P510/2
PHYSICS
Paper 2
July/Aug. 2019
2½ hours

RESOURCEFUL MOCK EXAMINATIONS 2019
Uganda Advanced Certificate of Education
Physics

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

*Answer only **five** questions, taking at least **one** question from each of the sections **A, B, C** and **D**, but **not** more than **one** question should be chosen from **either** section **A** or section **B**.*
*Any additional question(s) answered will **not** be marked.*
Mathematical tables and squared paper will be provided.
Non-programmable Silent Scientific Calculators may be used.

Assume where necessary:

Acceleration due to gravity,	g	=	$9.81 m s^{-2}$
Speed of light in Vacuum,	c	=	$3.0 \times 10^{8} m s^{-1}$
Speed of sound in air,	v	=	$3.30 \times 10^{2} m s^{-1}$
Electroniccharge,	e	=	$1.60 \times 10^{-19} C$
Electronic mass,	m_e	=	$9.11 \times 10^{-31} kg$
Permeability of free space,	μ_o	=	$4\pi \times 10^{-7} H m^{-1}$
Permittivity of free space,	ε_0	=	$8.85 \times 10^{-12} F m^{-1}$
The Constant,	$\frac{1}{4\pi\varepsilon_0}$	=	$9.0 \times 10^{9} F^{-1} m$

SECTION A

1. (a) (i) Define the terms **linear magnification** and **virtual image**.

(2 marks)

(ii) A metal rod 10.0 cm long is placed along the principal axis of a converging mirror such that the mid-point of the rod is 35.0 cm from the pole of the mirror. Determine the radius of curvature of the mirror if it forms an image of magnification 2 on the screen.

(4 marks)

(iii) Describe an experiment to locate the position of a virtual image formed by a plane mirror using a search pin. (4 marks)

(b) A finite object is placed 40.0 cm in front of a diverging mirror of focal length 10.0 cm. The object is then moved at a speed of $10cms^{-1}$ towards the mirror.

(i) Calculate the speed of the image formed by the mirror.

(3 marks)

(ii) Explain the difference in the speed of object and that of image.

(2 marks)

(c) With the aid of diagrams, explain **two** advantages of using a convex mirror as a car rear mirror over a plane mirror. (5 marks)

2. (a) (i) Define the terms **conjugate foci** and **principal foci** as applied to converging lenses.

(2 marks)

(ii) Show that for a converging lens of focal length ,f to form an image on the screen the distance, d between the object and the screen must be equal or greater that 4f. (3 marks)

(b) You are provided with a plane mirror, convex lens, screen with wire gauze, metre rule, source of light and a plane screen.

UsingNewton's relation$f = \sqrt{xy}$, describe an experiment to determine the focal length, $f$of a convex lens. Where x and y are

distance of the object and image respectively from the principal focus, F of the lens?

(5 marks)

(c) A converging lens of focal length 24.0 cm is used to focus an inaccessible object pin inside a tube and forms an image of height 20.0cm on the screen. When the lens is moved 20.0 cm towards the screen a smaller image of height 5.0 cm is formed on the screen. Determine the,

(i) height of object pin.

(2 marks)

(ii) distance between the pin and the screen. (3 marks)

(d) An astronomical telescope has an objective lens of focal length 60 cm and eye piece of focal length 3 cm. When the telescope is used to view the moon an image is formed at the near point of 25 cm from the eye piece. Calculate the

(i) separation of the lenses.

(2 marks)

(ii) angular magnification of the telescope. (3 marks)

SECTION B

3. (a) Distinguish between radio waves and sound produced by a radio.

(3 marks)

(b) (i) Define a standing wave.

(1 mark)

(ii) Explain the formation of a stationary wave in closed pipes.

(3 marks)

(iii) A wire 1.0 m long under tension of 100 N is fixed at both ends and plucked from the middle to set it into vibration. An open organ pipe of length 0.5 m is sounded. If the vibrations of the wire and that of the air column in the pipe resonate at their first overtones, determine the mass of the wire.

(4 marks)

(c) Describe an experiment to determine the end-correction of closed pipes.

(5 marks)

(d) (i) Define Doppler Effect. (1 mark)

(ii) A traffic offer holding a speed trap sends electromagnetic waves of frequency, f and speed, c towards a distant car approaching him at a speed v. Derive the expression for the apparent frequency of the waves received by the speed trap. (3 marks)

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

(ii) Use Huygen's principle to show that when light waves travel from a medium of lower refractive index n_1 to that of higher refractive index n_2 the ratio of the velocities of light in the media is given by $\frac{v_1}{v_2} = \frac{n_2}{n_1}$ (4 marks)

(b) (i) What is meant by polarization as applied to light. (1 mark)

(ii) Explain how plane polarized light can be attained by method of reflection and state **one** application of this polarization. (4 marks)

(c) A diffraction grating spectrometer is set up to determine the wavelength of monochromatic light.

