Name_____

Feb. 3, 2012

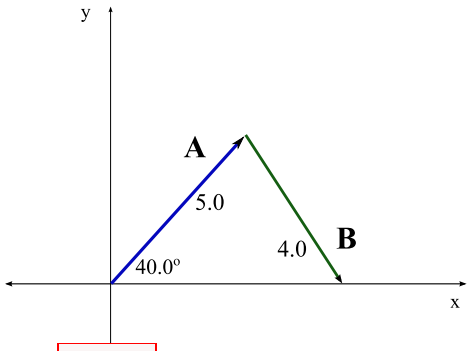
Quiz #1 — Spring 2012

Phys 2110 – Sec 4

1. Convert $30.2\,\frac{\text{cm}}{\text{s}}$ to units of $\frac{\text{km}}{\text{h}}$.

$$30.2\,\tfrac{\text{cm}}{\text{s}} = (30.2\,\tfrac{\text{cm}}{\text{s}})\left(\frac{3600\,\text{s}}{1\,\text{h}}\right)\left(\frac{1\,\text{m}}{100\,\text{cm}}\right)\left(\frac{1\,\text{km}}{1000\,\text{m}}\right) = 1.09\,\tfrac{\text{km}}{\text{h}}$$

2. Vector **A** has magnitude 5.00 and points at angle $\theta = 40.0°$ above the x axis. Vector **B** has magnitude 4.00 and a direction such that $\mathbf{A} + \mathbf{B}$ points in the x direction, as shown.



a) Find B_y.

The $y-$components of the two vectors must add up to zero: $A_y + B_y = 0$. So, since

$A_y = A\sin\theta_A = (5.00)\sin 40° = 3.21$ then $B_y = -A_y = \boxed{-3.21}$

b) If **B** points at an angle between $0.00°$ and $-90.0°$ (as the picture indicates), find the direction of **B**.

If ϕ is the direction of **B** then

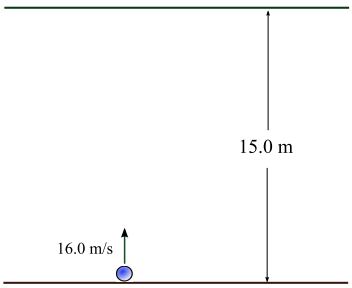
$$B_y = B\sin\phi \quad\Longrightarrow\quad \sin\phi = \frac{B_y}{B} = \frac{-3.21}{4.0} = -0.803$$

This gives

$$\phi = \sin^{-1}(-0.803) = -53.5°$$

which is in the correct quadrant. So $\phi = \boxed{-53.5°}$.

3. A projectile is fired upward from floor level inside a room with a ceiling of height 15.0 m. The launch speed of the projectile is 16.0 $\frac{\text{m}}{\text{s}}$.



a) Will the projectile hit the ceiling? *Explain how you know.*

If there were *no* ceiling then we would solve for the maximum height by solving for the value of y where the velocity is zero. Use:

$$v^2 = v_0^2 + 2ay \qquad \Longrightarrow \qquad y = \frac{v^2 - v_0^2}{2a} = \frac{0 - (16.0\,\frac{\text{m}}{\text{s}})^2}{(-9.80\,\frac{\text{m}}{\text{s}^2})} = 13.1\,\text{m}$$

The maximum height is less than the height of this room, so that *with* the ceiling the projectile never gets up to 15.0 m to strike it. The projectile **does not** hit the ceiling.

b)$_1$ If it *does* hit, with what speed does it strike the ceiling and how long did it take to reach the ceiling?

b)$_2$ If it *doesn't* hit, what was the maximum height attained by the projectile and how long did it take to get to maximum height?

The answer was already found in (a), namely **13.1 m**. Next find the time in the flight when the velocity was zero:

$$v = v_0 + at = 0 \qquad \Longrightarrow \qquad t = \frac{v - v_0}{a} = \frac{0 - 16.0\,\frac{\text{m}}{\text{s}}}{(-9.80\,\frac{\text{m}}{\text{s}^2})} = 1.63\,\text{s}$$

so it takes **1.63 s** to get to maximum height.

Just answer one of the (b)'s. Don't answer both.

You must show all your work and include the right units with your answers!

$$A_x = A\cos\theta \qquad A_y = A\sin\theta \qquad A = \sqrt{A_x^2 + A_y^2} \qquad \tan\theta = \frac{A_y}{A_x}$$

$$v = v_0 + at \qquad x = x_0 + v_0 t + \tfrac{1}{2}at^2 \qquad v^2 = v_0^2 + 2a(x - x_0) \qquad x - x_0 = \tfrac{1}{2}(v_0 + v)t$$

$$g = 9.80\,\tfrac{\text{m}}{\text{s}^2} \qquad 1\,\text{h} = 60\,\text{min} \qquad 1\,\text{km} = 10^3\,\text{m} \qquad \text{Ignore air resistance.}$$