Prefixes

a=10^{-18}, f=10^{-15}, p=10^{-12}, n=10^{-9}, $\mu = 10^{-6}$, m=10^{-3}, c=10^{-2}, k=10^{3}, M=10^{6}, G=10^{9}, T=10^{12}, P=10^{15}.
atto, femto, pico, nano, micro, milli, centi, kilo, mega, giga, tera, peta.

Physical Constants

$g = 9.80$ m/s^2 (gravitational acceleration)
$M_E = 5.98 \times 10^{24}$ kg (mass of Earth)
$m_e = 9.11 \times 10^{-31}$ kg (electron mass)
$c = 299792458$ m/s (exact speed of light)
$u = 1.6605 \times 10^{-27}$ kg (atomic mass unit)
$R = 8.314$ J/mol·K (gas constant)
$G = 6.67 \times 10^{-11}$ N·m^2/kg^2 (Gravitational constant)
$R_E = 6380$ km (mean radius of Earth)
$m_p = 1.67 \times 10^{-27}$ kg (proton mass)
$\sigma = 5.67 \times 10^{-8}$ W/m^2·K^4 (Stefan-Boltzmann constant)
$N_A = 6.022 \times 10^{23}$/mol (Avogadro's number)
$k = 1.38 \times 10^{-23}$ J/K (Boltzmann's constant)

Units and Conversions

1 inch = 1 in = 2.54 cm (exact)
1 mile = 5280 ft (exact)
1 m/s = 3.6 km/hour (exact)
1 acre = 43560 ft^2 = (1 mile)^2/640 (exact)
1 foot = 1 ft = 12 in = 30.48 cm (exact)
1 mile = 1609.344 m = 1.609344 km (exact)
1 ft/s = 0.6818 mile/hour
1 hectare = 10^4 m^2 (exact)

symbol	element	atomic number	mass number
H	hydrogen	1	1.00794
He	helium	2	4.00260
C	carbon	6	12.0107
N	nitrogen	7	14.0067
O	oxygen	8	15.9994
Ne	neon	10	20.180
Ar	argon	18	39.948
Fe	iron	26	55.845
Ni	nickel	28	58.693
Cu	copper	29	63.546
Au	gold	79	196.97
U	uranium	92	238.03

← Some Elemental Properties

Mass numbers are atomic masses in units of "u" where 1 u = 1.6605×10^{-27} kg, or, molar masses for the element (1 mole = 6.02×10^{23} atoms), measured in grams/mole. ($N_A \times 1$ u = 1 gram)

Trig summary

$\sin\theta = (\text{opp})/(\text{hyp})$, $\cos\theta = (\text{adj})/(\text{hyp})$, $\tan\theta = (\text{opp})/(\text{adj})$, $(\text{opp})^2 + (\text{adj})^2 = (\text{hyp})^2$.
$\sin\theta = \sin(180^\circ - \theta)$, $\cos\theta = \cos(-\theta)$, $\tan\theta = \tan(180^\circ + \theta)$, $\sin^2\theta + \cos^2\theta = 1$.

Vectors:

written $\vec{V}$ or $\mathbf{V}$, described by magnitude=V, direction=θ or by components (V_x, V_y).
$V_x = V\cos\theta$, $V_y = V\sin\theta$,
$V = \sqrt{V_x^2 + V_y^2}$, $\tan\theta = V_y/V_x$. θ is the angle from $\vec{V}$ to x-axis.
Addition: $\mathbf{A} + \mathbf{B}$, head to tail. Subtraction: $\mathbf{A} - \mathbf{B}$ is $\mathbf{A} + (-\mathbf{B})$, $-\mathbf{B}$ is $\mathbf{B}$ reversed.

Forces, Work, Energy

$F_{\text{gravity},y} = -mg$, $F_{\text{spring}} = -kx$, $W = Fd\cos\theta$, θ = angle btwn $\vec{F}$ and $\vec{d}$.
$\text{PE}_{\text{gravity}} = mgy$, $\text{PE}_{\text{spring}} = \frac{1}{2}kx^2$, $\text{KE} = \frac{1}{2}mv^2$.

Conservation or Transformation of Energy:

Work-KE theorem:
$\Delta\text{KE} = W_{\text{net}}$ = work of all forces.

