Name: KEY

Date:

Section C D F

The Masters School
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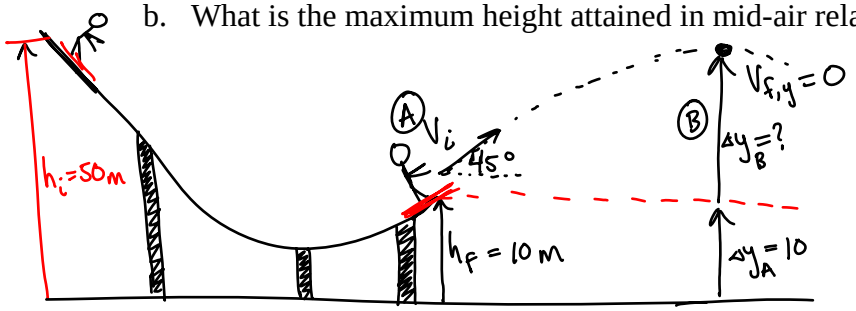
Physics

Mechanical Energy III

1. A ski jumper starts from rest 50 m above the ground on a frictionless track, and flies off the track at a 45° angle above the horizontal. If the track launch is at a height of 10 m from the ground:
   a. What is the skier's speed when leaving the track?
   b. What is the maximum height attained in mid-air relative to the ground?



a) set $h_f = 0$

Initial Energy = Final Energy

$KE_i + PE_i = KE_f + PE_f$

$KE_i + PE_{grav,i} = KE_f + PE_{grav,f}$

$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$

$mgh_i = \frac{1}{2}mV_f^2$

$V_f = \sqrt{2gh}$

$V_f = \sqrt{2g(40)}$

$V_f = 28.0$ m/s

(B) $V_{f_y}^2 = V_i^2 \sin\theta^2 - 2g\Delta y$

$2g\Delta y = V_i^2 \sin\theta 2$

$\Delta y_B = \frac{V_i^2 \sin\theta^2}{2g}$

$\Delta y_B = \frac{392}{19.62}$

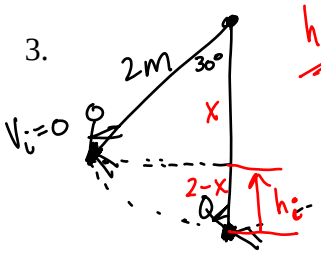
$\Delta y_B = 19.98$ m

$\Delta y_{tot} = \Delta y_B + \Delta y_A$

$\Delta y_{tot} = 29.98$ m

2. A 25 kg child on a 2.0 m long swing is released from rest when the swing supports make an angle of 30° with the vertical.
   a. What is the child's total mechanical energy?
   b. Disregarding friction, find the child's speed at the lowest position.
   c. If the speed of the child at the lowest position is 2.0 m/s, what is the mechanical energy lost due to friction?

3.



h_i

$x = 2(\cos 30)$

$x = 1.732$

$2 - x = .268$

$h_i = .268$

(a) Mechanical Energy$_i$ = $KE_i + PE_{grav,i} + PE_{elastic,i}$

$PE_{grav,i} = mgh_i$

$= (25)(9.81)(.268)$

$ME_{tot} = 65.71$ J

(b) (disregarding friction) $ME_i = ME_f$

$KE_i + PE_i = KE_f + PE_f$

$KE_i + PE_{grav,i} = KE_f + PE_{grav,f}$

$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$

$V = \sqrt{2gh}$

$V = \sqrt{2(9.81)(.268)}$

$V = 2.29$ m/s

(c) (with friction) $ME_i - W_{friction} = ME_f$

$KE_i + PE_i - W_{friction} = KE_f + PE_f$

$PE_i - W_{friction} = KE_f$

$PE_i - KE_f = W_{friction}$ (energy lost)

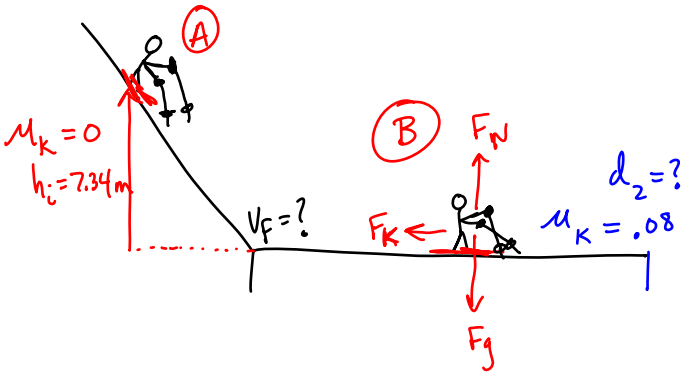
$mgh_i - \frac{1}{2}mV_f^2 = W_{friction}$

$65.71 - 50 = W_{friction}$

$15.71\ J = W_{friction}$

A skier starts from the top of an icy 7.34 m hill, and gains speed down the hill without any friction. Once the skier reaches the bottom, the snow is heavier, and creates a coefficient of kinetic friction of .08.

a. How fast was the skier going at the bottom of the hill?
b. How far would the skier go horizontally before coming to a full stop?



B

$F_{net_x} = F_K \neq 0$

$F_{net_y} = F_N - F_g = 0$

$F_N = F_g = mg$

a)

$PE_i = KE_f$

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

$v = \sqrt{2gh}$

$v = 12\ m/s$

b)

(with friction) $ME_i - W_{friction} = ME_f$

$KE_i + PE_i - W_{friction} = KE_f + PE_f$

$KE_i - W_{friction} = 0$

$KE_i = W_{friction}$

$\frac{1}{2}mv_i^2 = F_K d$

$\frac{1}{2}mv_i^2 = (\mu_K mg)d$

$d = \frac{v_i^2}{2\mu_k g}$

$d = \frac{12^2}{2(.08)(9.81)}$

$d = 91.74\ m$

$\mu_k = \frac{F_K}{F_N}$

$F_K = \mu_k F_N$

$F_K = \mu_k mg$