PHYSICS 231 – TEST # 2

NAME:

STUDENT ID #:

USEFUL CONSTANTS

$$\epsilon_0 = 8.85 \times 10^{-12} C^2/(N \cdot m^2)$$

$$k = \frac{1}{4\pi\epsilon_0} = 8.988 \times 10^9 \ N \cdot m^2/C^2$$

$$e = 1.6 \times 10^{-19} C$$

$$m_e = 9.1 \times 10^{-31} kg$$

USEFUL FORMULAS

Capacitance:

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

Parallel-plate capacitor:

$$C = \epsilon_0 \frac{A}{d}$$

Capacitors in series:

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

Capacitors in parallel:

$$C_{eq} = C_1 + C_2$$

Energy:

$$U = \frac{Q^2}{2C} = \frac{1}{2}CV^2 = \frac{1}{2}QV$$

Energy density:

$$u = \frac{1}{2}\epsilon_0 E^2$$

Capacitor filled with dielectric:

$$C = KC_0$$

Energy density in dielectric:

$$u = \frac{1}{2}\epsilon E^2 \ , \quad \epsilon = K\epsilon_0$$

Current and current density:

$$I = \frac{dQ}{dt} = n|q|v_d A \ , \qquad \vec{J} = nq\vec{v}_d$$

Resistivity:

$$\rho = \frac{E}{J}$$

Variation with temperature:

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

Ohm's law:

$$V = IR \ , \qquad R = \frac{\rho L}{A}$$

Power into a resistor:

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

Resistors in series:

$$R_{eq} = R_1 + R_2$$

Resistors in parallel:

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

Kirchhoff's rules:

$$\sum I = 0 \ , \qquad \sum V = 0$$

RC circuit:

- capacitor charging:

$$Q = C\mathcal{E}\left(1 - e^{-\frac{t}{RC}}\right) \ , \quad I = \frac{dQ}{dt} = \frac{\mathcal{E}}{R} e^{-\frac{t}{RC}}$$

- capacitor discharging:

$$Q = Q_0 e^{-\frac{t}{RC}} \ , \qquad I = \frac{dQ}{dt} = -\frac{Q_0}{RC} e^{-\frac{t}{RC}}$$