

1904/203  
PHYSICS TECHNIQUES II  
June/July 2023  
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN SCIENCE LABORATORY TECHNOLOGY

MODULE II

PHYSICS TECHNIQUES II

3 hours

**INSTRUCTIONS TO CANDIDATES**

*You should have the following for this examination:*

*Answer booklet;*

*Non-programmable scientific calculator.*

*This paper consists of TWO sections; A and B.*

*Answer ALL questions in section A and any TWO questions from section B in the answer booklet provided.*

*Each question in section A carries 4 marks while each question in section B carries 20 marks.*

*Maximum marks for each part of a question are indicated.*

*Candidates should answer the questions in English.*

**This paper consists of 7 printed pages.**

**Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**

SECTION A (60 marks)

Answer ALL questions in this section.

1. (a) Draw the circuit symbol of:
- (i) an electrolytic capacitor;
  - (ii) a fixed capacitor;
  - (iii) a variable capacitor. (3 marks)
- (b) Sketch a graph of charge against time for a capacitor during discharge. (1 mark)
2. Explain what happens to the leaf of a positively charged electroscope when a candle flame is brought near the cap. (4 marks)
3. Two plates of a parallel-plate capacitor are 0.0002 m apart. The potential difference between the plates is 100 V and the area of each plate is 0.001 m<sup>2</sup>.
- Determine the charge stored in the capacitor.
- ( $\epsilon_0 = 8.85 \times 10^{-12} \text{ Fm}^{-1}$ ) (4 marks)
4. (a) State the law of magnetism. (1 mark)
- (b) Explain how the direction of a magnetic field at a point is determined. (3 marks)
5. Explain why:
- (a) direct current is used to magnetise a material; (2 marks)
  - (b) alternating current is used in demagnetization. (2 marks)
6. (a) Define the term 'current'. (1 mark)
- (b) State **three** differences between a closed circuit and an open circuit. (3 marks)
7. (a) Calculate the power of an electric iron box if it draws a current of 10 A when connected to 240 V supply. (2 marks)
- (b) Explain why long distance power transmission is done at a high voltage. (2 marks)

8. (a) Define the term 'electrical resistance' of a conductor. (1 mark)
- (b) A charge of 150 Coulombs flows through a wire in one minute. Determine the electric current flowing in the wire. (3 marks)
9. (a) Define the term 'mutual induction'. (1 mark)
- (b) The transformer in a phone charger steps down the mains voltage from 240 V to 12 V. If its primary coil has 800 turns, determine the number of turns in the secondary coil. (3 marks)
10. Explain how a bicycle fitted with a dynamo can be made to produce a brighter light. (4 marks)
11. (a) Define the term 'doping' as used in semi-conductors. (1 mark)
- (b) The following are elements found in a periodic table:
- Boron
  - Aluminium
  - Bismuth
  - Magnesium
  - Iron

Identify **three** elements that can be used for doping. (3 marks)

12. (a) Sketch a graph of current against temperature for an intrinsic semi-conductor connected to a source of E.M.F. (2 marks)
- (b) Explain the shape of the graph. (2 marks)
13. (a) Define the term 'amplitude' of a wave. (1 mark)
- (b) **Figure 1** represents a wave travelling from point P to Q.

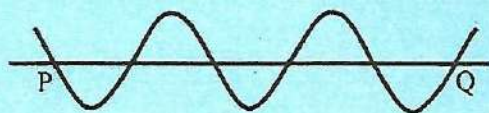


Fig. 1

If the distance between P and Q is 100 cm, determine the wavelength. (3 marks)

14. Highlight **four** industrial applications of radioactivity. (4 marks)
15. Differentiate between hard and soft x-rays. (4 marks)

**SECTION B (40 marks)**

Answer any **TWO** questions from this section.

16. (a) The results obtained during an experiment to determine the internal resistance of a cell are recorded in **table I**.

