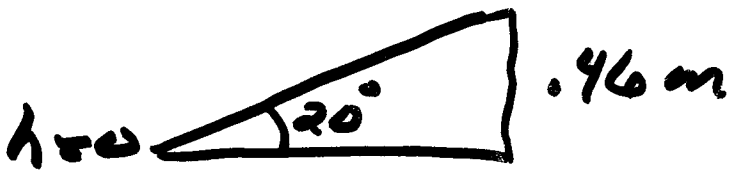
Read 7.1 - 7.3

No H.w Due

No class next week

Ex) A child of mass 50kg slides down a hill of height 0.46 m. If sled starts from rest and has a speed of 2.6 m/s at the bottom, how much energy* is lost due to friction what is frictional force if hill 20° above horizontal



(* mechanical)

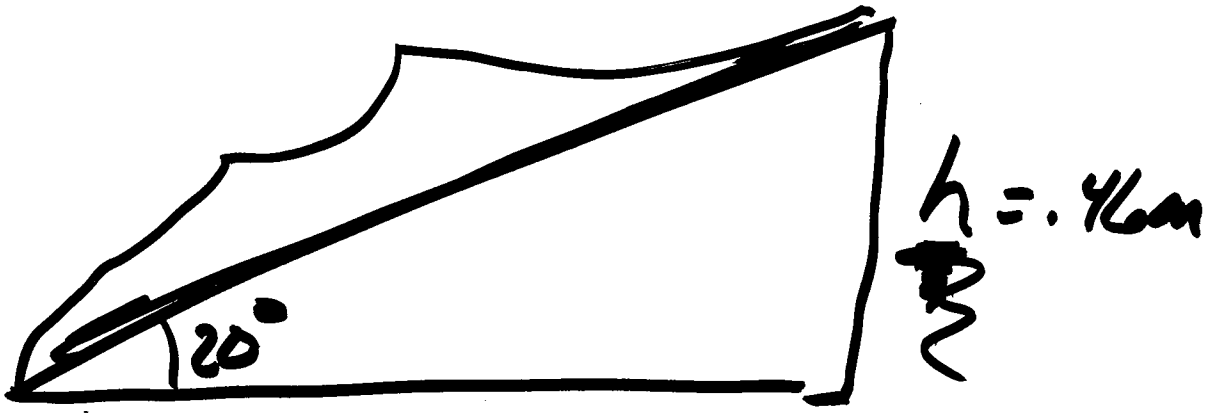
$W_{nc} = \Delta K + \Delta U$ (0, 0, $v_i = 0$, $U_f = 0$)

$= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + U_f - U_i$

$W_{nc} = \frac{1}{2}mv_f^2 - mgh$

$= \frac{1}{2}(50kg)(2.6m/s)^2 - (50kg)(9.8m/s^2)(.46m)$

$= \boxed{-56\,J}$



$W = F d \cos\theta$

$\theta = 180$

Friction opposes motion

$\cos\theta = 180° = -1$

$$F = \frac{-W}{d} = \frac{56\,J}{1.34m} = \boxed{42\,N}$$

$$d = \frac{.46m}{\sin 20°} = 1.34\,m$$

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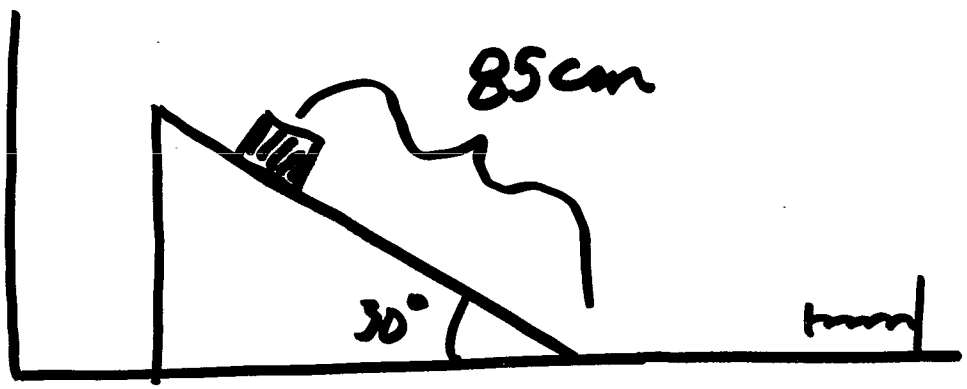
ex) A 0.50 kg block, starting from rest, slides down a 30° incline with $\mu_k = 0.25$. After sliding 85 cm down the incline, it slides across a frictionless horizontal surface and encounters a spring ($k = 35\ N/m$)

