BRAC UNIVERSITY
Principles of Physics-II (PHY-112)
Department of Mathematics and Natural Sciences
Assignment: 03 — **Section**: 08
Dispatch Date: March 27, 2024
Submission Deadline: April 3, 2024

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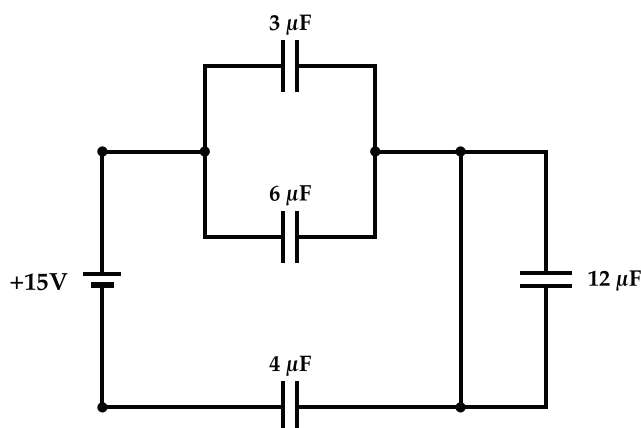Inspiring Excellence

Duration: 7 Days   **Spring 2024 (10F-29C)**   Marks: 15

Attempt all questions. Show Your work in detail. 1:1 plagiarism will be strictly penalized.

1. (a) Why can a dielectric material/insulator never have a negative dielectric constant? **(2)**

   (b) Measure the (i) charges stored, (ii) voltages across, and (iii) energy stored in each capacitor. **(4)**

   (c) Connect all the capacitors in series first and then in parallel connection with a dielectric material having a permittivity of $80 \, \text{F m}^{-1}$ inserted between each. Compare the energies found in both connections. Comment on which set provides more energy. **(4)**

2. (a) The two segments of the wire have equal diameters but different conductivities σ_1 and σ_2. Current I passes through this wire. If the conductivities have the ratio $\dfrac{\sigma_1}{\sigma_2} = 2$, what is the ratio $\dfrac{E_2}{E_1}$ of the electric field strengths in the two segments of the wire? **(2)**

   (b) A 0.40 A current runs through a copper wire of cross-sectional area $1.5 \, \text{mm}^2$ and through a light bulb. Copper has 8.5×10^{28} free electrons per cubic meter. (i) How many electrons pass through the light bulb each second? (ii) What is the current density of the wire? (iii) At what speed does a typical electron pass by any given point in the wire? (iv) If you were to use wire with a larger cross-sectional area, which of the above answers would change? Would they increase or decrease? **(3)**