

JÖFNUR

RAFSTÖÐUFRÆÐI

$$k = 1/(4\pi\epsilon_0)$$

$$\text{Coulomb } \mathbf{F} = \frac{kqQ}{r^2} \hat{\mathbf{r}}$$

Rafsvið

$$\mathbf{E} = \frac{kQ}{r^2} \hat{\mathbf{r}} \quad \mathbf{E} = k \int \frac{dq}{r^2} \hat{\mathbf{r}}$$

$$\text{Umhverfis langan vír } E = 2k\lambda/R$$

$$\text{Við þynnu } E = \sigma/2\epsilon_0$$

$$\text{Milli þynna, þéttir } E = \sigma/\epsilon_0$$

$$\text{Tvískautsvægi } \mathbf{p} = q \mathbf{d}$$

$$\mathbf{E} = k(-\mathbf{p}/r^3 + 3(\mathbf{p} \cdot \mathbf{r})\mathbf{r}/r^5)$$

$$\boldsymbol{\tau} = \mathbf{p} \times \mathbf{E}$$

$$U = -\mathbf{p} \cdot \mathbf{E}$$

$$\mathbf{F} = \nabla(\mathbf{p} \cdot \mathbf{E})$$

$$\text{Rafflæði } \Phi_E = \oint \mathbf{E} \cdot d\mathbf{A}$$

$$\text{Lögmál Gauss } \oint \mathbf{E} \cdot d\mathbf{A} = \frac{Q}{\epsilon_0}$$

Rafmætti

$$V_B - V_A = - \int_A^B \mathbf{E} \cdot d\mathbf{s}$$

$$\text{í einsleitu sviði } \Delta V = \pm E d$$

$$\text{fyrir punkthleðslu } V = \frac{kQ}{r}$$

$$\text{dreifð hleðsla } V = \int \frac{k dq}{r}$$

$$\text{Mættisorka } U = qV$$

$$\mathbf{E} = -\nabla V$$

$$\text{Rýmd } C = Q/V$$

$$\text{Plötupéttir } C = \epsilon_0 A/d$$

$$\text{Hliðt. } C_{eq} = C_1 + C_2 + \dots + C_N$$

$$\text{Raðt. } 1/C_{eq} = 1/C_1 + 1/C_2 + \dots + 1/C_N$$

$$U_E = Q^2/2C = QV/2 = CV^2/2$$

$$\text{Orkuþéttleiki } u_E = \frac{1}{2} \epsilon_0 E^2$$

$$\text{Rafsvari } C = \kappa C_0 \quad E_D = E_0/\kappa$$

RAFSEGULFRÆÐI

$$\text{Straumur } I = dQ/dt \quad J = I/A$$

$$\mathbf{J} = nq \mathbf{v}_d \quad \mathbf{J} = (1/\rho)\mathbf{E} = \sigma\mathbf{E}$$

$$R = V/I \quad R = \rho l/A \quad V = IR$$

$$P = IV = I^2 R = V^2/R$$

$$\rho = \rho_0(1 + \alpha(T - T_0))$$

$$\text{Kirchhoff: } \Sigma I = 0 \quad \Sigma V = 0$$

Viðnám

$$\text{raðt. } R_{eq} = R_1 + R_2 + \dots + R_N$$

$$\text{hliðt. } 1/R_{eq} = 1/R_1 + 1/R_2 + \dots + 1/R_N$$

Afhleðsla og hleðsla þéttis

$$Q = Q_0 e^{-t/\tau}; \quad I = I_0 e^{-t/\tau}$$

$$Q = Q_0(1 - e^{-t/\tau}); \quad I = I_0 e^{-t/\tau}$$

$$\tau = RC$$

$$\mathbf{F} = q \mathbf{v} \times \mathbf{B} \quad \mathbf{F} = I \boldsymbol{\ell} \times \mathbf{B}$$

$$d\mathbf{F} = I d\boldsymbol{\ell} \times \mathbf{B} \quad \boldsymbol{\mu} = NIA \hat{\mathbf{n}}$$

$$\boldsymbol{\tau} = \boldsymbol{\mu} \times \mathbf{B} \quad U = -\boldsymbol{\mu} \cdot \mathbf{B}$$

