

PHYS2080 Equation Sheet

Thermodynamics

$$\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$$

$$k_B = 1.38 \times 10^{-23} \text{ J/K}$$

$$R = 8.31 \text{ J/(mol.K)}$$

$$T_K = T_C + 273 \text{ K,}$$

$$\Delta T_K = \Delta T_C$$

$$T_F = \frac{9}{5} T_C + 32^\circ \text{F,}$$

$$T_C = \frac{5}{9} (T_F - 32)$$

$$\Delta L = \alpha L_0 \Delta T$$

$$\Delta A \approx 2\alpha A_0 \Delta T$$

$$\Delta V = \beta V_0 \Delta T \approx 3\alpha V_0 \Delta T$$

$$P_{\text{conduction}} = \frac{Q}{\Delta t} = k \frac{A}{l} (T_{\text{hot}} - T_{\text{cold}})$$

$$P_{\text{radiated}} = \frac{Q}{\Delta t} = \sigma e A T^4$$

$$PV = nRT,$$

$$nR = Nk_B$$

$$n = \frac{m}{M} = N/N_A$$

$$Q = mc\Delta T$$

$$Q = \pm mL$$

$$\text{At constant pressure: } Q = nC_P \Delta T$$

$$\text{At constant volume: } Q = nC_V \Delta T$$

$$C_P = C_V + R$$

$$K_{\text{avg,translational}} = \frac{3}{2} k_B T$$

$$K_{\text{tot}} = \frac{3}{2} Nk_B T = U \text{ (monoatomic gas)}$$

$$v_{\text{rms}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3k_B T}{m}}$$

$$v_{\text{avg}} = \sqrt{\frac{8RT}{\pi M}}$$

$$v_{\text{mp}} = \sqrt{\frac{2RT}{M}}$$

$$\Delta U = Q - W$$

$$\text{Isobaric process: } W = P\Delta V$$

$$\text{Isochoric process: } W = 0$$

$$\text{Isothermal process: } W = nRT \ln \frac{V_f}{V_i} = Nk_B T \ln \frac{V_f}{V_i} = P_i V_i \ln \frac{V_f}{V_i} = P_f V_f \ln \frac{V_f}{V_i}$$

$$PV = \text{constant}$$

$$PV^\gamma = \text{constant}$$

$$\gamma = C_P / C_V$$

$$W = Q_h - Q_c$$

$$e = W / Q_h = 1 - \frac{|Q_c|}{Q_h}$$

$$e_{\text{Carnot}} = 1 - \frac{T_C}{T_H}$$

$$\text{COP: } K_{\text{Cooling}} = \frac{Q_c}{W_{\text{motor}}} = \frac{Q_c}{|Q_h| - Q_c}$$

$$K_{\text{Heating}} = \frac{|Q_h|}{W_{\text{motor}}} = \frac{|Q_h|}{|Q_h| - Q_c}$$

$$\text{Carnot COP } K_{\text{Carnot,Heating}} = \frac{T_h}{T_h - T_c}$$

$$K_{\text{Carnot,Cooling}} = \frac{T_c}{T_h - T_c}$$

Basic Geometry

$$A_{\text{sphere}} = 4\pi R^2$$

$$A_{\text{cube}} = 6a^2$$

$$A_{\text{triangle}} = \frac{1}{2} bh$$

$$V_{\text{cylinder}} = \pi R^2 h$$

$$V_{\text{sphere}} = \frac{4}{3} \pi R^3$$

$$V_{\text{cube}} = a^3$$

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Sebastian Brünink



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