$F = (kQ_1Q_2)/r^2$ $F = q E$ $E_{point\ charge} = kQ/r^2$ $E_{sheet} = \sigma/\varepsilon_0$ $\sigma = Q/A$

E field lines start on positives, end on negatives. They never cross. Number of lines is prop. to charge. E fields strongest when lines closer together.

$PE = U = kq_1q_2/r$ $k = 9 \times 10^9\ N\text{-}m^2/C^2$ $\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N\text{-}m^2$

Potential: $V = U/q$ so $\Delta U = q\,\Delta V$ Point Charge: $V = kQ/r$

Uniform E-field: $\Delta V = E\,d$ $Q_{proton} = -Q_{electron} = 1.6 \times 10^{-19}$ Coulombs

Capacitor: $C = Q/\Delta V$ (Q is charge on each plate)
micro: 10^{-6} nano: 10^{-9} pico: 10^{-12}

Parallel Plate: $C = \kappa A \varepsilon_0 /d$ κ = dielectric constant

Energy: $U = (1/2) C (\Delta V)^2 = (1/2) Q \Delta V = (1/2)Q^2/C$

$I = \Delta Q/\Delta t$ drift vel.: $I = nev_DA$ $R = \rho L/A$ $\rho = \rho_0(1 + \alpha\Delta T)$

$\Delta V = IR$ internal resistance: $V = \varepsilon - I r$

Series: $R = R_1 + R_2 + \ldots$ $1/C = 1/C_1 + 1/C_2 + \ldots$

Parallel: $1/R = 1/R_1 + 1/R_2 + \ldots$ $C = C_1 + C_2 + \ldots$

$P = I^2R = I V = V^2/R$ $\tau = RC$ $V(\text{discharging}) = V_0 e^{-t/RC}$
$V(\text{charging}) = V_0 (1-e^{-t/RC})$

Magnetic force $|F_B| = qvB \sin\theta$ direction = right hand rule

1 Tesla = 10000 Gauss. $|F_B| = ILB \sin\theta$ [redacted]

[redacted]

mass spec: $mv^2/r = qvB$ and $qV = (1/2)\,mv^2$

velocity selector: $qE = qvB$ [redacted]