Important Values and Constants

by SuCh

$$\pi = \frac{22}{7} = 3.14$$
$$e = \frac{100}{37} = 2.718$$
$$\ln 2 = 0.693 \; ; \log 2 = 0.3 \; ; \sqrt{2} = 1.414$$

1 MECHANICS

1.1 Gravitational Constant: $G = 6.67 \times 10^{-11} \approx \frac{20}{3} \times 10^{-11} \; \frac{N-m^2}{kg^2}$

1.2 Reynold's Number: R

$$0 < R \leq 2000 \rightarrow \textit{Streamline}$$
$$2000 < R \leq 3000 \rightarrow \textit{Unstable}$$
$$R > 3000 \rightarrow \textit{Turbulent}$$

1.3 Velocity of sound at STP: $v_{sound} \approx 330 \; \frac{m}{s}$

1.4 Acceleration due to gravity: $g = 9.8 = \pi^2 \approx 10 \frac{m}{s^2}$

2 THERMAL PHYSICS

2.1 Molar Gas Constant: $R = 8.314 \approx \frac{25}{3} \; \frac{J}{mol-K}$

$= 0.0821 \; \frac{L-atm}{mol-K} = 2 \; \frac{cal}{K.mol}$

2.2 Avogadro's Constant: $N_A = 6.023 \; or \; 6.022 \times 10^{23} \frac{1}{mol}$

2.3 Boltzmann Constant: $k_B = 1.38 \times 10^{-23} \frac{J}{K}$

$$R = N_A \cdot k_B$$

2.4 Atomic Mass Unit: $1amu = 1.66 \times 10^{-27} \; kg$

2.5 KTG Speeds: $v_{rms} : v_{av} : v_{mp} = 1.224 : 1.128 : 1$

2.6 Ratio of specific heat: $\gamma = {C_p}/{C_v}$

$Mono \rightarrow \frac{5}{3} = 1.67 \mid Di \rightarrow \frac{7}{5} = 1.40 \mid Tri \rightarrow \frac{9}{7} \; open \; or \; \frac{8}{6} \; (closed)$

2.7 Standard Atmosphere: $1 \; atm = 1.01325 \times 10^5 \; Pa = 1.01325 \; bar = 760 \; Torr$

2.8 Stefan-Boltzmann Constant: $\sigma = 5.67 \times 10^{-8} \frac{W}{m^2 \cdot K^4}$

2.9 Wien Displacement Constant: $b = 0.0029 \; mK$

2.10 Dulong Petit Law: $C_{v,solids} \approx 3R$

2.11 Specific Heat Capacity: $s_w = 1 \frac{cal}{gm-℃} = 1 \frac{kcal}{kg-℃} = 4200 \frac{J}{kg-℃}$

$$s_{ice} = s_{steam} = {s_w}/{2} = 2100$$

2.12 Latent Heat: $L_{vap} = 540 \frac{cal}{gm} \mid L_{fus} = 80 \frac{cal}{gm}$

2.13 Ebullioscopic Constant: $K_b = 0.51$ | Cryoscopic Constant: $K_f = 1.86 \; \frac{K-kg}{mol}$

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3 ELECTRICITY and MAGNETISM

3.1 Coulombs Constant: $k = \frac{1}{4\pi\epsilon_\circ} = 9 \times 10^9 \frac{N-m^2}{C^2}$

3.2 Charge: $1\text{C} = 3 \times 10^9\ esu$

$1e = 1.6 \times 10^{-19}\ \text{C}$

3.3 Atomic masses: $m_{p^+} \approx m_n = 1.673 \times 10^{-27}\ kg$

$m_{e^-} = 9.1 \times 10^{-31}\ \approx 10^{-30}\ kg$

3.4 Electric **Permittivity** of free space(vacuum): $\epsilon_\circ = 8.85 \times 10^{-12} \frac{\text{F}}{m}$

3.5 Magnetic **Permeability** of free space(vacuum): $\mu_\circ = 4\pi \times 10^{-7} \frac{N}{A^2}$

$$c = \frac{1}{\sqrt{\mu_\circ \epsilon_\circ}}$$

3.6 Faraday Constant: $\text{F} = 96485 \frac{\text{C}}{mol}$

3.7 Bohr Magneton: $\mu_\text{B} = 9.27 \times 10^{-24} J/\text{T}$

4 MODERN PHYSICS

4.1 Speed of light: $c \approx 3 \times 10^8 \frac{m}{s}$

4.2 Energy: $1eV = 1.6 \times 10^{-19} J$

$1u = 931.5 \frac{MeV}{c^2}$

$hc = 12400\ eV\text{Å}$

4.3 Wavelength: $\lambda(\text{Å}) = \frac{12400}{E(eV)}$

4.4 Visible Light (VIBGYOR): $400nm \rightarrow 700nm \mid E_{max} = 3.1eV; E_{min} = 1.8eV$

4.5 Davisson and Germer Exp.: For Ni ~

Interatomic distance, $a = 2.15\text{Å}$ | Interplanar distance, $d = 0.91\text{Å}$

4.6 Bohr's Atom: Radius~ $a_\circ = 0.529\ \text{Å} \mid r_n = a_\circ \frac{\text{n}^2}{Z}$

Velocity~ $v_\circ = 2.18 \times 10^6 \frac{m}{s} \mid v_n = v_\circ \frac{Z}{n}$

Energy~ $E_\circ = -2.18 \times 10^{-18} J = -13.6\ eV \mid E_n = E_\circ \frac{Z^2}{n^2}$

4.7 H-atom Energy Levels: $13.6 \rightarrow 3.4 \rightarrow 1.5 \rightarrow 0.85 \rightarrow 0.544\ eV$

4.8 Rydberg's Constant: $\text{R}_\infty = 1.097 \times 10^7 \frac{1}{m} \mid \text{R}_\infty \cdot hc = 13.6\ eV$

4.9 Planck Constant: $h = 6.63 \times 10^{-34}\ Js$

4.10 X-Rays: $\lambda_{Hard} < 10\text{Å} < \lambda_{Soft}$

4.11 Density of Nucleus $\approx 10^{18} \frac{kg}{m^3}$ | Fe, Z = 56 has $(\frac{\text{BE}}{\text{Nucleon}})_{max} = 8.8\ MeV$

4.12 Radioactivity: $t_{avg} = 1.44 t_{\frac{1}{2}} | E_{fission} \approx 200\ MeV | E_{fusion} \approx 25\ MeV | KE, Thermal\ e^- \approx 0.4eV$