Physics Notes

Contents:

Atoms-

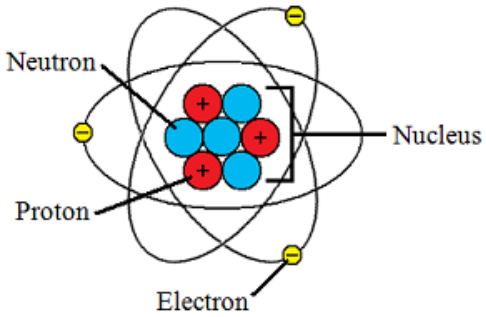
- Incredibly tiny
- Numerous
- Perpetually moving
- Ageless

Brownian motion

The theory of erratic random movement of microscopic particles in a fluid as a result of continuous bombardment from molecules of the surrounding medium is called Brownian motion.

Atomic Structure

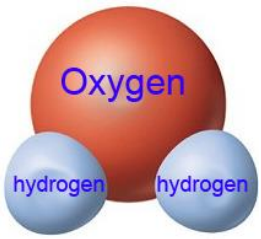
- The mass of the atom is concentrated in a small dense nucleus, which is a tiny fraction of the total volume.
- The volume of the atom is largely taken up by a "cloud" of electrons.
- Electrons surround a nucleus that contains protons and neutrons.
- Neutrons are neutral, but protons and electrons are electrically charged. Protons have a relative charge of +1, while electrons have a relative charge of -1. The number of protons in an atom is called its atomic number.
- When a substance is composed of only one kind of atom it is called an element e.g. gold
- Elements also have the same number of protons and electrons



- Isotopes are atoms of the same element with different numbers of neutrons which leads to different masses but same chemical behaviour.

Molecules

- Two or more atoms may combine by sharing electrons to form a molecule e.g. H_2O



Compounds and Mixtures

- When atoms of different elements bond to one another e.g. water, ammonia
- A substance that is mixed together without chemically bonding is a mixture e.g. sand combined with salt

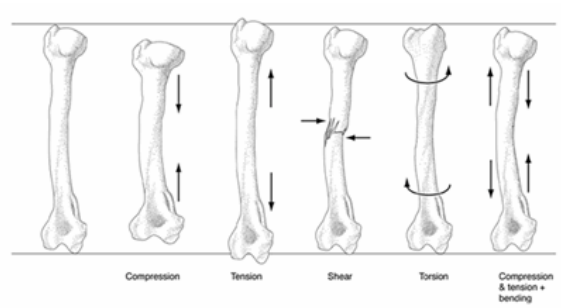
Property of solids

Density= Mass/ Volume

Density is a measure of the compactness of matter it is the amount of mass per unit volume.

Forces

Types of loading:

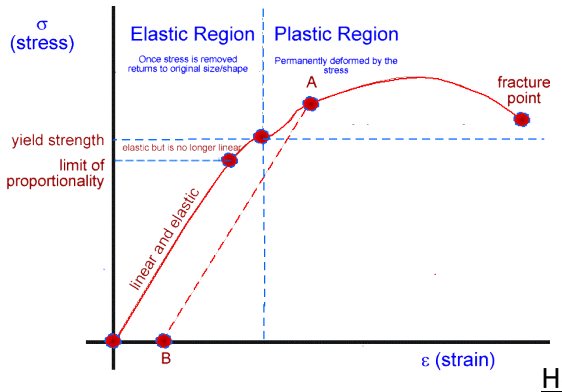


Elasticity:

When an object is subjected to external forces, it undergoes changes in size or in shape or both. The changes depend on the arrangement and bonding of the atoms in the material. A body's elasticity is how much its shape changes when a force acts on it, and how well it returns to its original shape when the force is removed.

Stress and Strain

Stress is the force required to induce a given deformation of the object, divided by the surface area over which the force is exerted. The fracture stress is the force/area that induces the object to break Strain is the fractional deformation of an object produced by an external force.



Hooke's Law

Law stating that the strain in a solid is proportional to the applied stress within the elastic limit of that solid. The distance beyond which permanent distortion occurs is called the elastic limit.

$$F = k\Delta x$$

Spring

A spring is an object that can be deformed by a force and then return to its original shape after the force is removed.

Stress

The force applied per unit area (Newtons)

Stress=Force/Area

Strain

The extent of the stretching/compression produced as the material responds to stress.

ΔL / L = change in length / original length

Elastic modulus

Elastic modulus is a measure of the intrinsic stiffness of a tissue (the slope of the stress-strain curve in the linear portion). Also known as Young's modulus.

E=Stress/Strain

Tensile Strength

The strength of a material is the stress at the point of fracture/failure

Bone is composed of collagen and minerals to provide tensile and compressive strength, and is anisotropic.

Tendons and ligaments are dense connective tissue, 50% water that help maintain joint stability and function. The remainder is mainly collagen with some elastin. The collagen provides high tensile strength, while elastin gives it elasticity.

Tension

Stretching force

Compression

Squashing force

Fractures

Arise when the applied force exceeds the bone's ability to withstand the applied force.

Fractures are more common for bending or shear forces, e.g. spiral fractures. Stress fractures may arise under repeated low compressive loads.