Phys 2110-4 2/27/12

Note Title 2/27/2012

Chap 7 Cons of energy

$U_{grav} = mgy$ $U_{spr} = \frac{1}{2}kx^2$

$K = \frac{1}{2}mv^2$ $W = \int F_x\,dx$

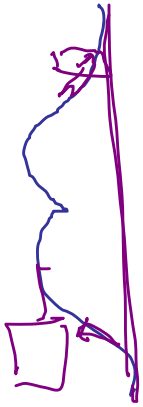
$$\Delta K + \Delta U = W_{non-cons}$$

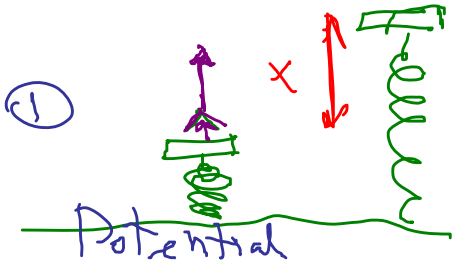
No fric, no extra forces $\Longrightarrow$ $E = K + U$

$\Delta K + \Delta U = 0$

$\Delta E = 0$ E conserved

7.21 A 120 g - arrow is shot vertically from a bow whose effective spring constant 430 N/m. If the bow is drawn 71 cm = X before shooting, to what height does arrow rise 0.71 m





Potential, grav.

$$E_1 = E_2$$

$$\frac{1}{2}kx^2 = mgh$$

$$h = \frac{kx^2}{2mg} = 92.2\text{m}$$

Example

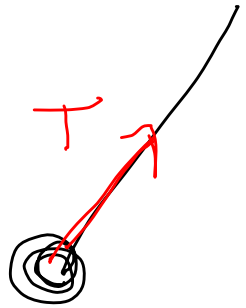
Cons of energy

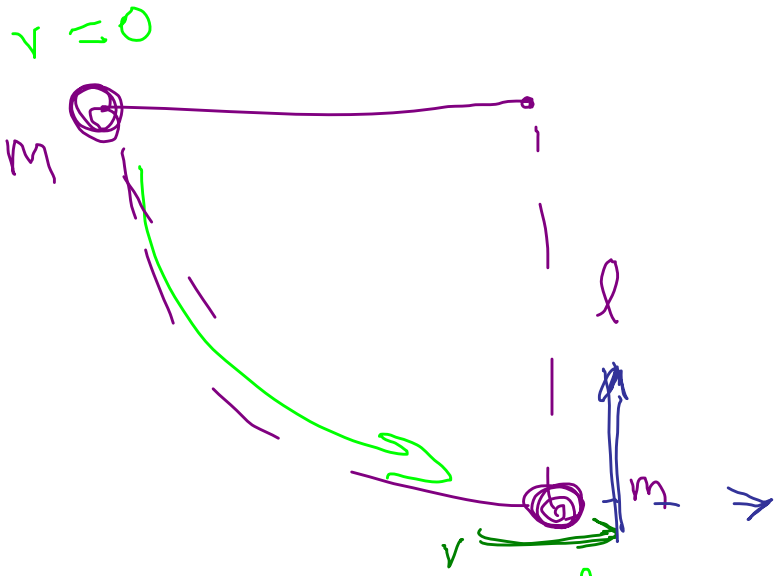
$$E_1 = E_2$$

$$mgl = \frac{1}{2}mv^2$$

$$v^2 = 2gl$$

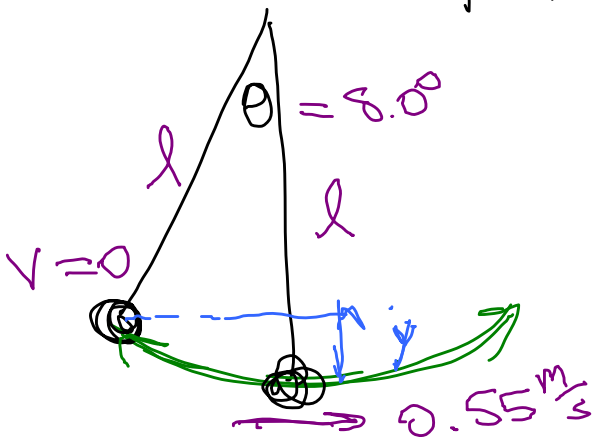
$$v = \sqrt{2gl}$$





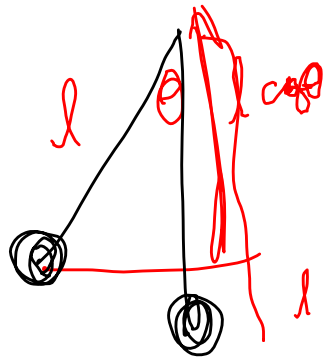
How fast it go at bottom?

7.46 The maximum speed of the pendulum bob in a grandfather clock is $0.55\ m/s$. If the pendulum makes a max angle of 8.0° with the vertical, what's the pendulum's length?



