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EXAMINATION PREPARATION PAPER 1: ELECTRICITY AND MAGNETISM

Learner Note: Know the difference between a motor and a generator in terms of the energy conversion, and then also between AC and DC in terms of the type of commutator used. Definitions are important, as well as the use of Ohm's Law in circuit problems.

SECTION A: TYPICAL EXAM QUESTIONS

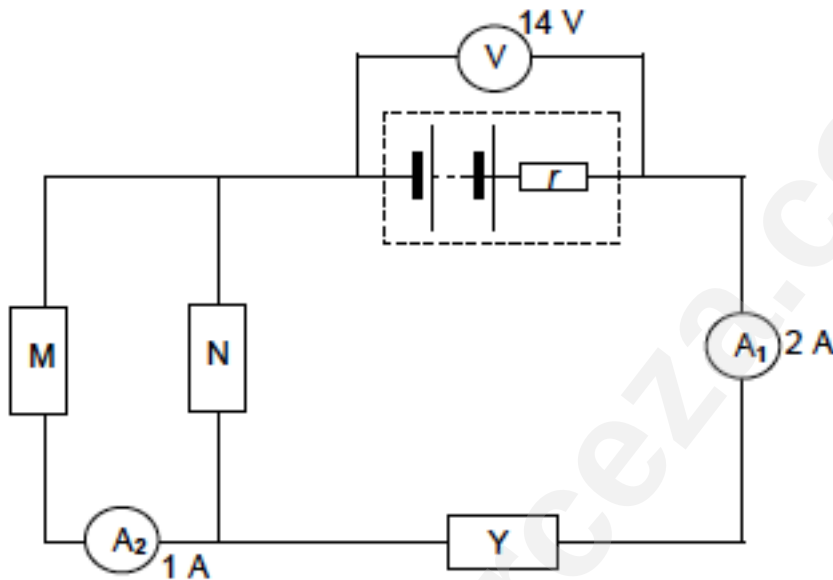
Question 1 10 minutes *(Taken from the DoE Physical Sciences Feb-March Paper 1 2010)*

Capacitors are circuit devices used to store electrical energy. The capacitance of capacitors depends, amongst other factors, on the plate area. The larger the plate area, the more the energy that can be stored.

- 1.1 Apart from plate area, state TWO other factors that can influence the capacitance of a capacitor. (2)
- 1.2 A certain parallel plate capacitor consists of two plates, each having dimensions of 2cm by 10cm. The plates are 0,2mm apart and are held at a potential difference of 20V. The space between the plates is filled with air.
- 1.2.1 Sketch the electric field pattern between the two oppositely charged parallel plates of the capacitor. (3)
- 1.2.2 Calculate the capacitance of this capacitor. (5)
- [10]**

Question 2 15 minutes (Taken from the DoE Physical Sciences Feb-March Paper 1 2010)

The circuit diagram below shows a battery, with an internal resistance r , connected to three resistors, M, N and Y. The resistance of N is 2Ω and the reading on voltmeter V is 14V . The reading on ammeter A_1 is 2A and the reading on ammeter A_2 is 1A . (The resistance of the ammeters and the connecting wires may be ignored.)

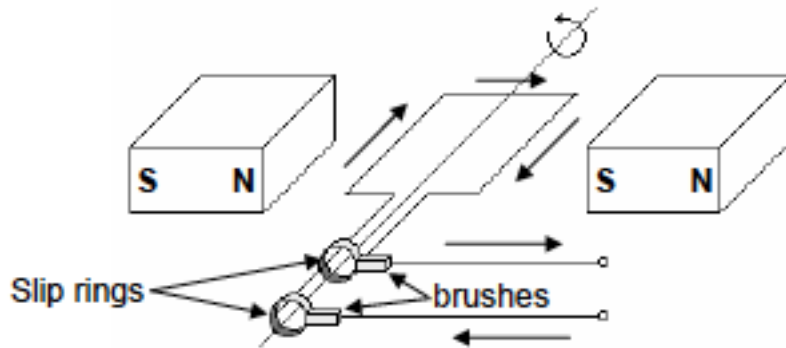


- 2.1 State Ohm's law in words. (2)
- 2.2 How does the resistance of M compare with that of N? Explain how you arrived at the answer. (2)
- 2.3 If the emf of the battery is 17V , calculate the internal resistance of the battery. (5)
- 2.4 Calculate the potential difference across resistor N. (3)
- 2.5 Calculate the resistance of Y. (4)

