P510/2
PHYSICS
Paper 2
July 2017
2½ hours

UGANDA ADVANCED CERTIFICATE OF EDUCATION
Mock Examinations
PHYSICS

PAPER 2

2 hours 30 minutes

INSTRUCTIONS:

- Attempt any **five** Questions including not more than two Questions from each of the section A, B and C.
- Draw double margins on all pages used.
- Silent non- programmable electronic scientific calculators may be used.
- Number your work clearly.
  Where necessary assume the following values of physical constants:

Acceleration due to gravity, g	$= 9.81\ m/s^2$
Speed of light in vacuum, C	$= 3.0 \times 10^8 m/s$
Electronic charge, e	$= 1.6 \times 10^{-19} C$
Permittivity of free space, μ_0	$= 4\pi \times 10^{-7} Fm^{-1}$
The constant, $\frac{1}{4\pi\varepsilon_0}$	$= 9.0 \times 10^9\ m\ F^{-1}$

SECTION A

1. (a) With the aid of sketch diagrams, explain the following terms as applied to optics.

   (i) Virtual object. (02 marks)

   (ii) Conjugated foci. (01 mark)

   (b) Describe in detail an experiment to determine the focal length of a diverging lens with the aid of a concave mirror. (05 marks)

   (c) (i) Sketch ray diagrams to show how a convex lens forms images of an extended object. (03 marks)

   (ii) Explain what is meant by sign convention as applied to lenses. (01 mark)

   (d) A right angled glass prism ABC has angle BAC = ACB = 45^0 and is made of glass whose refractive index is 1.6. A ray of light is incident upon the hypotenuse face AC so that after refraction it strikes face AB and emerges at minimum deviation.

   (i) Find the angle of incidence upon AC. (03 marks)

   (ii) What is the smallest angle of incidence upon AC for which light can still emerge at AB? (03 marks)

   (iii) If the angle of incidence upon AC is made zero, find the whole deviation for the ray of light. (02 marks)

2. (a) (i) Distinguish between angular magnification and linear magnification. (02 marks)

   (ii) Sketch a ray diagram to show a terrestrial telescope in normal

adjustment. (03 marks)

(c) (i) Draw a diagram showing the essential part of a projection lantern. (03 marks)

(ii) A projection lantern is required to project square slides of side 5.0cm on to a square screen of side 3.0m at a distance of 9.0 m away from the projection lens. Calculate the focal length of the lens suitable for the formation of the image. (04 marks)

3. (a) Distinguish between **transverse** and **longitudinal** waves. (02 marks)

(b) The displacement, y, of a wave traveling in the **x**-direction at time **t** is given By: $y = a\sin 2\pi\left(\frac{t}{0.2} - \frac{x}{3.0}\right)$ metres.

Find the:

(i) Velocity of the wave. (04 marks)

(ii) Period of the wave. (01 mark)

(c) (i) What is meant by **Doppler Effect**? (01 mark)

(ii) An ambulance traveling at 120 m/s sounds a siren of frequency 3kHz as it approaches a patient lying stationary. If the speed of the sound in air is 330m/s, find the apparent frequency of the siren as heard by the patient (03 marks)

(iii) State one application of Doppler Effect. (01 mark)

(d) (i) Describe the motion of air in a tube closed at one end vibrating at its **fundamental note**. (03 marks)

(ii) A cylindrical pipe of length 30cm is closed at one end. The air in the Pipe resonates with a tuning fork of frequency 540Hz sounded near the open end of the pipe. (05 marks)

4. (a) What is meant by the following terms:-

(i) **Constructive interference**, (02 marks)

(ii) **Destructive interference** as applied to two sources of light. (02 marks)

(b) Outline briefly the theory of **Young's double-slit** experiment. (05 marks)

