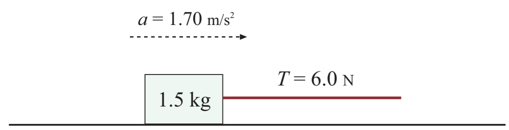
Name________________________

Oct. 25, 2006

# Quiz #2 — Fall 2006

## Phys 2010, NSCC

**1.** A 1.50 kg mass is dragged over a rough horizontal surface by a rope which pulls horizontally with a tension of 6.0 N. The acceleration of the block is found to be $1.7\frac{\mathrm{m}}{\mathrm{s}^2}$.




**a)** What is the magnitude of the friction force which acts on the block?

The forces on the block are the forward force of the rope (6.0 N) and a backwards force of kinetic friction. Then Newton's 2nd law gives

$$6.0\ \mathrm{N} - f_k = ma$$

Find $f_k$:

$$f_k = 6.0\ \mathrm{N} - ma = 6.0\ \mathrm{N} - (1.50\ \mathrm{kg})(1.7\tfrac{\mathrm{m}}{\mathrm{s}^2}) = 3.45\ \mathrm{N}$$

**b)** What is coefficient of kinetic friction for the block and surface?

When we "balance" the vertical forces we find that the normal force of the table is the weight of the block,

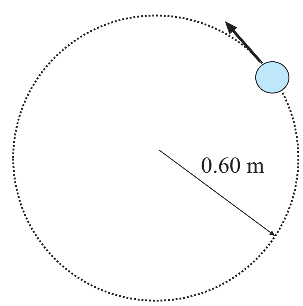
$$F_N = mg = (1.7\ \mathrm{kg})(9.800\tfrac{\mathrm{m}}{\mathrm{s}^2}) = 14.7\ \mathrm{N}$$

Use $f_k = \mu_k F_N$ and get

$$\mu_k = \frac{f_k}{F_N} = \frac{3.45\ \mathrm{N}}{14.7\ \mathrm{N}} = 0.235$$

**2.** A mass moves in a circle of radius 0.60 m at constant speed; it takes 1.0 s for the mass to go around the circle.

What are the magnitude and direction of the acceleration of the mass? (You can *show* the direction of the acceleration on the figure.)



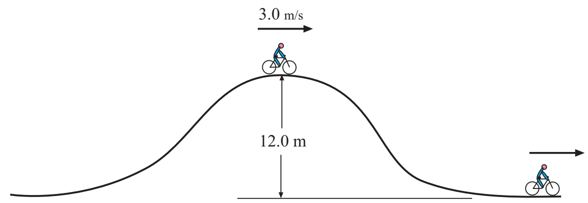

The speed of the mass is

$$v = \frac{2\pi R}{T} = \frac{2\pi(0.60\ \mathrm{m})}{(1.0\ \mathrm{s})} = 3.77\tfrac{\mathrm{m}}{\mathrm{s}}$$

The acceleration is "centripetal", that is, it always points to the center of the circle and it has magnitude

$$a_c = \frac{v^2}{R} = \frac{(3.77\frac{\mathrm{m}}{\mathrm{s}})^2}{(0.60\ \mathrm{m})} = 23.7\tfrac{\mathrm{m}}{\mathrm{s}^2}$$

**3.** A bicyclist has a speed of $3.0\frac{\rm m}{\rm s}$ when he is riding over the the top of a hill; he then coasts to the bottom of the hill, where the elevation is 12.0 m below that of the top. What is his speed when gets there? Ignore all kinds of friction.




Total energy is the same at the top and bottom of the hill; this gives

$$\tfrac{1}{2}m(3.0\tfrac{\rm m}{\rm s})^2 + mg(12.0\ {\rm m}) = \tfrac{1}{2}mv^2 + 0$$

where $v$ is the speed at the bottom of the hill. We can cancel the factor of $m$ and multiply by 2 to get

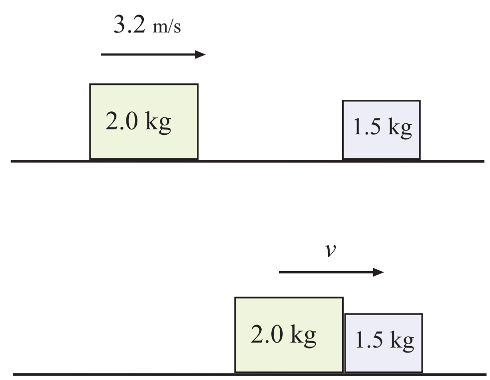
$$(3.0\tfrac{\rm m}{\rm s})^2 + 2(9.80\tfrac{\rm m}{\rm s^2})(12.0\ {\rm m}) = v^2$$

This gives

$$v^2 = 244\ \tfrac{\rm m^2}{\rm s^2} \qquad \Longrightarrow \qquad v = 15.6\tfrac{\rm m}{\rm s}$$

**4.** A 2.0 kg mass slides on a frictionless 1-dimensional track toward a 1.5 kg mass which is at rest. The masses stick together and move off with speed $v$.

Find $v$.




Momentum is conserved in the collision. This gives:

$$(2.0\ {\rm kg})(3.2\tfrac{\rm m}{\rm s}) = (2.0\ {\rm kg} + 1.5\ {\rm kg})v$$

Solve for $v$ and get:

$$v = 1.82\tfrac{\rm m}{\rm s}$$

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

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

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

$$g = 9.80\tfrac{\rm m}{\rm s^2} \qquad \mathbf{F}_{\rm net} = m\mathbf{a} \qquad {\rm Weight} = mg \qquad f_{\rm s}^{\rm Max} = \mu_s F_N \qquad f_{\rm k} = \mu_{\rm k} F_N$$

$$v = \frac{2\pi R}{T} \qquad a_c = \frac{v^2}{r} \qquad F_c = \frac{mv^2}{r}$$

$${\rm PE_{grav}} = mgh \qquad {\rm KE} = \tfrac{1}{2}mv^2 \qquad E = {\rm PE} + {\rm KE} \qquad \Delta E = W_{\rm nc}$$

$$\mathbf{p} = m\mathbf{v} \qquad \text{For isolated system} \quad \mathbf{p}_{\rm Tot} \quad \text{is conserved}$$