PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Fall Semester 2011**

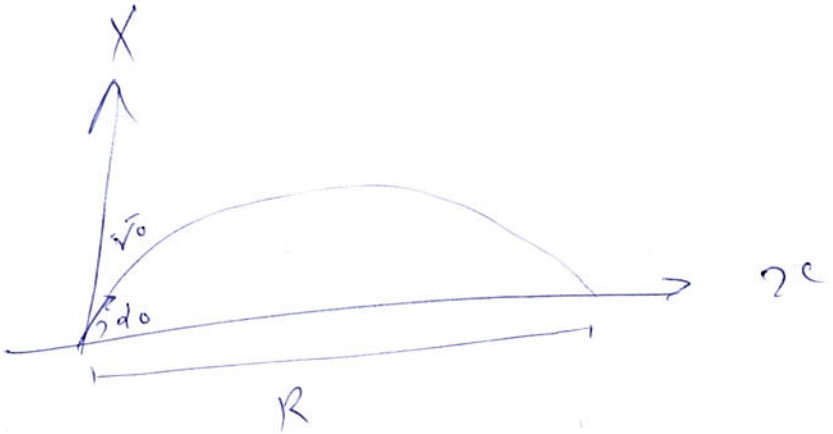
College of Arts and Sciences

Section 5 **Quiz 2** **6 October 2011**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A particle is thrown with initial speed v_0 at an angle α_0 with the horizontal axis. Derive the equation giving the horizontal range (horizontal distance from the starting point) R of the particle as a function of v_0 , α_0 , and g . Find out the angle α_0 that will maximize R for a constant v_0, explain your answer.



$$0 = -\frac{1}{2}gt^2 + v_0 \sin\alpha_0 t + 0 \Rightarrow t = \frac{2v_0 \sin\alpha_0}{g}$$

$$R = v_0 \cos\alpha_0 \, t = v_0 \cos\alpha_0 \, \frac{2v_0 \sin\alpha_0}{g}$$

$$\Rightarrow R = \frac{v_0^2 \sin 2\alpha_0}{g}$$

$\alpha_0 = 45° \Rightarrow$ Max. R

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Section 4 **Quiz 2** **6 October 2011**

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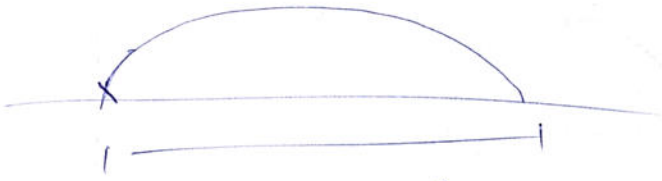
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A demolition crew uses dynamite to blow an old building up. Debris from the explosion flies off in all directions and is later found at distances as far as 50 m from the explosion. Estimate the maximum speed at which debris was blown outward by the explosion. (Ignore the air resistance, take g=10 m/s^2)

$\theta = 45$

$x = 50\ m$



$x_{max} = R$

$$R = \frac{v_0^2 \sin 2\theta}{g}, \quad \sin 2\theta = 1$$

$$\Rightarrow \boxed{v_0 = \sqrt{Rg} = \sqrt{50 \times 10} = 10\sqrt{5} = 22....}$$

$\therefore$ v_0 = max. speed

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Section 3 **Quiz 2** **6 November 2011**

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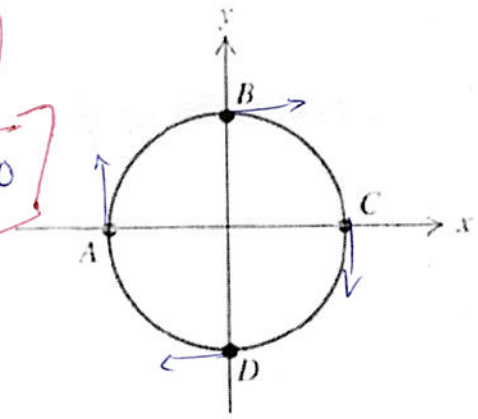
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

An athlete starts at point A and runs at a constant speed of 6 m/s around a circular track 100 m in diameter as shown in figure below. Find the x and y components of this runner's average velocity and acceleration between points (a) A and B (b) A and C (c) C and D, and (d) A and A (full lap). (Take $\pi=3$)

$R = \frac{100}{2} = 50\,(m)$

$2\pi R = VT \Rightarrow T = 50$



$\vec{V}_{AB} = \frac{\vec{r}_B - \vec{r}_A}{T/4} = \frac{50\hat{y} + 50\hat{x}}{50/4} = 4\hat{y} + 4\hat{x}$, $\vec{a}_{AB} = \frac{\vec{v}_B - \vec{v}_A}{T/4} = \frac{6\hat{x} - 6\hat{y}}{50/4}$