(c) In Young's double slit experiment, an interference pattern in which the ninth bright fringe 2.5cm from the center of the pattern was obtained. If the slit separation is 0.5mm and the distance between the slits and the screen is 1.5m. Calculate the wavelength of the light source. (04 marks)

(d) Explain the following terms as applied to physical optics:

(i) **Optical path length**, (01 mark)

(ii) **Coherent sources**. (02 marks)

(e) Two glass microscope slides have a fine hair trapped between them at one end and at the other, the slides are firmly clamped in close contact. On illuminating the slides normally with light of wave length 5.0×10^{-7}m, 20 dark bands are seen crossing the slides between the clamps and the hair. Estimate the diameter of the hair. (04 marks)

SECTION B

5. (a) Define **root – mean – square value** of current. (01 mark)

(b) With the aid of a labeled diagram describe the structure and action of a moving iron meter used to measure a.c. (05 marks)

(c) A sinusoidal alternating voltage of e.m.f 20V and frequency 60Hz is applied across a coil of wire of inductance 0.2H and negligible resistance.

(i) Find the reactance of the coil at the frequency. (03 marks)

(ii) Calculate the r.m.s value of the current which passes through the coil

(03 marks)

(iii) Using the same axes, sketch graphs to show the variation with time of the applied voltage and the current which flows. (03 marks)

(d) Explain why on average the power delivered to the inductor is zero.

(05 marks)

6. (a) Distinguish between **magnetic flux** and **magnetic flux density**.
(02 marks)

(b) (i) Two long wires A and B carrying currents I_1 and I_2 respectively in the same direction are placed a distance d metres apart in vacuum. Show that the distance between the neutral point and wire B is given by: $x = \frac{dI_1}{I_1 + I_2}$. (04 marks)

(ii) Given I_1 = 2A, I_2 = 3A and the distance of separation is 2cm. What is the distance between the neutral point and wire A. (02 marks)

(c) (i) Describe how current through a thin straight wire can be accurately measured using the current balance. (05 marks)

(ii) The diagram in figure1 below shows a solenoid of length 40cm carrying a current 9.81A and a rigid rectangular copper wire loop PQRS having sides QR of length 4.0cm and carrying current of 0.7A by the time the loop is horizontal and the system is horizontal and the system is in vacuum.

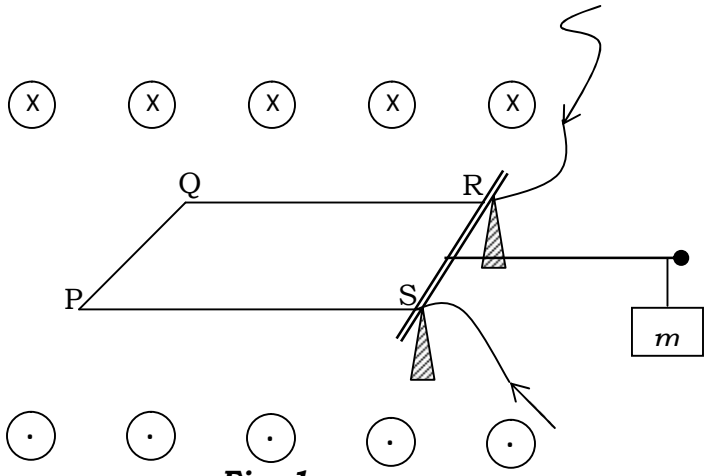

Fig. 1

Determine the number of turns of the solenoid required to balance a mass, *m= 22g* attached to a light rod hinged at the centre of the insulated pivoted beam. (04 marks)

(d) Explain why a current carrying conductor placed in a magnetic field experiences a force. (03 marks)

7. (a) State the laws of **electromagnetic induction**. (02 marks)

(b) (i) Briefly describe the structure and mode of operation of an a.c. transformer. (04 marks)

(ii) A transformer of 4.32W steps down voltage from 240V to 6V. If the transformer has 600 turns on the secondary and its efficiency is 90%. Calculate the current in the primary and the number of turns in the primary. (05 marks)

