Name____

Physics 120 Quiz #2, April 8, 2011

Please show all work, thoughts and/or reasoning in order to receive partial credit. The quiz is worth 10 points total.

1. Suppose that the motion of a fan cart along a horizontal track is investigated and the horizontal motion is shown in the graph below. What can you say about the horizontal motion of the cart?

   a. The cart moves to the right gradually speeding up.
   b. The cart moves to the right gradually slowing down.
   c. The cart moves to the left gradually slowing down.
   d. The cart moves to the right gradually slowing down, stops and starts moving to the left speeding up.
   e. The cart moves to the left gradually slowing down, stops and starts moving to the right speeding up.

2. A small space probe, of mass *240kg*, is launched from a spacecraft near Mars. It travels toward the surface of Mars where it will land. At a time *20.7s* after it is launched, the probe is at the location $\langle 4.3\times10^3, 8.7\times10^2, 0\rangle m$ and at this same time its momentum is $\langle 4.4\times10^4, -7.6\times10^3, 0\rangle \frac{kgm}{s}$. At this instant, the net force on the probe due to the gravitational pull of Mars plus the air resistance acting on the probe is $\langle -7.0\times10^3, -9.2\times10^2, 0\rangle N$.

   a. Assuming that the net force on the probe is approximately constant over this time interval, what is the momentum of the probe *20.9s* after it is launched?

$$\vec{p}_f = \vec{p}_i + \vec{F}_{net}\Delta t = \langle 4.4\times10^4, -7.6\times10^3, 0\rangle \tfrac{kgm}{s} + \langle -7.0\times10^3, -9.2\times10^2, 0\rangle \times 0.2Ns$$

$$\vec{p}_f = \langle 4.26\times10^4, -7.78\times10^3, 0\rangle \tfrac{kgm}{s}$$

   b. What is the location of the probe *20.9s* after launch? (Hint: you will need to calculate v_{avg}.)

$$\vec{r}_f = \vec{r}_i + \vec{v}_{avg}\Delta t = \vec{r}_i + \left[\frac{\vec{v}_i + \vec{v}_f}{2}\right]\Delta t = \vec{r}_i + \left[\frac{\vec{p}_i + \vec{p}_f}{2m}\right]\Delta t$$

$$\vec{r}_f = \langle 4.3\times10^3, 8.7\times10^2, 0\rangle m + \left[\frac{\langle 4.4\times10^4, -7.6\times10^3, 0\rangle \frac{kgm}{s} + \langle 4.26\times10^4, -7.78\times10^3, 0\rangle \frac{kgm}{s}}{2\times 240kg}\right]\times 0.2s$$

$$\vec{r}_f = \langle 4336, 864, 0\rangle m$$

Useful formulas:

$$\vec{p} = \gamma m \vec{v}$$

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$\vec{v}_{avg} = \frac{\vec{v}_i + \vec{v}_f}{2}$$

Momentum Principle: $\vec{p}_f = \vec{p}_i + \vec{F}_{net}\Delta t$

Position-update:

$$\vec{r}_f = \vec{r}_i + \vec{v}_{avg}\Delta t = \vec{r}_i + \frac{\vec{p}}{m\sqrt{1 + \frac{p^2}{m^2c^2}}}\Delta t$$

Geometry /Algebra

Circles	*Triangles*	*Spheres*
$C = 2\pi r$	$A = \frac{1}{2}bh$	$A = 4\pi r^2$
$A = \pi r^2$		$V = \frac{4}{3}\pi r^3$

Quadratic equation: $ax^2 + bx + c = 0$,

whose solutions are given by: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Vectors

magnitude of a vector: $|\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}$

writing a vector: $\vec{a} = \langle a_x, a_y, a_z \rangle = |\vec{a}|\hat{a} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$