**Table I**

Current (A)	0	0.1	0.2	0.3	0.4	0.5	0.6
Voltage (V)	1.5	1.36	1.22	1.08	1.14	0.82	0.68

- (i) Plot a graph of voltage (y-axis) against current. (7 marks)
- (ii) From the graph, determine the:
- (I) E.M.F. (1 mark)
- (II) internal resistance of the cell. (3 marks)
- (b) A transformer operates at a 240 mains supply and delivers 8 A at 100 V to an electrical appliance. The efficiency of the transformer is 90%.
- Determine the current in the primary coil. (5 marks)
- (c) (i) Define the term 'power'. (1 mark)
- (ii) A torch bulb is rated 5.0 V, 0.4 A. Determine the energy dissipated by the bulb in 10 minutes. (3 marks)
17. (a) The potential difference between the two electrodes of an X-ray tube is 60 kV.

Calculate the:

- (i) energy of an electron accelerated in the tube; (3 marks)
- (ii) wavelength of the radiation. (3 marks)

Plank's constant:  $h = 6.63 \times 10^{-34} \text{ Js}$

Electron charge:  $e = 1.6 \times 10^{-19} \text{ C}$

Velocity of electromagnetic radiation:  $= 3.0 \times 10^8 \text{ m/s}$

- (b) (i) Define the term 'wave'. (1 mark)
- (ii) State **four** differences between mechanical waves and electromagnetic waves. (4 marks)
- (iii) Give **one** example of an electromagnetic wave. (1 mark)
- (c) **Figure 2** shows two curves of two materials P and Q during magnetization using electrical method.

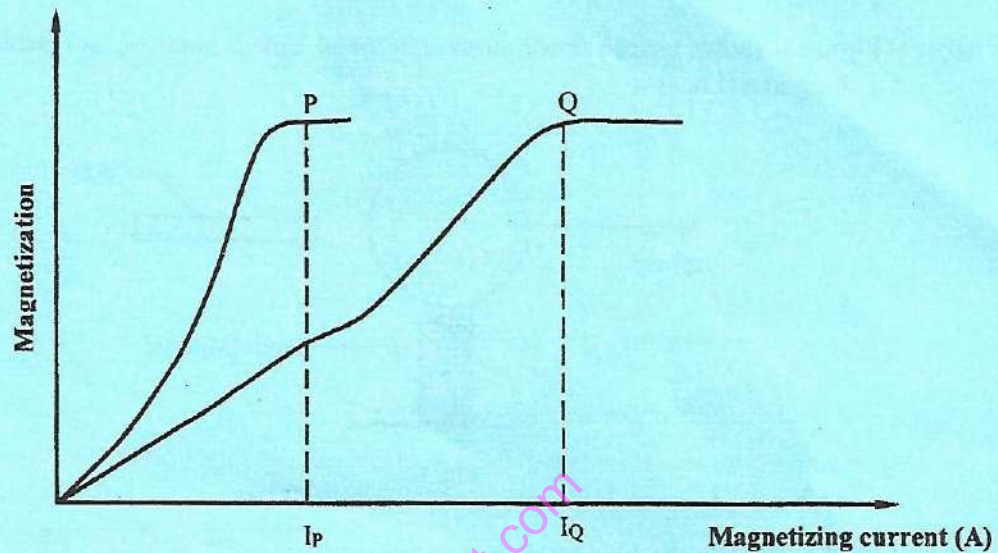


Fig. 2

Using the domain theory of magnetization, explain the differences between the two materials. (8 marks)

18. (a) **Figure 3** represents a circuit with three capacitors  $C_1$ ,  $C_2$  and  $C_3$  connected to a 12 V battery.