$\vec{V}_{AC} = \frac{50\hat{x} + 50\hat{x}}{50/2} = 4\hat{x}$, $\vec{a}_{AC} = \frac{-6\hat{y} - 6\hat{y}}{50/2} = -\frac{12\hat{y}}{50}$

$\vec{V} = \frac{-50\hat{y} - 50\hat{x}}{3T/4} = \frac{-40\hat{y} - 40\hat{x}}{3}$, $\vec{a} = \frac{-6\hat{x} + 6\hat{y}}{\frac{3\times 50}{4}} = -\frac{8\hat{x} + 8\hat{y}}{50}$

$\vec{V}_{AA} = \frac{-50\hat{x} + 50\hat{x}}{T} = 0$, $\vec{a}_{AA} = \frac{6\hat{y} - 6\hat{y}}{T} = 0$

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Section 2 **Quiz 2** **6 October 2011**

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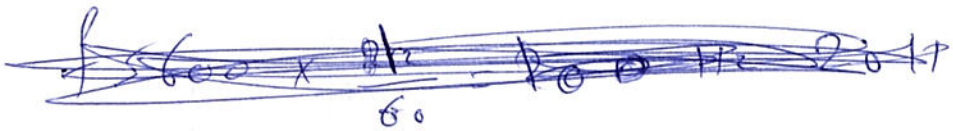
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A model of a helicopter rotor has four blades, each 4 m long from the central shaft to the blade tip. The model is rotated in a wind tunnel at 600 revolutions per minute.
(a) What is the linear speed of the blade tip, in m/s ?
(b) What is the radial acceleration of the blade expressed as a multiple of the acceleration of gravity, g ? (Take $\pi=3$ and $g=10\ m/s^2$)



600 Rev. 1 min.

1 Rev. T (s)

$\Rightarrow$ $T = \frac{60}{600} = 0.1\ s$

$f = 10 \Rightarrow \omega = 20\pi$

a) $V = R\omega = 20\pi \times 4 = 80\pi\ (m/s)$

b) $a = \frac{V^2}{R} = \frac{(80\pi)^2}{4} = \frac{6400\pi^2}{4}$

$= 1440\pi^2$

$\Rightarrow a = 1440\ g$

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Section 1 **Quiz 2** **6 October 2011**

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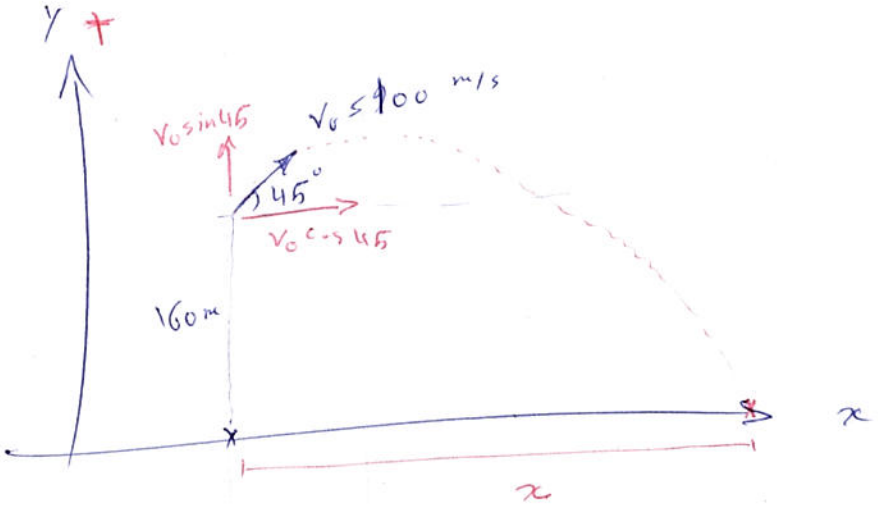
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

An airplane is flying with a velocity of 100 m/s at an angle of 45° above the horizontal. When the plane is 160 m directly above a dog that is standing on level ground, a suitcase drops out of the luggage compartment. How far from the dog will the suitcase land? (Ignore the air resistance, take g=10 m/s^2 and sin 45° = cos 45° = 0.7)



motion in y direction:

$$v_{0y} = v_0 \sin 45 = \frac{100}{\sqrt{2}} = 70$$

$$a_y = -g$$

$$\Delta y = -160$$

$$\Delta y = -\frac{1}{2} g t^2 + v_0 \sin 45\, t$$

$$\Rightarrow -160 = -5t^2 + \frac{100}{\sqrt{2}} t \Rightarrow 5t^2 - 70t - 160 = 0 \Rightarrow t = 16\ (s)$$

motion in x direction:

$$a_x = 0$$

$$v_{0x} = v_0 \cos 45 = 70$$

$$\Delta x = ?$$

$$\Delta x = v_{0x} t = 70 \times 16 = 1120$$