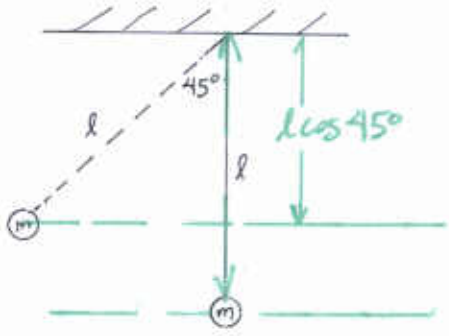
Name_____

Phys 121, Section 2
Quiz #4 — Fall 2000

1. A small 0.260 kg mass is attached to the end of a 1.50 m—long string. The string is pulled back by 45.0° from where the mass is at the lowest posistion.



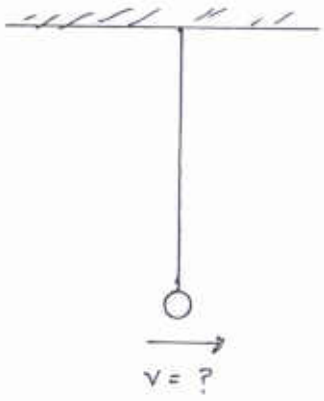
ℓ = 1.50 m
m = 0.260 kg

a) What is the height of the mass above its lowest position?

The difference in heights of the two positions is:

$$h = \ell - \ell\cos 45^\circ = \ell(1-\cos 45^\circ)$$
$$= (1.50\,\text{m})(1-\cos 45^\circ) = \boxed{0.439\ \text{m}}$$

b) The mass is released; what is the speed of the mass as it passes through the lowest position?



Energy is conserved!

Using "zero height" for the lowest position, adding up potential & kinetic energies for the initial and final positions gives:

$$E_0 = E_f \longrightarrow \underbrace{mgh}_{PE_0\ (\text{no KE})} = \underbrace{\tfrac{1}{2}mv^2}_{KE_f\ (\text{no PE})}$$

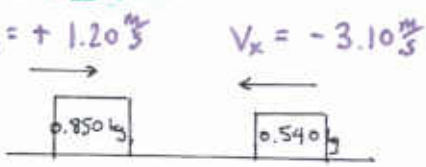
So:

$$gh = \tfrac{1}{2}v^2 \qquad v^2 = 2gh \qquad v = \sqrt{2gh}$$

Plug in numbers:

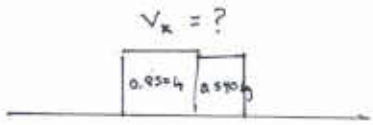
$$v = \sqrt{2\left(9.80\,\tfrac{\text{m}}{\text{s}^2}\right)(0.439\,\text{m})} = \boxed{2.93\ \tfrac{\text{m}}{\text{s}}}$$

Positive x direction is to the right, →



2. On a frictionless track, a 0.850 kg mass is moving to the right with a speed of $1.20\ \frac{m}{s}$. A 0.540 kg mass is moving to the left with speed $3.10\ \frac{m}{s}$

The masses collide and stick together. What is the *velocity* of the united mass just after the collision?



Momentum of the system is conserved, with V_{xf} being the final x-velocity of the joined masses, this gives:

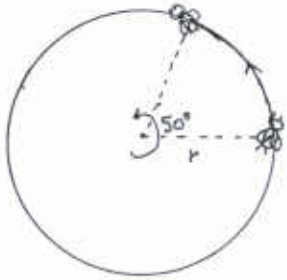
$$(0.850\ kg)(1.20\ m/s) + (0.540\ kg)(-3.10\ m/s) = (0.850\ kg + 0.540\ kg)\, V_{xf}$$

$$\rightarrow \quad -0.654\ \frac{kg\,m}{s} = (1.39\ kg)\, V_{xf}$$

$$V_{xf} = \boxed{-0.470\ m/s}$$

I.e. speed of mass is $0.470\ m/s$ and it is moving to the left.

3. A bug sits on the edge of a disk of radius 12.0 cm. If the disk turns through an angle of 50°, through what distance does the bug move?



Distance bug moves is the arclength for radius $r = 0.120\ m$ and angle

$$\theta = 50^\circ \left(\frac{\pi\ rad}{180\ deg}\right) = 0.873\ rad.$$

So it is

$$s = r\theta = (0.120\ m)(0.873\ rad)$$

$$= \boxed{0.105\ m}$$

$$= \boxed{10.5\ cm}$$

$r = 12.0\ cm$

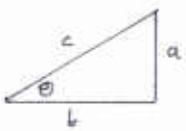
You must show all your work!

$g = 9.80\ \frac{m}{s^2}$ $\quad \pi\ \text{rad} = 180\ \text{deg}$ $\quad C = 2\pi r$ $\quad A = \pi r^2$

$\text{KE} = \frac{1}{2}mv^2$ $\quad \text{PE}_{\text{grav}} = mgh$ $\quad \mathbf{p} = m\mathbf{v}$ $\quad \mathbf{F} = m\mathbf{a}$ $\quad \Delta E = \Delta\text{KE} + \Delta\text{PE} = W_{\text{non-con}}$

When $\sum \mathbf{F}_{\text{external}} = 0$, $\quad \mathbf{P}_0 = \mathbf{P}_f$

$s = r\theta$ $\quad \omega = \omega_0 + \alpha t$ $\quad \theta = \omega_0 t + \frac{1}{2}\alpha t^2$



$\sin\theta = a/c$

$\cos\theta = b/c$

$\tan\theta = a/b$