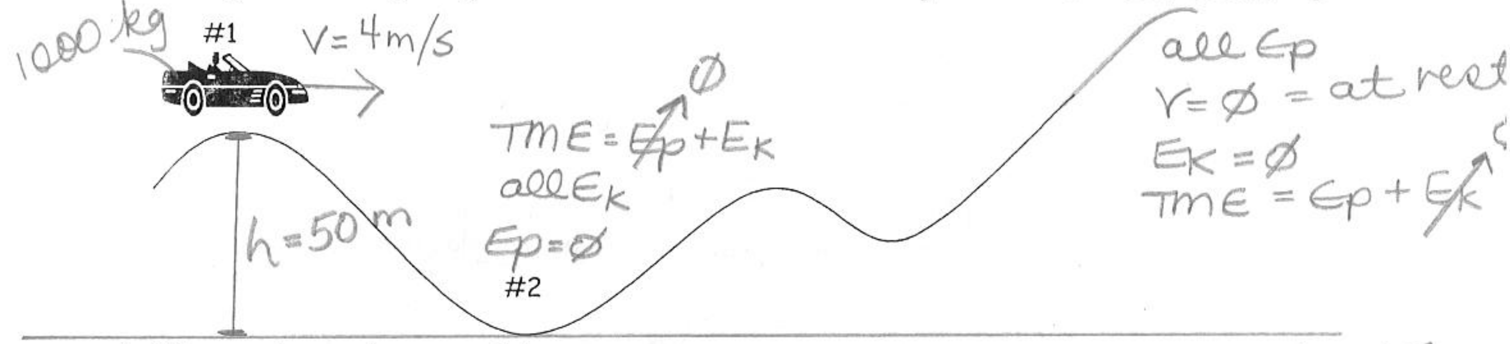
SE 402

Conservation of Energy Worksheet

1) The frictionless car below is moving at 4 m/s at position #1 (50 m above ground level). It has a mass of 1000 kg and is rolling along the hills in neutral. Point #2 is at ground level.



a) What is the total energy of the car at point #1?

$TME = E_p + E_K$

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

$= (1000\ kg)(9.8\ m/s^2)(50\ m) + (\frac{1}{2}(1000\ kg)(4\ m/s)^2)$

$= 490000\ J + 8000\ J$

$= 498000\ J$

b) What is the total energy of the car at point #2?

$TME = 498000\ J$

same ME everywhere on the hill!

c) How fast will the car be moving when it reaches position #2 (at ground level)?

#2 $TME = E_p^{\nearrow \emptyset} + E_K$ no Ep bec on the ground

$TME = E_K$ $E_K = 498000\ J$ $E_K = \frac{1}{2}mv^2$

$V = 31\ /s$

$V = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{(498000\ J)}{1000\ kg}}$

d) What is the maximum height above the ground that the car can reach on the right side?

max h = Ø V = Ø E_K

$TME = E_p + E_K^{\nearrow 0}$

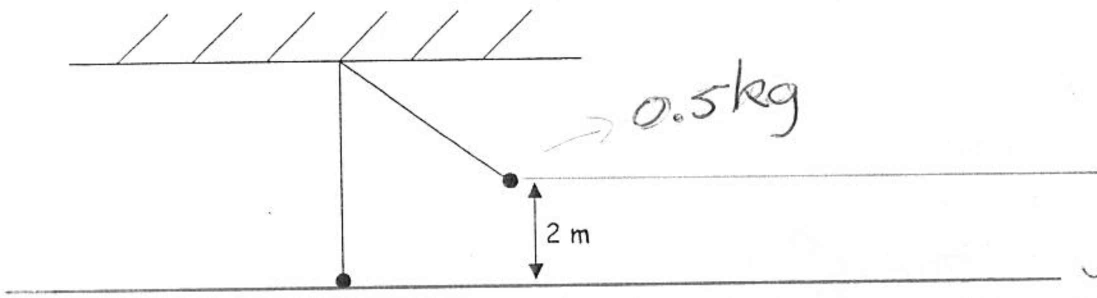
$TME = 498000\ J$

$\frac{E_p}{mg} = \frac{mgh}{mg}$

$\frac{498000\ J}{(1000\ kg)(9.8\ m/s^2)} = h = 50.\ m$

m = 1 kg (I'm just saying) if they don't say! -h

2) A pendulum is pulled sideways so that it is raised a vertical distance of 2 m above its resting position. Find the maximum speed the pendulum reaches after being released.