General energy-transformation law:
$\Delta\text{KE} + \Delta\text{PE} = W_{\text{NC}}$ = work of non-conservative forces.

Power:

$P_{\text{ave}} = W/t$, or use P_{ave} = energy/time.

OpenStax Ch. 11: Static Fluids

Density:

$\rho = m/V$, SG=$\rho/\rho_{\mathrm{H_2O}}$, $\rho_{\mathrm{H_2O}} = 1000$ kg/m^3 = 1.00 g/cm^3 (at 4°C).

Static Pressure, Buoyancy:

$P = F/A$, $P_2 = P_1 + \rho g h$, $\Delta P = \rho g h$, $P = P_{\mathrm{atm.}} + P_G$, $B = \rho g V$ or $F_B = \rho g V$.

Pressure Units:

1 Pa = 1 N/m^2, 1 bar = 10^5 Pa = 100 kPa, 1 mm-Hg = 133.3 Pa.

1.00 atm = 101.3 kPa = 1.013 bar = 760 torr = 760 mm-Hg =14.7 lb/in^2.

OpenStax Ch 12: Fluid Dynamics

Moving fluid:

$Q = A_1 v_1 = A_2 v_2 =$ a constant, Bernouli Eqn: $P + \frac{1}{2}\rho v^2 + \rho g y =$ a constant.

Viscosity:

Definition: $F = \eta A v/\ell$, Poiseuille Eqn: $Q = \pi r^4 (P_2 - P_1)/(8\eta L)$.

OpenStax Ch 13: Ideal Gases & Kinetic Theory

Atomic Theory & Moles:

$n = \frac{N}{N_A}$, $n = \frac{M}{M_A}$, M=sample, $N_A = 6.022 \times 10^{23}$/mol, 1 u = $\frac{1 \text{ gram}}{N_A} = 1.6605 \times 10^{-27}$ kg.

Temperature scales:

T(°C) = $\frac{5}{9}$[T(°F)-32], T(°F)=$\frac{9}{5}$ T(°C)+32, T(K)=T(°C)+273.15

Thermal Expansion:

$\Delta L = \alpha L_0 \Delta T$, $\Delta V = \beta V_0 \Delta T$.

Ideal Gas Law:

$PV = nRT$, or $PV = N k_{\mathrm{B}} T$, $R = 8.314$ J/mol·K, $k_{\mathrm{B}} = R/N_A = 1.38 \times 10^{-23}$ J/K.

Kinetic Theory:

$\overline{\mathrm{KE}} = \frac{1}{2} m v_{\mathrm{rms}}^2 = \frac{3}{2} k_{\mathrm{B}} T$, $v_{\mathrm{rms}} = \sqrt{3 k_{\mathrm{B}} T/m} = \sqrt{3RT/M_A}$, $m = M_A/N_A =$ atom or molecule.

OpenStax Ch 16: Oscillations and Waves

Oscillators, frequency, period, etc.:

$F = -kx = ma$, $f = 1/T$, $\omega = 2\pi f = 2\pi/T$, $\omega = \sqrt{k/m}$, $\omega = \sqrt{g/L}$.

Oscillator energy, speed, etc.:

$E = \frac{1}{2} m v^2 + \frac{1}{2} k x^2 = \frac{1}{2} k A^2 = \frac{1}{2} m v_{\mathrm{max}}^2$, $v_{\mathrm{max}} = \omega A$.

Waves:

$\lambda = vT$, $v = f\lambda$, $v = \sqrt{F_T/(m/L)}$, $I = P/A$, $I = P/4\pi r^2$.

Standing waves:

node to node distance = $\lambda/2$, sketch displacement of string or molecules.

nodes at both ends of strings. nodes (antinodes) at closed (open) ends of pipes.

OpenStax Ch 17: Sound

Sound in air:

$v \approx (331 \text{ m/s})\sqrt{T(\mathrm{K})/273 \text{ K}}$, T in kelvin, $v = 343$ m/s at 20°C, $d = vt$.

Sound intensity, Sound level:

$I = P/A$, $I = P/4\pi r^2$, $\beta = (10 \text{ dB}) \log(I/I_0)$, $I = I_0 \ 10^{\beta/(10 \text{ dB})}$, $I_0 = 10^{-12}$ W/m^2.