(iii) Mention any three sources of energy loss in a practical transformer and briefly discuss how they can be minimized. (03 marks)

(c) A circular coil of 200 turns of mean radius 112 mm has resistance of 5Ω. The coil is connected in series with a ballistic galvanometer of resistance 20Ω and arranged such that its plane is perpendicular to the magnetic meridian. When the coil is quickly turned through 180^0, about the vertical axis, the galvanometer gives a deflection of 10 divisions. When the galvanometer is disconnected and a capacitor of 1.2μF, charged to 20V is discharged through the capacitor, the galvanometer gives a deflection of 20 divisions.

(i) Calculate the horizontal component of the earth's magnetic flux density. (04 marks)

(ii) Find the current, which if passed through the coil gives the same magnetic flux density at the centre of the coil. (02 marks)

SECTION C

8. (a) Distinguish between **electric field intensity**, **E** and **electrical potential**, **V** at a point. (02 marks)

(b) (i) State **coulomb's law** of electrostatics. (02 marks)

(ii) Sketch the electrostatic field pattern for a positive charge placed between two negative charges. (02 marks)

(iii) The diagram in figure2 below shows charges Q_1, Q_2 and Q_3 of magnitudes $+1\ \mu C$, $-2\ \mu C$ and $-3\ \mu C$ respectively .

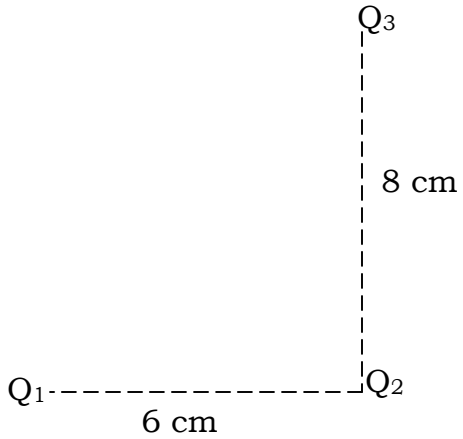

Fig. 2

(c) Describe how the Vander Graff generator can be used to generate negative electricity. (05 marks)

(d) With the aid of a graph explain the effect neighboring a neutral conductor on electric potential due to a charged conductor. (04 marks)

9. (a) What is a **dielectric constant**? (02 marks)

(b) (i) Explain the effect of a dielectric placed between the plates of a charged capacitor. (06 marks)

(ii) Give two other uses of dielectrics in capacitors. (02 marks)

(c) Explain what would happen if a conductor instead of a dielectric was placed between the plates of a capacitor. (02 marks)

(d) A 2 μF capacitor that can just withstand a p.d. of 5kV uses a dielectric with a dielectric constant 6 which breaks down if the electric field strength in it exceeds $40MNC^{-1}$. Find the:

(i) thickness of the dielectric, (02 marks)

(ii) effective area oof each plate, (02 marks)

(iii) energy stored per unit volume of the dielectric. (03 marks)

10. (a) Define the terms **electrical resistivity** and **temperature coefficient of Resistance**. (02 marks)

(b) (i) Explain why the temperature coefficient of resistance is positive for metals. (03 marks)

(ii) What are **super conductors**? (01 marks)

(c) The temperature coefficient of resistance for two wires A and B of diameters $1.2x10^{-3}$mm and $8.0x10^{-4}$mm are $0.0004K^{-1}$ and $0.0003K^{-1}$ respectively. If the ratio of their resistances at $0\ ^0C$ is $^3/_2$. Calculate:

(i) the ratio of the resistance at 100^0C. (03 marks)

(ii) their electrical resistivities at 100^0C given that they have the same length. (03 marks)

(d) (i) Derive the balance condition for wheatstone bridge. (04 marks)

(ii) Explain why the wheatstone bridge is not suitable for measuring very or very high resistances. (04 marks)

END