

2/18/2015

PRINCIPLE OF WORK AND ENERGY

$$W_{\text{NET}} = \Delta K = K_2 - K_1 \\ = \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2$$

WORK DONE BY SOME COMMON FORCES

IF ~~AS~~ A SYSTEM DOES WORK,
ITS POTENTIAL ENERGY DECREASES

GRAVITY: $W_G = \underbrace{mg}_{\text{WEIGHT}} (h_1 - h_2)$
HEIGHT ABOVE SOME REFERENCE

SPRINGS: $W_{\text{SPR}} = \frac{1}{2} k (s_1^2 - s_2^2)$
↑ SPRING CONSTANT S IS STRETCH OR COMPRESS FROM NATURAL LENGTH

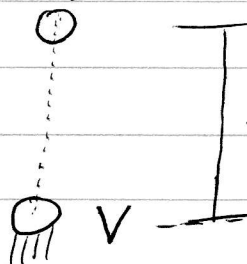
FRICTION: $W_f = -F_{fk} \cdot s$
↑ DISTANCE TRAVELLED
↑ FRICTION FORCE (KINETIC)

DRAG: $W_D = -F_D \cdot s$
↑ DIST. TRAVELLED
↑ DRAG FORCE

⋮

EXTENDED EXAMPLE: THROWING AN OBJECT INTO AIR. HOW HIGH DOES IT GO?

NEWTON: GRAVITATIONAL FORCE CAUSES DECELERATION WHICH REDUCES INITIAL SPEED TO ZERO.



$$F_G = ma \text{ so } a = g \text{ (DOWN)}$$

$$0 = v_f = v - gt \quad t = \frac{v}{g}$$

$$\text{AND } y = \frac{1}{2}gt^2$$
$$h = \frac{1}{2}g\left(\frac{v}{g}\right)^2 = \frac{1}{2}\frac{v^2}{g}$$

ENERGY: CONSERVATION

KINETIC ENERGY AT BOTTOM
TURNS COMPLETELY INTO
POTENTIAL ENERGY AT TOP

$$K_{\text{BOTTOM}} = P_{G \text{ TOP}}$$

$$\frac{1}{2}mv^2 = mgh$$
$$h = \frac{v^2}{2g}$$

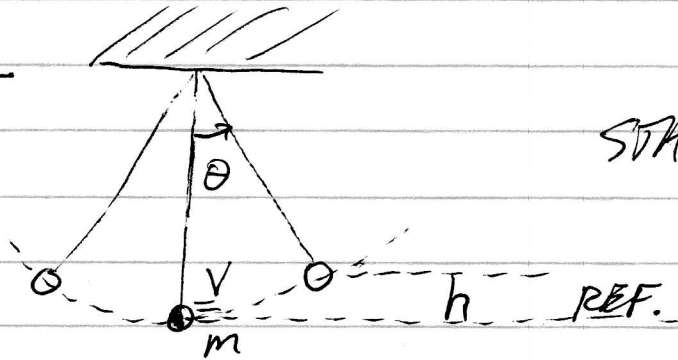
WORK AND ENERGY

GRAVITY DOES WORK ON THE OBJECT
REDUCING ITS KINETIC ENERGY TO
ZERO.

$$W_{NET} = \Delta K = K_2 - K_1$$

$$-mgh = 0 - \frac{1}{2}mv^2 \rightarrow h = \frac{v^2}{2g}$$

PENDULUM



STARTS FROM REST

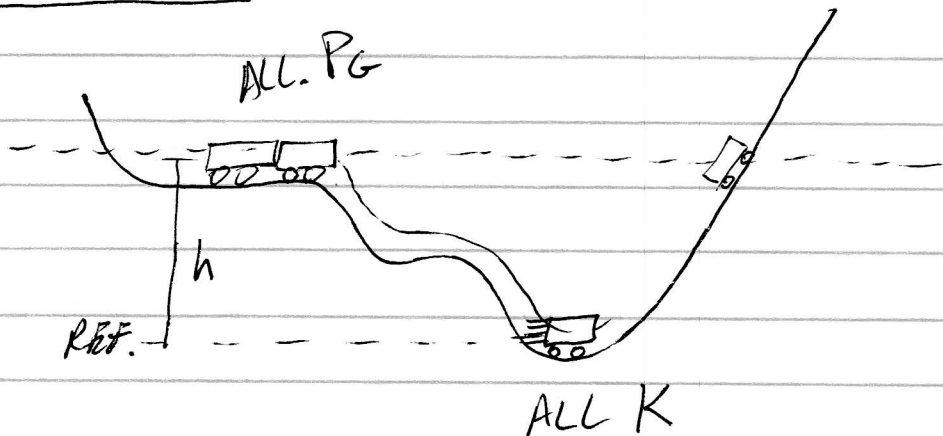
START: ALL ENERGY IS POTENTIAL ($P_G = mgh$)

