Momentum and Energy Review Map

<u>Vectors</u> – magnitude and direction

momentum
impulse
force
displacement
velocity

<u>Scalars</u> – magnitude only

work
energy
spring constant
time
speed

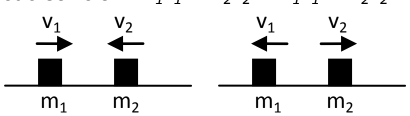
Momentum: $p = mv$

Impulse (change in momentum): $J = F_{net}t = \Delta p$

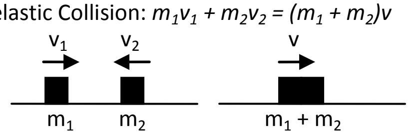
Law of Conservation of Momentum

$p_{before} = p_{after}$

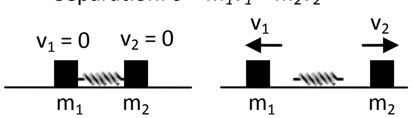
Elastic Collision: $m_1v_1 + m_2v_2 = m_1v_1 + m_2v_2$



Inelastic Collision: $m_1v_1 + m_2v_2 = (m_1 + m_2)v$



Separation: $0 = m_1v_1 + m_2v_2$



Systems in which two objects collide and **<u>stop</u>** can be modeled as elastic, inelastic, or a 'reverse' separation

You must be especially careful with signs of velocities in conservation of momentum problems!

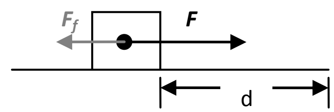
Work/Energy Principle

Energy is the ability to do work… Work results in a change in total energy

$W = Fd = \Delta E_T$

For work to be done – need force AND motion

Work done horizontally → Kinetic Energy (and/or Heat)

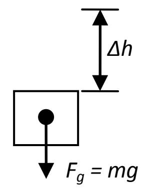


If frictionless, all work → KE

If $F = F_f$ all work → HEAT (no gain in speed)

$KE = ½ mv^2$

Work done vertically → Gravitational Potential Energy (and/or Heat)

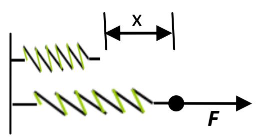


If frictionless, all work → PE

If there is a difference between PE gained and work done some work was done against friction (HEAT)

$\Delta PE = mg\Delta h$

Work done on a spring → Spring Potential Energy (and/or Heat)



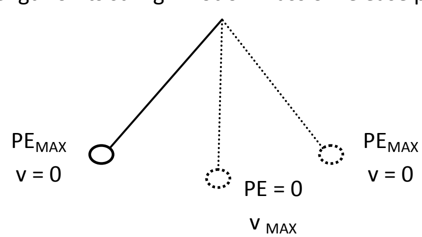
If frictionless, all work → PE_S

If there is a difference between PE_S gained and work done some work was done against friction (HEAT)

$PE_S = ½ kx^2$

Pendulum

Period (time for one complete oscillation) of a pendulum depends on the length of its string – not on mass or release position



Power

Rate at which work is done or energy is used

$$P = \frac{W}{t} = \frac{Fd}{t} = Fv$$

Law of Conservation of Energy

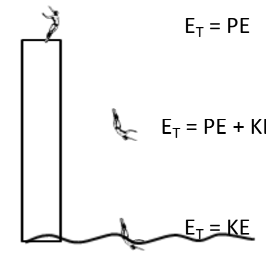
$E_T = PE + KE + Q$

PE and KE are forms of mechanical energy

Heat is non-mechanical, so frictionless systems **<u>perfectly</u>** conserve mechanical energy!

Cliff Diver – assuming no air resistance…

$PE_{TOP} = KE_{BOTTOM}$

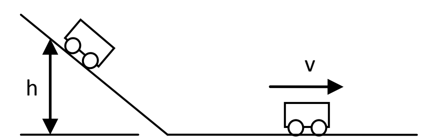


Sliding Down Slope – if frictionless…

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

If not frictionless…

$PE_{TOP} + KE_{TOP} = KE_{BOTTOM} + Q$ (work done by friction)



Spring Toy – if no energy is lost

$PE_S \rightarrow KE_{MAX} \rightarrow PE_{TOP}$