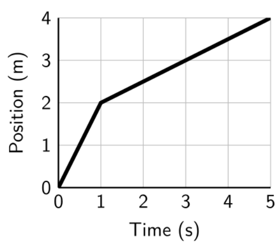
Physics 131-01 Test 1

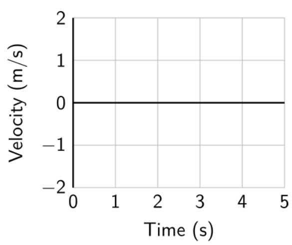
I pledge that I have neither given nor received unauthorized assistance during the completion of this work.

Signature ________________________________

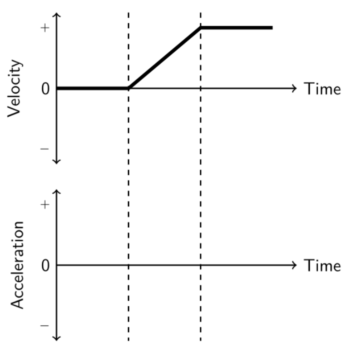
Questions (8 pts. apiece) Answer in complete, well-written sentences WITHIN the spaces provided.

1. Draw the velocity graphs for an object whose motion produced the position-time graphs shown below on the left. Note: Unlike most real objects, you can assume these objects can change velocity so quickly that it looks instantaneous with this time scale. Explain your reasoning.



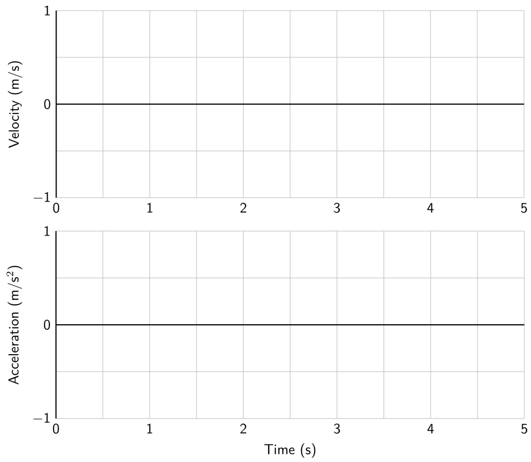


2. For each of the velocity-time graphs below, sketch the shape of the acceleration-time graph that goes with it. Explain your reasoning.

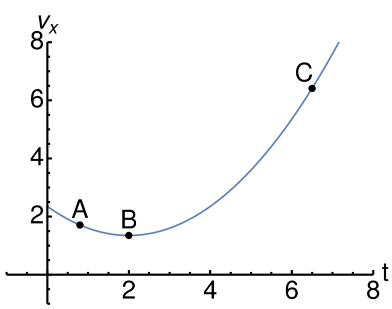


3. In the circular motion lab the airplane moves in a circle. What is the direction of its velocity? Does the velocity have a component in the direction of the position vector? Why or why not? Explain your reasoning.

4. Consider a cart moving in the negative x direction while speeding up at a constant rate. Draw the expected velocity and acceleration graphs below. Explain your reasoning.



5. The figure below shows the velocity-time graph for a moving object. At which points marked with a letter is (a) the object speeding up and (b) the object is moving to the left? Explain your reasoning.



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

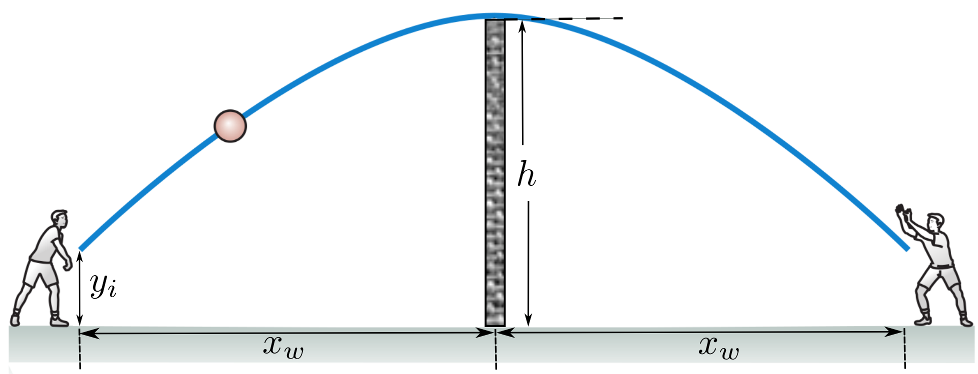
Note: Derivatives should be calculated using the the definition in terms of a limit.

1. 12 pts. When a large star explodes and becomes a supernova the remaining core can become a neutron star. If a neutron star has a radius $r = 1.2\times10^4\ m$ and rotates every 0.1 s, then what is the centripetal acceleration of a particle on the star's equator?

2. 20 pts. A person walks at a constant speed of $v_1 = 6.0\ m/s$ in a straight line from point A to point B and then back along the line from B to A at a speed of $v_2 = 2.0\ m/s$. (a) What is the average speed over the entire trip? (b) What is the average velocity over the entire trip?

3. 28 pts. You're a distance $x_w = 9.0\ m$ from a wall of height $h = 6.0\ m$ seen in the figure (ignore the thicknesss of the wall). You want to toss a ball to your friend who is the same distance x_w from the wall on the other side. The throw is made at an angle $\theta = 48°$ to the horizontal and from an initial height $y_i = 1.0\ m$. Start your solution from the equations for $x(t)$, $y(t)$, $v_x(t)$, and $v_y(t)$ from projectile motion.

   1. What minimum speed will allow the ball to clear the wall?
   2. Your friend can reach up to $y_r = 2.2\ m$. Will your friend be able to catch the ball?



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

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

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

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

$$x = \frac{1}{2}at^2 + v_0 t + x_0 \qquad v = at + v_0 \qquad a_g = -g$$

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

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

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

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

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

$$\mathrm{Volume} = \frac{4}{3}\pi r^3 \quad \mathrm{Volume} = \pi r^2 l \quad \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c} \quad c^2 = a^2 + b^2 - 2ab\cos C$$