Cons of energy:
Origin at bottom

$$\Sigma_1 = U_1 = mgy$$
$$= mg(l - l\cos\theta)$$
$$= mgl(1 - \cos\theta)$$



$$E_1 = mgl(1-\cos\theta)$$

$$E_2 = \frac{1}{2}mv^2$$

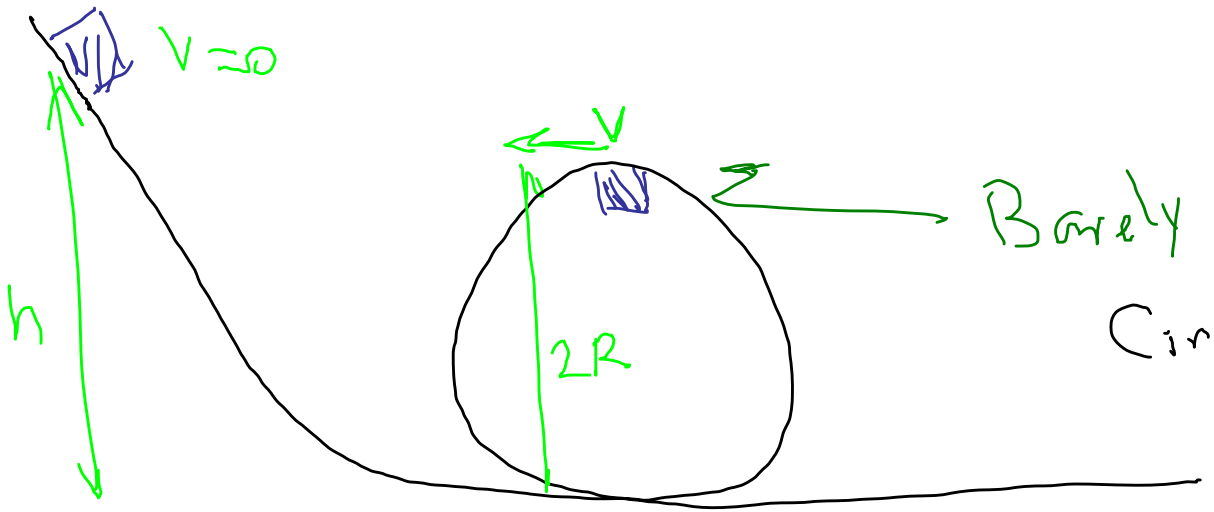
$$E_1 = E_2$$

$$l = \frac{v^2}{2g(1-\cos\theta)}$$

7.45

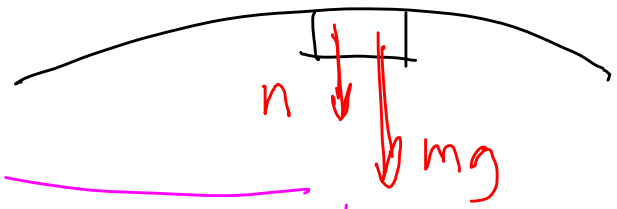
$h > 2R$

Stay on track



Barely stay on track

Circular path, V



At very least $n = 0$

$$F_c = mg = \frac{mv^2}{R}$$

$$v^2 = gR$$

~~Cons of energy~~

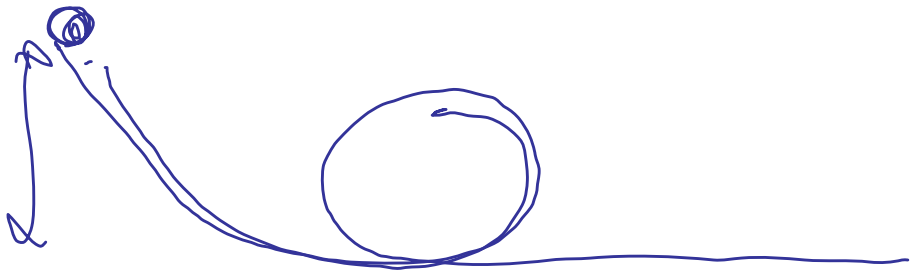
$$mgh = \frac{1}{2}mv^2 + mg(2R)$$

$$v^2 = gR$$

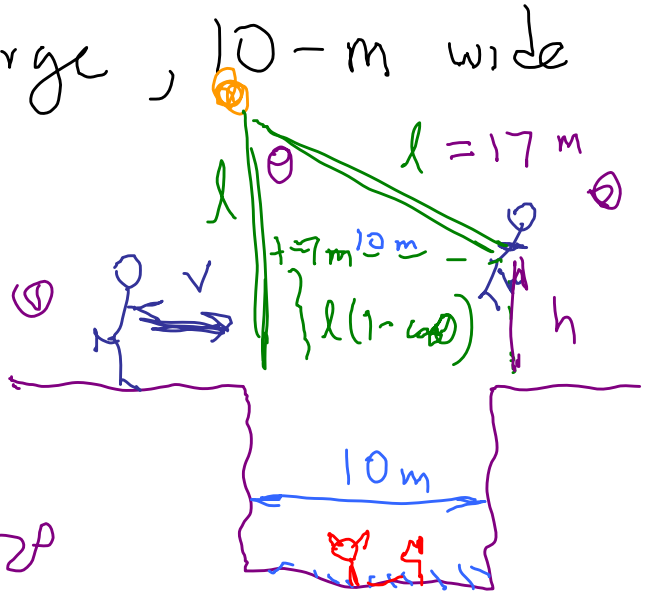
$$mgh = \frac{1}{2}mv^2 + mg(2R)$$

$$gh = \frac{1}{2}gR + 2gR$$

$$h = \frac{1}{2}R + 2R = \frac{5}{2}R$$



7.62 A 17 m vine hangs vertically from tree on side of gorge, 10-m wide. How fast must he run?



$E_1 = \frac{1}{2}mv^2$