a) what is maximum compression of spring

the block then goes back up incline

b) How far along incline does block travel before coming to rest



Find speed at bottom

at top $v_i = 0$ $U_i = mgh$

bottom $v_f = ?$ $U_f = 0$

E_i at top

$\frac{1}{2}mv_0^2 + mgh$ $E_i = mgh$

$$mgh - F_f d = \frac{1}{2}mv_f^2$$

$F_f = \mu_k F_N = \mu_k mg\cos\theta$

$h = d\sin\theta$

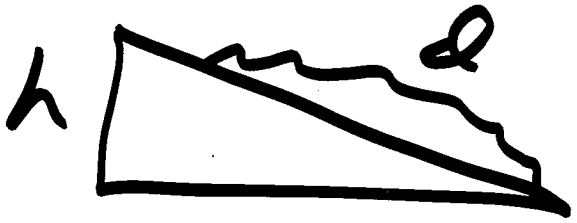
$$v_f = \sqrt{2gh - \frac{2F_f d}{m}}$$

$$v_f = \sqrt{2gd\sin\theta - \frac{2\mu_k mg\cos\theta d}{m}}$$

$$= \sqrt{2gd(\sin\theta - \mu\cos\theta)} = 2.17\ m/s$$

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

$$x = v\sqrt{\frac{m}{k}} = .26\ m$$



$v = 2.17 \text{ m/s}$

$$\frac{1}{2}mv^2 - Fd = mgh \qquad h = d\sin\theta$$

$$\frac{1}{2}mv^2 - Fd = mgd\sin\theta$$

$$\frac{1}{2}mv^2 = mgd\sin\theta + Fd$$

$$\frac{1}{2}mv^2 = d(mg\sin\theta + F)$$

$$d = \frac{\frac{1}{2}mv^2}{mg\sin\theta + F}$$

$$= \frac{\frac{1}{2}mv^2}{mg\sin\theta + \mu_k mg\cos\theta}$$

$$d = \frac{\frac{1}{2}v^2}{g(\sin\theta + \mu_k\cos\theta)}$$

$$\boxed{d = .33 \text{ m}}$$

A box slides down an inclined plane with friction and compresses a spring with spring constant K. The box then goes back up the incline to a height h. I then replace the spring with a new spring with spring constant 4K.
How far back up the incline will box go?

- A) same
- B) Twice as high
- C) ½ as high
- D) 4 times as high
- E) unable to determine

Interactive Question

A ball drops some distance and gains 30 J of kinetic energy. Do not ignore air resistance. How much gravitational potential energy did the ball lose?

A) More than 30 J
B) Exactly 30 J
C) Less than 30 J
D) It depends on the mass of the ball.
E) More information is needed to determine the answer.

Power

Power defined as the rate at which energy is transferred or transformed

Energy transfer into the system is done by external work

Power defined as rate that work is done

$$P = W/t$$

unit J/s = watt (W)

1 horsepower = 550 ft-lbs = 746 W

Note $P = \frac{W}{t} = \frac{F d \cos\theta}{t} = F v \cos\theta$

ex) A deep sea chamber is raised 1700 m at a constant velocity in 5 minutes. If cable has a tension of 8900 N, how much power is required to lift chamber?

$$P = \frac{W}{t} = \frac{Fd\cos\theta}{t}$$

$\theta = 0.0°$

$\cos 0° = 1$

$$P = \frac{8900\,N \cdot 1700\,m}{300\,s}$$

$$5.04 \times 10^4\,W$$

$$5.04 \times 10^4\,W \left| \frac{1\,hp}{746\,W} \right.$$

$$= 67.6\,hp$$