Nonconservative Forces

Name:

1. You are in a room in a basement with a smooth concrete floor (friction force equals 40 N) and a nice rug (friction force equals 55 N) that is 3 m by 4 m. However, you have to push a very heavy box from one corner of the rug to the opposite corner of the rug. Will you do more work against friction going around the floor or across the rug, and how much extra?

a. Across the rug is 275 J extra
b. Around the floor is 5 J extra
c. Across the rug is 5 J extra
d. Around the floor is 280 J extra

$d = \sqrt{3^2+4^2} = 5m$

$W = Fd\cos 0 = (55N)(5) = 275N$ ⟩ Across

$d = 3+4 = 7$

$W = (40)(7) = 280N$

2. A 2kg block sliding down a ramp from a height of 3m above the ground reaches the ground with a kinetic energy of 50 J. Total work done by friction on the block is:

A) 6J B) 9J C) 18J D) 44J

$W_{NET} = \Delta KE$

$W_g + W_f = \Delta KE$

$mgh + W_f = KE_f - KE_i$

$(2)(9.8)(3) + W_f = 50 - 0$

$W_f = -8.86\ J$

3. A box is pushed 30m across a horizontal floor by a constant horizontal force of 25N, the kinetic energy of the box increases by 300J. How much total internal energy is produced during this process?

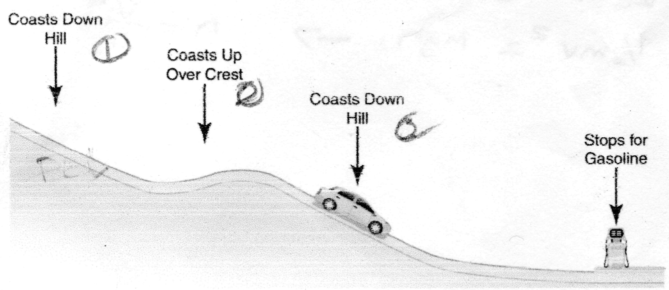
? → $\Delta W = \Delta KE$ + INTERNAL ENERGY

$Fd = KE$ + INTERNAL

INTERNAL $= 25 \times 30 - 300 = 450\ J$

4. 13. Consider the following scenario. A car for which friction is *not* negligible accelerates from rest down a hill, running out of gasoline after a short distance. The driver lets the car coast farther down the hill, then up and over a small crest. He then coasts down that hill into a gas station, where he brakes to a stop and fills the tank with gasoline. Identify the forms of energy the car has, and how they are changed and transferred in this series of events.

PE↓
KE↑
ENERGY - FICTN



② KE↓ PE↑ E − FRIC

③ PE↓ KE↑

c) KE → HEAT ENERGY

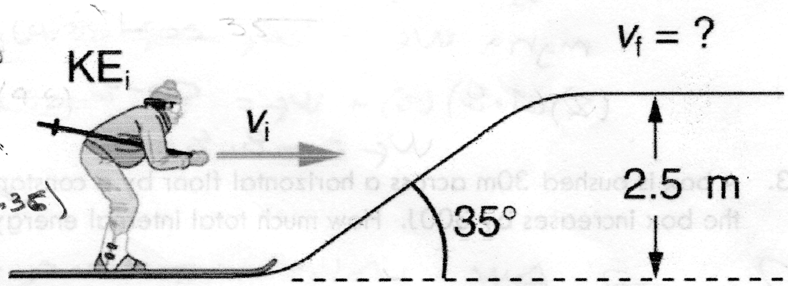
5. Alicia, a 60kg bunjgee jumper, steps off a 40m high bridge. The bungee cord behaves like a spring with a spring constant of 40N/m. Assume there is no slack in the cord. A) Find speed of jumper at height of 15m above ground. B) Find speed of jumper at 30m above ground C) How close does jumper get to ground?

6. A 60.0-kg skier with an initial speed of 12.0 m/s coasts up a 2.50-m-high rise as shown in Figure 7.39. Find her final speed at the top, given that the coefficient of friction between her skis and the snow is 0.0800. (Hint: Find the distance traveled up the incline assuming a straight-line path as shown in the figure.)

