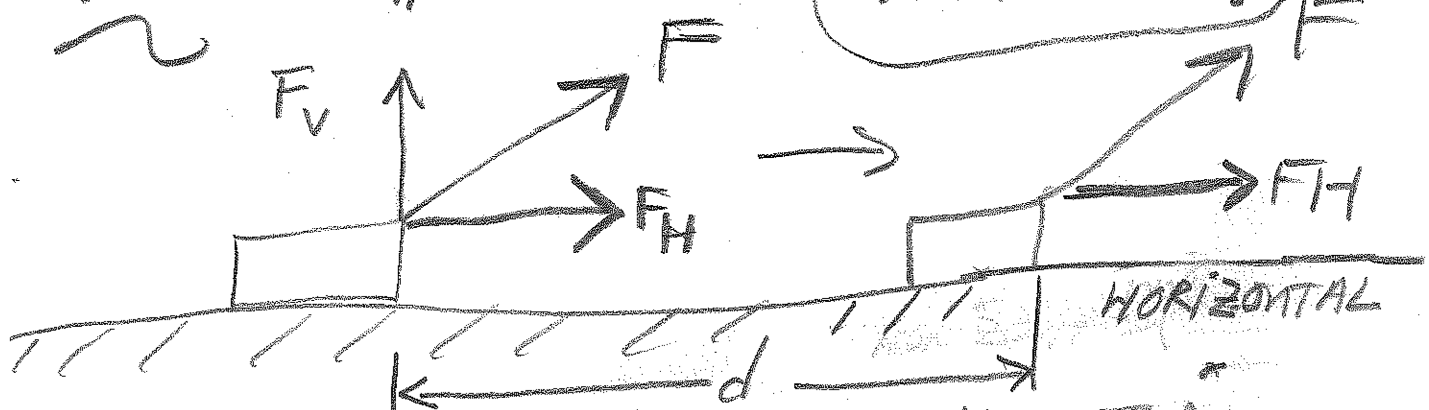
CH. 7 9-3-13

ENERGY

p 82

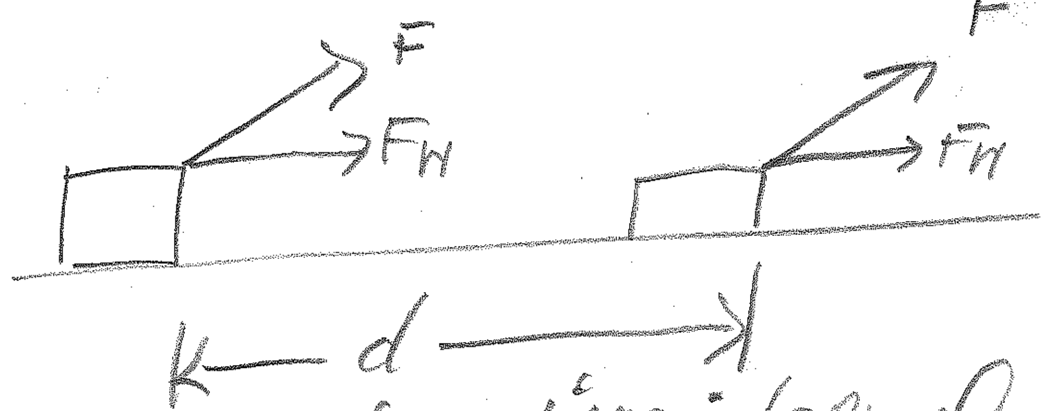
WORK = $F_H \cdot d$

pull on BOX with FORCE F.



F_H = component along direction of motion (HORIZONTAL)

$$POWER = \frac{WORK}{time\ interval} = \frac{F_H \cdot d}{\Delta t}$$



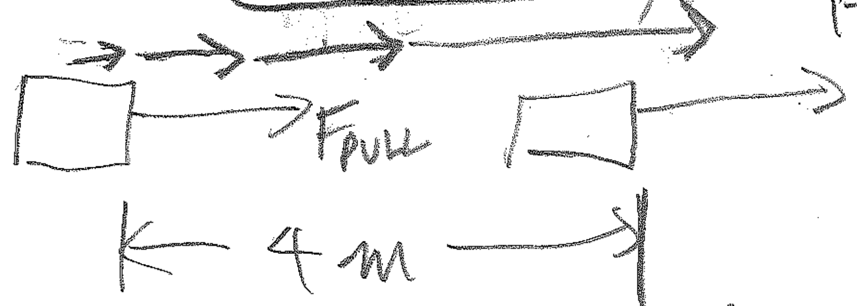
Δt = time interval

CH 7 9-3-13 (2

WORK

speeding up:

