Engineering Science (EG-086)

Introduction

Lecturer: Dr Zak Abdallah works with Rolls Royce University Tech Cantre in materials and research as well as Swansea materials Research and Development
I am required to email him to make an appointment if i wish to speak with him. I have no thursday lectures and there are no Monday lectures unless explicitly stated.

Recommended reading

- Physics for scientists and engineers : a strategic approach with modern physics / Randall D. Knight.

Testing

There are two online assesments worth 25% in total, with a final exam in January worth 75%.

1 Quantities, Units and Dimesnsions 04/10/18

Random Error - Unpredictable and can be reduced by averaging multiple results

Systematic Error - Predictably inaccurate, this is cause by the the measurement device not being calibrated correctly. It is consistently wrong, so, for example, will always be too high.

2 States of Matter 10/10/17

Kinetic Theory of Matter

- All matter is made of atoms. The electrostatic interaction between between these atoms results in potential energy
- The average kinetic energy of the atoms/ molecules is the temperature of the substance. As the thermal energy increases the rate of motion of the molecules/atoms increases.
- When in the gaseous state, atoms can move and collide elasticallt with each other and the surrounding container. The rate of these collisions is refered to as pressure.

$$\text{Potential Energy} + \text{Kinetic Energy} = \text{Internal Energy}$$

Binding forces exist between atoms which hold them together, such as Ionic, Covalent, and Metallic bonding. Repulsive electrostatic forces push atoms apart. These are caused by the electrons of each atom repeling each other.

Crystaline solids are very atomicaly uniform, while Amorphous solids have a less uniform structure.

Heat is a measure of Thermal Energy, normally added to a substance. Temperature is the average Kinetic Energy of the atoms. Therefore, Heat $\neq$ Temperature

Gas Laws

Boyle's Law states that for a constant temperature: $\frac{V_1}{P_2} = \frac{V_2}{P_1}$
Charles' Law states that for a constant pressure: $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
Amonton's Law states that for a constant volume: $\frac{P_1}{T_1} = \frac{P_2}{T_2}$
Avogadro's Law states that for a constant pressure and temperature: $\frac{V_1}{n_1} = \frac{V_2}{n_2}$
where n = number of moles

Ideal Gas Law

$$PV = nRT$$

Where:

P - Pressure (Pa)

V - Volume (m^3)

n - Number of moles (mol)

R - Gas constant (8.314 J/mol K)

T - Temperature (K)

This can also be written as:

$$PV = mRT$$

Where:

P - Pressure (Pa)

V - Volume (m^3)

m - Mass(Kg)

R - Gas constant (8.314 J/mol K)

T - Temperature (K)

Phase Change

Phase $\equiv$ State

- If no phase change is involved, all energy added to matter in the form of heat increases the kinetic energy of the molecules, meaning the temperature increases
- During a phase change the temperature remains fixed until the phase change is complete, despite energy being added through heat.
- All of this energy is used to change the potential energy, while the kinetic energy remains the same
- Both phases are saud to be in thermal equilibrium during this transition

3 Thermal properties of matter