FAFA45

Basic mechanics and electronics

Momentary Speed

$$v_{medel} = \frac{s}{t},\ \ v_{momentant} = \frac{ds}{dt}$$

Momentary Acceleration

$$a_{medel} = \frac{v}{t} = \frac{v^2 - V_0^2}{2s}$$

$$a_{momentan} = \frac{dv}{dt} = \frac{d^2x}{dt^2}$$

Momentum

$$\mathbf{p = m \cdot v}$$

Force

$$\mathbf{F} = \frac{d\mathbf{p}}{dt} = \frac{m \cdot d\mathbf{v}}{dt} = m \cdot \mathbf{a}$$

Work

$$W = \int_{s_1}^{s_2} \mathbf{F} \cdot \mathbf{ds}$$

Kinetic energy

$$W_[kin] = \frac{m \cdot v^2}{2}$$

Potential energy

$$W_{pot} = -\int_{A}^{B} \mathbf{F} \cdot \mathbf{ds = W_{pot}(B) - W_{pot}(A)}$$

Effect

$$P_{medel} = \frac{W}{t}$$

$$P_{momentan} = \frac{dW}{dt}$$

Coulumbs law

$$F = \frac{1}{4\pi\epsilon_0}\frac{q_1 \cdot q_2}{r^2}$$

Electric flow

$$\Phi_E = \mathbf{E \cdot dA}$$

Force on charge in electric field

$$\mathbf{F = q \cdot E}$$

Force on charge in electric field

$$F = q \cdot v \cdot B$$

Where v is perpendicular to B.

Electric potential energy

$$W = q \cdot E \cdot d$$

Voltage

$$U = \frac{W}{q}$$

Energy in condensator

$$W = \frac{1}{2} \cdot Q \cdot U$$

Instantaneous current

$$I_{medel} = \frac{Q}{t}, i = \frac{dq}{dt}$$

Ohms law

$$U = R \cdot I$$

Resistivity

$$R = \rho\frac{L}{A}$$

Temperature dependence

$$R_t = R_0[1 + \alpha(T - T_0)]$$

Where R_0 is the resistance at temperature T_0

Battery

$$U = E - R_i \cdot I$$

Electric average power

$$P_{medel} = \frac{W}{t} = U \cdot I$$

Series circuit

$$U_{TOT} = U_1 + U_2 + ...$$

Resistance in series circuit

$$R_{TOT} = R_1 + R_2 + ...$$

Parallel circuit

$$I_{TOT} = I_1 + I_2 + ...$$

Resistance in Parallel circuit

$$\frac{1}{R_{TOT}} = \frac{1}{R_1} + \frac{1}{R_2} + ...$$

Kirchhoffs law 1

$$I_1 + I_2 + I_3 + ... = 0$$

Kirchhoffs law 2

$$U_1 - R_1 I - R_2 I - U_2 = 0$$

Charge of condensator

$$Q = C \cdot U$$

Plate capacitor

$$C = \frac{\epsilon_r \epsilon_0 A}{d}$$

Energy in Capacitor

$$W = \frac{Q \cdot U}{2}$$

Capacitance is series circuit

$$\frac{1}{C_{TOT}} = \frac{1}{C_1} + \frac{1}{C_2} + ...$$

Capacitance is Parallel circuit

$$C_{TOT} = C_1 + C_2 + ...$$

Magnetic flow

$$\Phi_m = \mathbf{B} \cdot \mathbf{dA}$$

Magnetic field around a long straight conductor

$$B = \frac{\mu_0 \cdot I}{2\pi \cdot}$$

Magnetic field in long straight coil

$$B = \frac{\mu_r \mu_0 N \cdot I}{l}$$

Induced Voltage

$$u_{ind} = -\frac{d\Phi_m}{dt}$$

Self induction in coil

$$u_{ind} = -L \cdot \frac{di}{dt}$$

Energy in coil

$$w = \frac{L \cdot I^2}{2}$$

Angular frequency

$$\omega = 2\pi \cdot f = \frac{2\pi}{T}$$

Instantaneous value, alternating voltage

$$u = \hat{u} \cdot sin(\omega t + \alpha)$$

Effective value

$$u = \frac{\hat{u}}{\sqrt{2}}$$

Impedance of Coil

$$Z_L = \omega \cdot L$$

Capacitor impedance

$$Z_C = \frac{1}{\omega C}$$

Total impedance

$$Z = \sqrt{|Z_L - Z_C|^2 + R^2}$$

$$Z = \frac{u}{i}$$

Resonance

$$f_{res} = \frac{1}{2\pi\sqrt{LC}}$$

Thermodynamics

Heat expansion

$$\frac{\Delta L}{L} = \alpha \Delta T$$

$$\frac{\Delta V}{V} = \beta \Delta T$$

$$\beta = 3\alpha$$

Heat

$$Q = mc\Delta T$$

$$l_s = \frac{Q_s}{m}$$

$$l_a = \frac{Q_a}{m}$$

Fluid preassure

$$p_{tot} = p_{\text{fluid}} + p_{\text{air}} = \rho g h + p_{\text{air}}$$

Ideal gas law

$$pV = NkT$$

$$pV = nRT$$

Gas density and particle density

$$\rho = \frac{m_{tot}}{V} = \frac{pM}{RT}, \quad n_o = \frac{N}{V} = \frac{p}{kT}$$

Barometric height formula

$$p = p_0 e^{-\rho_0 g h / p_0}, \quad h = \frac{p_0}{\rho_0 g} \ln \frac{p_0}{p}$$

Relative humidity

$$R_M = \frac{p_{\text{water}}}{p_{\text{saturation}}}$$

van der Waals' equation

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

Critical point

$$V_k = 3nb, \quad T_k = \frac{8a}{27Rb}, \quad p_k = \frac{a}{27b^2}$$