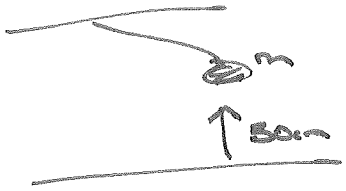
Physics 1100

Extra Credit #17

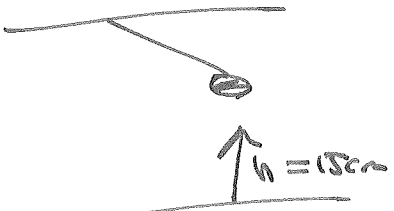
Conservation of Energy Ranking Test

$U_1 = mgy_1 \Rightarrow$



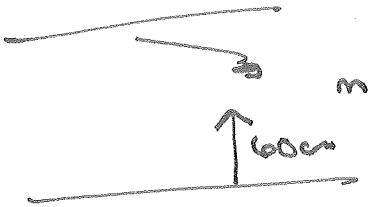
$m = 4kg$

$U_1 = (4kg)(9.8)(.3m) = 11.76J$

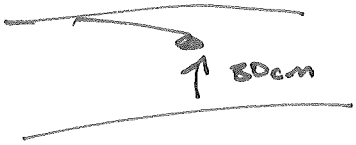


$m = 8kg$

$U_2 = (8kg)(9.8 m/s^2)(0.15m) = 11.76J$ ← HALF the height, but twice the mass



$m = 1kg$ $U_3 = (1kg)(9.8 m/s^2)(0.6m) = 5.88J$



$m = 2kg$ $U_4 = (2kg)(9.8 m/s^2)(.3m) = 5.88J$

↑ twice the mass, HALF the height

$m = 2kg$ $U_5 = (2kg)(9.8 m/s^2)(.6m)$

$= 11.76J$

$m = 3kg$ $U_6 = (3kg)(9.8 m/s^2)(0.45m) = 13.23J$

RANK ACCORDINGLY

b) RANK maximum Kinetic Energies.

Tension Does no work ⇒ Conservation of Mechanical Energy

⇒ $K_1 + U_1 = K_2 + U_2$ $\quad K_1 = 0$, (starts From rest)

⇒ MAX. Kinetic Energy Occurs where U_2 is smallest

so choose Coordinates where $U_2 = 0^*$ ⇒ $U_1 = K_2$ so largest

U_1 gives largest K_2, so same ranking As part (a)

(* this is the same height for all pendulum since they have SAME length)

c) RANK MAX speed → NOW, MASS Becomes UNimportant

$\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2$ ⇒ $\frac{1}{2}v_1^2 + gy_1 = \frac{1}{2}v_2^2 + gy_2$

⇒ $v_2 = \sqrt{2g(y_1 - y_2)}$

y_2 is SAME for all since they have SAME length

$y_1 = h$ given in pictures

⇒ RANK by VALUE of h

7.4 bar with 160 Food Calories $\Rightarrow U = 160\,Cal \times \frac{4186\,J}{cal}$

$\Rightarrow U = 669760\,J$

All Energy into Grav. Pot. Energy $\Rightarrow \Delta U_g = 669760\,J$

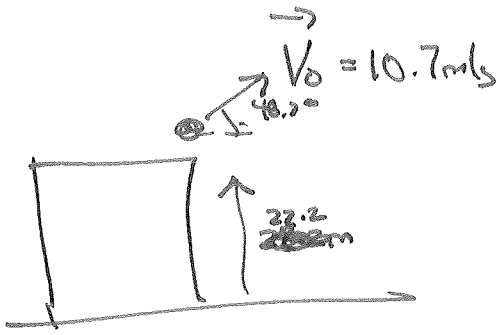
$\Delta U_g = mgy_2 - mgy_1$ let $y_1 = 0$, $y_2 = h = ?$

$m = 67kg \Rightarrow 669760J = (67kg)(9.8m/s^2)h \Rightarrow h = \frac{669760J}{(67kg)(9.8m/s^2)}$

$\Rightarrow h = 1020m$

b) if only 21% goes into $\Delta U_g \Rightarrow \Delta U_g = .21(669760J)$
$= 140649.6J$

$\Rightarrow h = \frac{140649.6J}{(67kg)(9.8m/s^2)} = 214.2m$



No Air Resistance ⇒ Gravity only force doing work

$$\Rightarrow \frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2$$

$v_1 = 10.7\,m/s$, $y_1 = 22.2\,m$, $v_2 = ?$, $y_2 = 0$

$$\Rightarrow \frac{1}{2}m(10.7\,m/s)^2 + m(9.8\,m/s^2)(22.2\,m) = \frac{1}{2}mv_2^2$$

$$\Rightarrow v_2^2 = 2\left(\frac{1}{2}(10.7\,m/s)^2 + (9.8\,m/s^2)(22.2\,m)\right)$$

$$\Rightarrow v_2 = \sqrt{(10.7\,m/s)^2 + 2(9.8\,m/s^2)(22.2\,m)} = \sqrt{549.61\,m^2/s^2}$$

$$= 23.4\,m/s$$

b) IF THROWN at -48.2°? ⇒ No change. Kinetic Energy only depends on speed $v_1 = 10.7\,m/s$, $y_1 = 22.2\,m$ AGAIN ⇒ $v_2 = 23.4\,m/s$

c) if we include Air Resistance, v_2 will be smaller than 23.4m/s in each case. But throwing Below horizontal decreases time of flight, so Air Resistance will have less time to Act on BALL, so speed will be greater than when thrown Above horizontal.