P510/2
PHYSICS
(Theory 2

July/August 2023
2½ hours

MASAKA DIOCESAN EXAMINATIONS BOARD
Uganda Advanced Certificate of Education
Joint Mock Examinations 2023
PHYSICS
(THEORY)
Paper 2
2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

*Answer **five** questions, taking at least **one** from each of the sections, **A**, **B** **C** and **D**, but not more than **one** question should be chosen from either **A** or **B**.*
*Any additional questions answered will **not** be marked.*
Mathematical tables and graph paper are provided.
Non-programmable scientific calculators may be used.

Assume where necessary:

Speed of light in a vacuum, C	=	$3.0 \times 10^{8}ms^{-1}$
Acceleration due to gravity g	=	$9.81ms^{-2}$
Electron charge e	=	$1.6 \times 10^{-19}C$
Electron mass	=	$9.11 \times 10^{-31}kg$
Plank's constant, h	=	$6.6 \times 10^{-34}Js$
Permittivity of free space μ_o	=	$4.0\pi \times 10$
Permittivity of free space ε_o	=	$8.85 \times 10^{-12}\ Fm^{-1}$
Constant $\frac{1}{4\pi\varepsilon_o}$	=	$9.0 \times 10^{9}mF^{-1}$
One electron volt (eV)	=	$1.6 \times 10^{-19}J$
Avogadro's number N_A	=	$6.02 \times 10^{23}mol^{-1}$
Resistivity of Nichrome wire at 25^0	=	$1.2 \times 10^{-6}\Omega m$
Specific heat capacity of water	=	$4.2 \times 10^{3}jkg^{-1}K^{-1}$

SECTION A:

1. a) What is meant by reversibility of light as applied to formation of real image by convex lens? (2 marks)

   a) i) Describe the structure and mode of operation of compound microscope in normal adjustment. (4 marks)

   ii) The objective and eye piece of astronomical telescope have focal length 100cm and 5cm respectively. If the final image is formed at near point and diameter of objective is 200mm. Find the diameter of the eye ring. (5 marks)

   b) Derive an expression for refractive index of prism surrounded by water of refractive index n_w in terms of refracting angle A, the angle of minimum deviation D, and n_w. (5 marks)

2. a) i) Define radii of curvature of a lens. (1 mark)

   ii) State the characteristics of image formed by concave lens. (1 mark)

   b) Derive lens formula for concave lens using exerted object. (4 marks)

   c) i) Define refractive index of a material. (1 mark)

   ii) Describe an experiment to determine refractive index of water by using convex lens and plane mirror. (4 marks)

   d) A small quantity of a liquid of refractive index 1.4 is poured on a horizontal plane mirror and a biconvex lens of focal length 30cm and refractive index 1.5 is then placed on top of the liquid. The pin is moved along the axis of the lens until no parallax between it and its image. Find the distance between the pin and the lens. (5 marks)

   e) Describe how mirage is formed. (4 marks)

SECTION B:

3. a) Define the following as applied to waves.

   i) harmonics
   ii) fundamental note. (2 marks)

   b) A source of sound moving with velocity u_s approaches an observer moving with velocity u_s in the same direction.

   i) Derive the expression for the frequency of sound heard by the observer. (3 marks)

   ii) Explain what happens to the pitch of sound heard by the observer in (b) (i) above when observer moves faster than the source. (2 marks)

   c) Describe a simple experiment to show interference in longitudinal waves. (4 marks)

   d) A stretched wire of length 0.75m radius 1.36 mm and density $1389kgm^{-3}$ is clamped at both ends and plucked in the middle. When the wire produces fundamental note, it resonates with closed pipe producing first over tone. The air length in the pipe is 0.15m. Calculate the tension in the wire (speed of sound in air = $330ms^{-1}$) (6 marks)

   e) Explain why sound propagates as an adiabatic process. (3 marks)