(i) Draw a labelled diagram to show the essential features of the spectrometer. (2 marks)

(ii) State the initial adjustments made before the spectrometer is used. (3 marks)

(d) A source emits two wavelengths 450nm and 600nm. The light is incident normally on a diffraction grating of 500 lines per mm. Find

(i) the angular separation of these lines in the second order spectrum. (3 marks)

(ii) the respective orders for the two wavelength to overlap. (2 marks)

SECTION C

5. (a) Define the following terms;

(i) magnetic flux . (1 mark)

(ii) magnetic flux density. (1 mark)

(b) (i) Write down the expression for the magnetic flux density, B of a solenoid of made from a wire of length l with number of turns, $N$and current , I passing through it place in a vacuum. (1 mark)

(ii) Describe an experiment to determine the magnetic flux density along the axis of a solenoid using a search coil and a ballistic galvanometer. (5 marks)

(c) (i) What is meant by the term ampere. (1 mark)

(ii) Derive and expression for the force per metre, F exerted on each of the two infinitely long straight parallel wires carrying currents $I_1$and I_2placed a distance r apart in a vacuum. (4 marks)

(d) (i) Explain why two parallel wires carrying current in the opposite direction repel each other. (3 marks)

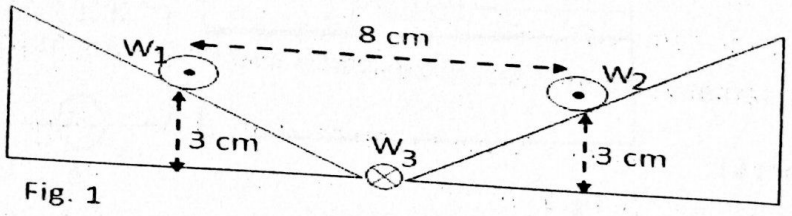

Fig. 1

(ii) Figure 1 shows three infinitelylong straight parallel wires W_1, $W_2$and W_3 each of equal mass, m and carrying current of 4.0 A in the directions indicated. W_1 and W_2 are placed on slanting edged of inclined planes. When W_1 and $W_3$are held fixed in their positions, W_2 is prevented from sliding down the inclined plane. Find the mass, m of each wire. (4 marks)

6. (a) (i) State Faraday's law of electromagnetic induction. (1 mark)

(ii) Describe an experiment to verify the law in Faraday's law above. (5 marks)

(b) (i) What is meant by the term **back e.m.f**. (1 mark)

(ii) A closed square wire loop of side 4.0 cm and resistance $2.0 \times 10^{-3}\ \Omega$ is placed in a uniform magnetic field provided by a solenoidwith its plane normal to the field. When the strength of the magnetic field is decreased to zero in 1.6 seconds current of 0.7A is induced in the wire loop. Find the magnetic flux density of the magnetic field. (4 marks)

(c) (i) Definea weber. (1 mark)

(ii) A flat circular coil of 50 turns each of area 2.0 cm^2 is connected to a ballistic galvanometer and the total resistance of the circuit is 100 Ω. The coil is placed so that its plane is normal to the magnetic field of flux density 0.25 T. Determine the quantity of charge that passes through the galvanometer. (3 marks)

(d)

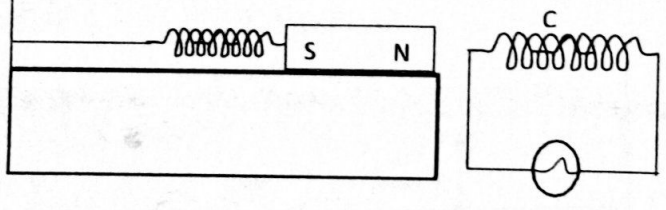

Fig. 2

The figure shows a coil, C connected across a bulb B place near the north pole of a bar magnet lying horizontally on a smooth table with a spring fixed at the end of the table. Explain what is observed when

(i) the magnet is made to oscillate along the surface of the table. (3 marks)

(ii) the oscillating magnet is suddenly stopped. (2 marks)

7. (a) (i) Distinguish between **peak value** and **root mean square value** of alternating voltage.

(2 marks)

(ii) Derive the relationship between the peak value and the r.m.s value of alternating voltage.

(3 marks)

(b) A coil **L,** a capacitor, **C** and a resistor, **R** are connected in series with the source of alternating voltage, **V** and frequency, ***f***.

(i) Explain how the circuit arrangement is used in turning a radio receiver.

(4 marks)

(ii) Sketch on the same axes graphs showing the variation of the capacitive reactance and inductive reactance with the frequency.

(2 marks)

(c) Alternating voltage $V = 339.4 \sin 100\pi t$ is applied across a coil of inductance 4.0 H. Calculate the root mean square value of the alternating current through the coil.

(4 marks)

(d) With the aid of a diagram describe the structure and mode of operation of repulsive type moving-iron ammeter.

(5 marks)

SECTION D

8. (a) (i) Distinguish between **e.m.f** and **internal resistance** of a cell.

(2 marks)

(ii)

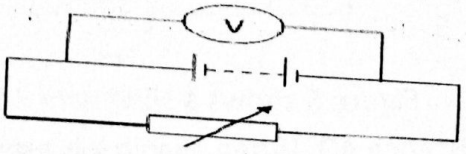

Fig. 3

The figure 3 above shows a battery connected across a variable resistor,R. Explain why the reading of the voltmeter, V increases when the resistance is increased.

