P510/2
PHYSICS
JULY-AUG 2022
2 ½ HOURS

KAMSSA JOINT MOCK EXAMINATIONS
Uganda advanced certificate of education
PHYSICS PAPER 2
TIME: 2 HOURS 30 MINUTES

INSTRUCTIONS TO CANDIDATES

- Attempt five questions, including at least one, but no more than two from each of the sections A, B C and D but not more than one question from either sections A or B.
- Mathematical tables and squared paper will be provided.
- Non-programmable scientific electronic calculators may be used.
- Assume where necessary the following constants.
- Acceleration due to gravity g = $10mJ^{-2}$
- Speed of light in a vacuum c = $3 \times 10^{8}ms^{-1}$
- Electron charge e = $1.6 \times 10^{-19}J$
- Electron mass m_e = $9.11 \times 10^{-31}kg$
- Plank's constant, l = $6.6 \times 10^{-34}JS^{-1}$
- Permeability of the free space μo = $450 \times 10^{7}Hm^{-1}$
- Permitivity of free space ε0 = $8.85 \times 10^{-12}\ Fm^{-1}$
- The constant $\frac{1}{4\pi\varepsilon o}$ = $9.0 \times 10^{9}F^{-1}m$
- One electron volt eV = $1.6 \times 10^{-19}C$
- Resistivity of nichrome Wire at $25^{0}C$ = $1.2 \times 10^{6}\Omega$
- Specific heat capacity of water = $4.2 \times 10^{3}Jkg^{-1}k^{-1}$

SECTION A

(a) Define the following terms as applied to lenses.

(i) Focal length (1 mark)

(ii) Focal plane (1 mark)

(b) Describe how you would determine the focal length of a convex lens basing on Newton's lens formula. (5marks)

(c) In an experiment to determine the refractive index of paraffin the apparatus was first set up as shown using a convex lens of focal length $\boldsymbol{f}$**:** Some water of refractive index 4/3 was placed on the mirror and the lens on top. A pin placed at a height, $\boldsymbol{h1}$ vertically above the lens coincides with its image. The experiment was repeated using paraffin instead of water and the new position of coincidence was found to be at a height, $\boldsymbol{h2}$. Show that the refractive index np of paraffin is given by $np=1+[\boldsymbol{h1}(\boldsymbol{h2}-\boldsymbol{f})/\boldsymbol{3h2}(\boldsymbol{h1}-\boldsymbol{f})]$ (6marks)

(d) (i) What is meant by **visual angle** and **magnifying** power as applied to Optical instruments? (2 marks)

(ii) Derive an expression for **magnifying power** of a Galilean telescope in Normal adjustment . (4 marks)

(e) Explain the significance of a convex mirror in a Cassegrain reflectings telescope.(1mark)

2. (a) What is meant by the following terms?

(i) Monochromatic light. (1 mark)

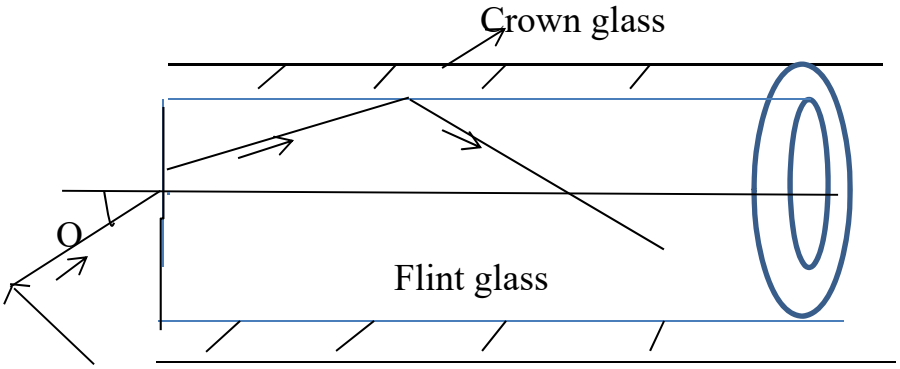
(ii) Absolute refractive index of a material. (1 mark)

(b) (i) Describe a simple experiment to determine the refractive index of the liquid using air cell method. (5marks)

(ii) Why is monochromatic light is used in the experiment (b)(i) above. (1mark)

(c) (i) Define the terms **critical angle** and **total internal reflection**. (2 marks)

The diagram below shows a cross-section through the diameter of the light pipe with an incident ray of light in its plane.



