Stoß (elastisch): $\Delta E_{kin} = 0$

$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$

$v_1' = \frac{(m_1 - m_2) v_1 + 2 m_2 v_2}{(m_1 + m_2)}$

$v_2' = \frac{(m_2 - m_1) v_2 + 2 m_1 v_1}{m_1 + m_2}$ $\quad p = F\Delta t$

Stoß (unelastisch): $\Delta E_{kin} > 0$

$m_1 v_1 + m_2 v_2 = (m_1 + m_2) v'$

$v' = (m_1 v_1 + m_2 v_2) / (m_1 + m_2)$

Wellen: $c = \lambda f$

$v_{long} = \sqrt{\frac{E}{\rho}}$ $\quad v_{trans} = \sqrt{\frac{\sigma}{\rho}}$

$v = v_0 + v_A \ln(m_0 / m)$

Überschall: $\sin\varphi = c/v = 1/M$

Doppler: $f' = f(c \pm v_E)/(c \mp v_S)$ $\quad \frac{\text{Annäh.}}{\text{entf.}}$

Rotation: $\omega = 2\pi/T$ $\quad v = \omega r$

$\alpha = \omega^2 r$ $\quad T = 1/f$ $\quad W = \int F dx$

$\vec{M} = J\vec{\alpha} = \vec{r} \times \vec{F} = \vec{\tau}$ $\quad \vec{L} = J\vec{\omega}$

$J = \int r^2 dm$ $\quad \omega = M\varphi$ $\quad \vec{F} = \dot{\vec{p}}$

$\Delta \vec{L} = \vec{M} \Delta t$

$p = F_\perp / A$ $\quad p = \rho g h = F_g / A$

$p = p_0 e^{-\rho_0 g \cdot h / p_0}$

$F_A = \rho V g$ $\quad Q = m c \Delta T$ $\quad \Delta l = \alpha l_0 \Delta T$

Volumina:

Prisma/Zylinder: $A_G \cdot h$

Pyramide: $1/3\, A_G\, h$ / Kegel

Superposition I:

$x = x_1 + x_2 = A[\cos(\omega t + kz) + \cos(\omega t - kz + \varphi)] = 2A\cos(kz - \varphi/2)\cos(\omega t + \varphi/2)$ ortsabh. Ampl.

$\sin x + \sin y = 2 \sin\frac{x+y}{2} \cos\frac{x-y}{2}$

$\sin - \sin = 2\cos \quad \sin$

$\cos + \cos = 2\cos \quad \cos$

$\cos - \cos = -2\sin \quad \sin$

$\sin^2 x = \frac{1}{2} - \frac{1}{2}\cos(2x)$

$\cos^2 x = \quad +$

Ebene Welle: $x(z,t) = C e^{i(\omega t - kz)}$

$k^2 = \omega^2 / v_{ph}^2$

Superposition II:

einlauf.: $x_1 = A\cos(\omega t + kz)$

rücklauf.: $x_2 = A\cos(\omega t - kz + \varphi)$

freies E.: $\varphi = 0$ $\quad$ festes E.: $\varphi = \pi$

$k = 2\pi/\lambda = \omega/c$

Pendel: M: $\omega^2 = g/l$ $\quad$ P: $\omega^2 = mgR/J$

Oszillator $y = A\cos(\omega t + \varphi)$

$\omega_0^2 = g/l$ bzw. D/m

Ged. Oszillator

$y = A e^{-\gamma t}\cos(\omega t + \varphi_0)$ schwach

$\ddot{x} + 2\gamma\dot{x} + \omega_0^2 x = 0$

$\omega_0^2 = c/m$ $\quad 2\gamma = k/m$

$\omega^2 = \omega_0^2 - \gamma^2$

$y = e^{-\gamma t}[A e^{\delta t} + B e^{-\delta t}]$ Kriechfall

$\delta = \sqrt{\gamma^2 - \omega_0^2}$

$y = v_0 t e^{-\gamma t}$ | aperiodischer Grenzfall

$\gamma = \omega_0$

Erzwungene Schwingung

$x = A_1 e^{-\gamma t}\cos(\omega_1 t + \varphi_1) + A_2\cos(\omega t + \varphi)$

