Welcome back ☺
- Pick up a clicker!

http://www.loqu.com/top-10-most-significant-land-speed-records-of-all-time/blogs/hotday-5390

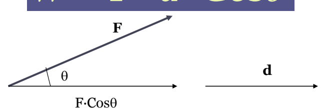
- **Warm-up: 11/30/09**
  - **The land-speed record for a wheel-driven car is nearly 738 km/h.** (*recorded at the Bonneville Salt Flats on 10/18/01*) **If the mass of this car was approximately 1.0x10³ kg, what was its kinetic energy?**

Work, Energy and Power

Work

- The transfer of energy through motion
- Calculated by multiplying the magnitude of the ***applied force*** by the ***displacement*** covered in the *direction* of the force :

$$W = F \cdot d \cdot Cos\theta$$



- Units = Newton-meter (N·m) = Joule (J)

Work done by a non-constant force

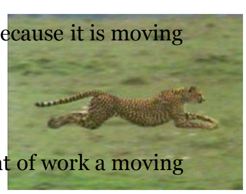
- **Example:** work done by a compressed or stretched spring.
  - Calculate using a Force-displacement graph
  - Calculate the area under the line (integral)

•For a spring: work = elastic potential energy stored in spring→ $E_{elastic} = ½ kd^2$

Kinetic Energy (K)

- The energy a body has because it is moving

$$K = \frac{1}{2} \cdot m \cdot v^2$$



- A measure of the amount of work a moving body is capable of doing
- Work-Kinetic Energy Theorem: The amount of work done on a system is equal to its change in kinetic energy

W = ΔK

Click picture for source site

Sample Problem:

- A hammer head of mass 0.50 kg is moving with a speed of 6.0 m·s⁻¹ when it strikes the head of a nail sticking out of a piece of wood. When the hammer head comes to rest, the nail has been driven a distance of 1.0 cm into the wood. Calculate the average frictional force exerted by the wood on the nail.

$$F \cdot (0.010\text{ m}) = \frac{1}{2} \cdot (0.50\text{ kg}) \cdot \left(0 - (6.0\text{ m} \cdot \text{s}^{-1})^2\right)$$

$$F \cdot (0.010) = 9.0\text{ N} \cdot \text{m}$$

$$\text{F} = \frac{9.0\text{ N} \cdot \text{m}}{0.010\text{ m}}$$

$$F = 9.0 \text{ x } 10^2\, N$$

Sample problem #2—use your clickers!

- A car (m = 1150 kg) experiences a force of 6.00 x 10^3 N over a distance of 125 m. If the car was initially traveling at 2.25 m·s^{-1}, what is its final velocity? $W = \Delta K$

$$\left(6.00 \times 10^3 N\right) \cdot (125m) = \frac{1}{2}(1150kg)\left(v_f^2 - \left(2.25m \cdot s^{-1}\right)^2\right)$$

$$1309.4 = v_f^2$$

$$36.2m \cdot s^{-1} = v_f$$

Potential Energy (U)

- The amount of energy that is stored in a body
- A measure of how much work *CAN* be done
- **<u>Gravitational Potential Energy</u>:** the amount of work that can be done on a body as a result of its position above a reference point (in Earth's gravitational field)

E_p = mgh

Where m = mass (kg)

g = acceleration due to gravity (9.81 m·s^{-2})

And h = height (m) above reference level

The Principle of Energy Conservation

- The total amount of energy a body possesses will remain constant, although the type of energy may be transformed from one form to another
  - Note: many times the energy transforms into a "useless" form, so it appears that energy has been lost…when it really hasn't!
- **Conservation of Mechanical Energy:**

$$K_i + U_i = K_f + U_f$$

Forms of Energy:

- <u>Thermal Energy</u>
  - the kinetic energy of atoms and molecules (remember, "heat" is the transfer of this energy between systems)
- <u>Chemical energy</u>
  - energy associated with electronic structure of atoms and the electromagnetic force
- <u>Nuclear energy</u>
  - energy associated with nuclear structure of atoms and the strong nuclear force

Forms of Energy:

- <u>Electrical energy</u>
  - associated with an electric current (kinetic energy of electrons in a conductor)
- <u>Radiant (light) energy</u>
  - energy associated with photons of light
- <u>Mechanical energy</u>
  - associated with the movement of position of physical bodies (kinetic and potential energy)