BOTTOM: ALL ENERGY IS KINETIC ($K = \frac{1}{2}mv^2$)

OTHER

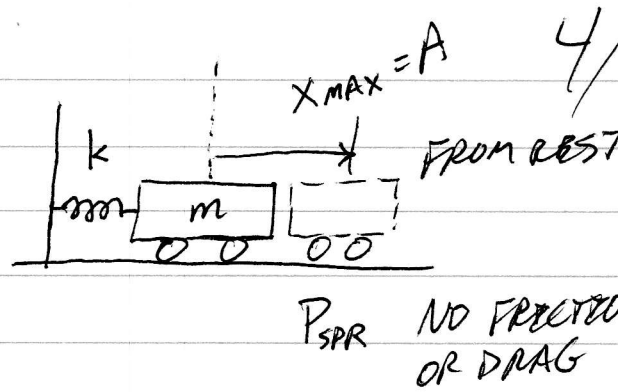
SIDE: ALL ENERGY IS POTENTIAL ($P_G = mgh$)

ROLLER COASTER



~~BOX & SPRING~~

BOX & SPRING



OSCILLATING SYSTEMS

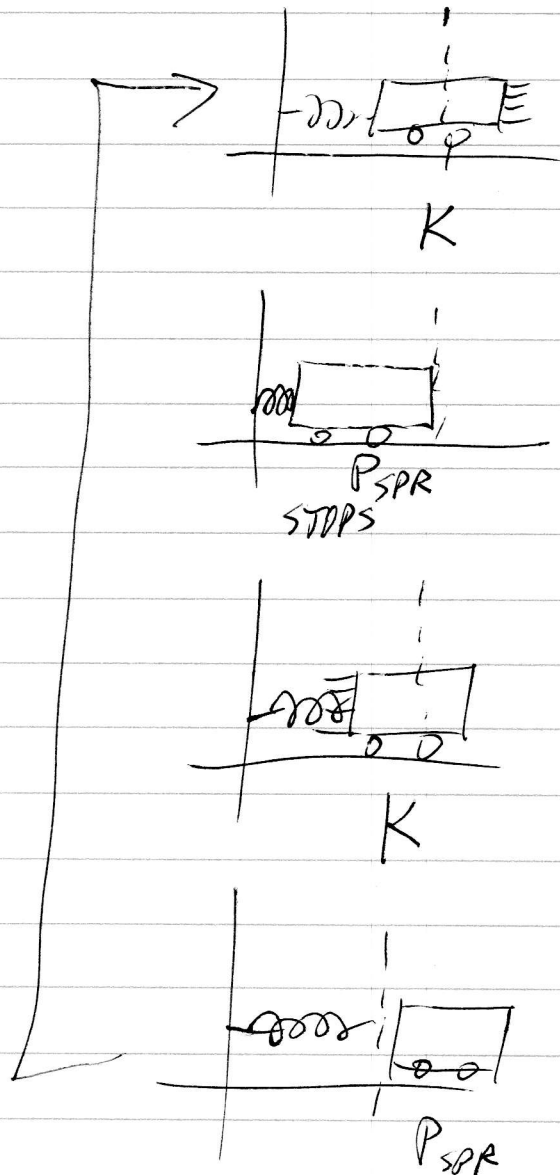
ENERGY IN SYSTEM IS CONSTANT,

BUT SWAPS BACK AND FORTH FROM P TO K.

1 CYCLE IS IS FROM ORIGINAL STATE BACK TO ORIGINAL STATE

TIME TO COMPLETE ONE CYCLE IS

PERIOD T
(SECONDS)



FREQUENCY - HOW MANY CYCLES OCCUR
PER SECOND

$$f = \frac{\text{CYCLES}}{\text{SEC}} \text{ OR Hz}$$

$$\frac{1 \text{ CYCLE}}{1 \text{ SEC}} = 1 \text{ Hz}$$

$$T = \frac{1}{f} \text{ OR } f = \frac{1}{T}$$

AMPLITUDE - MAXIMUM DEVIATION FROM
REST POSITION

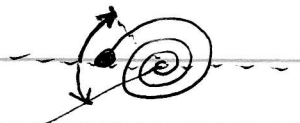
*** - AMPLITUDE IS RELATED TO TOTAL
ENERGY IN SYSTEM

SIMPLE HARMONIC MOTION OR SIMPLE HARMONIC
OSCILLATOR

- PERIOD AND FREQUENCY ARE
NOT AFFECTED BY AMPLITUDE

WE CAN USE THIS TO KEEP TIME

SPRING WATCH



ATOMIC
CLOCK



QUARTZ-PIEZOELECTRIC