[16]

Question 3 5 minutes (Taken from the DoE Physical Sciences Feb-March Paper 1 2010)

3.1 A simplified sketch of a generator is shown below.



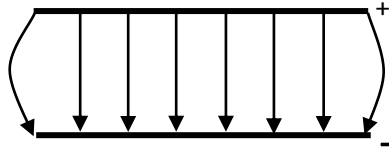
- 3.1.1 Is the output voltage AC or DC? Give a reason for your answer. (2)
- 3.1.2 State TWO effects on the output voltage if the coil is made to turn faster. (2)
- 3.1.3 What is the position of the coil relative to the magnetic field when the output voltage is a maximum? (1)
- 3.2 In South Africa, the major source of electricity is coal-driven generators. Recently society has become concerned about fossil fuels (like coal) as the primary source of electrical energy. Some business people have proposed that government should invest in windmills as an alternative source of energy.

State ONE advantage and ONE disadvantage of using windmills over coal-driven generators in supplying energy. (2)

[7]

SECTION B: SOLUTIONS AND HINTS**Question 1:**

- 1.1 Dielectric ✓
Distance between plates ✓ (2)

1.2.1

Checklist	Mark
Evenly spaced field lines.	✓
Direction of field lines from positive to negative.	✓
Field lines curved at the ends.	✓

1.2.2 (3)

$$C = \frac{\epsilon_0 A}{d} \checkmark = \frac{(8,85 \times 10^{-12}) \checkmark (2 \times 10^{-2}) \checkmark (10 \times 10^{-2}) \checkmark}{0,2 \times 10^{-3} \checkmark}$$

$$= 8,85 \times 10^{-11} \text{ F } \checkmark$$

[10]**Question 2:**

- 2.1 The current through a conductor is directly proportional to the potential difference across its ends at constant temperature. ✓✓ (2)

- 2.2 Equal ✓

2 A divides equally at T (and since $I_M = 1 \text{ A}$ it follows that $I_N = 1 \text{ A}$) ✓

OR

$$I \propto \frac{1}{R}, \therefore R_M = R_N \quad (2)$$

$$2.3 \quad \text{emf} = IR + Ir \quad \checkmark \therefore 17 = 14 + Ir \quad \checkmark \therefore Ir = 3 \text{ V}$$

$$r = \frac{V_{\text{lost}}}{I} \quad \checkmark = \frac{3}{2} \quad \checkmark = 1,5 \, \Omega \quad \checkmark \quad (5)$$

$$2.4 \quad V_N = IR_N \quad \checkmark = (1)(2) \quad \checkmark = 2 \text{ V} \quad \checkmark \quad (3)$$

$$2.5 \quad V_Y = 14 - 2 = 12 \text{ V} \quad \checkmark$$

$$V_Y = IR_Y \quad \checkmark \therefore 12 = (2)R_Y \quad \checkmark$$

$$\therefore R_Y = 6 \, \Omega \quad \checkmark \quad (4)$$

[16]

Question 3

3.1 AC – alternating current ✓

A separate slip ring connected to each wire. ✓ (2)

3.1.2 Increase in peak (or rms) voltage ✓

Increase in frequency ✓ (2)

3.1.3 The plane of the coil is parallel to the magnetic field. ✓

(1)

3.2 Advantage:

Less environmental pollution ✓ (noise, gases, etc.)

Disadvantage

- Will not operate in absence of wind. ✓
- Many windmills needed to generate sufficient electricity – unsightly appearance in environment. (2)

[7]