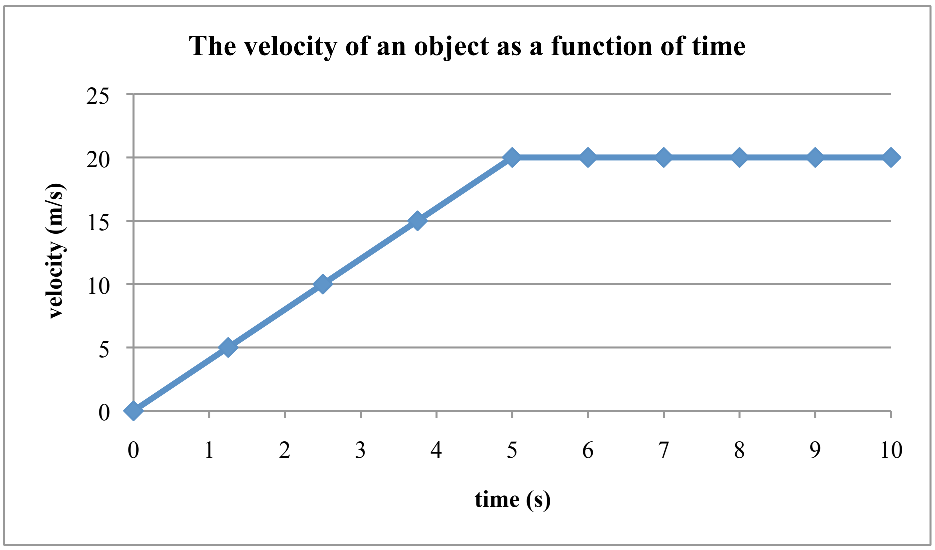
Name____
Physics 110 Quiz #1, April 5, 2013

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

Suppose that an object is moving in a straight line along the positive x-axis. The velocity of the object as a function of time is shown below.



1. Over the time interval $0s \le t \le 5s$, the acceleration of the object is
   a. positive and increasing with time.
   b. positive and constant in time.
   c. negative and decreasing in time.
   d. negative and constant in time.

2. Over the interval of time between $5s \le t \le 10s$, the object is displaced by an amount
   a. $0m$ in the positive x-direction.
   b. $50m$ in the positive x-direction.
   c. $100m$ in the positive x-direction.
   d. $100m$ in the negative x-direction

3. Suppose that over the interval of time $10s \le t \le 20s$, the object needs to be brought to rest. What is the least constant acceleration that will bring the object to rest over this time interval?

From the information in the problem and from the graph we have,
$v_{fx} = v_{ix} + a_{xt} \rightarrow 0 = 20\frac{m}{s} + a_x(10s) \rightarrow a_x = -2\frac{m}{s^2}$, or $2\frac{m}{s^2}$ in the negative x-direction.

4. What is the displacement of the object over the time interval $10s \le t \le 20s$?

The displacement is given by (assuming that the initial position of the object at $t = 10s$ is $x_i = 0m$) $x_f = x_i + v_{ix}t + \frac{1}{2}a_x t^2 = \left(20\frac{m}{s}\right)(10s) + \frac{1}{2}\left(-2\frac{m}{s^2}\right)(10s)^2 = 100m$

5. What is the displacement of the object over the entire time interval $0s \le t \le 20s$?

Assuming the initial position is $x_{i1} = 0m$, the displacement over the first interval is $\bar{v}_1 = \frac{\Delta x_1}{\Delta t_1} \rightarrow \Delta x_1 = \bar{v}_1 \Delta t_1 = \left(\frac{0\frac{m}{s} + 20\frac{m}{s}}{2}\right)(5s) = 50m$. The displacement over the second interval is $\bar{v}_2 = \frac{\Delta x_2}{\Delta t_2} \rightarrow \Delta x_2 = \bar{v}_2 \Delta t_2 = \left(20\frac{m}{s}\right)(5s) = 100m$. The displacement over the third time interval is $100m$ from part 4. The net displacement is the sum of each of these displacements and is $250m$.

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

$$\text{Quadratic equation}: ax^2 + bx + c = 0,$$

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

Vectors

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

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

Useful Constants

$$g = 9.8\,{}^{m}\!/_{s^2} \qquad G = 6.67\times10^{-11}\,{}^{Nm^2}\!/_{kg^2}$$

$$N_A = 6.02\times10^{23}\,{}^{atoms}\!/_{mole} \qquad k_B = 1.38\times10^{-23}\,{}^{J}\!/_{K}$$

$$\sigma = 5.67\times10^{-8}\,{}^{W}\!/_{m^2K^4} \qquad v_{sound} = 343\,{}^{m}\!/_{s}$$

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

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

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

$$U_g = mgh$$

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

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

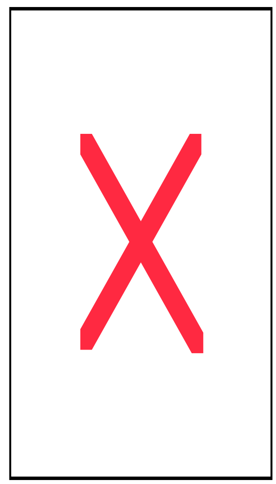
$$W_R = \tau\theta = \Delta E_R$$

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

$$\Delta E_R + \Delta E_T + \Delta U_g + \Delta U_S = 0$$

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

Heat



Rotational Motion

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

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

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

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

$$L = I\omega$$

$$L_f = L_i + \tau\Delta t$$

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

$$a_r = r\omega^2$$

Sound

$$v = f\lambda = (331 + 0.6T)\,\tfrac{m}{s}$$

$$\beta = 10\log\frac{I}{I_0}; \quad I_o = 1\times10^{-12}\,\tfrac{W}{m^2}$$

$$f_n = nf_1 = n\frac{v}{2L}; \; f_n = nf_1 = n\frac{v}{4L}$$

Fluids

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

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

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

$$F_B = \rho g V$$

$$A_1 v_1 = A_2 v_2$$

$$\rho_1 A_1 v_1 = \rho_2 A_2 v_2$$

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

Simple Harmonic Motion/Waves

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

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

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

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

$$x(t) = A\sin\left(\tfrac{2\pi t}{T}\right)$$

$$v(t) = A\sqrt{\frac{k}{m}}\cos\left(\tfrac{2\pi t}{T}\right)$$

$$a(t) = -A\frac{k}{m}\sin\left(\tfrac{2\pi t}{T}\right)$$

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

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

$$I = 2\pi^2 f^2 \rho v A^2$$