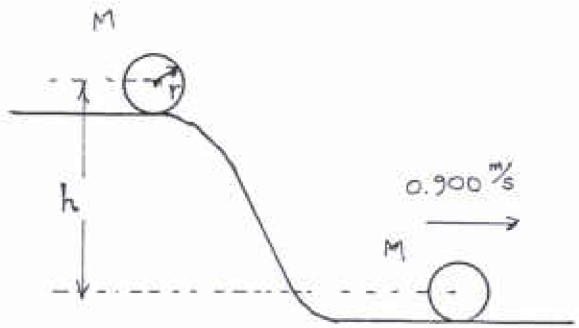
Name________________________

Phys 121
Quiz #5



$r = 5.00$ cm
$= 0.0500$ m

1. A cylinder of radius 5.00 cm is initially stationary; then it rolls without slipping down a ramp from one level surface (at height h) to another. The final linear speed of the cylinder is 0.900 m/s.

a What is the final *angular* speed of the cylinder?

$$\omega = \frac{V_c}{r} = \frac{0.900 \text{ m/s}}{0.050 \text{ m}}$$

$$= 18 \,/\mathrm{s}$$

b) What is the final kinetic energy of the cylinder? (Since I haven't told you the mass of the cylinder, you can leave it as an unknown in your expression.)

Hint: A cylinder is an elongated "disk"...

$$KE = \tfrac{1}{2} M v^2 + \tfrac{1}{2} I \omega^2$$

$$= \tfrac{1}{2} M v^2 + \tfrac{1}{2}\left(\tfrac{1}{2} M r^2\right)\omega^2 \qquad \text{Use } r\omega = V$$

$$= \tfrac{1}{2} M v^2 + \tfrac{1}{4} M v^2 = \tfrac{3}{4} M v^2 = \tfrac{3}{4} M \left(0.900 \tfrac{\text{m}}{\text{s}}\right)^2$$

... or anything close to this

c) Friction forces do no work in this problem. What conservation law can we use to find the initial height of the cylinder?

Conservation of (total) mechanical energy.

d) Find the initial height of the cylinder.

$$E_i = E_f$$

$$Mgh = \tfrac{3}{4} M \left(0.900 \tfrac{\text{m}}{\text{s}}\right)^2$$

M cancels... not needed!

$$h = \frac{3}{4} \frac{\left(0.900 \frac{\text{m}}{\text{s}}\right)^2}{9.8 \frac{\text{m}}{\text{s}^2}} = 6.2 \times 10^{-2} \text{ m} = 6.2 \text{ cm}$$

(Illustration was exagerated!)

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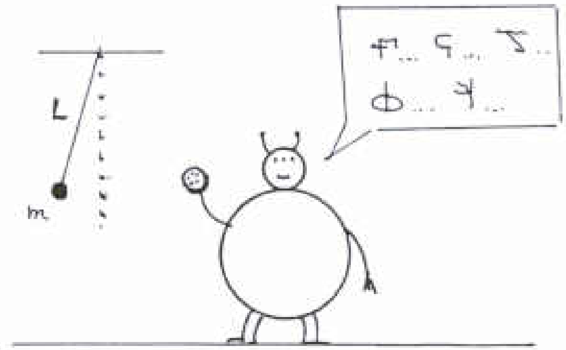

2. On the planet Tr̨åḿ– łåw̄, a physics student swings a simple pendulum of length 1.2 m with a small 300 g mass attached to the end; he/she/it finds that it makes 20 complete swings in 62.8 s

a) What is the value of g on the planet Tr̨åḿ– łåw̄?

$L = 1.2\,m$
$m = 300\,g$

Since $f = \frac{20\ [\text{cycle}]}{62.8\,s} = 0.318\,/s$

Use $f = \frac{1}{2\pi}\sqrt{g/L}$

$f^2 = \frac{1}{4\pi^2}\frac{g}{L}$ $\quad g = 4\pi^2 L f^2 = 4\pi^2 (1.2\,m)(0.318/s)^2$

$= 4.8\ m/s^2$

b) What would the frequency (f) of this pendulum be if it were swung on earth?

On earth

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{L}} = \frac{1}{2\pi}\sqrt{\frac{9.8\ m/s^2}{1.2\ m}} = 0.45\ \frac{[\text{cycle}]}{s}$$

You must show all your work!

$$180^\circ = \pi \text{ radians} \qquad 1 \text{ revolution} = 360^\circ \qquad g_{\text{earth}} = 9.80\,\frac{\text{m}}{\text{s}^2}$$

$$\omega = \omega_0 + \alpha t \qquad \theta = \omega_0 t + \tfrac{1}{2}\alpha t^2 \qquad \omega^2 = \omega_0^2 + 2\alpha\theta \qquad \theta = \tfrac{1}{2}(\omega_0 + \omega)t$$

$$s = \theta r \qquad v_T = \omega r \qquad a_c = \frac{v_T^2}{r} = \omega^2 r \qquad a_T = \alpha r$$

$$\tau = Fr\sin\phi = (Force)\cdot(Lever\ arm) \qquad \text{(Watch signs!)} \qquad \tau_{\text{net}} = I\alpha$$

$$\text{PE}_{\text{grav}} = mgh \qquad \text{PE}_{\text{spr}} = \tfrac{1}{2}kx^2 \qquad \text{KE}_{\text{rot}} = \tfrac{1}{2}I\omega^2 \qquad \text{KE}_{\text{roll}} = \tfrac{1}{2}Mv^2 + \tfrac{1}{2}I\omega^2$$

$$I_{\text{disk}} = \tfrac{1}{2}MR^2 \qquad I_{\text{sphere}} = \tfrac{2}{5}MR^2 \qquad I_{\text{rod, mid}} = \tfrac{1}{3}ML^2 \qquad I_{\text{rod, end}} = \tfrac{1}{12}ML^2$$

$$\omega = 2\pi f \qquad f = \frac{1}{T} \qquad f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} \qquad f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$