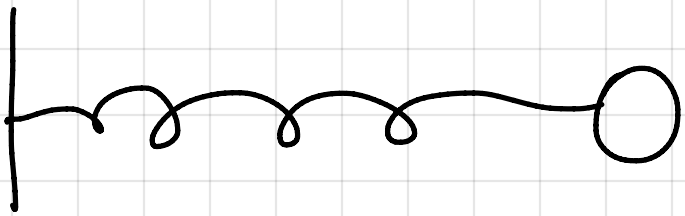
PHYS 2211, Summer 2021

# Week 7: More Energy

- ✓ Spring potential energy
- ✓ power
- ✓ dissipation of energy
- ✓ thermal energy & heat

# Spring Potential Energy



$L_0$ = relaxed length

$L$ = current length

$$\vec{F}_s = -k(L - L_0)\,\hat{i}$$

$$s$$

$L > L_0$ = stretch

$L < L_0$ = compression

$$U_s = \frac{1}{2} k s^2$$

$$\Delta U_s = \frac{1}{2} k \left( s_f^2 - s_i^2 \right)$$

$\Delta K$, $\Delta U_g$, etc...

## Power

$$P = \frac{\Delta E}{\Delta t} = \frac{W}{\Delta t} = \frac{\vec{F} \cdot \Delta \vec{r}}{\Delta t} = \vec{F} \cdot \vec{v}$$

("work")

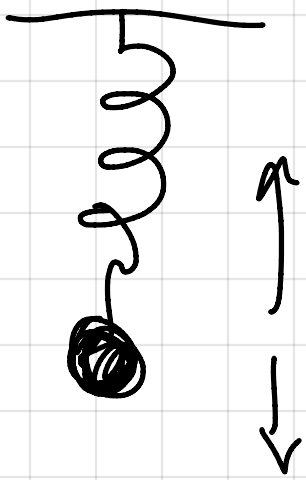
Units of power: $\frac{J}{s}$ = Watts (W)

("watts")

## Dissipation

dissipative forces ⇒ friction, air resistance

Some of the system's energy will be lost to the surroundings



Ideal: $U_s + U_g + K$ = constant

Real: $U_s + U_g + K$ = get smaller

# Thermal Energy & Heat

$$\Delta E_{sys} = W_{surr} + q$$


heat (q) = exchange in energy between system & surroundings caused by a difference in temperature

change in thermal energy: $\Delta E_{th} = mC\Delta T$

- $m$: mass of system IN GRAMS
- $C$: heat capacity $\left(\frac{J}{g\,^\circ C}\right)$
- $\Delta T$: $^\circ C$ OR Kelvin (NO $^\circ F$)

$$\Delta E_{sys} = W_{surr} + Q$$

↓

$$\Delta E_{th} = W_{surr} + Q$$

System is insulated then $Q = 0$

System is isolated then $W_{surr} = 0$

"closed" system ⇒ insulated system
(+ isolated sometimes)

"open" system ⇒ $Q \neq 0$

$$\Delta E_{th} = Q \quad ?$$

ONLY WHEN $W_{surr} = 0$