Physics 131- Fundamentals of Physics for Biologists I

Professor: Wolfgang Losert wlosert@umd.edu

12/10/2012

Shooting into water
http://www.youtube.com/watch?NR=1&v=yvSTuLIjRm8&feature=endscreen

For credit surveys:

MPEX (online)

FMCE (bubble sheet, can do during recitation tomorrow)

For extra doughnuts:

EvalUM (if we are ahead of Dr Redish's class in participation! - this morning we were 8% behind!)

Outline

Q and A session Wed 3pm Room 1303

Office hours: Thu 5-6.30pm Course center

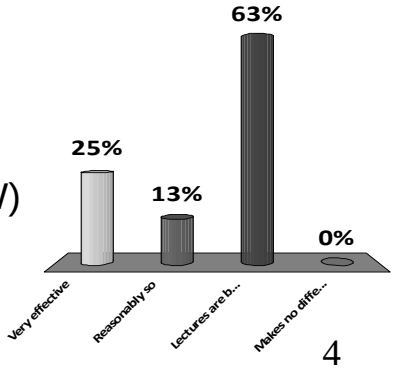
Fri 2pm-3pm My office rm 3341 AVW

First Law of Thermodynamics

Preview of Second Law of Thermodynamics

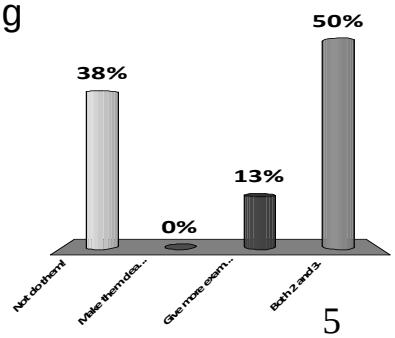
In this class instead of my lecturing to you a lot, you did readings the night before. How effective did you find this in helping you make sense of the physics?

1. Very effective
2. Reasonably so
3. Lectures are better (even if this means more HW)
4. Makes no difference to me



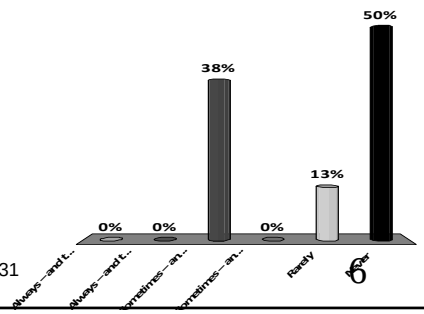
What changes would you make to the readings (aside from posting them sooner ☺)?

1. Not do them!
2. Make them clearer
3. Give more examples in the reading instead of waiting until class
4. Both 2 and 3.



Did you ever read the answer that I wrote to the questions you asked?

1. Always – and they were often helpful
2. Always – and they were useless
3. Sometimes – and they were helpful
4. Sometimes – and they were useless
5. Rarely
6. Never



Final exam

8am Saturday in this room

- Sample problems on elms
- Q and A on Wednesday 3pm
- Sample problems,

First Law of Thermodynamics

Total energy of a system

Macroscopic System
Kinetic and Potential Energy

Internal energy

$$E = KE + PE + U$$

Exchanges of energy between the system and the rest of the universe

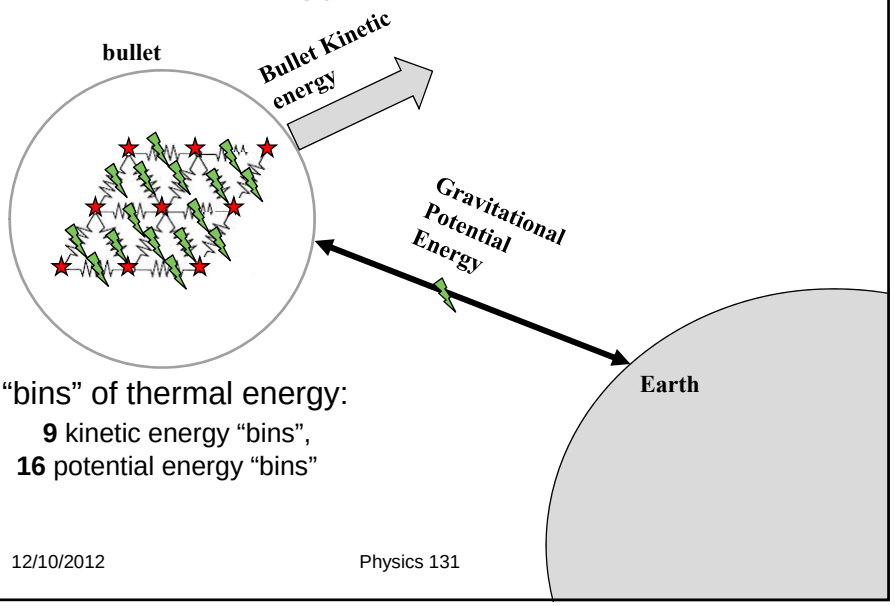
$$\Delta E = Q - W$$

Work done by the system on "them"

