

St John Baptist De La Salle Catholic School, Addis  
Ababa

Grade 10 Physics Take-Home Examination Solutions  
3rd Quarter

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Notes, and use of other aids is allowed. Read all directions carefully and write your answers in the space provided. To receive full credit, you must show all of your work. **Cheating or indications of cheating and similar answers will be punished accordingly.**

**Information**

- The Take-Home Exam is due on **Tuesday, April 19.**
- You should Work on it **individually** and consult me if you have any questions. As I have reiterated multiple times, cheating will have a serious consequence.
- For purposes of neatness and simplicity of grading, you should do the assignment on an **A-4 paper.**

Name:\_\_\_\_\_ Roll Number:\_\_\_\_\_ Section:\_\_\_\_\_

1. (2 points) In a circuit, we are using conducting wires made from Manganese.
  - (i) If we assume there are 3 free electrons per an atom of manganese, what is its electron density?
  - (ii) How much current flows through a cylindrical manganese wire of volume  $27 \text{ cm}^3$ , length 3cm if the circuit is switched on for 5 seconds?
2. (3 points) Assume that we have an RC circuit(a circuit consisting of both a resistor and a capacitor). In the circuit, we use a capacitor of capacitance  $65\mu\text{F}$  and a resistor of resistance  $10\text{K}\Omega$ .

- (i) If the source of potential difference in the circuit is a dry cell with a voltage of 12V, find how long it takes for the potential difference across the plates of the capacitor to be 7V.
  - (ii) At the instant that the capacitor has a potential difference of 7V, what is the current through the circuit? In terms of percentage, by how much has the amount of current changed to 7V from the initial amount?
  - (iii) Let's assume that the capacitor is fully charged now and the potential difference across its plates is 12V. If we disconnect the dry cell from the circuit, the capacitor will start to act like a battery and supply its stored charge to the circuit. How much voltage would be dissipated when  $\tau$  amount of time has passed?
3. (2 points) A 1.5V battery has an internal resistance of  $0.3\Omega$ . A load of variable resistance is connected across the battery and adjusted to have resistance 4 times resistance to that of the internal resistance of the battery.
- (i) Find the total power dissipated in the circuit.
  - (ii) Find the current through the circuit.
  - (iii) Find the potential difference across the terminals of the battery.
4. (1 point) Explain how current density(**J**) is related to Ohm's Law. Give an expression for resistivity( $\rho$ ) in terms of the cross-sectional area of a conductor and the current passing through it.
- Read the posted notes to attempt this question.*
5. (3 points) A  $5.0\mu\text{F}$  parallel-plate capacitor is connected to a constant voltage source. If the distance between the plates of this capacitor is 4mm and the capacitor holds a charge of  $13.6\mu\text{C}$ .
- (i) What is the strength of the electric field between the plates of this capacitor?
  - (ii) If an electron was to be placed in between the plates of the capacitor, how much force would it experience?