THE PHYSICAL QUANTITIES (PQ-s) DESCRIBING THE ...

SC - SCALAR Q.
VE - VECTOR Q.

ELECTRIC FIELD:

"DAD"

CHARGE (PQ)

(SC) q, Q

UNIT: COULOMB (1C)

$I = \frac{Q}{t}$

$Q = I t$

$1C = 1A \cdot 1s$

"MOM"

CURRENT (PQ)

i, I (SC)

UNIT: AMPERE (1A)

BASIC UNIT OF SI

ELECTRIC FIELD STRENGTH (PQ)

$E = \frac{F}{q}$ (VE)

UNIT: $1\frac{V}{m}$

VOLT PER METER

... IN THE TERMS OF ...

FORCE F

WORK W

PROCESS:

DEF. OF WORK:

$W = F \cdot \ell \quad | : q$

WORK = FORCE x LENGTH (DISTANCE)

$U = E \cdot \ell$

$E = \frac{U}{\ell}$ VOLTAGE / LENGTH

PROPERTIES OF THE SUBSTANCE..

VOLTAGE (PQ)

(SC) $U = \frac{W}{q}$

UNIT: VOLT $1V = \frac{1J}{1C}$

STATE:

POTENTIAL (PQ) (SC)

φ OR $V = \frac{E_p}{q}$ POT ENERGY / CHARGE

CYCLE:

ELECTRO-MOTIVE FORCE (EMF) (PQ) (SC)

$\mathcal{E} = \frac{W_{NEF}}{q}$

WORK OF NON-ELECTRIC FORCES

EMF = SUM OF ALL VOLTAGES

FARADAY-MAXWELL LAW OF ELECTROMAGNETIC INDUCTION:

$\mathcal{E}_{IND} = \sum_i U_i = \oint \vec{E} \cdot d\vec{l} = -\frac{d}{dt} \int_S \vec{B} \cdot d\vec{A}$

MAGNETIC FLUX

PERMITTIVITY (PQ)

a) RELATIVE:

$\varepsilon_r = \frac{E_0}{E}$ VACUUM / SUBSTANCE (SC)

b) ABSOLUTE: $\varepsilon = \varepsilon_0 \varepsilon_r$

$[\varepsilon] = [\varepsilon_0]$ (PERMITTIVITY CONSTANT)

THE SAME UNIT: $\frac{C^2}{N \cdot m^2} \equiv \frac{F}{m}$

CHARGE q

CAPACITANCE (PQ) (SC)

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

UNIT: FARAD $1F = 1C/1V$

RESISTANCE (PQ) (SC)

$R = \frac{U}{I}$ VOLTAGE / CURRENT

UNIT: OHM $1\Omega = \frac{1V}{1A}$

RESISTIVITY (PQ) (SC)

$\rho = \frac{R \cdot A}{\ell}$

UNIT: $1\Omega \cdot m$

MAGNETIC FIELD:

... IN THE TERMS OF FORCE ONLY:

MAGNETIC FLUX (PQ) (SC)

$\Phi = B \cdot A \cos\beta$

UNIT: WEBER $1Wb = 1T \cdot m^2$

MAGNETIC INDUCTION (PQ) (VE)

$B = \frac{F}{I\ell}$

UNIT: TESLA $1T = \frac{1N}{1A \cdot 1m}$

MAGNETIC FLUX DENSITY

PROPERTIES OF THE SUBSTANCE ..

PERMEABILITY (PQ)

a) RELATIVE $\mu_r = \frac{B}{B_0}$ SUBSTANCE / VACUUM (SC)

b) ABSOLUTE: $\mu = \mu_0 \mu_r$

$[\mu] = [\mu_0]$ (PERMEABILITY CONSTANT)

$= \frac{N}{A^2} = \frac{H}{m}$

CURR. I

INDUCTANCE (PQ)

$L = \frac{\Phi}{I}$ (SC)

OR $L = -\frac{\mathcal{E}_{SELF}}{di/dt}$

UNIT: HENRY $1H = \frac{1Wb}{1A}$

CURRENT DENSITY (VE)

$J = \frac{Q}{tA}$ (PQ)

MMF

AMPERE - MAXWELL LAW

$\oint \vec{H} \cdot d\vec{l} = \int \left(\frac{d\vec{D}}{dt} + \vec{J} \right) \cdot d\vec{A}$

WHAT WOULD HAPPEN WITHOUT SUBSTANCE?

ELECTRIC INDUCTION (PQ)

$\mathcal{D} = \varepsilon_0 E_0 = \varepsilon_0 \varepsilon_r E = \varepsilon E$

UNIT: $1\frac{C}{m^2}$ $D = \frac{\text{CHARGE}}{\text{AREA}}$ (VE)

GAUSS LAW FOR THE EL. FIELD:

$\oint_S \vec{D} \cdot d\vec{A} = \sum_i q_i$

GAUSS LAW FOR THE MAG. FIELD:

$\oint_S \vec{B} \cdot d\vec{A} = 0$

... WITHOUT SUBSTANCE:

MAGNETIC FIELD STRENGTH (PQ) (VE)

$H = \frac{B}{\mu_0 \mu_r} = \frac{B}{\mu}$

UNIT $1\frac{A}{m}$ $H = \frac{\text{CURRENT}}{\text{LENGTH}}$