$$\text{Rafeind á braut } evB = mv^2/r$$

$$\boldsymbol{\mu} = -(e/2m)\mathbf{L} \quad L = mvr$$

Lorentz $\mathbf{F} = q(\mathbf{E} + \mathbf{v} \times \mathbf{B})$

Hall $nq = \frac{-J_x B_y}{E_z}$

Langur vír $B = \mu_0 I / 2\pi R$

Tveir vírar $F/\ell = \frac{\mu_0 I_1 I_2}{2\pi d}$

Biot-Savart

$$d\mathbf{B} = \frac{\mu_0}{4\pi} \frac{I d\boldsymbol{\ell} \times \hat{\mathbf{r}}}{r^2}$$

Spóla $B = \frac{1}{2} \mu_0 n I (\sin \theta_2 - \sin \theta_1)$

Ampere $\oint \mathbf{B} \cdot d\boldsymbol{\ell} = \mu_0 I$

Segulflæði $\Phi_B = \mathbf{B} \cdot \mathbf{A}$

$$\Phi_B = \int \mathbf{B} \cdot d\mathbf{A}$$

Faraday $\mathcal{E} = -\frac{d\Phi_B}{dt}$

Sjálfsþan, víxlþan

$$\mathcal{E}_{11} = -L_1 \frac{dI_1}{dt} \quad N_1 \Phi_{11} = L_1 I_1$$

$$\mathcal{E}_{12} = -M \frac{dI_2}{dt} \quad N_1 \Phi_{12} = M I_2$$

Spóla $L = \mu_0 n^2 A \ell$

LR-rás

$$I = I_0 (1 - e^{-t/\tau})$$

$$I = I_0 e^{-t/\tau}$$

$$\tau = \frac{L}{R} \quad I_0 = \mathcal{E}/R$$

Orka í spólu $U_L = \frac{1}{2} L I^2$

Orkuþéttleiki $u_B = \frac{B^2}{2\mu_0}$

LC- sveiflur

$$\frac{d^2 Q}{dt^2} + \frac{1}{LC} Q = 0 \quad \omega_0 = \frac{1}{\sqrt{LC}}$$

Deyfðar LC-sveiflur

$$L \frac{d^2 Q}{dt^2} + R \frac{dQ}{dt} + \frac{Q}{C} = 0$$

$$Q = Q_0 e^{-Rt/2L} \cos(\omega' t + \delta)$$

$$\omega' = \sqrt{\omega_0^2 - \left(\frac{R}{2L}\right)^2}$$

Riðstraumur $i = i_0 \sin(\omega t)$

$$v = v_0 \sin(\omega t + \phi)$$

rms gildi

$$I = \sqrt{(i^2)_{av}} = \frac{i_0}{\sqrt{2}} \approx 0.707 i_0$$

$$V = \sqrt{(v^2)_{av}} = \frac{v_0}{\sqrt{2}} \approx 0.707 v_0$$

$$X_L = \omega L \quad X_C = 1/\omega C$$

Samviðnám $Z = \sqrt{R^2 + (X_L - X_C)^2}$

$$\tan \phi = \frac{X_L - X_C}{R}$$

Afl

$$P = I^2 R = IV \cos \phi$$

$$P = \frac{V^2 R}{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

Spennir $i_2 N_2 = i_1 N_1 \quad i_2 v_2 = i_1 v_1$

Maxwell

$$\oint \mathbf{E} \cdot d\mathbf{A} = \frac{Q}{\epsilon_0}$$

$$\oint \mathbf{B} \cdot d\mathbf{A} = 0$$

$$\oint \mathbf{E} \cdot d\boldsymbol{\ell} = -\frac{d\Phi_B}{dt}$$

$$\oint \mathbf{B} \cdot d\boldsymbol{\ell} = \mu_0 \left(I + \epsilon_0 \frac{d\Phi_E}{dt} \right)$$

Á diffurformi

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{B} = \mu_0 \left(\mathbf{J} + \epsilon_0 \frac{\partial \mathbf{E}}{\partial t} \right)$$