4. a) i) State Huygen's principle. (1 mark)

   ii) The wave length of light in air is 620mm. Find its wave length in a material of refractive index 1.6 (3 marks)

   b) i) Define unporalized light. (1 mark)

   ii) Explain why sound waves cannot be polarized. (2 marks)

   iii) The polarizing angle of light incident in air on a glass plate is 56.5^0. What is the refractive index of glass? (3 marks)

   c) Describe how concentration of sugar in a solution can be measured by polarization. (5 marks)

   d) In Young's double slit experiment the distance between adjacent bright fringes is 10^{-3}m. If the distance between the slits and the screen is doubled, the slit separation halved and light of wave length 650nm changed to light of wave length 400nm. Find the new separation of fringes. (6 marks)

SECTION C:

5. a) i) Define magnetic flux linkage. (1 mark)

ii) Draw magnetic field pattern around straight wire carrying current into the paper. (2 marks)

b) i) Explain why a current carrying conductor placed in magnetic field experiences a force.

ii) Describe the structure and mode of operation of moving coil galvanometer. (5 marks)

c) i) Define electro magnetic moment. (1 mark)

ii) A small circular coils of 10 turns and when radius 2.5cm is mounted at the centre of a long solenoid of 750 turns per metre with its axis at right angles to the axis of solenoid. If the current in the solenoid is 2.0A find initial torque on the circular coil when a current of 1A is passed through it. (4 marks)

d) State the features of earth's magnetic fields. (3 marks)

6. a) i) What is meant by back e.m.f in dc motor. (2 marks)

ii) What are factors affecting efficiency of d.c. motor? (1 mark)

b) i) Define reactance. (1 mark)

ii) A p.d V = Vosinwt is connected across an inductor show the voltage leads current by $\frac{\pi}{2}$ (3 marks)

iii) Draw on same exises the graph showing phase relationship between current and voltage in an inductor. (2 marks)

c) An inductor is connected in series with the d.c source and the switch. Explain why sparks are observed when which is closed and reopened. (3 marks)

d) Describe the structure and mode of operation of full wave rectifier meter. (5 marks)

e) A lamp rated 120V, 2A. It is connected to A.C source of 240V and 50H2 in series with a capacitor. Find capacitance of the capacitor. (3 marks)

7. a) i) State the laws of electro magnetic induction. (2 marks)

ii) A circular disc of radius r is rotating about its axis at angular velocity w in uniform field. Derive for the expression of e.m.f between the centre of the disc and its rim. (4 marks)

b) Describe an experiment to measure magnetic flux density between poles of a strong magnet by using search coil. (5 marks)

c) Describe the structure and mode of operation of transformer. (5 marks)

d) A transformer of 4.32s steps down voltage from 240V to 6V. If the transformer has 60 turns in the secondary and efficiency of 90%, find;

i) the current in secondary coil. (2 marks)

ii) number of turns in primary coil. (2 marks)

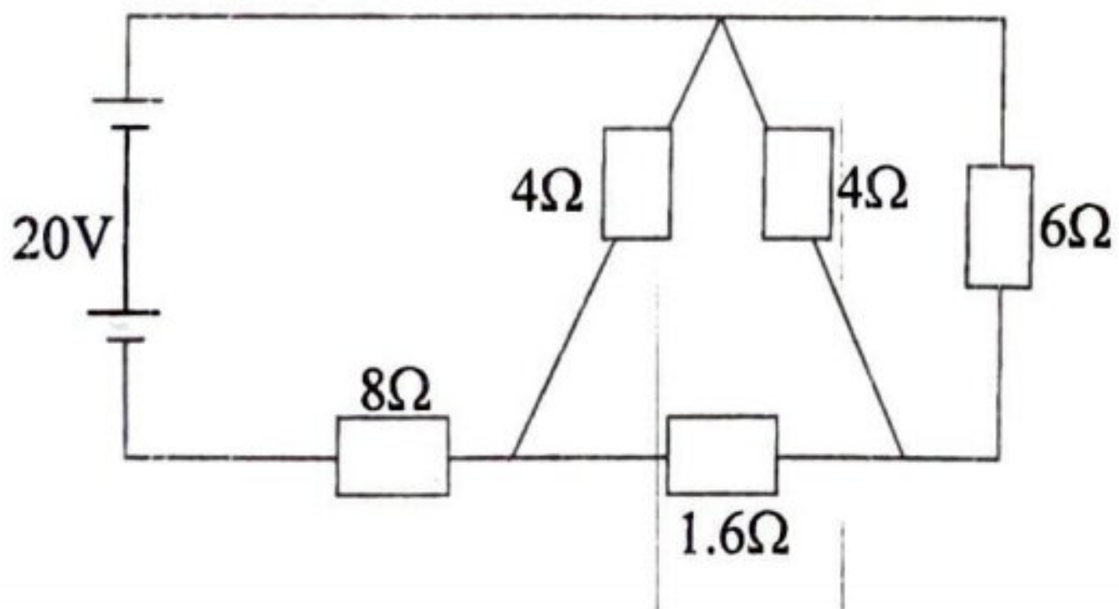
SECTION D:

