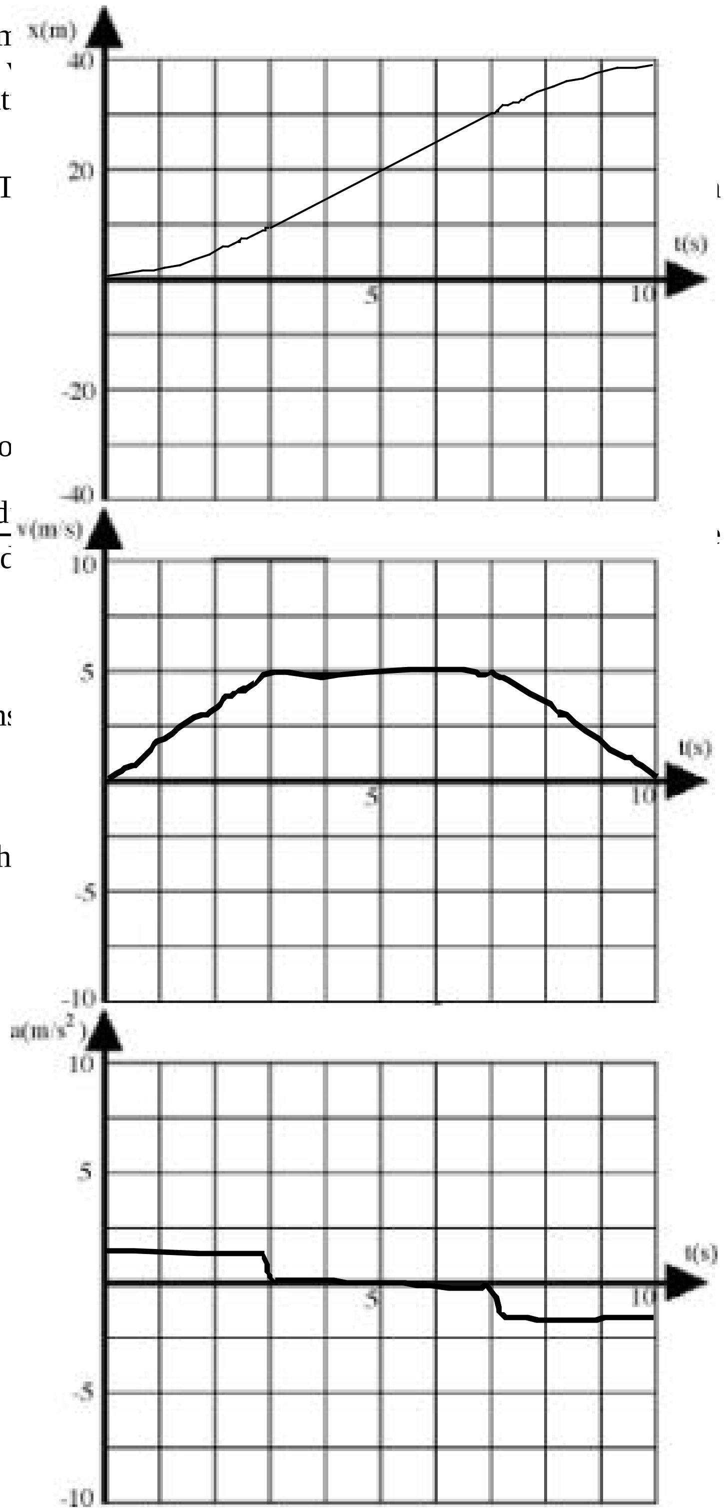
Name:________________________________________

Solve the following problems in the space provided. Use the back of the page if needed. Each problem is worth 20 points. You <u>must</u> show your work in a logical fashion starting with the correctly applied physical principles which are on the last page. Your score will be maximized if your work is easy to follow because partial credit will be awarded.

1. The position of a car as a function of tim
you would go about sketching the velocity v
you would go about sketching the accelerat




(a)The definition of velocity is $\vec{v} \equiv \frac{d\vec{r}}{dt}$. T
versus time graph.

The slope is constant from t=3s to t=7s.

$$v = \frac{\Delta x}{\Delta t} = \frac{30 - 10}{7 - 3} = 5 m/s.$$

At t=0s and again at t=10s the slope is zero

(b)The definition of acceleration is $\vec{a} \equiv \frac{d}{c}$
velocity versus time graph.

The slope is zero from t=3s to t=7s.

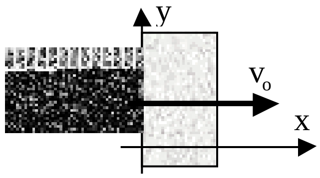
From t=0s to t=3s the slope is roughly cons

$$a = \frac{\Delta v}{\Delta t} = \frac{5.0 - 0}{3 - 0} = 1.7 m/s^2.$$

From t=7s to t=10s the slope is also rough

$$a = \frac{\Delta v}{\Delta t} = \frac{0 - 5.0}{10 - 7} = -1.7 m/s^2.$$

2. In a crazy movie stunt, a car traveling at 80.0m/s collides with and passes through a 3.00m thick wall of jello emerging with a speed of 40.0m/s. Find (a)the time required for the car to pass through the jello and (b)the acceleration of the car (assumed constant) as it passes through.