$\omega_R = \sqrt{\omega_0^2 - 2\gamma^2}$

$|A| = (F_0/m) / \sqrt{(\omega_0^2 - \omega^2)^2 + (2\gamma\omega)^2}$

$\tan\varphi = -(2\gamma\omega)/(\omega_0^2 - \omega^2)$

gekoppelte Oszillatoren:

$\omega_\pm^2 = \frac{D+\varepsilon}{m} \pm \frac{\varepsilon}{m}$ $\quad \omega_- \Rightarrow \varphi_0 = 0$ $\quad \omega_+ \Rightarrow \varphi_0 = \pi$

Normalkoord. $(x \pm y)/2$

Drehschw. $T = 2\pi/\Omega = 2\pi\sqrt{J/D}$

$\varphi(t) = \varphi_{max}\cos\Omega t$ $\quad M = -D\varphi$

$\frac{pV}{T} = nR = Nk_B = \text{konst}$ $\quad [n] = \text{mol}$

$N = N_A n$ $\quad \bar{E}_{kin} = \frac{3}{2} k_B T$

$pV = \frac{2}{3} N \bar{E}_{kin} = \frac{1}{3} N m_T \bar{v}^2$

$dV = r^2 \sin\theta\, dr\, d\theta\, d\varphi$

Gewicht eines Liters Luft: 1,29 g

Geschwindigkeiten:

$f(v) = C\exp(-mv^2/2k_B T)$

Wärmeenergie: $\Delta W = \Delta Q = cM\Delta T = C_G \Delta T$

Reibung (Zyl.): $\Delta W = mg\, 2\pi r n$

Innere E: $U = N \cdot \bar{E}_{kin} = 3/2\, N k_B T$

$U = \frac{1}{2} f N k_B T$ $\quad f \triangleq$ Freiheitsgrade

Wärmeleitung: $\dot{Q} = -\lambda \cdot A \cdot dT/dx$

Ausdehnung: $l = l_0(1 + \alpha\Delta T)$ / entspr. V

Trägheitsmomente:

	v	h
Punkt	mr^2	
Kreisring	mr^2	
Zylinder	$\frac{1}{2}mr^2$	$\frac{1}{2}m(r_a^2 - r_i^2)$
Kugel	$\frac{2}{5}mr^2$	$\frac{2}{3}mr^2$
Stab	$1/12\, ml^2$	

Konstanten:

$c = 343$ m/s $\quad \rho_0 = 1{,}29$ kg/m³

$\gamma = 6{,}673 \cdot 10^{-11}$ m³/kg s²

$k_B = 1{,}3807 \cdot 10^{-23}$ J/K

$N_A = 6{,}022 \cdot 10^{23}$ 1/Mol

$m_E = 5{,}974 \cdot 10^{24}$ kg

$r_E = 6378$ km

$R = k_B N_A$

Fourier: $F(x) = a_0 + \sum_{n=1}^{\infty} a_n \sin(n k_0 x + \varphi_n)$

Reibung: $F_H = \mu F_N$

$F_R = \mu F_N / r$

$F_Z = mv^2/r = m\alpha = m\omega^2 r$

$F_C = 2m(\vec{v} \times \vec{\omega})$ $\quad v \perp \omega \perp r$

$J = J_0 + ml^2$

$\vec{R} = (\sum_i m_i \vec{r}_i)/M$

J (Quader) $\quad$ Fläche durch Drehachse

$1/12\, M(b^2 + c^2)$

$dF = r\,dr\,d\varphi$ $\quad dV = r\,dr\,d\varphi\,dz$

J Würfel: $\frac{1}{6} ma^2$

$J = \int dV \rho(\vec{r})(x^2 + y^2)$

$R = \frac{1}{M}\int dV \rho(\vec{r})\vec{r} = \frac{1}{M}\sum_i \vec{r}_i m_i$