P510/2
Physics
Paper 2
July/August 2019
2½ hours

BUGANDA EXAMINATIONS COUNCIL MOCKS

Uganda Advanced Certificate of Education

PHYSICS

PAPER 2

2HOURS 30 MINUTES

INSTRUCTIONS TO CANDIDATES

- Answer five questions, taking atleast one, from each of the sections **A**, **B**, **C** and **D** but not more than one question should be chosen from either section **A** or **B.**
- Any additional question(s) answered will not be marked.
- Mathematical tables and squared papers will be provided.
- Non programmable scientific calculators may be used.
- Assume where necessary:
  - Acceleration due to gravity, g = $9.81 ms^{-2}$
  - Electron charge, e = $1.6 \times 10^{-19} C$
  - Electron mass = $9.11 \times 10^{-31} kg$
  - Plank's constant, h = $6.6 \times 10^{-34} Js$
  - Speed of light in vacuum, C = $3.0 \times 10^{8} ms^{-1}$
  - Avogadro's number, N_A = $6.02 \times 10^{23} mol^{-1}$
  - Gas constant, R = $8.31 Jmol^{-1}K^{-1}$
  - Charge to mass ratio, e/m = $1.8 \times 10^{11} Ckg^{-1}$
  - The constant $\frac{1}{4\pi\varepsilon_o}$ = $9.0 \times 10^{9} F^{-1}m$
  - Permeability of free space, μ_o = $4.0\pi \times 10^{-7} Hm^{-1}$
  - Permittivity of free space ε_o = $8.85 \times 10^{-12} Fm^{-1}$

SECTION A

1(a) Define principal focus and power of a lens. (2marks)

(b) Two lenses **A** and **B** of power +5D and -4D respectively are arranged coaxially 8cm apart. An object 3cm tall is placed 60cm on front of lens **A** on the side remote from lens B. Find the;

(i) position of the final image. (5marks)

(ii) height of the final image (2marks)

(c)(i) Explain the terms chromatic and spherical aberrations in lenses. (4marks)

(ii) With the aid of diagrams explain how stopping down of lenses work. (3marks)

(d) Explain why magnifying glasses are free of chromatic aberration when viewing from very close to the lens. (4marks)

2(a) Define refractive index and radii of curvature of a convex lens. (2marks)

(b)(i) Derive the formula $\frac{1}{f} = (n - 1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$ for a convex lens, where **n** and **f** are the refractive index and the focal length of the lens respectively, while r_1 *and* r_2 are the radii of curvature of the surfaces of the lens. (5marks)

(ii) Determine the focal length of a diverging meniscus whose surfaces are of radii curvature 26cm and 32cm respectively and the refractive index of the glass is 1.52. (2marks)

(c) Describe an experiment to determine the refractive index of a liquid using a convex lens and a plane mirror. (6marks)

(d)(i) Describe with the aid of a diagram the structure and action of a compound microscope in normal adjustment. (4marks)

(ii) State what is meant by exit pupil of a compound microscope. (1mark)

SECTION B

3(a) State the principle of superposition of waves. (1mark)

(b) Two loud speakers connected to the same signal generator are placed 40m apart facing each other. An observer walks slowly from one speaker to another along the line of the speaker.

(i) What does the observer hear? (1mark)

(ii) Explain the observation in (i) above. (4marks)

(c) Describe with the aid of a diagram how you can determine the velocity of sound in air by a method involving formation of stationary waves. (5marks)

(d)(i) Explain how beats in sound are formed. (2marks)

(ii) Two tuning forks **W** and **Y** are sounded together to produce beats of frequency 8Hz. Fork W has a known frequency of 482Hz. When fork **Y** is loaded with a small piece of plasticine, beats at a frequency of 4Hz are heard when the two tuning forks are sounded together. Calculate the frequency of **Y**. (3marks)

(iii) State another frequency that will produce beats with **Y** at the same rate as W. (1mark)

(e) Two notes of frequencies 480Hz and 512Hz are produced together. Find the phase difference between the waves a point 0.8m from the point where they were first in phase. (3marks)

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

(ii) Use Huggen's principle to prove the laws of reflection of light. (5marks)

(b)(i) What is polarized light? (1mark)

