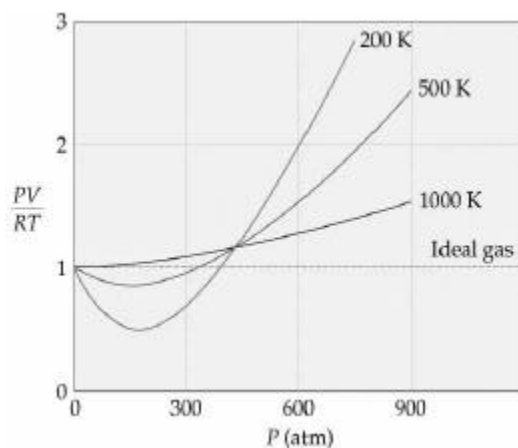


Announcements – 10/11/00

- **“Quiz” - we will review in a moment**
- **Exam #2: Wed., 10/18, 7:00 pm**
 - will cover material through **today**
 - see the Exam#2 info page for more info
 - extra Problem/Review session:
Sunday 10/15, 4 - 6 pm
- **Demo on MONDAY . . .** (no class Friday!)
- **No Office Hour on Friday** - *additional Office Hour this week on Thursday (2 - 3 pm)*

1

Effect of Temperature



-negative deviations
are more significant
at lower temps

-due to decreased
molecular motion,
allowing more
significant
intermolecular
interactions

2

van der Waals Equation

- Corrects the IGL using *empirically-corrected* pressure and volume terms:

Volume:

$$V - nb$$

\uparrow \swarrow
 # mol actual volume of
 particular gas species

Pressure:

$$P + \frac{n^2 a}{V^2}$$

\swarrow \nearrow
 attractions between "strength" of
 pairs of molecules molecular attractions

3

van der Waals Equation

Putting it all together:

$$(P + n^2 a / V^2)(V - nb) = nRT$$

TABLE 10.3 Van der Waals Constants for Gas Molecules

Substance	$a(\text{L}^2\text{-atm/mol}^2)$	$b(\text{L/mol})$
He	0.0341	0.02370
Ne	0.211	0.0171
Ar	1.34	0.0322
Kr	2.32	0.0398
Xe	4.19	0.0510
H ₂	0.244	0.0266
N ₂	1.39	0.0391
O ₂	1.36	0.0318
Cl ₂	6.49	0.0562
H ₂ O	5.46	0.0305
CH ₄	2.25	0.0428
CO ₂	3.59	0.0427
CCl ₄	20.4	0.1383

4

Thermochemistry

- A part of *Thermodynamics* dealing with **energy changes** associated with physical and chemical reactions

Why do we care?

- will a reaction proceed spontaneously?
- if so, to what extent?

It won't tell us:

- how *fast* the reaction will occur
- the *mechanism* by which the reaction will occur

5

What is Energy?

- Energy is the ***capacity to do work or to transfer heat***

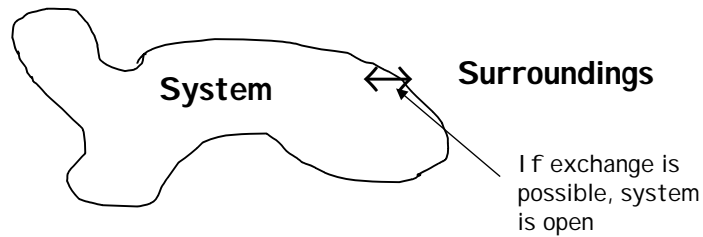
-**Kinetic Energy**: energy associated with mass in motion (recall: $E_k = \frac{1}{2}mv^2$)

-**Potential Energy**: energy associated with the *position* of an object relative to other objects (energy that is *stored* - can be converted to kinetic energy)

6

The System

- We must define what we are studying:



System: portion of the universe under study

Surroundings: everything else

7

Energy Transfer

- Energy can be transferred in two different ways:

1. By doing **Work** (applying a force over a distance)

$$W = F \times d$$

2. _____ - **q** (results in a change in temperature)

Note: *W, q, and E all have the same units (Joule), but:*

- W & q depend on *path* path
- E is *independent of path* (_____ functi on)

8

First Law of Thermodynamics

- "The total energy of the universe is *constant*."
- "Energy is neither created or destroyed in a process, only converted to another form."

-Conservation of Energy

- "You can't win . . . you can only break even."

$$\Delta E = q + w$$

Change in energy of the system

Heat Flow:
+ is into system
- is out of system

Work: + is done on system
- is done by system