$\sin\theta = \frac{10\text{ m}}{17\text{ m}}$ $\quad \theta = 62°$

$h = l(1-\cos\theta)$

$E_2 = mgh$

$\frac{1}{2}mv^2 = mgh$

$v = 7.98\ \frac{m}{s}$

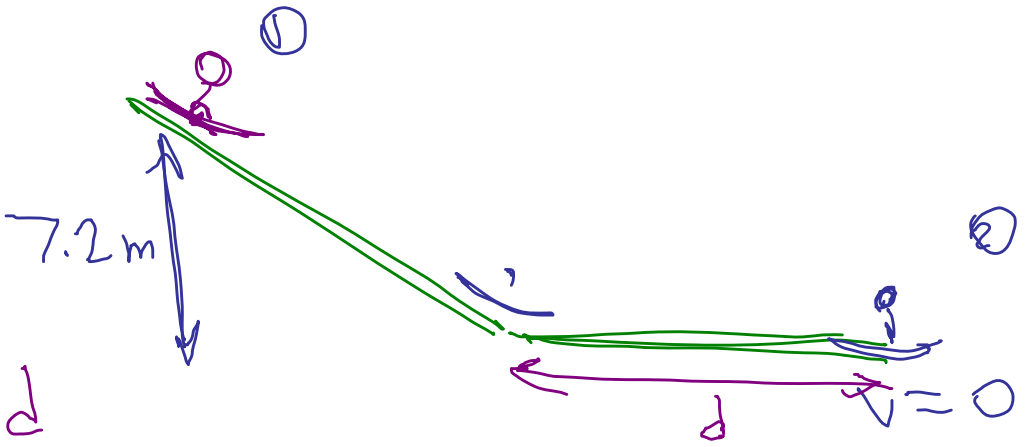
7.59 A child sleds down frictionless hill whose vert. drop is 7.2m. At bottom, level but rough, coeff. of kin. fric = 0.51. How far does she slide across stretch?

$$\Delta E = 0 - mgh$$

$$= -mgh$$

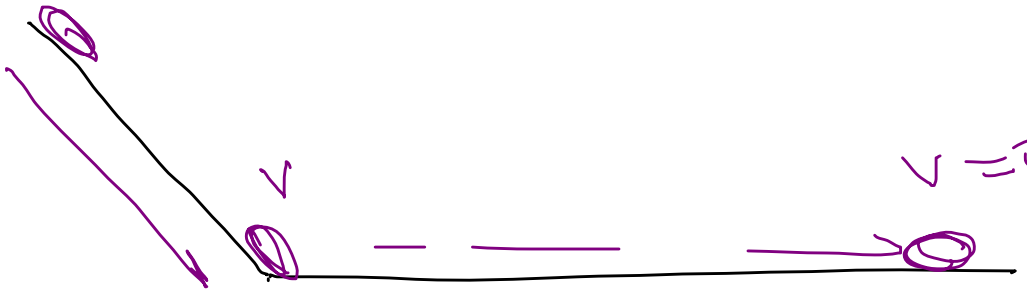
$$\Rightarrow W_{fric} = -f_k d$$

$$= -\mu_k mg d$$



$$mgh = \mu_k mg d$$

$$d = \frac{h}{\mu_k} = \frac{7.2\,m}{0.51} = 14.1\,m$$



Potential Energy

1-dim motion
force not constant

$$W_{a\to b} = -\Delta U$$

$$= \int_a^b F_x \, dx$$

Choose $a = 0$ $\qquad \Delta U = -\int_0^b F_x \, dx$

$0 \to x$

$$U(x) = \Delta U = -\int_0^x F_x(x') \, dx'$$

Switch int & den

$$F_x = -\frac{dU}{dx}$$

Spring pot'l energy $U_{spring} = \frac{1}{2}kx^2$