$\Delta KE = W_G + W_f$

$W_f = fd$

$= (\mu mg\cos\theta) * 4.358\,m$



$\frac{1}{2}m(v^2 - v_0^2) = mgh + \mu mg\cos\theta(4.35)$

$\frac{1}{2}(v^2 - 144) = 24.5 + (.642)(4.58)$

$+ 2.81$

$d =$

$v^2 - 144 = 27.31$

$v^2 - 144 = 54.625$

$v^2 = 198.625$

$\boxed{V = 14.09}$

d, 35, B, A, $-h = 2.5$

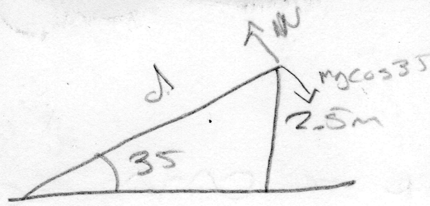
$h = d\sin 35$

$d = \frac{h}{\sin 35} = 4.358\,m$

7. (a) How high a hill can a car coast up (engine disengaged) if work done by friction is negligible and its initial speed is 110 km/h? (b) If, in actuality, a 750-kg car with an initial speed of 110 km/h is observed to coast up a hill to a height 22.0 m above its starting point, how much thermal energy was generated by friction? (c) What is the average force of friction if the hill has a slope 2.5° above the horizontal?

a) $KE = PE$

$\frac{1}{2}mv^2 = mgh \rightarrow h = \frac{v^2}{2g} =$



$= \frac{h}{\sin\theta} = \frac{2.5}{\sin 35} = 4.36m$

$= \mu mg\cos 35$

$= .08 \times 60k \times 9.8 \times \cos 35 = 38.53N$

$KE_i + W_{nc} = KE_f + PE_f$

$+ \overset{fd}{(38.5N)(4.36m)} = \frac{1}{2}mv_0^2 + mgh$

$= \frac{1}{2}(60k)(12m/s)^2 - (60kg)(9.8m/s^2)(2.5) - 168J$

$= 4320 - 1470 - 168$

$v_f = \sqrt{\frac{2}{60}(2682J} = 9.4$

$KE_i + PE_i + W_{nc} = KE_f + PE_f$

$W_{nc} = \Delta KE + \Delta PE$

$\Delta KE = -\Delta PE$

$= 110\ km/h = 30.55\ m/s$

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

$h = \frac{v_0^2}{2g} = 47.63m$

$50kg,\ h = 22m,$

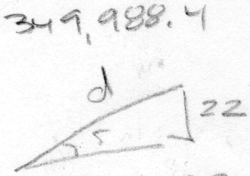
$KE_i + W_{nc} = PE_f$

$\frac{1}{2}mv_i^2 + W_f = mgh$

$W_f = (750)(9.8)(22) - (\frac{1}{2})(750)(30.55)^2$

$349,988.4$

$= -1.88 \times 10^5 J$



$W_f = 1.88 \times 10^5 = f \times d$

$d \sin 5 = 22$

$f, \frac{22}{\sin 2.5} = 1.88$

$d = \frac{22}{\sin 2.5}$

$f = 393.3N$

$KE_i + \cancel{PE_i} + W + OI = KE_f + \cancel{PE_f} + OE_f$

$W = Fd = (25)(30) = 750\ J$

REMAINING W GETS TRANSFERRED

5) $m = 60kg$ $h = 40m$ $k = 40N$

$TME = KE + PE \rightarrow KE + PE_g + PE_k$

CONS $\cancel{KE_1} + PE_{g1} + \cancel{PE_{k1}} = KE_2 + PE_{g\Delta} + PE_s$

$KE_2 = PE_{gT} - PE_{g\Delta} - PE_s$

$\frac{1}{2}mv^2 = mg\Delta y - \frac{1}{2}k(\Delta y)^2$ (40 - 15)

$v^2 = 2g\Delta y - \frac{k}{m}(\Delta y)^2$

$v^2 = (2)(9.8)(25) - \frac{40}{60}(25)^2 = 73.3 m/s$

$V = 8.6 m/s$

b) $v^2 = (2)(9.8)(10) - (\frac{40}{60})(10)^2 = 129$

$v = 11.4$

c) $\cancel{KE_1} + PE_g = \cancel{KE_2} + PE_g + PE_s$

$\Delta PE = PE_s$

$mg\Delta y = \frac{1}{2}k(\Delta y)^2$

$2mg = k\Delta y$

$\Delta y = \frac{2mg}{k} = \frac{2(60)(9.8)}{40} = 29.4$

IF $\Delta y = 29.4$ - JUMPER MUST BE

40 - 29.4 - OR HIGHER