Selected formulas

Kinematics

velocity	$\vec{v} = \frac{\Delta\vec{r}}{\Delta t}$
acceleration	$\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$
angular velocity	$\omega = \frac{\Delta\alpha}{\Delta t}$
velocity in circular motion	$v = \omega \cdot r$
Centripetal acceleration	$a_{cp} = \frac{v^2}{r} = \omega^2 \cdot r$
Angular acceleration	$\varepsilon = \frac{\Delta\omega}{\Delta t}$
Transverse acceleration	$a_{tr} = \varepsilon \cdot r$
velocity in accelerated movement in a straight line	$v = v_0 + a \cdot t$
distance in accelerated movement in a straight line	$s = v_0 \cdot t + \frac{1}{2} a \cdot t^2$

Oscillations and Waves

simple harmonic motion	$x(t) = A \cdot \sin(\omega t + \varphi)$ $v(t) = A \cdot \omega \cdot \cos(\omega t + \varphi)$ $a(t) = -A \cdot \omega^2 \cdot \sin(\omega t + \varphi)$
period of oscillations (mass on a spring and a simple pendulum)	$T = 2\pi\sqrt{\frac{m}{k}}$; $T = 2\pi\sqrt{\frac{l}{g}}$
frequency and wavelength	$f = \frac{1}{T}$; $\lambda = v \cdot T$
wave refraction	$\frac{\sin(\theta_1)}{\sin(\theta_2)} = \frac{v_1}{v_2} = \frac{n_2}{n_1}$
diffraction grating	$n \cdot \lambda = d \cdot \sin(\alpha)$
Doppler effect	$f = f_0 \frac{v_{sound} \pm v_{obs}}{v_{sound} \mp v_{source}}$

Contemporary Physics

mass-energy equivalence	$E = m \cdot c^2 = \frac{m_0 \cdot c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$
photon energy	$E = h \cdot f = \frac{h \cdot c}{\lambda}$
photoelectric effect	$h \cdot f = W + E_{k\,max}$
de Broglie wavelength	$\lambda = \frac{h}{p}$
relativistic momentum	$p = \frac{m_0 \cdot v}{\sqrt{1 - \frac{v^2}{c^2}}}$
radioactive decay	$N = N_0 \cdot \exp(-\lambda \cdot t) = = N_0 \cdot 2^{\frac{t}{T_{1/2}}}$
energy levels of hydrogen atom	$E_n = \frac{-13.6\ eV}{n^2}$
Hubble's law	$v = H \cdot r$

Dynamics

momentum	$\vec{p} = m \cdot \vec{v}$
II Newton's law	$\vec{F} = m \cdot \vec{a} = \frac{\Delta\vec{p}}{\Delta t}$
moment of force	$M = r \cdot F \cdot sin\sphericalangle(\vec{r};\vec{F})$
moment of inertia	$I = \sum_{i=1}^{n} m_i \cdot r^2$
angular momentum of a material point	$L = m \cdot v \cdot r \cdot sin\sphericalangle(\vec{r};\vec{v})$
angular momentum of a rigid body	$L = I \cdot \omega$
II Newton's Law for angular motion	$\frac{\Delta L}{\Delta t} = M$; $\varepsilon = \frac{M}{I}$
work	$W = F \cdot \Delta x \cdot cos\sphericalangle(\vec{F};\Delta\vec{x})$
power	$P = \frac{W}{\Delta t}$
translational kinetic energy	$E_{kin} = \frac{1}{2} m \cdot v^2$
rotational kinetic energy of a rigid body	$E_{kin} = \frac{1}{2} I \cdot \omega^2$

Gravity, Elasticity, and Friction

Newton's law of universal gravitation	$F_g = G\frac{m_1 \cdot m_2}{r^2}$
gravitational field intensity	$\vec{\gamma} = \frac{\vec{F_g}}{m}$
gravitational potential energy	$E_p = -G\frac{m_1 \cdot m_2}{r}$
changes in gravitational potential energy of an object near the surface of the Earth	$\Delta E_p = m \cdot g \cdot \Delta h$
the first and second cosmic velocities for Earth	$v_I = \sqrt{\frac{G \cdot M_E}{R_E}}$; $v_{II} = \sqrt{\frac{2 \cdot G \cdot M_E}{R_E}}$
Kepler's third law	$\frac{T_1^2}{R_1^3} = \frac{T_2^2}{R_2^3} = \text{const}$
spring force (Hooke's law)	$\vec{F_s} = -k \cdot \vec{x}$
elastic potential energy	$E_{pot} = \frac{1}{2} k \cdot x^2$
kinetic friction	$F_{kf} = \mu_k \cdot F_N$
static friction	$F_{sf} \leq \mu_s \cdot F_N$

