GR2

$\Delta V = -\int_{s_i}^{s_f} E_s \, ds$

$E_s = -\frac{\Delta V}{ds}$

$\Delta V = \frac{kq}{r}$

$k = \frac{1}{4\pi\varepsilon_0}$

$\Delta U = q\Delta V$

$U = \frac{kq_1q_2}{r}$

Kinematics

$v_f = v_i + at$

$y_f - y_i = v_{oy}t + \frac{1}{2}a_y t^2$

$d = \frac{1}{2}at^2 + v_o t$

$v_f^2 = v_i^2 + 2ad$

$-W = K = \Delta U = qE\Delta s$

$E = \frac{Q}{A\varepsilon_0}$ (from pos. toward neg.)

$\Delta U = -W$

$K = \frac{1}{2}mv^2$

$\text{Force} = qE$ (E: elec. field)

$\vec{E} = \frac{\Delta V_c}{d} = -\frac{\Delta V}{\Delta s}$

$V = \frac{q}{4\pi r\varepsilon_0} = \frac{kq}{r}$

$V = Es$

$E = \frac{dV}{ds}$ (deriv. of Elec. Potential in terms of distance)

Cons. of Energy

$K_f + qV_f = K_i + qV_i$

$K_f = K_i - q\Delta V$

$\frac{1}{2}mv_f^2 = \frac{1}{2}mv_i^2 - q\Delta V$

charge of dist. from neg. electrode

$E_{wire} = \frac{\Delta V_{wire}}{L}$

$I = \frac{Q}{\Delta t} = \frac{\text{charge}}{\text{time}}$

R of material $\rightarrow R = \rho\frac{\text{Length}}{\text{Area}}$, for ohmic material, $R = \frac{1}{\text{Slope}}$

$C = \frac{\varepsilon_0 A}{d}$ ← dist. between capacitor plates

$C = \frac{Q}{\Delta V_{capacitor}}$

$U = \frac{QV}{2} = \frac{Q^2}{2C} = \frac{CV^2}{2}$

$U_c = \frac{1}{2}C\Delta V_c^2$

$V = \frac{Q}{C}$

$V = IR$

$P = I\Delta V = I^2R = \frac{V^2}{R}$

$= \frac{U}{\Delta t} = \frac{mgy}{\Delta t}$ $U = mgy$

Power (P) $1\,W = 1\frac{J}{s}$

Current (I) $1\,A = 1\frac{C}{s}$

Resistance (R) $1\,\Omega = 1\frac{V}{A}$

Elec. Potential (V) $1V = 1\frac{J}{C}$

Capacitance (C) $1\,\text{Farad} = 1\frac{C}{V}$

4 or more measurements:

$\text{Best} = \text{Avg.} \pm \delta$

$\delta = \frac{\sigma}{\sqrt{n}} = \frac{\text{st. dev.}}{\sqrt{n}} = \sqrt{\frac{\sum_{i=1}^{n}(T_n - T_{avg})^2}{n-1}} \Big/ \sqrt{n}$ ← num. of trials

battery / resistors / capacitors

$\mathcal{E} - Ir - IR + \frac{Q}{C} = 0$

Capacitors:

$C = \frac{A\varepsilon_0}{d}$ $V = \frac{Q}{C}$

Discharging $\tau = RC$

1) $Q(t) = Q_{max}e^{-t/\tau}$
2) $I(t) = I_{Initial}e^{-t/\tau}$
3) $V(t) = V_{max}e^{-t/\tau}$

also for charging

charging: $Q(t) = Q_{max}(1 - e^{-t/\tau})$

Uncertainty (3 or less trials)

$\text{Best} = \text{Avg.} = \frac{T_{trial_1} + T_2 + T_3}{3} \pm \delta_{trial}$

$\delta_{trial} = \frac{T_{max} - T_{min}}{2}$