$F_{PULL} = 2N$, RIGHT

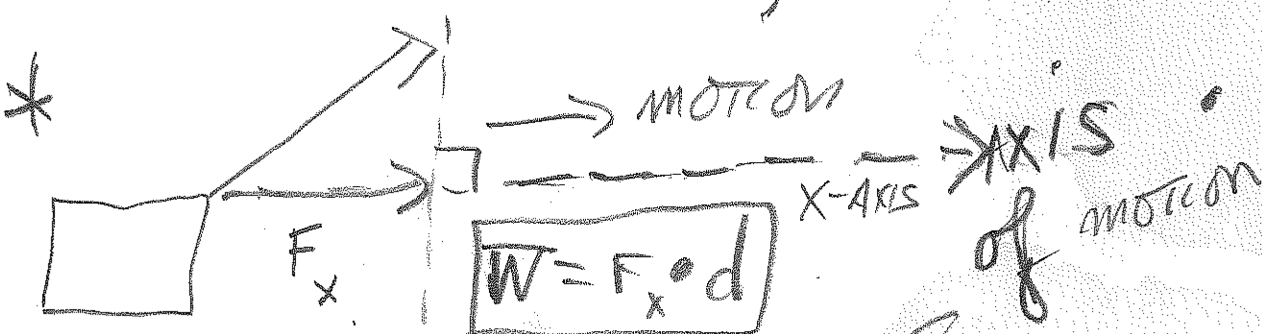


$F_{PULL} = 2N$, RIGHT

$$\text{WORK} = \underbrace{\text{FORCE}}_{*} \cdot \text{DISTANCE}$$
$$= (2N)\cdot(4m)$$
$$= 8 N\cdot m$$
$$= 8 \text{ JOULES}$$
$$= 8 (J)$$

$2N, 45^\circ$

*



$$\boxed{W = F_x \cdot d}$$

* component of FORCE along the motion.

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WORK ENERGY THEOREM

p 106

$$\Delta KE = \frac{1}{2} \cdot mass \cdot speed^2 \quad **$$

$$\Delta KE = \frac{1}{2} mv^2 \quad *$$

$$F = m \cdot \frac{\Delta v}{\Delta t}$$

** p107

$$F \cdot d = m \cdot \frac{\Delta v}{\Delta t} \cdot d$$

* ASSUMES YOU START FROM rest

note: $a = \frac{\Delta v}{\Delta t}$

THUS:

$F \cdot d = m \cdot a \cdot d$

use $d = \frac{1}{2}at^2$:

$F \cdot d = m \cdot a \cdot \frac{1}{2}at^2$

$F \cdot d = \frac{1}{2}m \cdot a^2 t^2$

BUT: $V = at$

THUS: $v = at$, $a = $ constant

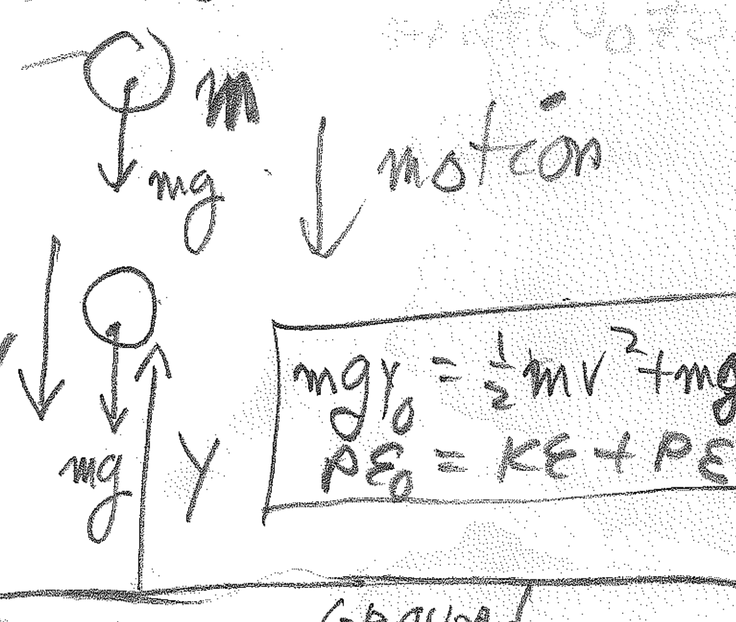
THUS: $\boxed{F d = \frac{1}{2}mv^2}$

note: $\frac{1}{2}mv^2$ = kinetic energy

Conservation of Energy:

suppose I drop an object.