(ii) Describe how polarized light can be produced by reflection. Indicate the procedure you would use to detect the polarized light. (5marks)

(iii) List two uses of polarized light. (2marks)

(c) A diffraction grating has 500 lines per mm. When it is illuminated normally by monochromatic light, the angle between the central maximum and the first maximum is 16.5^{o}. Find the;

(i) wave length of the light (4marks)

(ii) number of diffraction maxima obtainable. (2marks)

SECTION C

5(a) What is meant by the term;

(i) magnetic meridian (1mark)

(ii) angle of dip (1mark)

(b) Describe how you can determine the horizontal component of the earth's magnetic flux density using a deflection magnetometer. (5marks)

(c)(i) Write the expression for the magnetic flux density at a point distance, **x**, from a conductor carrying current of **I**, in vacuum. (1mark)

(ii) Using a diagram explain how magnetic force acts on a current carrying conductor placed perpendicular to the field. (3marks)

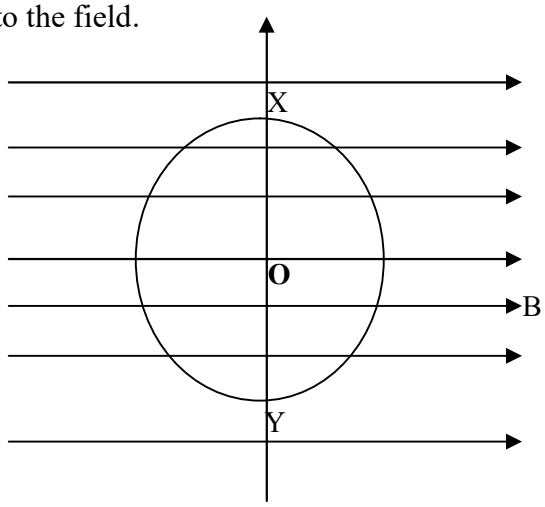


Figure 1

A circular loop of wire is placed in a uniform magnetic field of flux density, **B**, with the axis of the wire as shown in figure 1. Explain what happens to the loop when current starts to flow through it in a clockwise direction if the loop is pivoted about the axis XOY. (3marks)

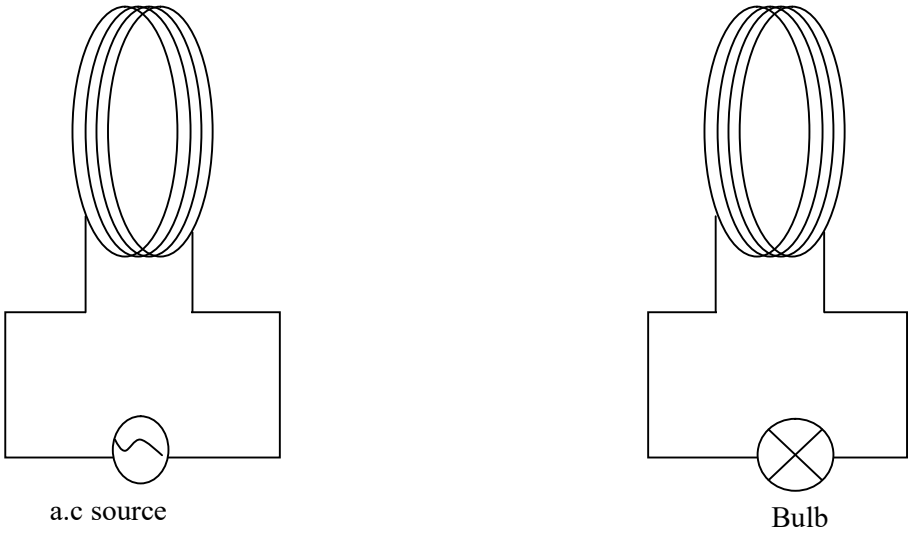
(d) A circular coil of 50 turns each of radius 12.0cm lies flat on a table. The earth's magnetic field intensity at the location is $54.2Am^{-1}$ while the angle of dip is 72.0^{o}. Find the;

(i) magnetic flux threading the coil. (3marks)

(ii) torque on the coil if a current of 1.8A is passed through it. (3marks)

6(a) What is meant by self induction and mutual induction? (2marks)

(b) Two coils **P** and **q** are placed coaxially near each other as shown in figure 2.