8. a) i) What is meant by internal resistance of cell? (1 mark)

ii) Why is it that terminal p.d of cell is does not equal to its e.m.f? (2 marks)

b) The figure 1 below shows a network of five resistors connected to a battery of 20V and negligible internal resistance.

Figure 1



Find the current following through 8Ω. (4 marks)

c) i) Define temperature coefficient of resistance and state its s.1 unit. (2 marks)

ii) Explain why semi conductors have negative temperature coefficient of resistance. (2 marks)

d) Describe an experiment to determine temperature coefficient of resistance of a metal wire using a metre bridge. (6 marks)

e) Derive balance condition for Metre Bridge. (3 marks)

9. a) i) Define micro farad. (1 mark)

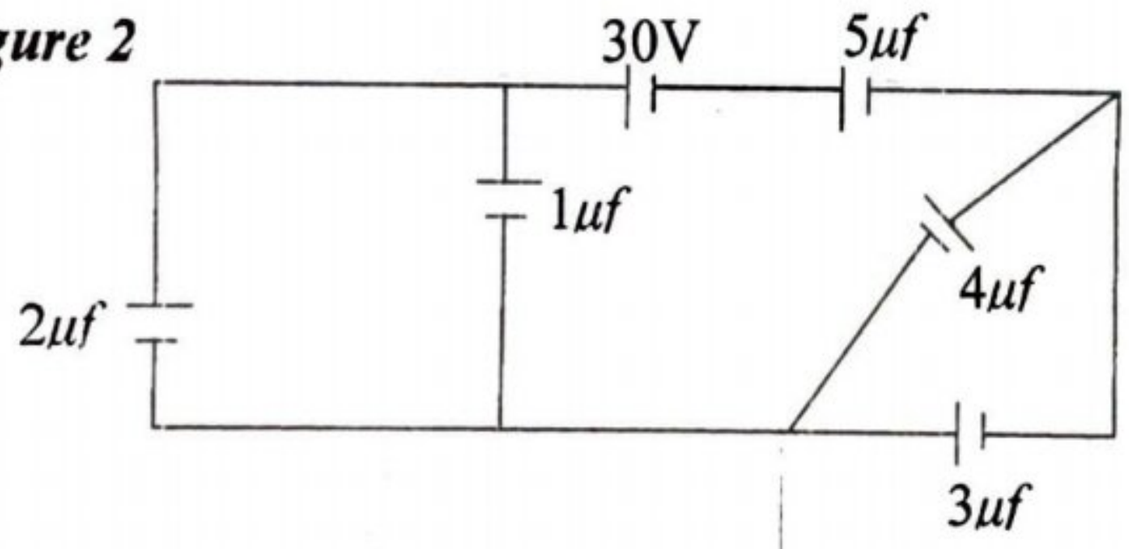
ii) Derive an expression for the work done to change a capacitor of capacitance C to a p.d.V (4 marks)

b) i) Explain effect of placing insulator between the plates of a charged capacitor on p.d between the plates. (3 marks)

ii) Describe an experiment to determine dielectric constant by using B.G. (4 marks)

c)

