E-notes for
B.Sc Sem II
Unit-IV

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Newton's formula for velocity of sound in air.

The speed of sound is defined as the distance travelled per unit time by a sound wave propagating through a medium.

Newtons formula:- Newton created the first theoretical calculation of the sound speed in air based on the idea that compression and rarefactions from very slowly in air when a sound wave travells through a gaseous medium, Hence the heat generated during the rarefaction and cooling Phases tends enough time to dissipate, keeping the mediums temperature constant. Thus the Boyel's law applies and longitudanal waves Propagate through air by a isothermal process in which the temperature of the medium remains constant. Thus for a given mass of the gas at pressure P and volume V, we have,

$$PV = \text{Constant}$$

On differentiating above equation we get

$$PdV + VdP = 0 \quad \text{or} \quad P = \frac{-dP}{dV/V}$$

$$\text{or} \quad P = \frac{\text{decrease in volume}}{\text{Volume Strain}} = E$$

where E is the isothermal elasticity of the gas.

Putting $E = P$ the pressure in air in the formula for the velocity of sound, in gaseous medium. $V = \sqrt{\frac{E}{P}}$, we get -

$$\boxed{V = \sqrt{\frac{P}{\rho}}} \rightarrow (1)$$ this is the required Newton's formula for the velocity of sound waves in air. Its numerical value is determined by putting the value of P and ρ at S.T.P. in eq. (1) we get.

Velocity of sound (V0) = 280 / second.