Exchanges of energy between the system and the rest of the universe - ignoring Macroscopic Motion

$$\Delta U = Q - W$$

Total Energy of a 9 atom bullet



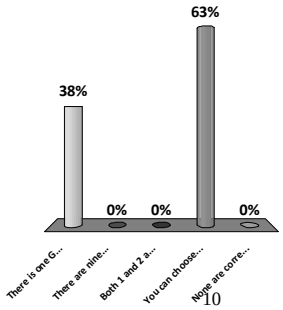
25 "bins" of thermal energy:

9 kinetic energy "bins",

16 potential energy "bins"

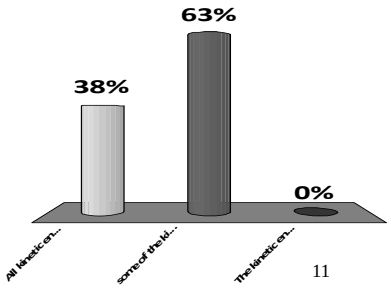
Gravitational Potential Energy

1. There is one Gravitational potential energy between bullet and earth
2. There are nine gravitational potential energies between each atom and the earth
3. Both 1 and 2 are correct at the same time, you can add the energies
4. You can choose either 1 or 2 as the way to describe gravity
5. None are correct



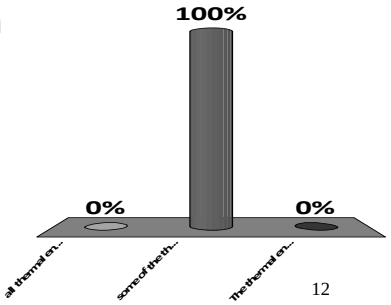
Our 9 atom bullet taken out of hot water is shot into an insulated container with cold water. It comes to rest in the container (see mythbusters, shooting into water). What happens to the macroscopic kinetic energy KE of the bullet?

1. All kinetic energy from the bullet heats the water
2. some of the kinetic energy from the bullet heats the water
3. The kinetic energy of the bullet does not heat up the water



Our 9 atom bullet taken out of hot water is shot into an insulated container with cold water. It comes to rest in the container (see mythbusters, shooting into water). What happens to the thermal energy of the bullet?

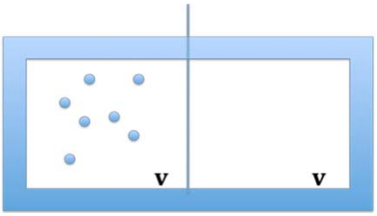
1. all thermal energy from the bullet heats up the water
2. some of the thermal energy from the bullet heats up the water
3. The thermal energy of the bullet does not heat up the water



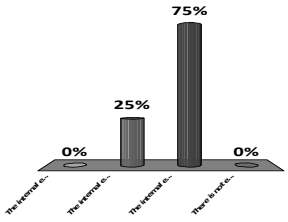
Only a fraction of the thermal energy will leave the bullet: Each of the 25 thermal energy "bins" will go from the hot water temperature T_H to the cold water temperature T_C. So the fraction of thermal energy that leaves the bullet is

$$\varepsilon = \frac{T_H - T_C}{T_H} = 1 - \frac{T_C}{T_H}$$

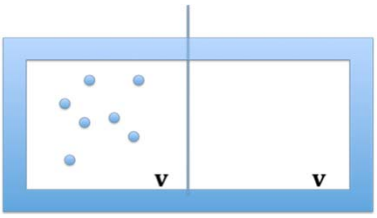
Suppose an isolated box of volume 2V is divided into two equal compartments. An ideal gas occupies half of the container and the other half is empty. When the partition separating the two halves of the box is removed and the system reaches equilibrium again, how does the new internal energy of the gas compare to the internal energy of the original system?



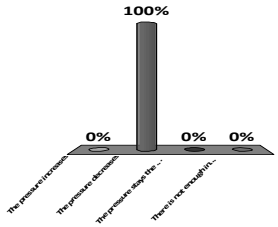
1. The internal energy increases
2. The internal energy decreases
3. The internal energy stays the same
4. There is not enough information to determine the answer



Suppose an isolated box of volume 2V is divided into two equal compartments. An ideal gas occupies half of the container and the other half is empty. When the partition separating the two halves of the box is removed and the system reaches equilibrium again, how does the **pressure** of the gas compare to the **pressure** of the original system?



1. The pressure increases
2. The pressure decreases
3. The pressure stays the same
4. There is not enough information to determine the answer



Egg placed in boiling water

	$\Delta U_{internal}$	**Q** (heat absorbed BY the system)	**W** (work done BY the system)
1	> 0	0	< 0
2	< 0	0	> 0
3	0	> 0	> 0
4	> 0	> 0	0
5	< 0	> 0	> 0
6	0	< 0	> 0
7	> 0	< 0	< 0
8	< 0	< 0	0
9	0	0	0