Figure 2



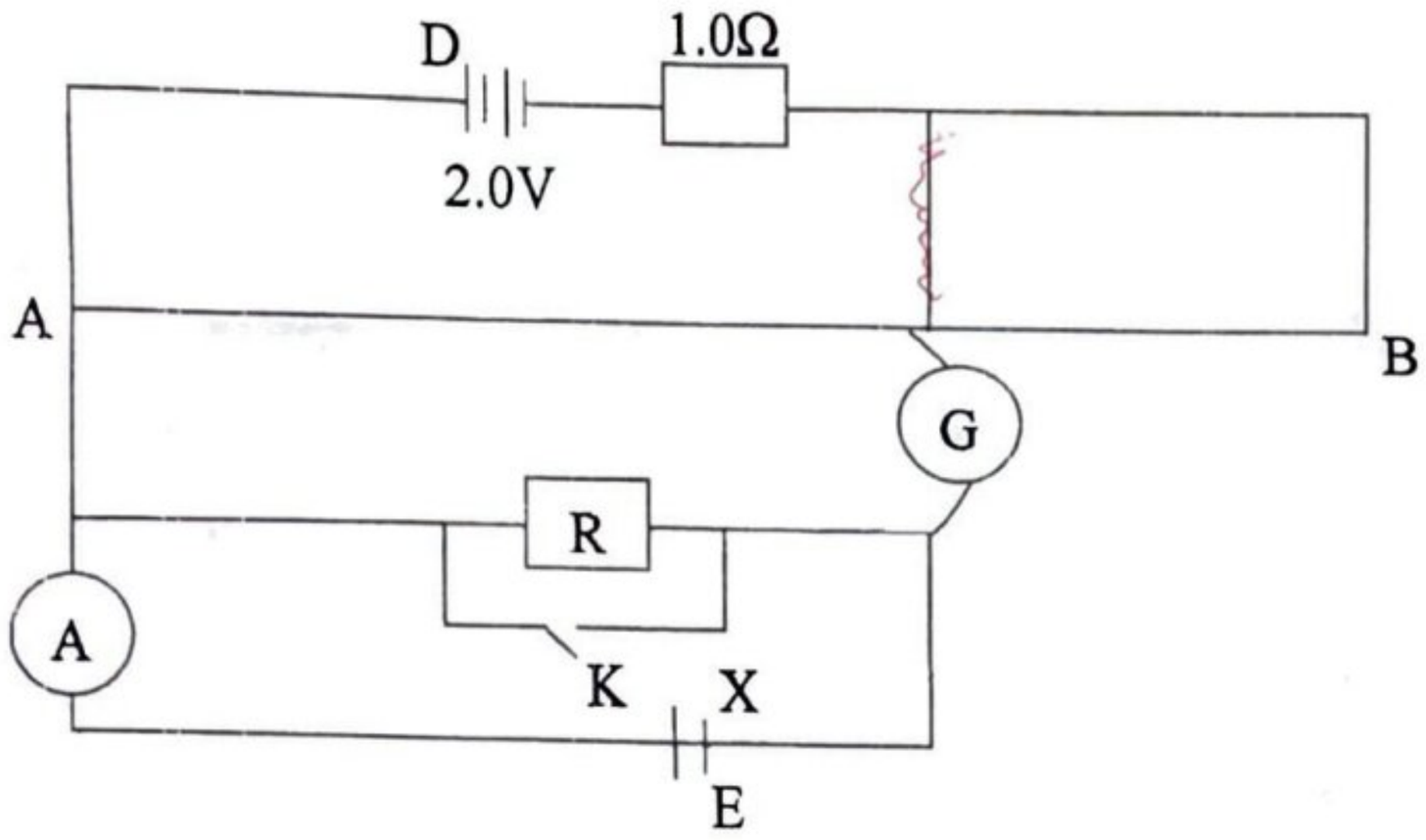
The figure 3 shows the network of capacities connected to 30V source. Find charge stored on $3\mu f$. (5 marks)

d) Describe how van dee graaf generator works. (5 marks)

10. a) Outline the principle of potentiometer. (3 marks)

b) Describe an experiment to determine e.m.f of thermo complex by using potentiometer.

c)



E is driver cell of negligible internal resistance and e.m.f 2V. AB is a uniform resistance wire of 5Ω and length 100cm. When K is closed the balance length is 90cm.

Find;

i) the e.m.f E

ii) the value R and balance length given that when K is opened the ammeter reading is 0.5A and internal resistance of E is 0.1Ω.

d) Derive an expression for maximum power produced in a resistor R connected to a source of e.m.f and internal resistance r. (4 marks)

END