United International University

School of Science and Engineering

Final Term Examination; Year 2020; Trimester: Summer
Course: PHY 105/2105; Title: Physics; Sec: A-E
Full Marks: 25; Time: 1 Hour 30 Minutes

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.
Questions no 1, 2, 3 and 4 are mandatory to answer. Answer any one from question no 5 and 6.

1. **(a)** If two charges produce dipole moment, show the direction of it. Can it be possible to design an equation for which the both electric dipole moment and electric potential energy are present? How can you draw an electric potential graph varying in between -7V to +5V? — 2.5 CO1

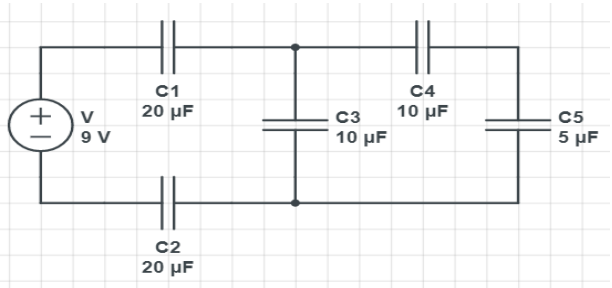
(b) Why the dielectric materials are very poor conductor of electric current? — 1.5 CO1

(c) Is there any major difference between emf and terminal voltage? If any, write down it. — 1 CO1

2. **(a)** A neutral water molecule (H_2O) in its vapor state has a permanent dipole moment with dipole charge $q=|\pm 18e|$. The dipole distance of H_2O molecule is 1.12 pm. **(i)** If the molecule is placed in an electric field of 12.5×10^4 N/C, what maximum torque can the field exert on it? (Such a field can easily be set up in the laboratory) **(ii)** How much work must an external agent do to rotate this molecule by 180^0 in this field, starting from its initial position, for which $\theta = 70^0$? — 2.5 CO3

(b) A sodium (mass $23m_p$, charge $+11e$) and an alpha particle (mass $4m_p$, charge $+2e$) approach one another with the same initial speed v from an initially large distance r =5.2 fm. When these two particles will get closed to one another before turning around, what will be their initial speed? **[**Given, $k=8.99\times10^9$ Nm^2C^{-2}, $m_p=1.67\times10^{-27}$ kg, and $e= 1.6\times10^{-19}$ Coulomb**]** — 2.5 CO3

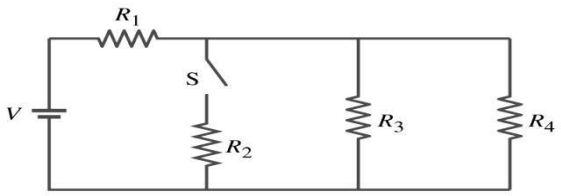
3. **(a)** In the following figure, V =9.0 V, C_1=C_2 =20 μF, C_3=C_4 =10 μF, and C_5=5 μF. What is the **(i)** equivalent capacitance C_{eq}? **(ii)** equivalent charge q_{eq}? and **(iii)** charge q_1 on capacitor 1? — 2.5 CO3



(b) A circular parallel plate capacitor has diameter 20 cm. Capacitance between parallel plate capacitor is 300 μF and the voltage difference between two plate is 6V. Calculate **(i)** the distance between two parallel plate of a capacitor, **(ii)** the charge, and **(iii)** the energy stored. [Given, ϵ_0 $=8.85\times10^{-12}$ C^2/Nm^2] — 2.5 CO3

4. **(a)** A 55.0 Ω resistor of a 12-gauge copper wire in a home has a cross-sectional area of 2.21×10^{-6} m^2 is connected to the terminals of a battery whose emf is 14.0 V and whose internal resistance is 0.5 Ω. The conduction electron density in copper is 8.49×10^{28} electrons/m^3. Calculate **(i)** the current in the circuit, **(ii)** the terminal voltage of the battery, V_{ab}, **(iii)** the power dissipated in the resistor R and in the battery's internal resistance r, and **(iv)** the drift speed v_d of the electrons. **[**Given, e= 1.6×10^{-19} Coulomb**]** — 2.5 CO3

(b) Find the current and the voltage across each resistor of the circuit below. Given, R_1=R_3=R_4=6kΩ and V=4.5V. — 2.5 CO3



5. **(a)** Establish a relation between torque $\vec{\tau}$, electric dipole moment $\vec{p}$, and electric field $\vec{E}$. 2.5 CO2

(b) Find out the electric potential V due to an electric dipole. 2.5 CO2

6. **(a)** Find out the capacitance for parallel plate capacitor. 2.5 CO2

(b) Suppose the voltage varies sinusoidally with time as $V = V_0 sin 2\pi f t$. Find out the average electric power $\bar{P}$ in a typical home. 2.5 CO2

CO1: Define different physical quantities with examples. **CO2:** Find out/Derive/Show/Discuss the various equations of Electric Potential, Capacitor and Capacitance, and Current, Resistance and EMF, etc. **CO3:** Evaluate different numerical problems based on the basic characteristics of Electric Potential, Capacitance, Combination of capacitors, Combination of resistors, Energy stored and power dissipation in a circuit, etc.