$x_o = 0$

$x = 3.00m$

$v_o = 80.0m/s$

$v = 40.0m/s$

$a = ?$

$t = ?$

(a)Using the kinematic equation without the acceleration,

$$x - x_o = \tfrac{1}{2}(v + v_o)t \qquad t = \frac{2(x - x_o)}{v + v_o}$$

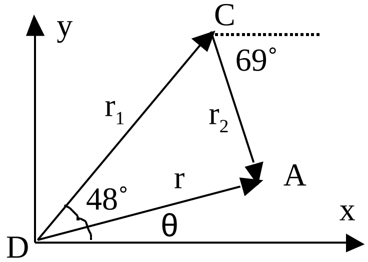
$$t = \frac{2(3.00 - 0)}{40.0 + 80.0} \qquad \boxed{t = 50.0ms}.$$

(b) Using the kinematic equation without the time,

$$v^2 = v_o^2 + 2a(x - x_o) \qquad a = \frac{v^2 - v_o^2}{2(x - x_o)}$$

$$a = \frac{(40.0)^2 - (80.0)^2}{2(3.00 - 0)} \qquad \boxed{a = -800m/s^2}.$$

3. A plane flies 788miles at 48.0° north of east to go from Dallas to Chicago. The plane then travels 560miles at 69.0° south of east to get to Atlanta. Find the distance and direction that a plane would have to travel directly from Dallas to Atlanta.




Resovle the vectors into components,

$$\vec{r}_1 = 788\cos 48^\circ\,\hat{i} + 788\sin 48^\circ\,\hat{j} = 527\hat{i} + 586\hat{j}$$

$$\vec{r}_2 = 560\cos 69^\circ\,\hat{i} - 560\sin 69^\circ\,\hat{j} = 201\hat{i} - 523\hat{j}$$

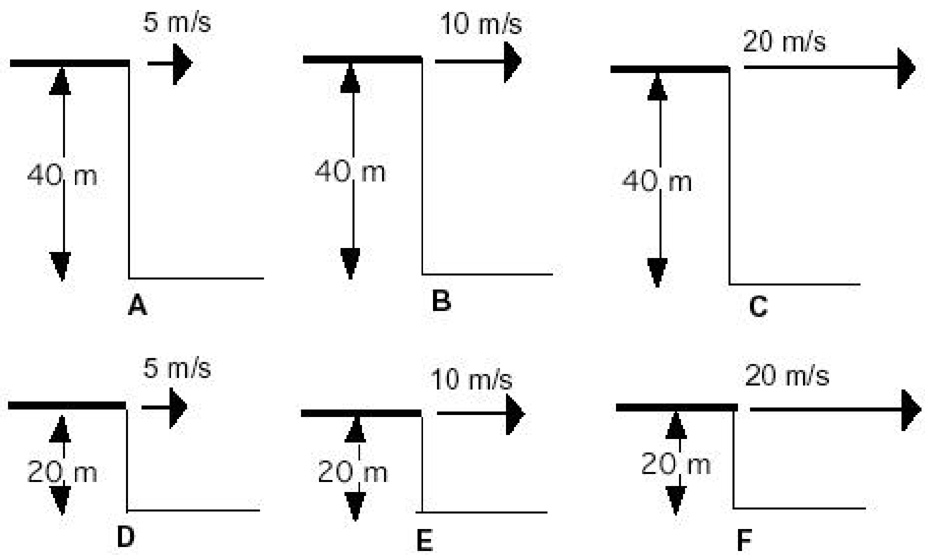
Add the vector components,

$$\vec{r} = (527 + 201)\hat{i} + (586 - 523)\hat{j} = 728\hat{i} + 63\hat{j}.$$

Use the Pythagorean Theorem, $r = \sqrt{728^2 + 63^2}$ $\boxed{r = 731miles}$.

Use the definition of tangent, $\theta = \arctan\frac{63}{728} = \arctan(0.0865)$ $\boxed{\theta = 4.95^\circ}$.

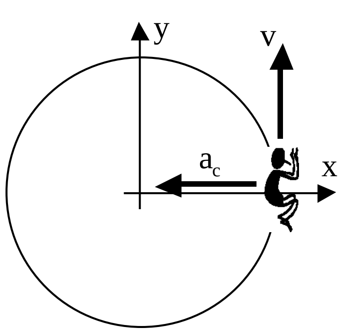
4. Pictured below are six waterfalls all of which have the same amount of water flowing over them. The waterfalls differ in height and in the speed of the water as it goes over the edge. The specific values of the heights and speeds are given in the figures. Rank these situations from shortest to longest based on how long it takes the water to go from the top of the falls to the bottom. That is, put first the situation where it takes the water the most time to go from the top of the falls to the bottom, and put last the one that takes the least time. Explain your reasoning for full credit.




The vertical motion is independent of the horizontal motion. The vertical motion is freefall, so the time of fall just depends upon the height. So, A, B and C take the same time to fall as do D, E and F. A, B, and C take longer because the water has further to fall.

$$\boxed{D=E=F<A=B=C}$$

5. A 15.0m diameter Ferris Wheel turns at a constant rate of 0.700 revolutions per minute. Find the distance traveled by a passenger in one rotation, (b)the velocity (magnitude and direction) of the passengers when they are half way up, and (c)the acceleration (magnitude and direction) of the passengers when they are halfway up.




(a)The distance around is the circumference,
$C = 2\pi r = \pi D = (3.14)(15.0)$ $\boxed{C = 47.1m}$.

(b)The time for a rotation is, $T = \dfrac{60s}{0.700rev}$ $T = 85.7s$

Using the definition of speed, $v \equiv \dfrac{dx}{dt}$ $v = \dfrac{C}{T} = \dfrac{47.1}{85.7} = 0.549m/s$.

The direction can be determined from the picture at the right, $\boxed{\vec{v} = (0.549m/s)\hat{j}}$.

(c)Using the equation for centripetal acceleration, $a_c = \dfrac{v^2}{r} = \dfrac{(0.549)^2}{7.50} = 0.0402m/s^2$.

The direction is toward the center of the circular motion, $\boxed{\vec{a}_c = -(0.0402m/s^2)\hat{i}}$.