Foundation in Science

Physics for Health Sciences

FS2053

3 credits

Updated by Physics Team 2023

Become the future of better healthcare

FS2053 Course Outline:

1. ***Forces acting on the body (Lecture – 3 hours)***
2. **Kinematics (Lecture – 2 hours)**
3. **Biomechanics (Lecture – 2 hours)**
4. **Heat and body temperature (Lecture –2 hours)**
5. **Pressure, fluids, gases and breathing (Lecture – 2 hours)**
6. **Sound and hearing (Lecture – 2 hours)**
7. **Electromagnetic Spectrum, light and vision (Lecture – 4 hours)**
8. **Electricity (Lecture – 4 hours)**
9. **Diagnostic X-rays (Lecture – 1.5 hours)**
10. **Radioprotection in medicine (Lecture – 1.5 hours)**

FS2053 Chapter 5 - Learning outcomes

Pressure, fluids, gases and breathing

By the end of the lesson, you should be able to:

- Explain the gas laws and their application to the behaviour of gases in different conditions.

The Gas Laws

- a set of fundamental principles in physics and chemistry that describe the behaviour of gases under different conditions.
- establish relationships between the variables such as :

  Pressure (P) in Pa or Nm^{-2}
  Volume (V) in m^3
  Temperature (T) in K
  Amount Of Substance (n) in mole

- can be used to compare two different gases, or determine the properties of a gas after one of its state variables have changed
- There are several gas laws, including Avogadro's Law, Boyle's Law, Charles's Law, Pressure Law, and the Ideal Gas Law.

Avogadro's Law

Avogadro's Law states that equal volumes of all ideal gases (at the **same temperature and pressure**) contain the same number of particles, 6.02×10^{23}

Boyle's Law

Boyle's Law states that equal pressure is inversely proportional to volume (when **temperature is constant**)

$$P_1V_1=P_2V_2$$

Example of calculation involved Boyle's law.
A bubble is at 25m below the surface of the sea. When the bubble rises to the surface of the sea, its volume becomes 10 cm^3. What is the original volume of the bubble?

Link: Video solution

Link: Solution

Charle's Law

Charles's Law states that volume is proportional to temperature **(when pressure is constant).**

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Example of calculation involved Charles's law.
A cylinder contains 200 cm^3 of gas at a temperature of 27°C. The gas is heated until its temperature increases by 30°C. What is the final volume of the gas?

Link: video solution

Link: Solution

Pressure Law

Pressure Law states that pressure is proportional to temperature (**when volume is constant**).

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Example of calculation involved Pressure law.
A fixed mass of gas in an enclosed metal container has a pressure of 2.5×10^5 Pa. If the gas is heated from 27°C to 87°C, calculate the final pressure of the gas.

Link: video solution

Link: Solution

Ideal Gas equation

These separate gas laws are then combined to give one overall equation that governs the behavior of gasses – **The Ideal Gas equation**

Pressure x Volume ∝ Temperature

$$\mathbf{PV = nRT}$$

Where $\boldsymbol{R = 8.314\ JK^{-1}.mol^{-1}}$ and **n=number of moles**

Atmospheric pressure

$\boldsymbol{= 76\ cmHg = 1.013 \times 10^5 Pa = 1.013 \times 10^5\ Nm^{-2} = 10\ m\ water}$

This very important equation governs the behaviour of the world around us and many of the processes in the human body.