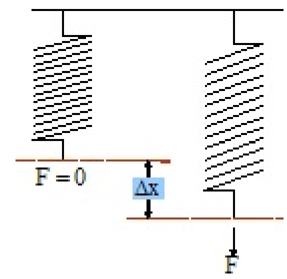
Physics 2204
Unit 3: Work, Power and Energy
Study Guide

Work:	• is the amount if energy that placed in or taken out of a system • is defined as a force acting upon an object to cause a displacement in the direction of the force. $W = \vec{F}_{II} \bullet \vec{d}$ $W = \vec{F} \bullet \vec{d}\, Cos\theta$ W = Joule (J) F = Newton (N) d = displacement (m) • Conditions for work: 1) Force MUST cause the displacement 2) Displacement MUST happen parallel to the force 3) The greater the angle between the direction of the force and the direction that the object moves, the smaller will be the work done on the object. Three ways of describing work: 1) Zero Work -Object does not move -Force is at 90 o with motion 2) Positive Work -Force is in direction of motion 3) Negative Work -Force opposes motion
Power:	refers to the rate at which work is done. $Power = \frac{Work}{\Delta time} = \frac{W}{\Delta t}$ Or $Power = \frac{Energy}{\Delta Time} = \frac{E}{\Delta t}$ Work (W) is measured in joules (J) Time(t) is measured in seconds (s) Power(P) is measured in J/s or Watts

Hooke's Law :	states that stretch is proportional to the applied force on a spring. The force needed to distort a spring is related to the displacement from the rest position according to: $\vec{F}_{spring} = -k\Delta x$  F is a "spring force" or "restoring force" (as the spring tries to return to its original or unloaded form) (Units: N) x is the elongation or the deformation of the spring. Basically the difference in length of the spring when stretched from its unstretched length. (Units: m) k is the "constant of elasticity" or basically a number that describes how elastic or stretchy a material is. (units: N/m) Slope of a restoring force versus mass give the constant of elasticity . The steeper the slope, the greater the k value and stiffer the spring.
Gravitational Potential Energy:	refers to potential energy that is stored every time something is lifted against gravity. $PE = F_g \Delta h$ $PE = mg \Delta h$ Mass (m) is measure in kg Free-fall acceleration (g) is measured in m/s/s Height (h) is measured in m Gravitational Potential Energy (PE) is measured in joules (J) The more work that is done on an object in lifting it, the more gravitational potential energy it will have.
Elastic Potential Energy:	is the energy stored in elastic materials as the result of their stretching or compressing $PE_{Elastic} = \frac{1}{2}kx^2$ (N/m) is spring constant x (m) is the amount of compression/stretch relative to equilibrium position $PE_{elastic}$ (J) measure for energy is joules

Kinetic energy (K.E. OR E_k)	is the energy of motion. An object which has motion - whether it be vertical or horizontal motion - has kinetic energy $$KE = \frac{1}{2} m \vec{v}^2$$ mass (m) is measured in kg velocity ($\vec{v}$) is measured in m/s kinetic energy (KE) is measured in Joules (J)
Work- Energy Theorem :	resultant force changes the velocity of an object and does work on that object. When work is done on a perfectly frictionless horizontal surface all the work is transformed into kinetic energy of the object. $$W = \Delta KE$$ $$W = KE_2 - KE_1$$ $$W = \frac{1}{2} m \vec{v}_f^2 - \frac{1}{2} m \vec{v}_i^2$$ $$\vec{F}_{//} \bullet \vec{d} = \frac{1}{2} m \vec{v}_f^2 - \frac{1}{2} m \vec{v}_i^2$$ TWO conditions of the Work-Energy Theorem**:** (1) There is assumed to be no friction. If there were friction, not all of the applied force would be translated into motion and thus KE, some would be wasted overcoming friction (2) The motion is assumed to be horizontal. That is, the object was not raised or lowered.
Mechanical energy:	the energy due to the position of something or the movement of something. Mechanical Energy can be divided into to categories;: 1) Potential Energy (PE) 2) Kinetic Energy (KE)

Conservation Of Mechanical Energy	Energy can't be created or destroyed. It can only be transformed into other types of energy. the TOTAL amount of energy is CONSTANT $$ME_i = ME_f$$ $$PE_i + KE_i = PE_f + KE_f$$ If no energy is lost due to friction, mechanical energy is conserved at all points in the motion.
Efficiency	a measure (usually expressed as a percent) of the amount of useful output energy from a machine, compared with the input energy needed to run a machine. $$\text{Efficiency} = \frac{\text{Output Energy}}{\text{Input Energy}} \times 100\%$$ Input Energy (Work in) (J) is the amount of energy going into a system Output Energy (Workout) (J) is the amount of energy going out of a system. Nothing is perfectly efficient, therefore, Work in is usually greater than work out.
Simple Harmonic Motion	is periodic motion in the absence of friction and produced by a restoring force that is directly proportional to the displacement and oppositely directed. To calculate acceleration : $$\vec{a} = -\frac{k\vec{x}}{m}$$ Acceleration is always opposite to displacement.