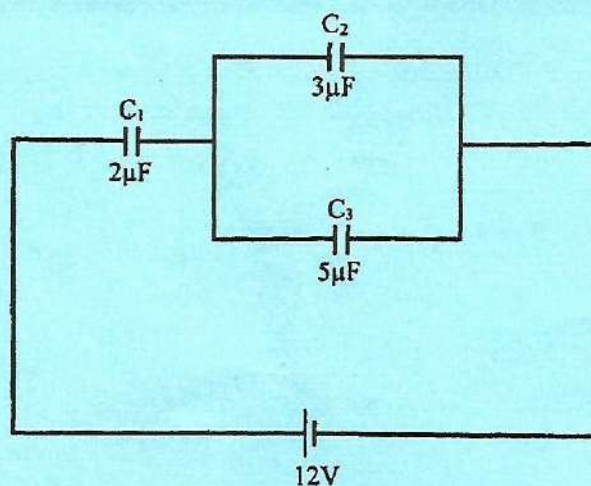
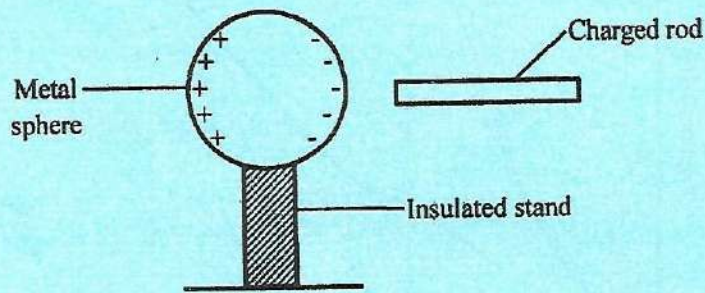


Fig. 3

$$V = \frac{Q}{C}$$
$$Q = CV$$

Determine the:

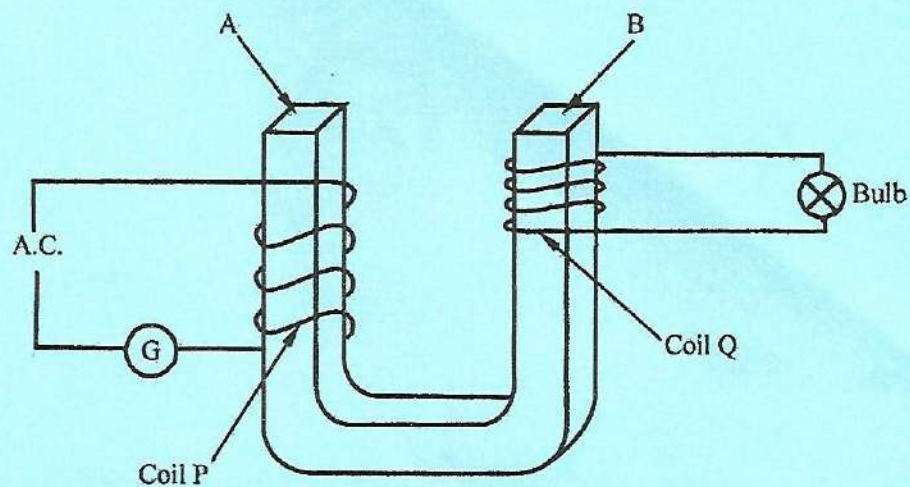
- (i) effective capacitance; (5 marks)
  - (ii) total charge of the circuit; (3 marks)
  - (iii) potential difference across  $C_1$  and  $C_2$ ; (4 marks)
  - (iv) charge on  $C_2$ . (2 marks)
- (b) **Figure 4** shows charge distribution on a metal sphere placed on an insulated stand with a charged rod near it.



**Fig. 4**

- (i) Explain the type of charge on the rod. (3 marks)
- (ii) The side of the sphere opposite the rod is touched with a finger and the rod is removed. The sphere is then found to have acquired a charge. Explain. (3 marks)

19. (a) Using a labelled circuit diagram with two junction diodes and a centre-tap transformer, explain the production of a full wave rectification. (10 marks)
- (b) **Figure 5** shows two arms A and B of a U-shaped soft iron material connected to an A.C supply through a coil P.



**Fig. 5**

A small coil Q is connected to a low voltage bulb on the arm B.

Explain why the bulb:

- (i) lights when current flows in coil P; (1 mark)
  - (ii) becomes dimmer when the coil P is moved upward so that few turns are in touch with arm A; (2 marks)
  - (iii) becomes brighter when an iron bar is placed across A and B; (2 marks)
  - (iv) goes off when the A.C is replaced by a D.C current in coil P. (2 marks)
- (c) The initial mass of a radioactive substance of half life 5 years is 40.0 g. Determine the mass remaining after 20 years. (3 marks)

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