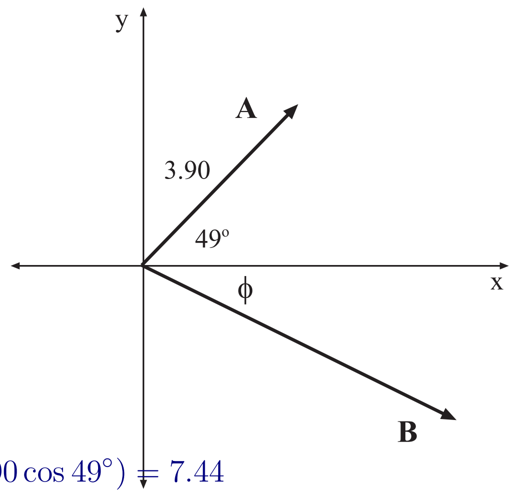
Name______________________________

Feb. 17, 2006

Phys 2110 – Spring 2006
Quiz #2

1. Vector A has magnitude 3.90 and is directed at an angle of 49.0 above the $+x$ axis. Vector $\mathbf{B}$ is some other vector such that

$$\mathbf{A} + \mathbf{B} = 10.0\,\hat{\mathbf{i}}$$



a) Find the x and y components of $\mathbf{B}$.

The x component of the given vector equation is

$$A_x + B_x = 10.0 \qquad \Longrightarrow \qquad B_x = 10.0 - A_x = 10.0 - (3.90\cos 49^\circ) = 7.44$$

and the y component of the given vector equation is

$$A_y + B_y = 0.0 \qquad \Longrightarrow \qquad B_y = -A_y = -3.90\sin 49^\circ = -2.94$$

b) Find the magnitude and direction of $\mathbf{B}$.

The magnitude of $\mathbf{B}$ is

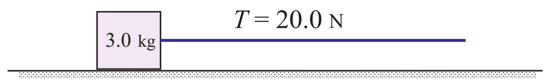
$$B = \sqrt{B_x^2 + B_y^2} = \sqrt{(7.44)^2 + (-2.94)^2} = 8.00$$

and the direction of $\mathbf{B}$ is found from

$$\tan\theta = \left(\frac{-2.94}{7.44}\right) = -0.396 \qquad \Longrightarrow \qquad \theta = -21.6^\circ$$

This choice for θ does put it in the right quadrant since B_y is negative.

2. A 3.0-kg block is dragged on a horizontal surface by a rope pulling horizontally with a constant tension of 20.0 N.



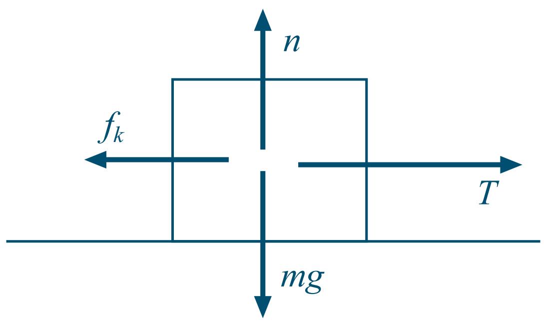
Starting from rest, the block moves 9.10 m in 2.00 s.

a) What is the magnitude of the block's acceleration?

With $v_i = 0$, then

$$x_f = 0 + 0 + \tfrac{1}{2}a(\Delta t)^2 \qquad \Longrightarrow \qquad a = \frac{2x}{(\Delta t)^2} = \frac{2(9.10\ \text{m})}{(2.00\ \text{s})^2} = 4.55\tfrac{\text{m}}{\text{s}^2}$$

b) Draw a free–body diagram showing *all* the forces acting on the block.



c) Find the magnitude of the force of kinetic friction.

Using the free-body diagram, we have

$$T - f_k = ma \qquad \Longrightarrow \qquad f_k = T - ma = 20.0\ \text{N} - (3.0\ \text{kg})(4.55\tfrac{\text{m}}{\text{s}^2}) = 6.35\ \text{N}$$

d) Find the coefficient of kinetic friction for the block and surface.

Since $n = mg$ here, and $f_k = \mu_k n$, we get:

$$\mu_k = \frac{f_k}{n} = \frac{f_k}{mg} = \frac{(6.35\ \text{N})}{(3.0\ \text{kg})(9.8\frac{\text{m}}{\text{s}^2})} = 0.216$$

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

$$v_{fx} = v_{ix} + a_x \Delta t \qquad x_f = x_i + v_{ix}\Delta t + \tfrac{1}{2}a_x(\Delta t)^2 \qquad v_{fx}^2 = v_{ix}^2 + 2a_x(x_f - x_i) \qquad \Delta x = \tfrac{1}{2}(v_{ix} + v_{fx})\Delta t$$

$$g = 9.80\tfrac{\text{m}}{\text{s}^2} \qquad |a_{\text{slope}}| = g\sin\theta \qquad \mathbf{F}_{\text{net}} = m\mathbf{a} \qquad W = mg$$

$$f_{s,\,\max} = \mu_s n \qquad f_k = \mu_k n$$