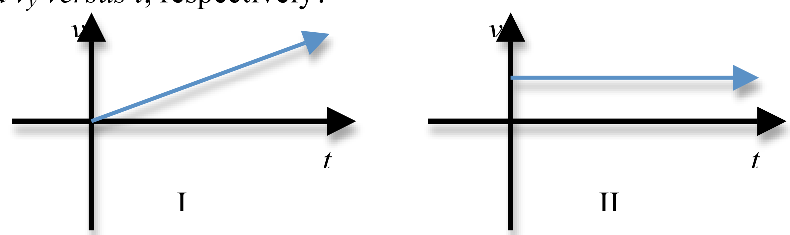
Name________________________________

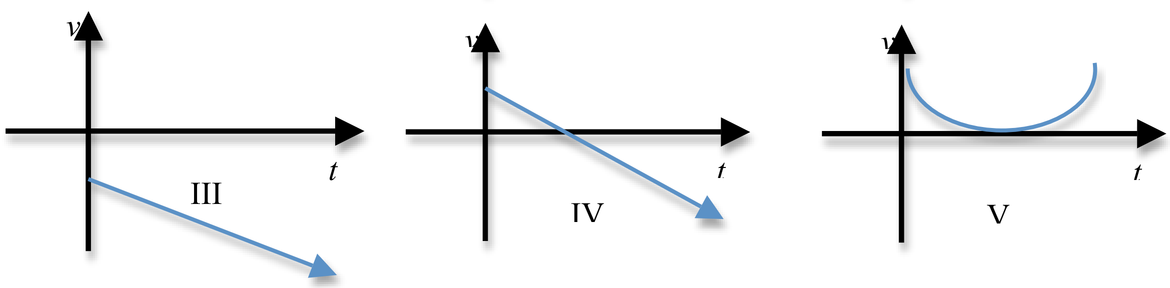
Physics 110 Quiz #2, September 23, 2011

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

1. A stone is thrown at an angle of 45° below the horizontal x-axis in the $+x$-direction. If air resistance is *ignored*, which of the velocity *versus* time graphs shown below best represents v_x *versus* t and v_y *versus* t, respectively?

	v_x *vs t*	v_y *vs t*
a.	IV	I
b.	III	II
c.	I	V
d.	II	III





2. Suppose that you won a contest in which you could win a fabulous prize if you can throw a basketball from the midpoint of the court (which is located *14m* from the hoop) through the hoop at the other end of the court. Suppose that you throw the basketball at an angle of *30°* with respect to the floor and that the ball leaves your hand at a height of *2.1m* above the floor.

   a. What initial speed (the magnitude of the velocity) would you have had to throw the basketball at so that you would make the shot, if the hoop is *3.05m* above the ground at the end of the court *14m* from you?

   Taking the origin at the basketball, we have

$$y_f = (v_i \sin\theta)t - \frac{g}{2}t^2 = x_f \tan\theta - \frac{g x_f^2}{2v_i^2\cos^2\theta};\ \text{ where }\ x_f = (v_i\cos\theta)t$$

$$\therefore 0.95m = 14m\tan 30 - \frac{9.8\,\tfrac{m}{s^2}\times(14m)^2}{2\cos^2 30 v_i^2} \Rightarrow v_i = 13.4\,\tfrac{m}{s}$$

   b. If you were to make the half court shot, what would the time of flight of the basketball have been from the time the ball left your hand until it went through the hoop at the end of the court?

$$t = \frac{x_f}{v_i\cos\theta} = \frac{14m}{13.4\,\tfrac{m}{s}\cos 30} = 1.21s$$

Useful formulas:

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

$r_f = r_i + v_{ir}t + \frac{1}{2}a_r t^2$

$v_{fr} = v_{ir} + a_r t$

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

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

Vectors

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

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

Useful Constants

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

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

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

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

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

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

$U_g = mgh$

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

$W_T = FdCos\theta = \Delta E_T$

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

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

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

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

Heat

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

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

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

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

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

$PV = Nk_BT$

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

$\Delta Q = mc\Delta T$

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

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

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

Rotational Motion

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

$\omega_f = \omega_i + \alpha t$

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

$\tau = I\alpha = rF$

$L = I\omega$

$L_f = L_i + \tau\Delta t$

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

$a_r = r\omega^2$

Fluids

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

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

$P_d = P_0 + \rho gd$

$F_B = \rho gV$

$A_1v_1 = A_2v_2$

$\rho_1A_1v_1 = \rho_2A_2v_2$

$P_1 + \frac{1}{2}\rho v^2{}_1 + \rho gh_1 = P_2 + \frac{1}{2}\rho v^2{}_2 + \rho gh_2$

Simple Harmonic Motion/Waves

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

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

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

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

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

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

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

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

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

$I = 2\pi^2f^2\rho vA^2$

Sound

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

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

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