Optics

critical angle	$\sin(\theta_c) = \frac{n_2}{n_1}$
Brewster's angle	$\text{tg}(\theta_B) = \frac{n_2}{n_1}$
thin lens equation, mirror equation	$\frac{1}{x} + \frac{1}{y} = \frac{1}{f}$
lensmaker's equation (thin lens approximation)	$\frac{1}{f} = \left(\frac{n_{lens}}{n_0} - 1\right)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$
spherical mirrors	$f = \frac{R}{2}$

Thermodynamics	
density	$\rho = \frac{m}{V}$
pressure	$P = \frac{F}{S}$
difference in hydrostatic pressure	$\Delta P = \rho \cdot g \cdot h$
buoyant force	$F_B = \rho_F \cdot V \cdot g = m_F \cdot g$
first law of thermodynamics	$\Delta U = Q - W$
work done by a gas at a constant pressure	$W = P \cdot \Delta V$
specific heat	$c = \frac{Q}{m \cdot \Delta T}$
molar specific heat	$C = \frac{Q}{n \cdot \Delta T}$
latent heat	$L = \frac{Q}{m}$
the average translational kinetic energy of molecules of an ideal gas	$E_k = \frac{3}{2} k_B \cdot T$
ideal gas law (equation of state for an ideal gas)	$P \cdot V = n \cdot R \cdot T$
heat engine efficiency	$e = \frac{W}{Q_H} = \frac{Q_H - Q_L}{Q_H}$
efficiency of Carnot engine	$e = \frac{T_H - T_L}{T_H} = 1 - \frac{T_L}{T_H}$

Magnetic Field	
force on an electric charge *q* moving in a magnetic field *B*	$F = q \cdot v \cdot B \cdot sin\sphericalangle(\vec{v}; \vec{B})$
force on a wire carrying a current *I* with length *l* in a uniform magnetic field *B*	$F = I \cdot l \cdot B \cdot sin\sphericalangle(\vec{l}; \vec{B})$
magnetic field *B* in free space due to current in a long straight wire	$B = \frac{\mu_0 \cdot I}{2\pi \cdot r}$
magnetic field at the centre of a current loop	$B = \frac{\mu_0 \cdot \mu_r \cdot I}{2 \cdot r}$
magnetic field inside a solenoid	$B = \frac{\mu_0 \cdot \mu_r \cdot N \cdot I}{l}$
magnetic flux	$\Phi_B = B \cdot A \cdot cos\sphericalangle(\vec{B}; \vec{A})$
electromotive force (Faraday's law of induction)	$\mathcal{E} = -\frac{\Delta \Phi_B}{\Delta t}$
electromotive force of self-induction	$\mathcal{E} = -L\frac{\Delta I}{\Delta t}$
alternating current - effective or rms (root-mean-square) values of current and voltage	$I_{rms} = \frac{I_0}{\sqrt{2}}$; $V_{rms} = \frac{V_0}{\sqrt{2}}$

Electric Current	
electric current (definition)	$I = \frac{\Delta Q}{\Delta t}$
electric power	$P = V \cdot I = \frac{V^2}{R} = I^2 \cdot R$
resistance and resistivity	$R = \rho \cdot \frac{l}{A}$
Ohm's Law	$I = \frac{V}{R}$
terminal voltage of an electric cell	$V = \mathcal{E} - I \cdot r$
equivalent resistance (resistors in series and in parallel)	$R_{eq} = \sum_{i=1}^{n} R_i$ $\frac{1}{R_{eq}} = \sum_{i=1}^{n} \frac{1}{R_i}$
equivalent capacitance (capacitors in series and in parallel)	$\frac{1}{C_{eq}} = \sum_{i=1}^{n} \frac{1}{C_i}$ $C_{eq} = \sum_{i=1}^{n} C_i$

Electrostatics	
Coulomb's Law	$F = k\frac{q_1 \cdot q_2}{r^2}$
electric field	$\vec{E} = \frac{\vec{F}}{q}$
voltage	$V = \frac{W}{q}$
relationship between voltage and uniform electric field	$V = E \cdot d$
capacitance; capacitance of a parallel plate capacitor	$C = \frac{q}{V}$ $C = \frac{\varepsilon \cdot A}{d} = \frac{\varepsilon_0 \cdot \varepsilon_r \cdot A}{d}$
energy stored on a capacitor	$W = \frac{1}{2} q \cdot V = \frac{1}{2} C \cdot V^2$