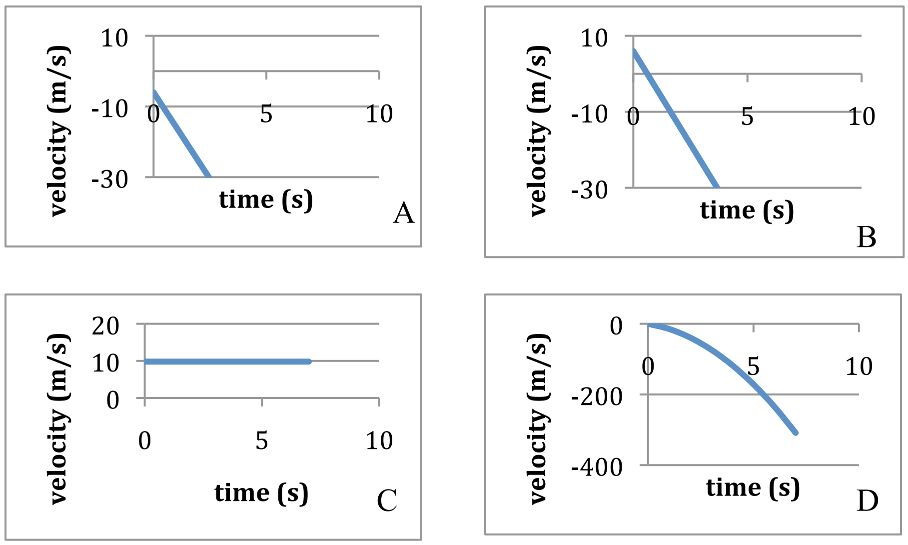
Name____________________________________

Physics 110 Quiz #2, April 9, 2010

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

1. You are standing on top of a tall building and you throw an object vertically downward. Which of the following graphs shows the velocity of the object as a function of time?

   a. A
   b. B
   c. C
   d. D



2. Suppose that you are driving down a road at 24.4 m/s (~55 mph) and come to a one-lane bridge. You decide to cross the bridge and at the instant you begin to cross, you notice a slow moving bus 100m ahead of you traveling at a constant speed of 6.7 m/s (~15 mph). You can't leisurely slow down, so just as soon as you start down the bridge you apply the brakes to avoid a collision of your car and the bus and your car decelerates at a constant rate of 1 m/s^2.

   a. What are the trajectories for the bus and for your car as functions of time?

$$x_{f,bus} = 100 + 6.7t$$

$$x_{f,car} = 24.4t - 0.5t^2$$

   b. Do you collide with the bus? If so, when and where, with respect you the start of the bridge? (Hint: you will need to solve a quadratic equation involving time.)

$$x_{f,car} = x_{f,bus} \rightarrow 100 + 6.7t = 24.4t - 0.5t^2 \rightarrow 0.5t^2 - 17.7 + 100 = 0 \rightarrow t = \begin{Bmatrix} 7.1s \\ 28.3s \end{Bmatrix}$$

$$x_{f,bus} = 100 + 6.7t = 100 + 6.7(7.1) = 147.6m$$

Useful formulas:

Motion in the r = x, y or z-directions

$$r_f = r_0 + v_{0r}t + \tfrac{1}{2}a_r t^2$$

$$v_{fr} = v_{0r} + a_r t$$

$$v_{fr}^2 = v_{0r}^2 + 2a_r \Delta r$$

Uniform Circular Motion

$$a_r = \frac{v^2}{r}$$

$$F_r = ma_r = m\frac{v^2}{r}$$

$$v = \frac{2\pi r}{T}$$

$$F_G = G\frac{m_1 m_2}{r^2}$$

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: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Vectors

$$magnitude\ of\ a\ vector = \sqrt{v_x^2 + v_y^2}$$

$$direction\ of\ a\ vector \rightarrow \phi = \tan^{-1}\left(\frac{v_y}{v_x}\right)$$

Useful Constants

Linear Momentum/Forces

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

$$\vec{p}_f = \vec{p}_i + \vec{F}\Delta t$$

$$\vec{F} = m\vec{a}$$

$$\vec{F}_s = -k\vec{x}$$

$$F_f = \mu F_N$$

Work/Energy

$$K_t = \tfrac{1}{2}mv^2$$

$$K_r = \tfrac{1}{2}I\omega^2$$

$$U_g = mgh$$

$$U_S = \tfrac{1}{2}kx^2$$

$$W_T = FdCos\theta = \Delta E_T$$

$$W_R = \tau\theta = \Delta E_R$$

$$W_{net} = W_R + W_T = \Delta E_R + \Delta E_T$$

$$\Delta KE + \Delta U_g + \Delta U_S = 0$$

$$\Delta KE + \Delta U_g + \Delta U_S = -\Delta E_{diss}$$

Heat

$$T_C = \tfrac{5}{9}\left[T_F - 32\right]$$

$$T_F = \tfrac{9}{5}T_C + 32$$

$$L_{new} = L_{old}(1 + \alpha\Delta T)$$

$$A_{new} = A_{old}(1 + 2\alpha\Delta T)$$

$$V_{new} = V_{old}(1 + \beta\Delta T):\ \beta = 3\alpha$$

$$PV = Nk_BT$$

$$\tfrac{3}{2}k_BT = \tfrac{1}{2}mv^2$$

$$\Delta Q = mc\Delta T$$

$$P_C = \frac{\Delta Q}{\Delta t} = \frac{kA}{L}\Delta T$$

$$P_R = \frac{\Delta Q}{\Delta T} = \varepsilon\sigma A\Delta T^4$$

$$\Delta U = \Delta Q - \Delta W$$

Rotational Motion

$$\theta_f = \theta_i + \omega_i t \tfrac{1}{2}\alpha t^2$$

$$\omega_f = \omega_i + \alpha t$$

$$\omega^2{}_f = \omega^2{}_i + 2\alpha\Delta\theta$$

$$\tau = I\alpha = rF$$

$$L = I\omega$$

$$\Delta s = r\Delta\theta:\ v = r\omega:\ a_t = r\alpha$$

$$a_r = r\omega^2$$

Fluids

$$\rho = \frac{M}{V}$$

$$P = \frac{F}{A}$$

$$P_d = P_0 + \rho g d$$

$$F_B = \rho g V$$

$$P_1 + \tfrac{1}{2}\rho v^2{}_1 + \rho g h_1 = P_2 + \tfrac{1}{2}\rho v^2{}_2 + \rho g h_2$$

Simple Harmonic Motion/Waves

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$$T_S = 2\pi\sqrt{\frac{m}{k}}$$

$$T_P = 2\pi\sqrt{\frac{l}{g}}$$

$$v = \pm v_{\max}\left(\sqrt{1 - \frac{x^2}{A^2}}\right)$$

$$v_{\max} = \omega A$$

$$a_{\max} = \omega^2 A$$

$$v = f\lambda$$

$$v = \sqrt{\frac{F_T}{\mu}}$$

$$f_n = nf_1 = n\frac{v}{2L}$$