Öldulíkingar

$$\nabla^2 \mathbf{E} - \mu_0 \epsilon_0 \frac{\partial^2 \mathbf{E}}{\partial t^2} = 0$$

$$\nabla^2 \mathbf{B} - \mu_0 \epsilon_0 \frac{\partial^2 \mathbf{B}}{\partial t^2} = 0.$$

Um þætti sléttar bylgju

$$\mathbf{E} = E_0 \sin(kz - \omega t) \hat{\mathbf{x}}$$

$$\mathbf{B} = \frac{1}{c} \hat{\mathbf{k}} \times \mathbf{E}$$

$$\mathbf{E} = -c \hat{\mathbf{k}} \times \mathbf{B}$$

$$c = (\mu_0 \epsilon_0)^{-1/2} \quad E = cB \quad c = \lambda f$$

Orkuþéttleiki

$$u = \epsilon_0 E^2 = \frac{B^2}{\mu_0} = \sqrt{\frac{\epsilon_0}{\mu_0}} EB$$

Poynting-vigur

$$\mathbf{S} = \frac{\mathbf{E} \times \mathbf{B}}{\mu_0} \quad S_{ave} = \frac{E_0 B_0}{2\mu_0}$$

Skriðþungi, geislaþrýstingur

$$p = \frac{U}{c} \quad \frac{F}{A} = \frac{S}{c} = u$$

LJÓSFRAEDI

$$n = \frac{c}{v}$$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

$$m = \frac{y_1}{y_0} = -\frac{q}{p}$$

$$\frac{n_1}{p} + \frac{n_2}{q} = \frac{n_2 - n_1}{R}$$

$$\frac{1}{f} = (n - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

$$\delta = m\lambda$$

$$m = 0, \pm 1, \pm 2, \dots$$

$$\delta = \left(m + \frac{1}{2} \right) \lambda$$

$$d \sin \theta = m\lambda$$

$$d \sin \theta = \left(m + \frac{1}{2} \right) \lambda$$

$$I = 4I_0 \cos^2\left(\frac{\phi}{2}\right)$$

$$a \sin \theta = m\lambda$$

$$d \sin \theta = m\lambda$$

$$I = I_0 \frac{\sin^2(\alpha/2)}{(\alpha/2)^2} \quad \alpha = 2\pi a \sin \theta / \lambda$$

Skautun

$$\text{Malus} \quad I = I_{max} \cos^2 \phi$$

$$\text{Brewster} \quad \tan \theta_p = \frac{n_b}{n_a}$$

INNGANGUR AÐ SKAMMTAFRAEDI

Óvissulögmál Heisenberg

$$\Delta x \Delta p \geq h$$

$$\Delta t \Delta E \geq \hbar/2$$

ATÓM OG KJARNEDLISFRAEDI

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

$$hf = \frac{hc}{\lambda} = E_f - E_i$$

Vetnislíkan Bohr

$$E_n = K_n + U_n = -\frac{1}{\epsilon_0^2} \frac{me^4}{8n^2 \hbar^2} = -\frac{hcR}{n^2}$$

$$L_n = m v_n r_n = n \frac{h}{2\pi}$$

Svarthlutageislunarlíkan Rayleigh

$$I(\lambda) = \frac{2\pi c k T}{\lambda^4}$$

Svarthlutageislunarlíkan Planck

$$I(\lambda) = \frac{2\pi hc^2}{\lambda^5 (\exp(hc/\lambda kT) - 1)}$$

$$1 \text{ u} = 1 \text{ amu} = 1 \text{ Da} = 1.660538921$$

$$\times 10^{-27} \text{ kg}$$

$$1 \text{ u} = 931.494095 \text{ MeV}/c^2$$

$$m_e = 0.511 \text{ MeV}/c^2$$

$$E_{rest} = m_0 c^2$$

$$E_{total} = mc^2$$

$$\alpha(t) = \lambda n(t)$$

$$T_{1/2} = \frac{\ln 2}{\lambda}$$

Massajafna Bethe og Weizsäcker

$$BE = a_v A - a_s A^{2/3} - a_c \frac{Z^2}{A^{1/3}} - a_a \frac{(N-Z)^2}{A} + \delta(A)$$