Explain the following observations

(i) When the a.c supply is switched on the bulb lights. (2marks)

(ii) The brightness of the bulb increases when a soft iron rod is placed inside and along the common axis of the coils. (2marks)

(iii) When the iron rods are removed, the brightness of the bulb reduces as the coils are being moved further apart. (2marks)

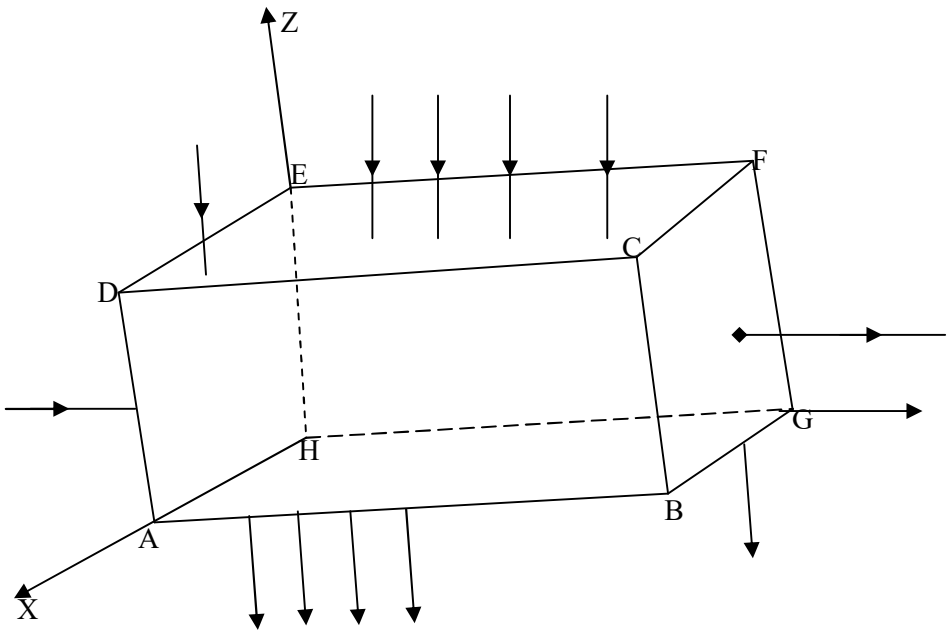


Figure 3

(c) Figure 3 shows a rectangular conductor ABCDEFGH carrying current **I** in a direction perpendicular to a vertical magnetic field of flux density **B**.

(i) Explain why a p.d develops between opposite faces of the conductor. (4marks)

(ii) If the conductor has 10^{22} free electrons per m^3, BC = 3mm and the current flowing is 2A in a magnetic field of flux density 0.4T, calculate the p.d induced. (3marks)

(d) A capacitor of capacitance 2500μF is fully charged to 40V. When the capacitor is discharged through a ballistic galvanometer, the galvanometer gives a maximum deflection of 20 divisions. A coil of 30 turns, each of radius 10cm is placed with its plane perpendicular to a uniform magnetic field. The coil is connected in series with the ballistic galvanometer. When the coil is rotated through 180^o, the galvanometer gives a maximum deflection of 15 divisions. Calculate the magnetic flux density if the total resistance in the circuit is 4Ω. (5marks)

7a(i) Describe with the aid of a diagram the mode of operation of an a.c generator. (5marks)

(ii) Explain how an a.c generator can be modified to operate as a d.c motor. (3marks)

(b) Define root mean square value of an alternating current and capacitive reactance. (2marks)

(c) An alternating voltage of 15V and frequency 600Hz is connected across a capacitor of 20μF in a circuit.

