HW03

(4) (A) ~~IF~~ IF YOUR WEIGHT IS, SAY, 160 POUNDS,

THEN $W = \text{WEIGHT} = 160 \text{ lbs} \left(\frac{4.45\,N}{1\,lb}\right)$

$$\underline{\underline{W = 712\,N}}$$

(B) IF $W = mg$, THEN $m = \frac{W}{g}$.

SO, $\underline{\underline{m}} = \frac{712\,N}{9.8\,m/s^2} = \underline{\underline{73\,kg}}$

(7) EFFICIENCY = 35%. THIS MEANS THAT 35% OF INPUT ENERGY IS CONVERTED INTO USEFUL WORK (ELECTRICAL ENERGY) AND 100% − 35% = 65% IS CONVERTED INTO WASTE HEAT.

HW04

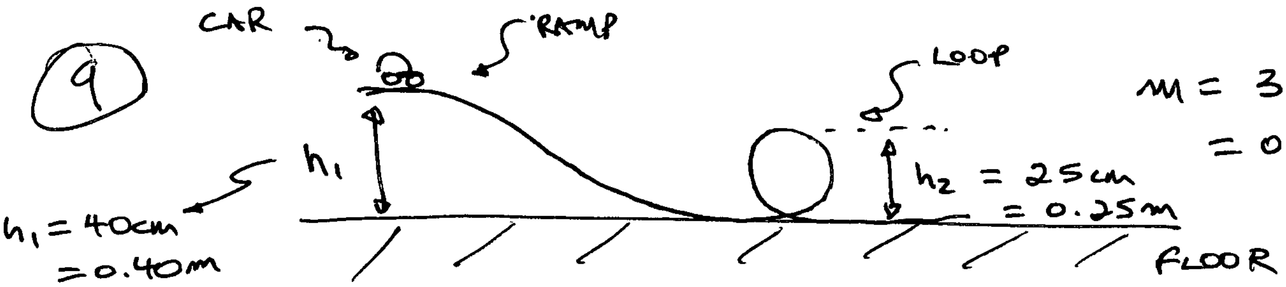
(8) $m = 2\,kg$, $V = 20\,m/s$] HAMMER IS <u>MOVING</u>, SO HAS KINETIC ENERGY.

* AFTER IT STOPS MOVING, ALL OF THAT KE WILL HAVE BEEN CONVERTED INTO HEAT.

SO, $Q = \text{HEAT} = KE = \frac{1}{2} m V^2$

$$\underline{\underline{Q}} = \frac{1}{2}(2\,kg)(20\,m/s)^2 = \underline{\underline{400\,J}}$$

(9)



$m = 35\,g$
$= 0.035\,kg$

* IF WE ASSUME CAR STARTS FROM REST, THEN $V_1 = 0\,m/s$ AND $KE_1 = \frac{1}{2} m V_1^2 = 0$. THUS, ALL THE INITIAL ENERGY IS GPE:

$$TE_1 = \underbrace{\cancel{KE_1}}_{=0} + GPE_1 = mgh_1 = (0.035\,kg)(9.8\,\tfrac{m}{s^2})(0.40\,m)$$

$$\underline{\underline{TE_1 = 0.137\,J}}$$

* BY THE TIME IT REACHES THE LOOP, AT IT'S HIGHEST POINT,

$Q = 35\%\,TE_1 = 0.35\,(0.137\,J) = 0.048\,J$

SO, HERE, $TE_2 = \underbrace{\cancel{KE_2}}_{=0 \text{ AT HIGHEST POINT.}} + Q + GPE_2$

SO $\underline{\underline{GPE_2}} = TE_2 - Q = 0.137\,J - 0.048\,J = \underline{\underline{0.089\,J}}$

* TO MAKE IT TO TOP OF LOOP, IT WOULD NEED AT LEAST $GPE = mgh_2 = (0.035\,kg)(9.8\,\tfrac{m}{s^2})(0.25\,m) = 0.086\,J$

SO IT HAS MORE THAN ENOUGH TO MAKE IT TO TOP!

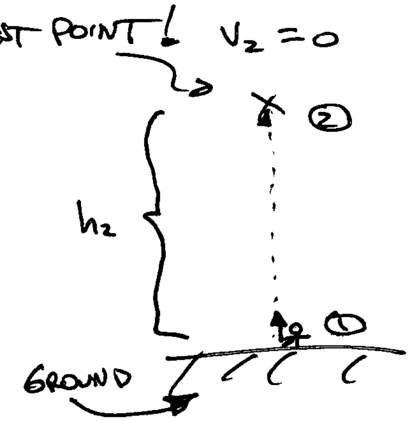
HW04

(10) (a) $m = 200\ g = 0.20\ kg$

$V_1 = 125\ m/s$

ASSUME HEIGHT OF GUN OFF GROUND IS NEGLIGIBLE $\therefore$

$h_1 = 0$.



AT TIME 1, $KE_1 = \frac{1}{2} m V_1^2 = \frac{1}{2}(0.20 kg)(125\ m/s)^2$

$KE_1 = 1562 J$

$GPE_1 = mgh_1 = (0.20 kg)(9.8 \frac{m}{s^2})(0 m)$

$GPE_1 = 0$.

AT TIME 2, $KE_2 = \frac{1}{2} m v_2^2 = 0 J$

$GPE_2 = mgh_2$, BUT WE SEEK h_2!

SINCE, BY THE LAW OF CONSERVATION OF ENERGY,

$TE_1 = TE_2$, WE HAVE $KE_1 = GPE_2$

SO $mgh_2 = 1562 J$

OR $h_2 = \frac{1562 J}{(0.20 kg)(9.8 m/s^2)} = 797 m$

(b) THE BULLET WILL HIT THE GROUND AT $125\ m/s$!

BY "SYMMETRY", WE CAN ARGUE ~~THAT~~ ALL OF THE GPE IT HAS AT THE TOP IS THEN CONVERTED TO KE WHEN IT COMES BACK DOWN. BY THE LAW OF CONSERVATION OF ENERGY, THIS $KE_3 = 1562 J$, WHICH CORRESPONDS TO A SPEED OF $125\ m/s$ (~~THAT~~'S HOW WE INITIALLY CALCULATED KE_1!)