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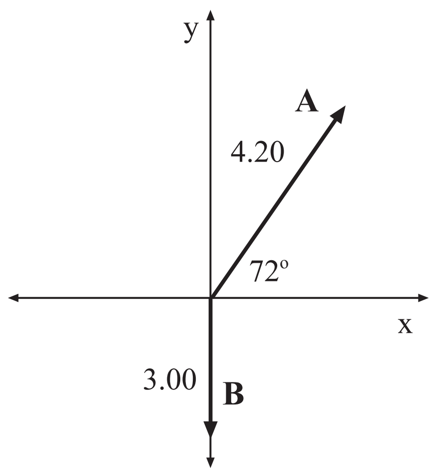
Sept. 20, 2006

Quiz #1 — Fall 2006

Phys 2010, NSCC



1. Vector **A** has magnitude 4.2 and is directed at 72.0° from the $+x$ axis. Vector **B** points in the $-y$ direction and has magnitude 3.00.

Find the magnitude and direction of the sum of the two vectors.

$$A_x = 4.20\,\cos 72^\circ = 1.298$$

$$A_y = 4.20\,\sin 72^\circ = 3.994$$

And it is clear that:

$$B_x = 0 \qquad B_y = -3$$

So if $\mathbf{C} = \mathbf{A} + \mathbf{B}$ then

$$C_x = A_x + B_x = 1.298 \qquad C_y = A_y + B_y = 0.994$$

and

$$C = \sqrt{C_x^2 + C_y^2} = 1.635$$

$$\tan\theta = \frac{C_y}{C_x} = 0.766 \qquad \Longrightarrow \qquad \theta = \tan^{-1}(0.766) = 37.4^\circ$$

where θ is the direction of $\mathbf{C}$ measured from the $+x$ axis.

2. Convert $3.12\,\frac{\mathrm{kg}}{\mathrm{m}^2}$ to units of $\frac{\mathrm{g}}{\mathrm{cm}^2}$

$$3.12\,\tfrac{\mathrm{kg}}{\mathrm{m}^2} = (3.12\,\tfrac{\mathrm{kg}}{\mathrm{m}^2})\cdot\left(\frac{1000\ \mathrm{g}}{1\ \mathrm{kg}}\right)\cdot\left(\frac{1\ \mathrm{m}}{100\ \mathrm{cm}}\right)^2 = 0.312\,\tfrac{\mathrm{g}}{\mathrm{cm}^2}$$

3. A cart rolling on a track undergoes a uniform acceleration (deceleration, really). At is initial position it has a velocity of $12.0\frac{\text{m}}{\text{s}}$ and after it has moved forward for 2.00 s its velocity is $3.00\frac{\text{m}}{\text{s}}$.

a) What is the acceleration of the cart?

$$a = \frac{v - v_0}{t} = \frac{(3.00\frac{\text{m}}{\text{s}}) - (12.0\frac{\text{m}}{\text{s}})}{(2.00\text{ s})} = -4.5\frac{\text{m}}{\text{s}^2}$$

b) How far did it move forward in the 2.00 s?

A convenient equation to use is

$$x = \tfrac{1}{2}(v_0 + v)t = \tfrac{1}{2}((12.0\tfrac{\text{m}}{\text{s}} + 3.0\tfrac{\text{m}}{\text{s}})(2.00\text{ s}) = 15.0\text{ m}$$

4. A projectile is shot straight upward from ground level with a speed of $55.0\frac{\text{m}}{\text{s}}$. How long does it take the projectile to reach maximum height?

With

$$v_0 = 55.0\tfrac{\text{m}}{\text{s}} \qquad v = 0 \qquad a = -9.80\tfrac{\text{m}}{\text{s}^2}$$

Use

$$v = v_0 + at \qquad \Longrightarrow \qquad t = \frac{v - v_0}{a}$$

$$t = \frac{0 - 55.0\frac{\text{m}}{\text{s}}}{(-9.80\frac{\text{m}}{\text{s}^2})} = 5.61\text{ s}$$

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

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

$$v_x = v_{0x} + a_x t \qquad x = v_{0x}t + \tfrac{1}{2}a_x t^2 \qquad v_x^2 = v_{0x}^2 + 2a_x x \qquad x = \tfrac{1}{2}(v_{0x} + v_x)t$$

$$v_y = v_{0y} + a_y t \qquad y = v_{0y}t + \tfrac{1}{2}a_y t^2 \qquad v_y^2 = v_{0y}^2 + 2a_y y \qquad y = \tfrac{1}{2}(v_{0y} + v_y)t$$

$$g = 9.80\tfrac{\text{m}}{\text{s}^2} \qquad R = \frac{2v_0^2\sin\theta\cos\theta}{g} \qquad \mathbf{F}_{\text{net}} = m\mathbf{a} \qquad \text{Weight} = mg$$