drop a ball from height y_0
from rest ($v_0 = 0$)



y_0

$\frac{1}{2}mv^2 = F \cdot d$

$\frac{1}{2}mv^2 = mg \cdot (y_0 - y)$

$\frac{1}{2}mv^2 = mgy_0 - mgy$

$\frac{1}{2}mv^2 + mgy = mgy_0$

$$\boxed{\begin{gathered} mgy_0 = \frac{1}{2}mv^2 + mgy \\ PE_0 = KE + PE \end{gathered}}$$

$y = 0$

$\Delta KE = F \cdot d$

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

$= mg \cdot (y_0 - y)$

W_g = work done by gravity

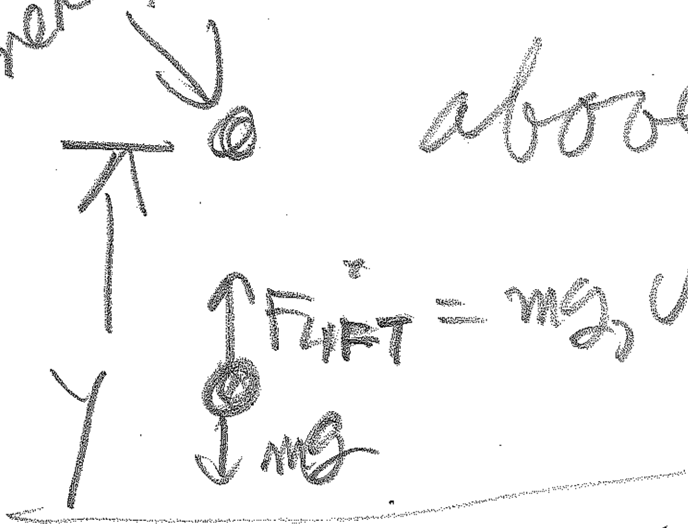
$$\boxed{PE = mgy}$$

m, y, $y = 0$

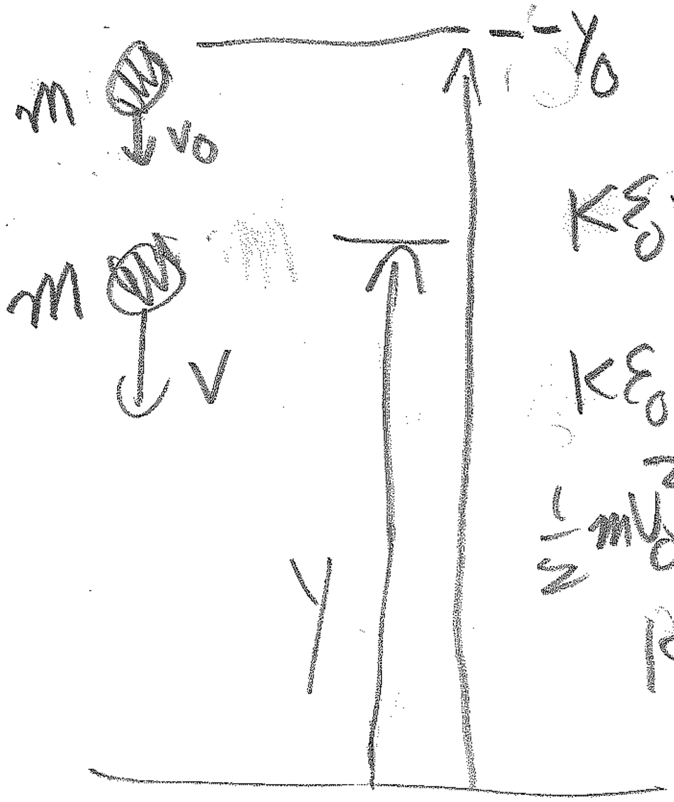
$PE = mgY$

NOTE: mgY = WORK YOU DO TO LIFT MASS m A DISTANCE Y ABOVE GROUND.

