QUIZ#4- CHAPTER 4
DATE: 16/10/17

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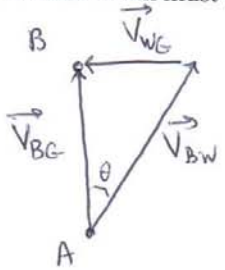
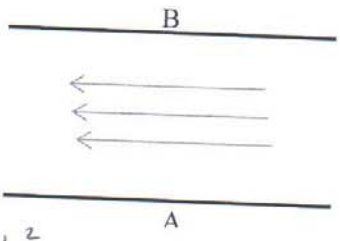
The speed of the water flow with respect to the ground in a river is 5.0 m/s toward the west. A boat with a speed of 15 m/s relative to the water leaves point A and heads in such a way that it crosses to point B.

(a) What is the speed of the boat relative to the ground?

(b) In what direction relative to the North must the boat be pointed?

a)





Use Pythagore theorem $V_{BW}^2 = V_{BG}^2 + V_{WG}^2$

$$V_{BG} = \sqrt{V_{BW}^2 - V_{WG}^2} = \sqrt{15^2 - 5^2} = \sqrt{200}$$

$$= \underline{14.1 \text{ m/s}}$$

b) $$\theta = \tan^{-1}\left(\frac{V_{WG}}{V_{BG}}\right) = \tan^{-1}\left(\frac{5}{14.1}\right) = \underline{19.5^\circ}$$

$\theta = 19.5^\circ$ East of North.

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A t = 0, a particle starts at the origin and moving in the x-y plane with a constant acceleration $\mathbf{a} = 2\mathbf{i} - 5\mathbf{j}$ (m/s^2), has an initial velocity $\mathbf{v_0} = 5\mathbf{i}$ m/s.
(a) What is the speed of the particle at t = 2s?
(b) What is the position of the particle at t = 2s?

(a) $\vec{V} = \vec{V}_0 + \vec{a}\,t$

$= 5\hat{i} + (2\hat{i} - 5\hat{j})(2)$

$= 5\hat{i} + 4\hat{i} - 10\hat{j} = 9\hat{i} - 10\hat{j}$ (m/s)

Speed $= \sqrt{9^2 + (-10)^2} = 13.5$ m/s

(b) $\vec{r} - \vec{r}_0 = \vec{V}_0 t + \frac{1}{2}\vec{a}\,t^2$

$= 5\hat{i}(2) + \frac{1}{2}(2\hat{i} - 5\hat{j})(4)$

$= 10\hat{i} + 4\hat{i} - 10\hat{j} = 14\hat{i} - 10\hat{j}$

$\boxed{\vec{r} = 14\hat{i} - 10\hat{j}}$ (m)

Another way: Δx: $V_x^2 = V_{ox}^2 + 2a_x \Delta x$

$9^2 = 5^2 + 2\times 2\,\Delta x \Rightarrow \Delta x = 14$ m

Δy: $V_y^2 = V_{oy}^2 + 2a_y \Delta y$

$10^2 = 0 + 2(-5)\Delta y \Rightarrow \Delta y = -10$ m

$\boxed{\vec{r} = 14\hat{i} - 10\hat{j}\ \text{m}}$

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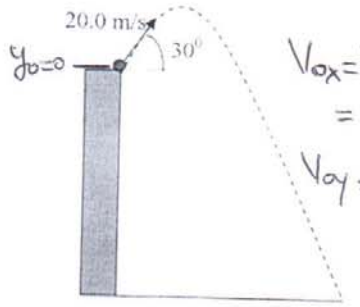
A stone is thrown from the top of a building as shown in the figure with a speed of 20.0 m/s. The stone hits the ground after 4.22 s from the time is was thrown.
(a) How high is the building?
(b) What is the speed of the stone just before hitting the ground?



$V_{0x} = V_0 \cos 30^\circ = 17.3 \text{ m/s}$

$V_{0y} = V_0 \sin 30^\circ = 10 \text{ m/s}$

(a) $y - y_0 = V_{0y} t - \frac{1}{2} g t^2$

$= 10.0 \times 4.22 - 4.9 \times (4.22)^2$

$= -45 \text{ m}$

The height of the building is 45m.

(b) $\vec{V} = V_x \hat{i} + V_y \hat{j}$ $\quad V_x = V_{0x} = 17.3 \text{ m/s}$

$V_y = V_{0y} - gt = 10 - 9.8 \times 4.22 = -31.4 \text{ m/s}$

$\vec{V} = 17.3 \hat{i} - 31.4 \hat{j} \text{ m/s}$

$\text{Speed} = \sqrt{17.3^2 + (-31.4)^2} = 35.8 \text{ m/s}$