

Physics Formulas

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Abstract

This is a list of formulas for physics...

1 Thermometry

Type of thermometers

Liquid thermometer

Thermometric Property: $\Delta V \propto \Delta\theta$

Formulae:

$$\theta = \frac{\ell_{\theta} - \ell_0}{\ell_{100} - \ell_0} \times 100^{\circ}\text{C} \quad , \quad T = \frac{\ell_T - \ell_{00}}{\ell_{tr} - \ell_{00}} \times 273.16 \text{ K}$$

Gas thermometer

Thermometric Property: $\Delta P \Delta V \propto \Delta\theta$ (where $P = \rho gh$)

Formulae:

$$\theta = \frac{P_{\theta}V_{\theta} - P_0V_0}{P_{100}V_{100} - P_0V_0} \times 100^{\circ}\text{C} \quad , \quad T = \frac{P_TV_T}{P_{tr}V_{tr}} \times 273.16 \text{ K}$$

Resistance thermometer

Thermometric Property: $\Delta R \propto \Delta\theta$ (where (i) $R = \frac{P}{Q} \times S$ (ii) $R_t = R_0(1 + at + bt^2)$)

Formulae:

$$\theta = \frac{R_{\theta} - R_0}{R_{100} - R_0} \times 100^{\circ}\text{C} \quad , \quad T = \frac{R_T}{R_{tr}} \times 273.16 \text{ K}$$

Thermoelectric thermometer

Thermometric Property: $\Delta\varepsilon \propto \Delta\theta$

Formulae:

$$\theta = \frac{\varepsilon_{\theta} - \varepsilon_0}{\varepsilon_{100} - \varepsilon_0} \times 100^{\circ}\text{C} \quad , \quad T = \frac{\varepsilon_T - \varepsilon_{00}}{\varepsilon_{tr} - \varepsilon_{00}} \times 273.16 \text{ K}$$

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2 Calorimetry

Heat Capacity and specific heat capacity

Heat Capacity

$$C = \frac{Q}{\Delta T} \quad (\text{JK}^{-1})$$

Specific Heat Capacity

$$c = \frac{Q}{m\Delta T} \quad (\text{Jkg}^{-1}\text{K}^{-1})$$

Molar Heat Capacity

$$C_v = \frac{Q}{n\Delta T} \quad (\text{Jmol}^{-1}\text{K}^{-1}) \quad , \quad C_p = \frac{Q}{n\Delta T} \quad (\text{Jmol}^{-1}\text{K}^{-1})$$

Measurement of specific heat capacity

Method of Mixture

$$mc(\theta_3 - \theta_2) = m_w c_w (\theta_2 - \theta_1) + m_c c_c (\theta_2 - \theta_1)$$

Electrical Heating Method

$$VIt = (mc_\ell + C)\Delta\theta$$

Continuous Flow Method (Callendar & Barnes' method)

$$\begin{cases} V_1 I_1 t = m_1 c (\theta_2 - \theta_1) + ht & (1) \\ V_2 I_2 t = m_2 c (\theta_2 - \theta_1) + ht & (2) \end{cases}$$

Specific Latent Heat

$$L_f = \frac{Q}{m} \quad (\text{Jkg}^{-1}) \quad , \quad L_v = \frac{Q}{m} \quad (\text{Jkg}^{-1})$$

Finding specific latent heat of fusion of ice

$$m_1 c_w (\theta_1 - \theta_2) + C(\theta_1 - \theta_2) = mL_f + m c_w (\theta_2 - 0)$$

Finding specific latent heat of vaporisation of water

$$mL_v + m c_w (100 - \theta_2) = (m_1 c_w + C)(\theta_2 - \theta_1)$$

Thermal Expansion of solid

Linear Expansion

$$\alpha = \frac{l_2 - l_1}{(\theta_2 - \theta_1)l_1} \Rightarrow l_2 = l_1[1 + \alpha(\theta_2 - \theta_1)]$$

Area Expansion

$$\beta = \frac{A_2 - A_1}{(\theta_2 - \theta_1)A_1} \Rightarrow A_2 = A_1[1 + \beta(\theta_2 - \theta_1)]$$
$$\beta = 2\alpha$$

Volume Expansion

$$\gamma = \frac{V_2 - V_1}{(\theta_2 - \theta_1)V_1} \Rightarrow V_2 = V_1[1 + \gamma(\theta_2 - \theta_1)]$$
$$\gamma = 3\alpha$$

Thermal Expansion of Liquid

$$\gamma_\ell = \frac{V_1 - V_0}{V_0\Delta\theta} \Rightarrow V_1 = V_0(1 + \gamma_\ell\Delta\theta)$$
$$3\alpha_c = \gamma_c = \frac{V'_1 - V_0}{V_0\Delta\theta} \Rightarrow V'_1 = V_0(1 + \gamma_c\Delta\theta)$$
$$\gamma_a = \frac{V_1 - V'_1}{V_0\Delta\theta} \Rightarrow \gamma_\ell = \gamma_a + \gamma_c$$