PHYSICS

Energy

- **What is Energy**
  - **_____ is perhaps the most central idea to all of Physics.**
  - **The universe is made of _____ and _____.**
  - **Historically energy was debated as of the _____ (not known by Newton).**
  - **Difficult to define, _____ is both a *thing* and a *process*.**
  - **A *thing* in _____ waves - a *process* when it holds _____ together.**
  - **_____ eventually defines it by the formula $E = mc^2$.**
- **Work**
  - **FORMULA: _____ = _____ x _____ [W = fd].**
  - **UNITS:**
    - **Force is in _____ (1N = 1kg m/sec^2)**
    - **Distance is in _____**
    - **Work is in _____ (1j = 1N m = 1kg m^2/sec^2)**
  - **EXAMPLE: weight lifters do _____joules of work; a kg of gas does _____joules of work.**

- **Power**
  - **FORMULA: _____ = _____ / _____ [Power = W/t].**
  - **UNITS: 1 _____ = 1joule/sec, or 1horsepower = 750 watts**
  - **EXAMPLE: a 133 horsepower engine is a 100 kW engine).**

- **Mechanical Energy … Potential Energy (PE) versus Kinetic Energy (KE)**
  - **Potential is due to _____ - Kinetic is due to _____ .**
  - **Potential Energy is the _____ work - Kinetic Energy is _____ work.**
  - **UNITS: Energy is measured in joules – just like work.**
  - **FORMULA: _____ = _____ x _____, so [PE = wt h].**
    (Sometimes PE = mgh, where mg is mass x gravitational acceleration. Newtons or pounds are a force that already has g built in.)
  - **FORMULA: _____ = ½ _____ x _____ ^{2}, so [KE = ½ mv^2]**

- **Work - Energy Theorem … Work is the change in kinetic energy. [W = ΔKE]**
  Derivation:
  - **Since W = fd**
  - **from Newton's 2nd Law: f = ma, so W = fd becomes W = mad**
  - **since d = ½ at^2, therefore fd = mad becomes fd = ma(½ at^2) = ½ m(at)^2**
  - **since a = Δv/t, then Δv = at, therefore ½ m(at)^2 becomes ½ mΔv^2**
  - **so fd = Δ½ mv^2, that is W = ΔKE**

- **The Law of Conservation of Energy**
  Energy can be converted from one form to another, but it cannot be created or destroyed.

- **What is a Machine?**
  - **A machine is a device that can either multiply a force or simply change its direction.**
    work input = work output … (force x distance)$_{in}$ = (force x distance)$_{out}$
  - **The Efficiency of a machine = (useful energy output) / (total energy input)**