Session A: LECTURE OUTLINE (SECTION A)
(This information should be reviewed independently by the student. This information will not be covered in an organized review session.)

I. Matter
   a. Pure Substances
   b. Mixture
   c. States
II. Properties
   a. Physical
   b. Chemical
   c. Intensive
   d. Extensive
III. Energy
   a. Units
   b. Definition
   c. Kinetic
   d. Potential
      i. Gravitational potential
      ii. Coulomb potential
   e. Electromagnetic
   f. Total energy
   g. Law of conservation of energy
IV. Force
   a. Definition
   b. Equation
   c. Work

Suggested problems: pp F12-F13 A.1, A.5, A.9, A.17, A.25

Matter

Chemistry is the study of matter and the changes associated with the matter. **Matter** is anything that has mass and takes up space.

- Matter exists as pure substances or mixtures. Pure **substances** cannot be separated into simpler substances by physical methods. Pure substances include elements and compounds. **Mixtures** can be broken down by physical methods.

Matter can exist in three states: **solid, liquid or gas**.

You should familiarize yourself with the **elements** which appear on the periodic table. You should memorize the names and symbols of the more common elements. You can find the elements on the inside front cover of the text book.

- Matter is precisely described by a unique set of physical and chemical properties. **Physical properties** include those properties that describe the matter in the absence of a chemical change, eg mass, temperature, melting point, boiling point, density, hardness, color, state. **Chemical properties** refer to the ability of a substance to change into another substance, eg reacts with oxygen, reacts with acids, decomposes with added heat, etc.

- Properties are also described depending on their dependence on the mass of a sample. **Intensive** properties are independent of the mass, such as density or temperature, while **extensive** properties are dependent on the mass, such as amount of heat contained in the sample or the volume of the sample.

ENERGY- measure of the capacity to do work

SI unit for energy is the joule, J

1 J = 1 kg*m^2*s^{-2}

- Kinetic Energy – the energy a body possesses due to its motion
- For a body of mass, m, and speed, *v* :
  $E_k = ½ mv^2$

Example: Calculate the E_k of a ball of mass 0.050 kg traveling at 2.5 m*s^{-1}.

E_k = ½ (.050 kg)(25 m*s^{-1}) = 16 J

- Potential Energy – the energy that an object possesses on account of its position in a field of force, two cases important in chemistry, gravitational and coulomb
  - Gravitational potential energy – potential energy of an object in a gravitational field
  - A body of mass, m, at a height, h above the earth:
    $E_p = mgh$
    Where g is the acceleration free fall, usually has a value of 9.81 m*s^{-2}

Example: What is the gravitational potential energy of a book, mass 1.5 kg, when it is on a table of height 0.82 m relative to its potential energy when it is on the floor?

E_p = (1.5 kg)(9.81 m*s^{-2})(.82 m) = 12 J

○ Coulomb potential energy – energy due to attractions and repulsions between electric charges
○ Coulomb potential energy of a particle of charge q_1 at a distance r from another particle of charge q_2 is proportional to the two charges and inversely proportional to the distance between them:

$$E_p = \frac{q_1 q_2}{4\pi\varepsilon_0 r}$$

ε_0 vacuum permittivity = $8.854 \times 10^{-12}\ J^{-1}*C^2*m^{-1}$

- Electromagnetic field carries energy through space in the form of electromagnetic radiation.

- The total energy is conserved. Energy can be converted from one form to another, but the total energy is conserved.

Force

- A force is an influence that changes the state of motion of an object
- Acceleration, a, is the rate of change of velocity
- Force = mass X acceleration
- Velocity is the rate of change of position, and has both magnitude and position
- Work is motion against an opposing force