YOUR WORK = stored energy



IF YOU THROW DOWN THE BALL:



$$KE_0 + PE_0 = \frac{1}{2}mv^2 + mgy$$

$$KE_0 + mgy_0 = \frac{1}{2}mv^2 + mgy$$

$$\frac{1}{2}mv_0^2 + mgy_0 = KE + PE$$

$$KE_0 + PE_0 = KE + PE$$

$y = 0$ $$\boxed{\frac{1}{2}mv_0^2 + mgy_0 = \frac{1}{2}mv^2 + mgy}$$

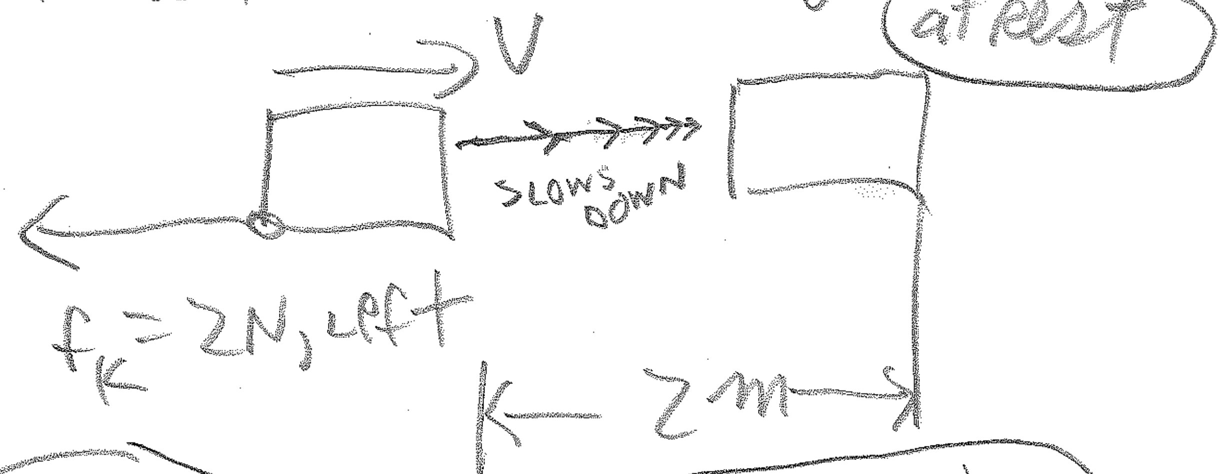
NOTE on conservation of energy with friction: 7

P109

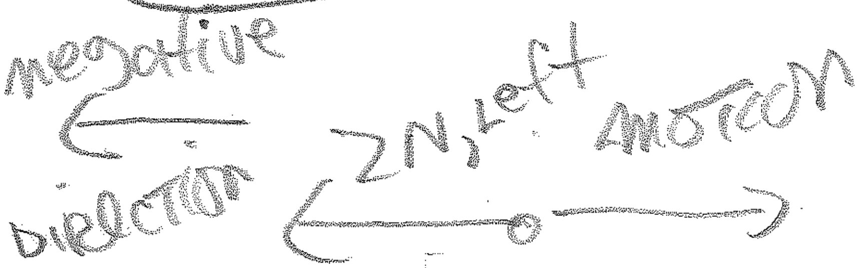
$$\text{Heat} \equiv \underbrace{(\text{friction force})}_{\text{MAGNITUDE}} \cdot \text{distance}$$

note:

friction work always negative:



$$\text{friction work} = (-2N)\cdot(2m) = -4\,N\cdot m \equiv -4\,J$$



$$\text{Heat} \equiv +4\,J$$

$$\text{Heat} = -\text{friction work} = -(\text{neg}) = \boxed{\text{POS}}$$

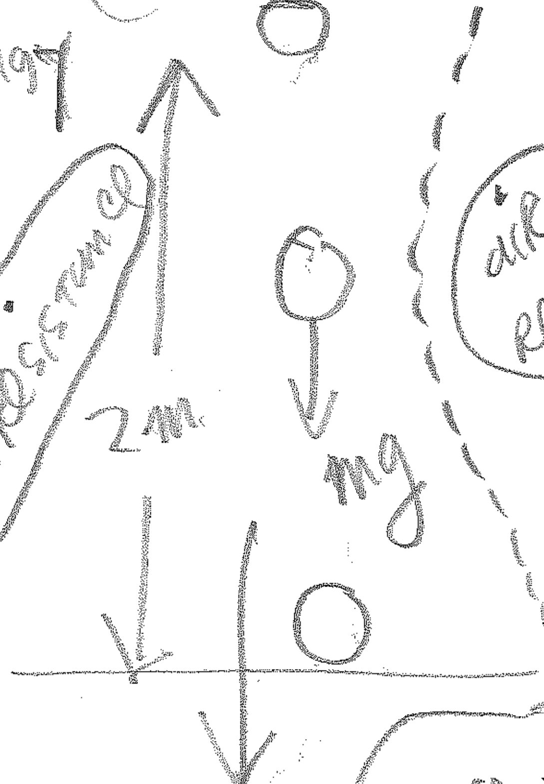
HINT TO QUIZ 4

DROP BALL

$m = 2kg$ (at least)

