PHYS 1211, Fall 2012

Test #1

September 6, 2012

2:00 pm– 3:15 pm

1. __________
2. __________
3. __________
4. __________

Total ________

Name ___________________

ID ___________________

NOTE: This test consists of one set of conceptual questions and three problems. In working the problems, you <u>must show all of your calculations</u> and your reasoning clearly to receive credit. Be sure to include units in your solutions when required.

1. Conceptual questions (10 points, no calculations required). State whether the following statements are ***True*** or ***False***.

a) There is only one unique coordinate system in which vector components can be added.

b) The addition of a vector and a scalar results in a vector.

c) In uniform circular motion, the magnitude of the centripetal (or radial) acceleration a_r is constant.

2. The height of a helicopter above the ground is given by $h=3.00t^3$, where h is in meters and t is in seconds. After 2.00s, the helicopter releases a small mailbag. How long after its release does the mailbag reach the ground? (30 points)

3. Let $\vec{E} = 2\hat{i} + 3\hat{j}$ and $\vec{F} = 2\hat{i} - 2\hat{j}$. Find (a) the magnitude of $\vec{E}$, (b) the magnitude and direction of $\vec{A} = \vec{E} + \vec{F}$, and (c) the magnitude and direction of $\vec{B} = -\vec{E} - 2\vec{F}$. (d) Sketch $\vec{A}$ and $\vec{B}$. (30 points)

4. An archer shoots an arrow with a velocity of 45.0 m/s at an angle of 50.0° above the horizontal. An assistant standing on level ground 150 m downrange from the launch point throws an apple straight up with the minimum initial speed necessary to meet the path of the arrow. (a) Determine the time for the arrow to hit the apple. (b) Determine the height, above the launch point of the arrow, when the arrow and apple collide. (c) Assuming that the arrow and apple are launched from the same height, what is the initial speed of the apple? (30 points)

Equations

$$\rho = M/V$$

$$\mathrm{v}_{xf} = \mathrm{v}_{xi} + a_x\left(t_f - t_i\right) \qquad \mathrm{v}_{yf} = \mathrm{v}_{yi} + a_y\left(t_f - t_i\right)$$

$$x_f = x_i + \tfrac{1}{2}\left(\mathrm{v}_{xi} + \mathrm{v}_{xf}\right)\left(t_f - t_i\right) \qquad y_f = y_i + \tfrac{1}{2}\left(\mathrm{v}_{yi} + \mathrm{v}_{yf}\right)\left(t_f - t_i\right)$$

$$x_f = x_i + \mathrm{v}_{xi}\left(t_f - t_i\right) + \tfrac{1}{2}a_x\left(t_f - t_i\right)^2 \qquad y_f = y_i + \mathrm{v}_{yi}\left(t_f - t_i\right) + \tfrac{1}{2}a_y\left(t_f - t_i\right)^2$$

$$\mathrm{v}_{xf}^2 = \mathrm{v}_{xi}^2 + 2a_x\left(x_f - x_i\right) \qquad \mathrm{v}_{yf}^2 = \mathrm{v}_{yi}^2 + 2a_y\left(y_f - y_i\right)$$

$$\mathbf{a}_y = -g\,\hat{\mathrm{j}} \qquad g = 9.80\,{}^{\mathrm{m}}\!/_{\mathrm{s}^2} = 32.2\,{}^{\mathrm{ft}}\!/_{\mathrm{s}^2}$$

$$\cos\theta = {}^{x}\!/_{h} \qquad \sin\theta = {}^{y}\!/_{h} \qquad \tan\theta = {}^{y}\!/_{x} \qquad h = \sqrt{x^2 + y^2}$$

$$\Delta x = x_f - x_i \qquad \mathrm{v}_{x,avg} = \frac{x_f - x_i}{t_f - t_i} \qquad \mathbf{a}_{avg} = \frac{\mathbf{v}_f - \mathbf{v}_i}{t_f - t_i}$$

$$\mathrm{v}_x = \lim_{\Delta t \to 0}\frac{\Delta x}{\Delta t} = \frac{dx}{dt} \qquad a_x = \lim_{\Delta t \to 0}\frac{\Delta \mathrm{v}_x}{\Delta t} = \frac{d\mathrm{v}_x}{dt}$$

$$az^2 + bz + c = 0 \qquad z = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$s = r\theta \qquad \omega_{avg} = \frac{\theta_f - \theta_i}{t_f - t_i} \qquad \omega = \lim_{\Delta t \to 0}\frac{\Delta\theta}{\Delta t} = \frac{d\theta}{dt}$$

$$\alpha_{avg} = \frac{\omega_f - \omega_i}{t_f - t_i} \qquad \alpha = \lim_{\Delta t \to 0}\frac{\Delta\omega}{\Delta t} = \frac{d\omega}{dt} \qquad T = \frac{2\pi}{\omega}$$

$$\mathrm{v}_t = r\omega \qquad a_r = {}^{\mathrm{v}_t^2}\!/_{r}$$