STÆRÐFRÆÐI

$$\nabla \times (\nabla \times \mathbf{F}) = \nabla(\nabla \cdot \mathbf{F}) - \nabla^2 \mathbf{F}$$

Vigrar:

$$\mathbf{A} \cdot \mathbf{B} = AB \cos \theta = A_x B_x + A_y B_y + A_z B_z$$

$$\mathbf{A} \times \mathbf{B} = \begin{vmatrix} \hat{\mathbf{i}} & \hat{\mathbf{j}} & \hat{\mathbf{k}} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

$$|\mathbf{A} \times \mathbf{B}| = AB \sin \theta$$

$$\hat{\mathbf{C}} = \frac{\mathbf{C}}{|\mathbf{C}|}$$

Hornafraeði:

$$C^2 = A^2 + B^2 - 2AB \cos \gamma$$

$$\frac{\sin \alpha}{A} = \frac{\sin \beta}{B} = \frac{\sin \gamma}{C}$$

$$\sin(x+y) = \sin x \cos y + \cos x \sin y$$

$$\cos(x+y) = \cos x \cos y - \sin x \sin y$$

$$\sin x + \sin y = 2 \sin\left(\frac{x+y}{2}\right) \cos\left(\frac{x-y}{2}\right)$$

$$\cos x + \cos y = 2 \cos\left(\frac{x+y}{2}\right) \cos\left(\frac{x-y}{2}\right)$$

$$\sin(-x) = -\sin x$$

$$\cos(-x) = \cos x$$

$$\sin 2x = 2 \sin x \cos x$$

$$\cos 2x = 2 \cos^2 x - 1$$

Raðir:

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2}x^2 + o(x^3)$$

$$\ln(1+x) = x - \frac{1}{2}x^2 + o(x^3)$$

$$\sin x = x + o(x^3)$$

$$\cos x = 1 - x^2/2 + o(x^4)$$

$$e^x = 1 + x + o(x^2)$$

Rúmheildi:

Kartísk hnit

$$\int dx \int dy \int dz f(x, y, z)$$

Sívalnings hnit

$$\int_0^R \rho d\rho \int_0^{2\pi} d\varphi \int_0^h dz f(\rho, \varphi, z)$$

Kúluhnit

$$\int_0^R r^2 dr \int_0^{2\pi} d\varphi \int_0^\pi \sin \theta d\theta f(r, \varphi, \theta)$$

Diffurvirkjar:

Kartísk hnit

$$\nabla V = \hat{\mathbf{x}} \frac{\partial V}{\partial x} + \hat{\mathbf{y}} \frac{\partial V}{\partial y} + \hat{\mathbf{z}} \frac{\partial V}{\partial z}$$

$$\nabla^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2}$$

Sívalningshnit

$$\nabla V = \hat{\rho} \frac{\partial V}{\partial \rho} + \hat{\phi} \frac{1}{\rho} \frac{\partial V}{\partial \phi} + \hat{\mathbf{z}} \frac{\partial V}{\partial z}$$

$$\nabla^2 V = \frac{1}{\rho} \frac{\partial}{\partial \rho} \left(\rho \frac{\partial V}{\partial \rho} \right) + \frac{1}{\rho^2} \frac{\partial^2 V}{\partial \phi^2} + \frac{\partial^2 V}{\partial z^2}$$

Kúluhnit

$$\nabla V = \hat{\mathbf{r}} \frac{\partial V}{\partial r} + \hat{\theta} \frac{1}{r} \frac{\partial V}{\partial \theta} + \hat{\phi} \frac{1}{r \sin \theta} \frac{\partial V}{\partial \phi}$$

$$\begin{aligned} \nabla^2 V &= \frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial V}{\partial r} \right) \\ &+ \frac{1}{r^2 \sin \theta} \frac{\partial}{\partial \theta} \left(\sin \theta \frac{\partial V}{\partial \theta} \right) \\ &+ \frac{1}{r^2 \sin^2 \theta} \frac{\partial^2 V}{\partial \phi^2} \end{aligned}$$