(2 marks)

b) (i) What is meant by a potential divider (1 mark)

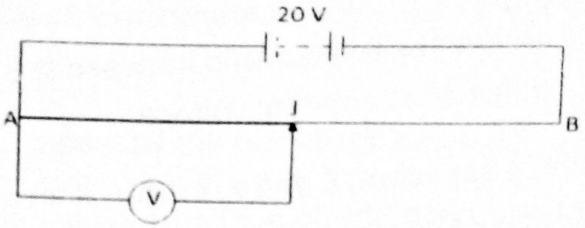

Fig. 4

(ii) The figure shows a uniform resistance wire AB of resistance 12.0 Ω and length 1.0m connected across a battery of e.m.f 20.0 V and negligible internal resistance. When a voltmeter, V of resistance R is connected between A and J it gives a reading of 8.0 V. Determine the value of resistance R if J is midway between A and B (4marks)

c) (i) Define the electrical resistivity of a wire. (1 mark)

(ii) You are provided with a dry cell, voltmeter, ammeter, connecting wires,a switch and a micrometer screw gauge.Describe an experiment with its graphical analysis to determine the resistivity of nichrome (5 marks)

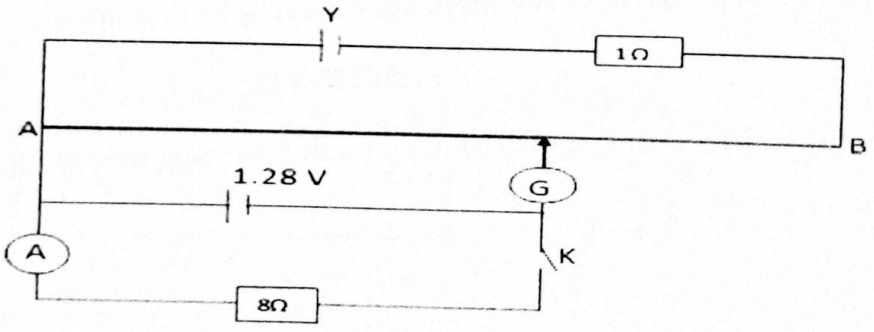

Fig. 5

(d) Figure 5 shows a slide wire AB of length 1.0m and uniform resistance 4Ω. When switch k is open the balance length is 80.0 cm. When k is closed the balance length 70.0cm and the ammeter A reads 0.1A. Determine the

(i) e.m.f of driver cell Y. (2marks)

(ii) percentage error in Ammeter reading (3marks)

9. (a) (i) What is meant by the term corona discharge? (2marks)

(ii) With the aid of a labelled diagram describe the mode of operation of the Van de graaff generator. (5marks)

b) (i) State **Coulomb's law** of electrostatics. (1mark)

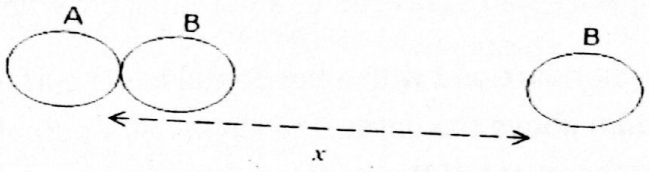

Fig.6

(ii) Figure 6 shows two identical metal balls A and B each of mass,m placed in contact with each other. Ball A is firmly fixed in its position. When the balls are given equal like charge,Q ball B repelled away from ball A and comes to rest at a distance, x in 2 seconds. . Show that the quantity of charge Qon the balls is given by

$$Q = \sqrt{2\pi\varepsilon_0 m x^3}$$ (4marks)

c) Distinguish between **electric potential** and **electric field strength**. (2marks)

d) (i) Figure 7 shows charges of magnitudes -5μc, -3μc and +6μc are placed at the three corners of a square of side 1.0m.Calculate the electric field intensity at the fourth corner.

(4 marks)

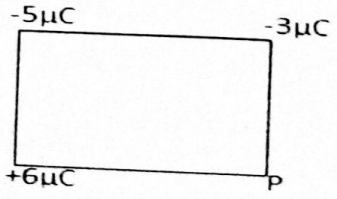

Fig. 7

(ii) Explain the attraction of a metal bar by a charged metal sphere placed near it. (2marks)

10 (a) (i) Define the terms capacitance of a capacitor and dielectic strength. (2 marks)

(ii) Derive an expression for the energy stored in a capacitor of capacitance C, charged to a potential difference, V (4marks).

b) A thundercloud with a horizontal lower surface of area $25km^2$ is 750m above the earth. The cloud has a potential of $1.0x10^5V$. If the arrangement of the earth and the cloud is treated as a capacitor, Calculate the

(i) capacitance of the arrangement. (3 marks)

(ii) electrical energy stored (3 marks)

c) Explain the effect of inserting an insulator between the plates of the capacitor on the potential difference across the plates. (4 marks)

d) Describe an experiment to determine the dielectric strength of a material using a ballistic galvanometer (4marks).

END