$PE = mgy$

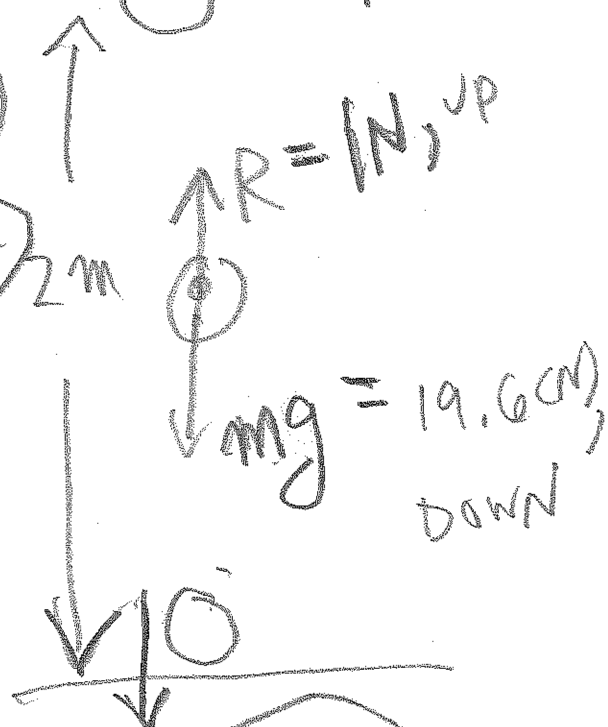
I. NO AIR RESISTANCE



2kg

$mgy = PE$

II. air resistance



$$mg = (2kg)(9.8\frac{m}{s^2}) = 19.6\,N$$

$$mgy_{TOP} = (2kg)(9.8\frac{m}{s^2})(2m) \approx 40J$$

I.

$$\boxed{40J = KE_{bot}}$$

$$KE_{TOP} + PE_{TOP} = KE_{bot} + PE_{bot}$$

$$0 + mgy_{TOP} = \frac{1}{2}mv^2_{bot} + 0$$

$$(9.8)(2) = \frac{v^2}{2} \Rightarrow v \approx 6\frac{m}{s}$$

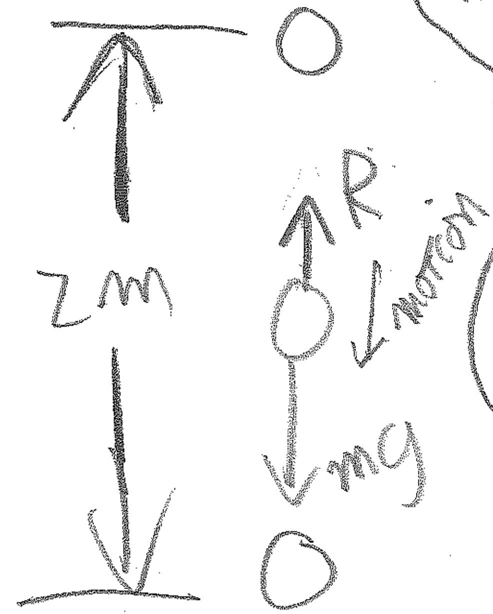
II.

$$KE_{TOP} + PE_{TOP} = KE_{bot} + PE_{bot} + \text{Heat}$$

Case II: air resistance

(9

$$PE_{TOP} = mgy_{TOP} = (2kg)(9.8\,\tfrac{m}{s^2})(2m) \approx 40\,J$$



$$\text{Heat} = (1N)(2m) = 2\,J$$

$$KE_{TOP} + PE_{TOP} = KE_{bot} + PE_{BOT} + \text{Heat}$$

$$0 + 40J = \tfrac{1}{2}mv_{bot}^2 + 0 + 2J$$

$$38J = KE_{bot}$$

Thus speed at bottom is less.

Note: Air friction work $= -2J$

10) ALSO DO CASE II FROM WORK PERSPECTIVE:

$$40J + (-2J) = \overline{W}_g + \overline{W}_R$$

$$\overline{W}_g + \overline{W}_R = 40J - 2J = \text{TOTAL WORK}$$

($\overline{W}_R$ = AIR FRICTION WORK)

ΔKE = TOTAL WORK

$$\boxed{\frac{1}{2} m v_{bot}^2 = 38J = 40J - 2J}$$

$\overline{W}_g$ = gravity work

$\overline{W}_R$ = Air friction work

$= -2J$

Heat $= -(-2J) = +2J$