PART ONE : ELECTRICITY AND MAGNETISM (50 POINTS).

Answer the following questions.

Multiple Choice Question:-
You are provided with five options in the following question. Select the correct one

1- Relate to the following circuit in which the battery has zero internal resistance.

![Circuit Diagram]

a: What is the current in the 4 Ω resistor while the switch S is open?
(A) 0 A ; (B) 0.6 A ; (C) 1.2 A ; (D) 2.0 A ; (E) 3.0 A

b: When the switch S is closed and the 10 μF capacitor is fully charged, what is the voltage across the capacitor?
(A) 0 V ; (B) 6 V ; (C) 12 V ; (D) 60 V ; (E) 120 V

2- Use Biot and Savart law to deduce the magnetic induction due to long straight wire.

3- Classify the following statements into True or False: Mark “T” for true, “F” for false.
   a- Electric field is the force per unit charge exerted on a test charge at any point provided that the test charge is small enough so that it does not disturb the charges that cause the field.
   b- Gauss’s theory is logically equivalent to Coulomb’s law. It states that the surface integral of the component of E normal to the surface, over any closed surface, equals a constant times the total charge Q enclosed by the surface.
   c- Any Norton’s equivalent circuit is the same as any Thevenin’s equivalent circuit.
   d- Kirchhoff’s second or voltage law states that the algebraic sum of the emfs and voltage drops around a circuit is zero.
   e- When a charged particle moves in an electric field work is done and energy transfers take place.

4- Use Norton’s theorem to develop an equivalent circuit to the supply R_L in the figure.
Calculate the values of load current, voltage and power delivered to the load resistance 20Ω.

![Equivalent Circuit Diagram]
5- Two capacitors initially uncharged are connected in series to a battery, as shown.

What is the charge on the top plate of C₁

a) -81 μC  
   b) -18 μC  
   c) 0 μC  
   d) +18 μC  
   e) 81 μC

\[ \mathcal{V} \]

\[ C₁ = 3 \, \mu F \]

\[ C₂ = 6 \, \mu F \]

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**PART TWO: GEOMETRICAL OPTICS (50 POINTS).**

1- Write the condition required for:
   a - Direct vision prism  
   b-achromatic prism

2- An achromatic group of lenses of equivalent power \( \frac{2}{3} \Delta \) consists of two lenses, the material of one of them is crown glass (\( w = 0.021 \)) and the material of other lens is from flint glass (\( w = 0.045 \)) calculate the power of each lens.

3- A small object is placed at point on the axis 30 cm from a converging lens (of focal length 15 cm), 10 cm beyond which in a second co-axial diverging lens of focal length 10 cm. Calculate the position and characterization of the image formed.

4- A thin convex lens with equal radii of curvature \( r₁ = r₂ = 40 \, \text{cm} \), has an refractive index 1.75. Calculate the power of the lens (a) when placed in air (b) when placed in water whose refractive index 1.34

GOOD LUCK.

See the other part of the Examination (HEAT) in the separate paper