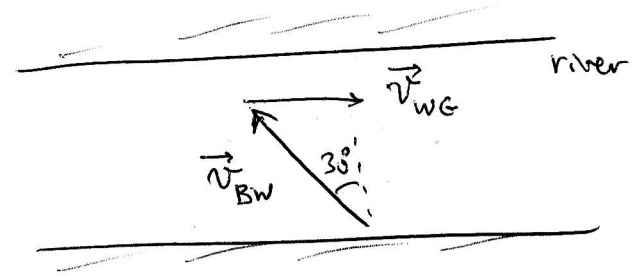
PHYS101
QUIZ#4- CHAPTER 4
DATE: 30/10/12

Name: Key Id#: Sect# 31

A boat is sailing at 12 km/h 30° west of north relative to a river that is flowing East at 6.0 km/h relative to ground. Find the magnitude and direction of the velocity of the boat relative to the ground.




$$\vec{v}_{BG} = \vec{v}_{BW} + \vec{v}_{WG}$$

$$v_{BG,x} = v_{BW,x} + v_{WG,x}$$

$$= -12 \sin 30^\circ + 6 = 0$$

$$v_{BG,y} = v_{BW,y} + v_{WG,y}$$

$$= 12 \cos 30^\circ + 0 = 10.4 \text{ Km/h}$$

$$\vec{v}_{BG} = 10.4\, j \text{ Km/h}$$

magnitude = 10.4 Km/h

direction = north

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The position of a particle as a function of time is given by $\vec{r} = 5.0\,t\,\hat{i} + 3.0\,t^2\,\hat{j}$.
Find the angle between the velocity and acceleration of the particle at t =2.0 s.

$$\vec{v} = \frac{d\vec{r}}{dt} = 5\,\hat{i} + 6t\,\hat{j}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = 6\,\hat{j}$$

at $t = 2s$ $\quad \vec{v} = 5\hat{i} + 12\hat{j}$

$$\vec{a} = 6\hat{j}$$

$\vec{v} \cdot \vec{a} = v\,a\cos\theta$ $\quad$ $\theta$ : angle between $\vec{v}$ and $\vec{a}$

$$\theta = \cos^{-1}\left(\frac{\vec{v}\cdot\vec{a}}{v\,a}\right)$$

$$\vec{v}\cdot\vec{a} = (5\hat{i} + 12\hat{j})\cdot 6\hat{j} = 72$$

$$v = \sqrt{25 + 144} = 13$$

$$a = 6$$

$$v\,a = 78$$

$$\theta = \cos^{-1}\left(\frac{72}{78}\right) = \boxed{22.6^\circ}$$

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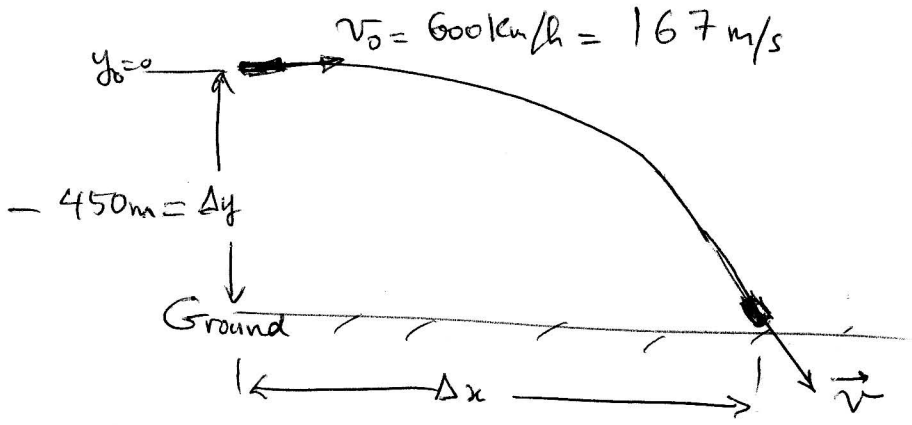
A certain airplane has a speed of 600 km/h and is moving horizontally when it releases an object. The airplane is at a height of 450 m from the ground.
Find the speed of the object just before it hits the ground.




$$\begin{cases} v_{0x} = 167 m/s \\ v_{0y} = 0 \end{cases}$$

$$\Delta y = v_{0y} t - \frac{1}{2} g t^2 \Rightarrow -4.9 t^2 = -450$$

$$t = 9.6 s$$

$$v_y = v_{0y} - gt = -9.8 * 9.6 = -94.1 m/s$$

$$v_x = v_{0x} = 167 m/s$$

$$\vec{v} = 167 \hat{i} - 94.1 \hat{j} \quad m/s$$

$$\text{Speed} = |\vec{v}| = 192 m/s$$