October 31, 2010 Physics 131 Prof. E. F. Redish

- **<u>Theme Music:</u> Bruce Springsteen**

  Working on a Dream

- **<u>Cartoon:</u> Pat Brady**

  Rose is Rose

Outline

- Quiz 7
- Buoyancy and flow examples
- Kinetic energy and work
- The Work-Energy Theorem

Foothold ideas: Buoyancy

- ***Archimedes' principle***: When an object is immersed in a fluid (in gravity), the result of the fluid's pressure variation with depth is an upward force on the object equal to the weight of the water that would have been there if the object were not.
- As a result, an object whose density is less than that of the fluid will float, one whose density is greater than that of the fluid will sink.
- An object less dense than the fluid will float with a fraction of its volume under the fluid equal to the ratio of its density to the fluid's density.

Foothold ideas: Incompressible Flow

- Flow = volume / sec crossing an area.

$$Q = Av$$

- Flow in a pipe: volume in = volume out

$$A_1 v_1 = A_2 v_2$$

- Resistance to flow –
  - – Drag is proportional to v and L.

$$\Delta P = ZQ$$

$$Z = 8\pi\mu \frac{L}{A^2}$$

In many of your science classes you talk about "energy."

What is it?

10/31/11 Physics 131 5

Energy

- N2 tells us that a force can change an object's velocity in one of two ways:
  - It can change the speed
  - It can change the direction
- Analyzing changes in speed leads us to study energy.
- Analyzing changes in direction leads us to study rotations.

10/31/11 Physics 131 **6**

Kinetic Energy and Work

- Consider an object moving along a line feeling a single force, *F*. When is moves a distance Δx, how much does its speed change?

$$a = F^{net} / m$$

$$\frac{\Delta v}{\Delta t} = \frac{F^{net}}{m}$$

$$\frac{\Delta v}{\Delta t}\Delta x = \frac{F^{net}}{m}\Delta x$$

$$\Delta v \frac{\Delta x}{\Delta t} = \frac{F^{net}\Delta x}{m}$$

10/31/11 Physics 131 **7**

$$\Delta v \frac{\Delta x}{\Delta t} = \frac{F^{net}\Delta x}{m}$$

$$\langle v \rangle \Delta v = \frac{F^{net}\Delta x}{m}$$

$$\frac{v_i + v_f}{2}(v_f - v_i) = \frac{F^{net}\Delta x}{m}$$

$$\tfrac{1}{2}(v_f^2 - v_i^2) = \frac{F^{net}\Delta x}{m}$$

$$\tfrac{1}{2}m(v_f^2 - v_i^2) = F^{net}\Delta x$$

Definitions:

Kinetic energy = $\tfrac{1}{2}mv^2$

Work done by a force *F* = $F\ \Delta x$

Result

$$\Delta(\tfrac{1}{2}mv^2) = F^{net}\ \Delta x$$

10/31/11 Physics 131 **8**