11 Physics – Heat & Thermodynamics Important Formula

Temperature scales

$$F = 32 + \frac{9}{5}C,$$

$$K = C + 273.16$$

Ideal gas equation

$pV = nRT,$ n:number of moles

van der Waals equation

$$\left(p + \frac{a}{V^2}\right)(V - b) = nRT$$

Thermal expansion

Linear Expansion : $L = L_0(1 + \alpha\Delta T)$

Area Expansion : $A = A_0(1 + \beta\Delta T),$

Volume Expansion : $V = V_0(1 + \gamma\Delta T),$

Relation : $\gamma = 2\beta = 3\alpha$

Thermal stress of a material

$$\frac{F}{A} = Y\frac{\Delta t}{t}$$

General

$M = mN_A,$ $k = R/ N\_A$

RMS speed

$$v_{rms} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{M}}$$

Average speed

$$v = \sqrt{\frac{8kT}{\pi m}} = \sqrt{\frac{8RT}{\pi M}}$$

Most probable speed

$$v_p = \sqrt{\frac{2kT}{m}}$$

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Pressure	$p = \frac{1}{3}\rho v_{rms}^2$
Internal energy	$U = \frac{f}{2} nRT$
Specific heat	$s = \frac{Q}{m\Delta T}$
Latent heat	$L = \frac{Q}{m}$
Specific heat at constant volume	$C_v = \frac{\Delta Q}{n\Delta T}\|_V$
Specific heat at constant pressure	$C_p = \frac{\Delta Q}{n\Delta T}\|_p$
Relation between C_p and C_v	$C_p - C_v = R$
Ratio of specific heats	$\gamma = \frac{C_p}{C_V}$
Relation between U and C_v	$\Delta U = nC_v\Delta T$
Specific heat of gas mixture	$C_v = \frac{n_1 c_{v1} + n_2 C_{v2}}{n_1 + n_2}, \ \gamma = \frac{n_1 C_{p1} + n_2 C_{p2}}{n_1 c_{v1} + n_2 C_{v2}}$
First law of thermodynamics	$\Delta Q = \Delta U + \Delta W$
Efficiency of the heat engine	$\eta = \frac{\text{work done by the engine}}{\text{heat supplied to it}} = \frac{Q_1 - Q_2}{Q_1}$
Conduction	$\frac{\Delta Q}{\Delta t} = -K\,A\frac{\Delta T}{x}$

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Kirchhoff's Law

$$\frac{\text{emmissive power}}{\text{absorptive power}} = \frac{E_{body}}{\mathrm{a}_{\mathrm{body}}} = E_{blackbody}$$

Wien's displacement law

$$\lambda_m T = b$$

Stefan – Boltzmann law

$$\frac{\Delta Q}{\Delta t} = \sigma e A T_4$$

Newton's law of cooling

$$\frac{dT}{dt} = -k(T - T_0)$$