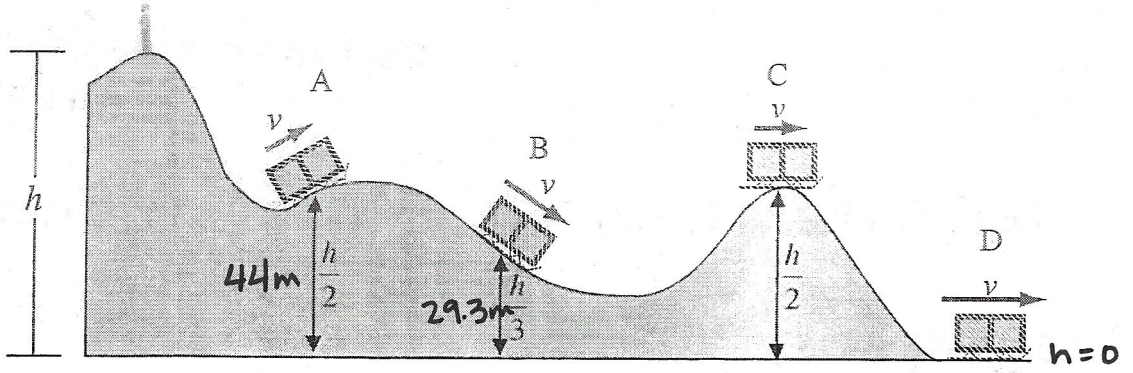
*note mechanical energy is potential & kinetic energy.

Physics 432
Work and Energy with Friction

Name Key
Period ____

1. In the picture below, the height (h) is 88m. The boy gave the 12kg sled an initial speed of 3 m/s. Assume all surfaces are frictionless.



a) What is the total mechanical energy at the top of the hill?
TE = 10402.8 J
TE = PE + KE TE = mgh + ½mv² TE = (12kg)(9.8m/s²)(88m) + ½(12kg)(3m/s)²
TE = 10348.8 J + 54 J

b) What is the total mechanical energy at point A?
TE = 10402.8 J

c) What is the kinetic energy at point A?
KE = 5228.4 J
TE = PE + KE 10402.8 J = mgh + KE 10402.8 = (12kg)(9.8m/s²)(44m) + KE
10402.8 J = 5174.4 J + KE

d) How fast was the sled moving at each point indicated above?

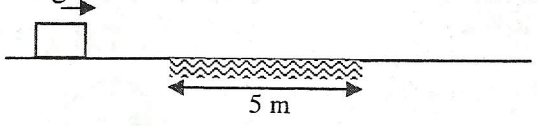
A: KE = ½mv²
5228.4 J = ½(12kg)v²
v = 29.5 m/s

C: same height as A
∴ same KE as A
v = 29.5 m/s

B: TE = PE + KE
10402.8 J = mgh + ½mv²
10402.8 J = (12kg)(9.8)(29.3m) + ½(12)v²
v = 34.05 m/s

D: TE = ~~PE~~ + KE
10402.8 J = ½mv²
10402.8 J = ½(12kg)v²
v = 41.6 m/s

2. A 3.0 kg mass slides along a level frictionless surface at 7.0 m/s. It hits a 5.0 m long region where the coefficient of kinetic friction is 0.2.

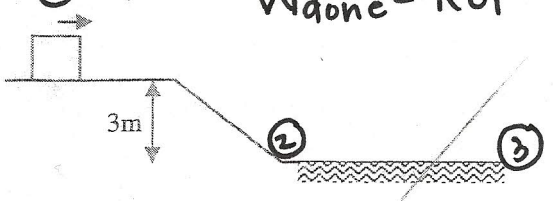


a) How much work does the force of friction do?
$W = F_f \cdot d$
$W = \mu_k mgd$
W = (.2)(3kg)(9.8)5m
W = 29.4 J

b) What is the speed on the other side of the frictional region?

$KE_1 - W_f = KE_2$
$\frac{1}{2}mv^2 - W_f = \frac{1}{2}mv^2$
$\frac{1}{2}(3kg)(7m/s) - 29.4J = \frac{1}{2}(3kg)v^2$
v = 5.4 m/s

3. A 3.0 kg mass is pushed by a 7 N force for 2.0 m and then slides down a 3.0 m high ramp.



$W_{done} = KE_i$

$F \cdot d$ = Energy added in the form of KE

$(7N)(2m) = KE$

$14J = KE$

$PE_1 = mgh = (3kg)(9.8m/s^2)(3m)$

$PE = 88.2J$

a) What is the final total mechanical energy of the mass?

0 J

b) What is the total mechanical energy of the mass before the frictional surface?

$TE_1 = KE_1 + PE$ $TE_1 = 14J + 88.2J$ $TE_1 = TE_2$ $TE_2 = 102.2J$

c) How far will the mass skid before stopping on a $\mu = 0.2$ frictional surface?

use this

$KE_3 = 0J$

$KE_2 - W_f = KE_3$

$TE_2 = KE_2$ (no PE @ Pt. 2)

$KE_2 - W_f = 0$

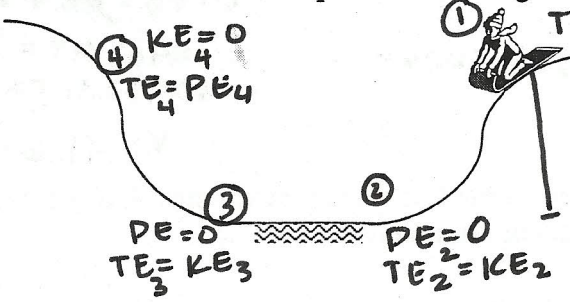
$KE_2 = W_f$

$102.2J = \mu_k mgd$

$102.2J = .2(3kg)(9.8m/s^2)d$

$d = 17.38m$

4. Excited by the freshly fallen snow, a young child of mass 40 kg takes her new sled out to the local snow bowl for a test drive. If she starts from rest atop the 12 m tall hill, how far up the other side of the bowl does she go? Assume the coefficient of friction between the sled and the snow is zero except for a 9 m long rough patch ($\mu = .5$) at the bottom of the bowl.



$TE_3 = TE_4$

$TE_1 = PE + KE$

$KE = 0$

$TE_1 = PE_1$

#2 $TE_1 = TE_2$

$4704J = TE_2$

$TE_2 - W_f = TE_3$

$4704 - W_f = TE_3$

$4704 - 1764J = TE_3$

$TE_3 = 2940J$

#1

$PE_1 = mgh$

$PE_1 = (40kg)(9.8)(12m)$

$PE_1 = 4704J$

#3 $W_f = \mu_k mgd$

$W_f = .5(40kg)(9.8)(9m)$

$W_f = 1764J$

#4

$PE_4 = TE_3$

$mgh = 2940J$

$(40kg)(9.8)h = 2940J$

$h = 7.5m$

Answers: 1a) 10403 J b) 10403 J c) 5229 J 2a) 29.4 J b) 5.4 m/s 3a) 0 J b) 102.2 J c) 17.38m 4) 7.5 m