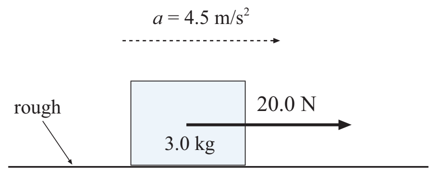
Name________________________________

Mar. 21, 2007

Quiz #2 — Spring 2007

Phys 2010 – NSCC

1. A 3.0 kg mass is dragged along a horizontal rough surface by a 20.0 N force. Its acceleration is found to be $4.5\frac{\mathrm{m}}{\mathrm{s}^2}$.



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

If the magnitude of the friction force is f_k then Newton's2nd law gives

$$20.0\ \mathrm{N} - f_k = ma = (3.0\ \mathrm{kg})(4.5\tfrac{\mathrm{m}}{\mathrm{s}^2}) = 13.5\ \mathrm{N}$$

This gives

$$f_k = 20.0\ \mathrm{N} - 13.5\ \mathrm{N} = 6.5\ \mathrm{N}$$

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

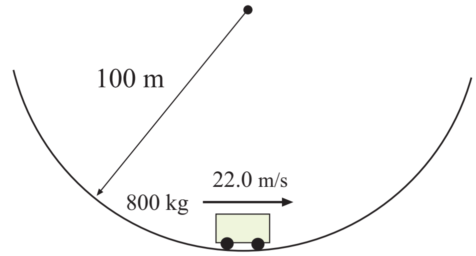
The normal force on the block from the surface here is just $F_N = mg = 29.4\ \mathrm{N}$. Then from (a),

$$f_k = \mu_k F_N \qquad \Longrightarrow \qquad \mu_k = \frac{f_k}{F_N} = \frac{(6.5\ \mathrm{N})}{(29.4\ \mathrm{N})} = 0.22$$

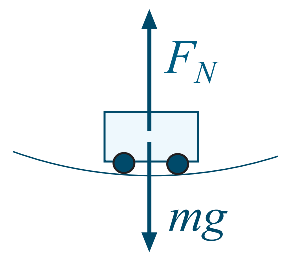
2. A car of mass 800 kg rolls along a road which has a curved depression (see figure). The radius of curvature of the road is 100 m.

If the car is moving at a speed of $22\frac{\text{m}}{\text{s}}$, what is the normal force of the road on the car at the bottom of the depression?

Your answer should include a free-body diagram (i.e. a force diagram).



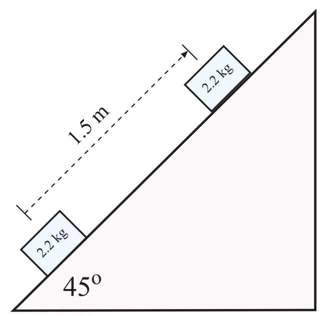
The forces on the car are as shown; normal force of the road points upward, gravity mg points downward. The net force on the car is the centripetal force, so:



$$F_N - mg = \frac{mv^2}{r} \qquad \Longrightarrow \qquad F_N = m\left(g + \frac{v^2}{r}\right)$$

$$(800 \text{ kg})\left(9.8\frac{\text{m}}{\text{s}^2} + \frac{(22\frac{\text{m}}{\text{s}})^2}{(100 \text{ m})}\right) = 1.17 \times 10^4 \text{ N}$$

3. When a 2.2 kg mass is dragged 1.5 m up a 45° slope, what is the change in its gravitational potential energy?



The change in height is

$$\Delta y = (1.5 \text{ m}) \sin 45^\circ = 1.06 \text{ m}$$

So the change in potential energy is

$$\Delta\text{PE} = mg\Delta y = (2.2 \text{ kg})(9.8\tfrac{\text{m}}{\text{s}^2})(1.06 \text{ m}) = 22.9 \text{ J}$$

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

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

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

$$g = 9.80\tfrac{\text{m}}{\text{s}^2} \qquad \mathbf{F}_{\text{net}} = m\mathbf{a} \qquad f_s^{\text{Max}} = \mu_s F_N \qquad f_k = \mu_k F_N \qquad a_c = \frac{v^2}{r} \qquad F_c = \frac{mv^2}{r}$$

$$W = Fs\cos\theta \qquad \text{KE} = \tfrac{1}{2}mv^2 \qquad \text{PE}_{\text{grav}} = mgy \qquad \Delta E = \Delta\text{KE} + \Delta\text{PE} = W_{\text{nc}}$$

$$\mathbf{p} = m\mathbf{v} \qquad \mathbf{J} = \Delta\mathbf{p} \qquad \mathbf{F}_{\text{av}} = \frac{\Delta\mathbf{p}}{\Delta t} \qquad \text{For isolated system, } \mathbf{P} \text{ is conserved}$$