INSTRUCTIONS

1. Write your name and your Index number in the spaces provided.
2. This paper consists of two sections, Section A and B. Answer ALL the questions in both section in the spaces provided in this paper.
3. ALL working must be clearly shown.
4. Mathematical tables and electronic calculators may be used.

FOR EXAMINER'S USE:

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This paper consists of 12 printed pages
Candidates should check to ensure that all pages are printed as indicated and no questions are missing
SECTION A (25 MARKS)

1. a) The figure below shows two parallel rays incident on a concave lens.

![Diagram](image)

Complete the diagram to show the effect of the lens on the rays. (2 marks)

b) State the conditions under which total internal reflection occurs. (2 marks)

2. A policeman standing between two cliffs fires a gun and hears the first echo after 4.2s later and the next echo after further 2.8s. If the velocity of sound in air is 340m\(^{-1}\), find the distance between the two walls. (3 marks)

3. The figure below shows a 12V battery connected to a network of resistors. Calculate the current flowing through the 2\(\Omega\) resistor. (4 marks)
4. The diagram below shows two parallel current carrying conductors A and B placed close to each other.

On the figure,
   i) Sketch the magnetic field pattern. (2 marks)
   ii) Indicate the force $F$ due to the current on each conductor. (1 mark)

5. The figure below shows an arrangement of the capacitors connected to 10V d.c supply.
Determine the:

i) Charge stored in the 2 \( \mu \)F capacitor.  

(2 marks)

ii) The combined capacitance of the arrangement.  

(2 marks)

6. A ray of light incident on the surface of glass prism is observed to behave as shown below.

Explain its observation.  

(2 marks)

7. How can it be shown that the strength of a magnet is concentrated at the poles?  

(2 marks)
8. State two effects that would be observed when water waves pass from deep to shallow water.

(2 marks)

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9. State the type of wave produced when a stretched wire is plucked.

(1 mark)

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10. a) The diagram below shows a ray of light striking a water glass interface.

\[ \text{Show that } \frac{n_w}{n_g} = \frac{1}{\sin C}. \]  

b) Calculate the angle \( \theta \) below if the refractive indices of glass and water are \( \frac{3}{2} \) and \( \frac{4}{3} \) respectively.

\[ \theta \]

60°

c) i) State Snell’s law of refraction.

(1 mark)
ii) The figure below shows a glass prism of refractive index 1.5.

Trace the path of the ray until it emerges. (2 marks)

11. a) Highlight two conditions that are necessary for interference to occur. (3 marks)

b) During young’s double slit experiment using a red light, state the effect of the following procedure on the interference fringes.

i) Decreasing the slit separation. (1 mark)

ii) Minimizing the distance between the slits and the screen. (1 mark)

iii) Covering one of the slits. (1 mark)

iv) Enlarging the slits. (1 mark)
c) Water waves are observed as they pass a fixed point with 20 crests per minute. A particular wave crest takes 2 seconds to travel between two fixed points 8 metres apart.

Determine the wave:

i) The frequency. (1 mark)

ii) The wave length. (3 marks)

d) The diagram below shows a wave form.

\[ \text{Time(s)} \]

Given that the velocity of the wave is \(2.8 \text{m}^{-1}\), determine the wave length. (3 marks)
12. a) An electric kettle is made of a wire whose resistance is 80Ω and connected to a 240 mains supply. Determine the

i) Power rating of the heater. (2 marks)

ii) Current flowing in the device. (2 marks)

iii) The cost of using the heater for 3 hours a day for 30 days. (Take KPLC rates to be 5/= per KWh) (3 marks)

b) Two heaters A and B are connected in parallel across a 240V mains supply. Heater A is rated 1000W and B is rated 2500W. Calculate the ratio of their resistances, $R_A/R_B$. (3 marks)

13. a) State Ohms law. (1 mark)

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b) You are provided with: resistance wire, a 2V d.c power supply, ammeter, a voltmeter, connection wire and rheostat. Describe with a diagram how you would verify ohms law. (6 marks)

c) Two coils P and Q are placed close to each other as shown in the figure below. P is connected to the battery, rheostat and a switch while Q is connected to the galvanometer G.

State with reason the behavior of the pointer of the galvanometer in each of the following cases:

i) When the switch is closed. (2 marks)

ii) When the switch is open. (2 marks)

d) The coils P and Q are wound on a soft iron core as shown in the figure below.
P has 1200 turns while Q has 500 turns. Resistance of Q is negligible and that of load R is 100Ω. Calculate:

i) Voltage measured by the voltmeter. (3 marks)

ii) Current in the coil Q. (2 marks)

iii) The current in the coil P. (2 marks)

14. In the circuit diagram below, a 3µF capacitor is charged from a 10V battery by connecting the switch to terminal X.

The switch is then connected to terminal Y to charge the 1µF capacitor from the 3 µF capacitor. Calculate:
i) Energy initially stored in the 3 \( \mu F \) capacitor. 

(2 marks)

ii) The final charge across the parallel arrangement. 

(3 marks)

b) What is the function of the copper strip in a lightening arrestor? 

(1 mark)