$E_p = 9.8\,J$

$E_p = mgh = (0.5\,kg)(9.8\,\frac{m}{s^2})(2\,m)$

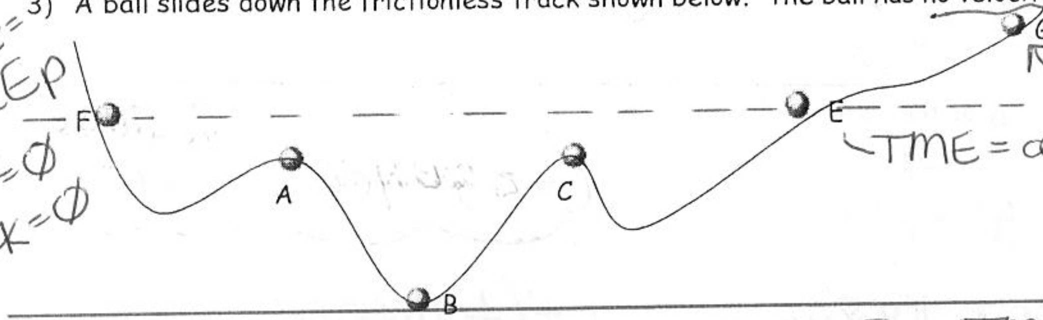
hiest pt = all E = Ø E_K

Ø E_p = hiest $E_K = 9.8\,J$

$E_K = \frac{1}{2} v^2 m$ $\quad V = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2(9.8\,J)}{0.5\,kg}}$

$V = 6.26\,\frac{m}{s}$

3) A ball slides down the frictionless track shown below. The ball has no velocity at position F.



TME = all E_p, V = Ø, E_K = Ø

G: can't get here

E: TME = all E_p

a) To what point does the ball rise on the opposite incline? E = TME = same E_p

b) At what point(s) in the diagram is the speed at a maximum? B = TME = all E_K Ø E_p

c) At what point(s) is the kinetic energy at a maximum? B = TME = all E_K Ø E_p

d) At what point(s) is the speed zero? F Ø V at rest = E = max h it can rise to

e) At what point(s) is the potential energy at a minimum? B = Ø E_p = Ø h

f) At what point(s) is the potential energy at a maximum? F + E

G is not poss bec no vel at F so all E_p at F = TME so E is max h.

4) An archer applies an average force to draw the bow string back. This causes the stretched bow to store 260 J of energy.

a) What type of energy is stored in the stretched bow? E_p potential to do work

b) How much kinetic energy does the arrow have **before** it is released? Ø = Ø V

c) How much potential energy will the arrow have **after** it leaves the bowstring? Ø all E_K

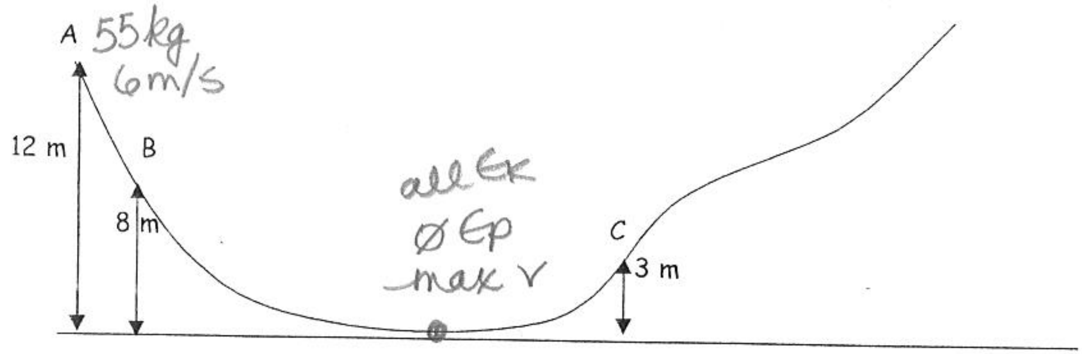
d) If a 0.3 kg arrow is shot from this bow, then how **fast** will it be moving just after it leaves the bowstring?

E_p pulled back = E_K as let go.

$E_K = \frac{1}{2} m v^2$ $\quad V = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2(260\,J)}{0.3\,kg}}$

V = 41.6 m/s

5) At point "A" on the hill, there is a 55 kg skier moving at 6 m/s.



a) Find the skier's maximum speed. Where on the hill does she achieve this speed? bottom = h = Ø

$TME_A = E_p + E_k = mgh + \frac{1}{2}mv^2$

$= (55\,kg)(9.8\,m/s^2)(12\,m) + \frac{1}{2}(55\,kg)(6\,m/s)^2$

$= 6468\,J + 990\,J$

$TME_A = 7458\,J = TME$ at bottom

$v = \sqrt{\frac{2E_k}{m}} = 16.5$

b) How far up the other hill will the skier be able to go? = max h = Ø v = Ø Ek

all $\frac{E_p}{mg} = \frac{mgh}{mg} = \frac{7458\,J}{(55\,kg)(9.8\,m/s^2)} = 13.8\,m = h$

c) How fast will the skier be moving at point B? $TME = 7458\,J$

$TME = E_p + E_k - E_p$
$- E_p$

$TME - E_p = E_k$

$7458\,J - (55\,kg)(9.8\,m/s^2)(8\,m) = E_k = 3146\,J$

$v = \sqrt{\frac{2E_k}{m}}$

$v = 10.7\,m/s$

d) How fast will the skier be moving at point C?

$TME - E_p = E_k$ at C

$7458\,J - (55\,kg)(9.8\,m/s^2)(3\,m) = E_k = 5841\,J$

$v = \sqrt{\frac{2E_k}{m}}$

$v = 14.6\,m/s$