(i) Explain why current flows in the circuit and yet there would be no current if it was a direct voltage source used. (3marks)

(ii) Calculate the value of the current flowing. (3marks)

(d) Describe how a full wave rectifier ammeter works. (4marks)

SECTION D

8(a) Define potential difference and the coulomb. (2marks)

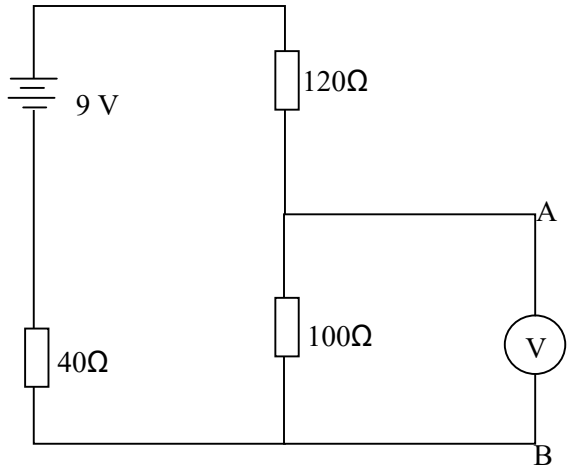


Fig.4

In the circuit in figure 4 the voltmeter V has resistance of 400Ω

(i) Find the voltmeter reading. (4marks)

(ii) What is the p.d across the 100Ω resistor when the voltmeter is removed? (2marks)

(iii) Explain why it is desirable to have a voltmeter of very high resistance. (2marks)

(c)(i) Define temperature coefficient of resistance of a conductor. (1mark)

(ii) Describe an experiment to determine the temperature coefficient of resistance of a conductor in form of wire. (6marks)

(iii) Explain why the resistance of a conductor increases when its temperature increases. (3marks)

9(a) Derive the balance condition for a wheat stone bridge. (4marks)

(b) What is meant by end correction of a metre bridge? (1mark)

(c) When a resistor of resistance 5Ω is connected on the right hand gap of a metre bridge, the balance point is found to be 35.2cm. When the resistors are interchanged, the balance point is found to be 30.4cm from the left hand end of the bridge wire. Find the;

(i) end correction (4marks)

(ii) contact resistance on the right hand end of the bridge wire given that the resistance of the wire is 6Ω. (2marks)

(d)(i) Describe how a potentiometer can be used to calibrate a voltmeter. (5marks)

(ii) Describe two factors that may limit the accuracy when using a potentiometer. (2marks)

(iii) Explain what happens when the e.m.f of the cell in the test circuit is greater than that of the driver cell. (2marks)

10(a)(i) Define capacitance and state its S.I units. (2marks)

(ii) Describe the experiment to determine capacitance of a capacitor. (4marks)

(b)

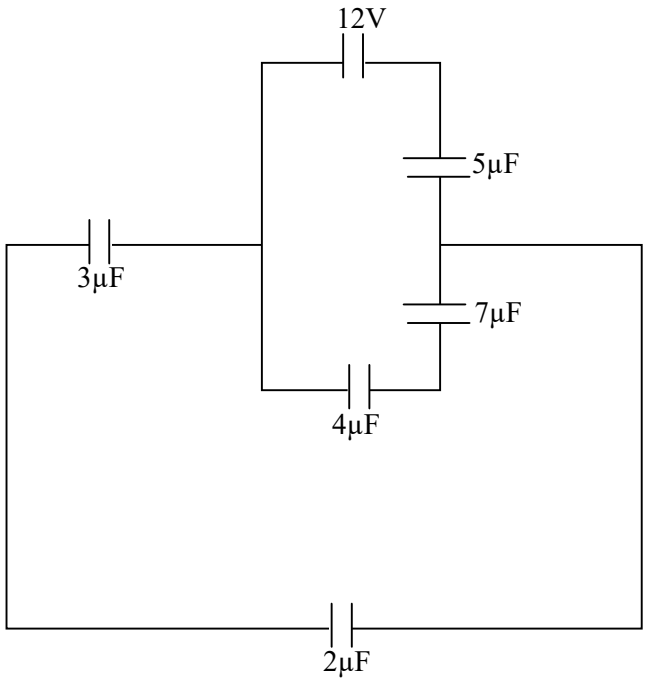


Figure 2

Figure 5 shows a network of capacitors connected to a d.c supply of e.m.f 12V. Calculate the;

(i) energy stored in the net work. (4marks)

(ii) p.d across the $5\mu F$ capacitor. (4marks)

(c) Explain how a high potential is built up in a Vander Graaff generator. (6marks)

END