

EQUATIONS FOR FINAL EXAM

ELEMENTS OF PHYSICS, SPRING 2022

Last modified: May 5, 2022

These equations will be provided as a part of the exam package.

$$\begin{aligned}
 s_{\text{av}} &= d/t, & a &= \Delta v/\Delta t, & d &= g t^2/2, & a &= F_{\text{net}}/m, & W &= m g, & p &= m v, & \Delta p &= F \Delta t, \\
 KE &= m v^2/2, & W &= F d, & W &= \Delta KE, & PE_g &= m g h, & W &= \Delta PE, & P &= \Delta E/\Delta t, & g &= 10 \text{ m/s}^2, \\
 F &= G m M/d^2, & G &= 6.7 \times 10^{-11} \text{ Nm}^2/\text{kg}^2, & F_{\text{buoyant}} &= D_{\text{fluid}} V g, & P &= F/A, & 1 \text{ atm} &= 1.01 \times 10^5 \text{ Pa}, \\
 P_g &= P - P_{\text{atm}}, & D &= M/V, & P &= D g h, & P_i V_i &= P_f V_f, & T_K &= T_C + 273, & P V &= N k T, \\
 1 \text{ cal} &= 4.2 \text{ J}, & \Delta U &= Q(\text{in}) + W(\text{on}), & Q &= c m \Delta T, & Q &= m L, & e &= 1.6 \times 10^{-19} \text{ C}, \\
 F &= k \frac{q Q}{d^2}, & k &= 9 \times 10^9 \text{ Nm}^2/\text{C}^2, & E &= F/q, & W &= \Delta EPE, & V &= EPE/q, & W &= \Delta V q, \\
 I &= q/t, & I &= V/R, & P &= I V, & F_m &= q v B, & V_s/V_p &= N_s/N_p, & V_p I_p &= V_s I_s, \\
 f &= 1/T, & v &= \lambda/T = \lambda f, & c &= 3 \times 10^8 \text{ m/s}, & E &= h f, & h &= 6.63 \times 10^{-34} \text{ Js} = 4.14 \times 10^{-15} \text{ eVs}, \\
 KE &= h f - \phi, & r_n &= (0.053 \text{ nm}) n^2, & E_n &= -\frac{13.6 \text{ eV}}{n^2}
 \end{aligned}$$

Properties of water

- Density liquid water: $D_w = 1.0 \text{ g/cm}^3 = 1000 \text{ kg/m}^3$
- Density of ice: $D_i = 0.92 \text{ g/cm}^3 = 920 \text{ kg/m}^3$
- Specific heat of liquid water: $c_w = 1 \frac{\text{cal}}{\text{g}^\circ\text{C}} = 4190 \text{ J/kg}\cdot\text{K}$
- Specific heat of ice: $c_i = 0.5 \frac{\text{cal}}{\text{g}^\circ\text{C}} = 2090 \text{ J/kg}\cdot\text{K}$
- Latent heat of melting/freezing: $L_{wi} = 80 \text{ cal/g} = 334 \text{ kJ/kg}$
- Latent heat of vaporization: $L_{wv} = 540 \text{ cal/g} = 2260 \text{ kJ/kg}$