Incident light

The refractive indices for flint glass, crown glass and the external medium are n_1 , n_2 and n_3 respectively. Show that a ray that enters the pipe is totally reflected at the flint-crown glass interface provided . (4marks)

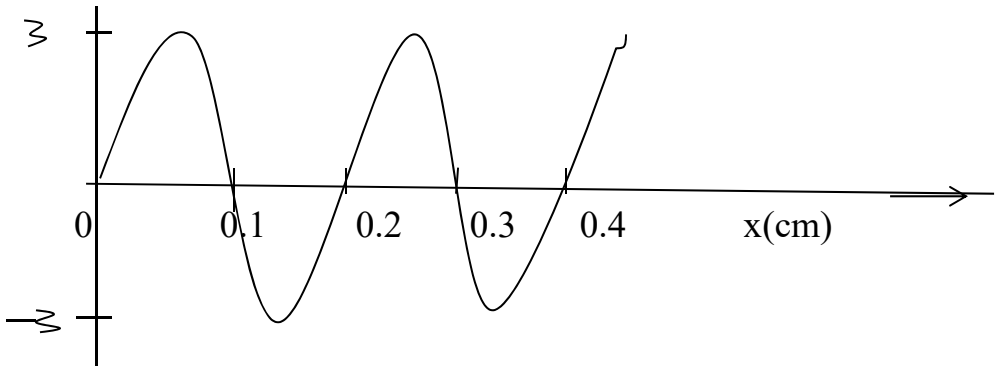
(d) (i) with the aid of a ray diagram, explain the **conjugate points** as applied to lenses.(2marks)

(ii) An object, O, placed in-front of a converging lens forms a real image, I on the screen. The distance between the object and its real image is, y *wh*ile that of the image from the lens is *x*. Derive the expression for the least possible distance between the object and its real image (4marks)

SECTION B

3. (a) Define the terms **frequency** and **amplitude** as applied to waves. (2marks)

(b) Figure 3 below shows a progressive wave travelling in the positive x- direction at a speed of $15ms^{-1}$ with a profile shown below. Show that the equation of the wave is given by $y= 3.0 \sin 150\pi(t- x/15)m$. (4marks)



(c) (i) The velocity of propagation of transverse waves along a wire under Tension, ***T*** is given by; $V = \sqrt{T/\mu}$ .Verify that this expression is Dimensionally correct. (4 marks)

(ii) The fundamental frequency note produced by wire **A** of length 50cm is four times the frequency note produced by another wire **B** of length 1.50 m when each of them is plucked in the middle. Determine the Relative mass per unit length of wire B to that of A, when the two wires are subjected to the same tension. (4 marks)

(d) With the aid of a diagram describe an experiment to show how the Fundamental frequency varies with tension in a given wire. (6marks)

4. (a) What is meant by the terms **path length** and **interference**. (2marks)

(b) (i) Explain how interference fringes are formed in air wedge film between two glass slides when monochromatic light is used. (5marks)

(ii) Describe the appearance of fringes when white light is used. (2marks)

(c) Given that the separation of slits in young's double slit experiment is, a and the distance of the double slits to the screen is b. Find the expression for the fringe separation when light of wave length λ is used. (5marks)

(d) In young's double slit experiment, light of wave length 4.7 x 10-7m is used. The separation between the slits is 0.42mm and the distance from the double slits to the screen is 1.4m.

(i) Find the distance between the second dark fringe and the fifth bright fringe. (4marks)

(ii) Explain what is observed when the primary slit is brought closer to the secondary slit. (2marks)

SECTION C

5a) Explain what is meant by

i) **Angle of dip** (1mark)

ii) **magnetic meridian** (1mark)

iii) **angle of declination** (1mark)

b) A plane is flying **horizontally** in the earths surface where the magnetic flux density of the earth is **0.48×10^{-2}T**. Calculate the component of the earths magnetic flux density that will affect the plane. (Assume the **angle of dip** at that point is **30^0**) (3marks)

c) Sketch the magnetic **field lines** around

i) **A Solenoid** (1mark)

ii) **A circular coil carrying current**. (1mark)

d) Derive the expression for the **torque** on a rectangular coil of length **l** and breadth **b** of **N** turns curing a current **I** placed in a uniform magnetic flux density **B**.when its plane makes angle θ with the field (4 marks)

e) Explain why a **current carrying conductor** placed in a magnetic field experiences a **force**. (4marks)

f) A rocket 5m long carrying a current of **2A** is fired vertically upwards in an area where the angle of **inclination is 60^0** and magnetic flux density of the earth is **84×10^{-3}T**. Calculate the **force** it will experience. (4marks)

6a) Define the terms **magnetic flux** and **magnetic flux density**. (2marks)

b) A straight wire of length **30cm** and resistance **0.75Ω** lies at right angles to a magnetic field of flux density **0.5T**. The wire moves when a p.d of **2.5V** is applied across its ends. Calculate the;

i) **initial force** on the wire. (2marks)

ii) **maximum** speed attained by the wire (3marks)

c)i) Sketch the magnetic field pattern around a vertical straight wire carrying a current in the earths magnetic field and use it to explain a neutral point in a magnetic field. (3marks)

ii) Two long parallel wires placed **10cm** apart in air carry current of **16A** and **20A** respectively in the same direction. Determine the position where magnetic flux is zero. (5marks)

d) Describe with the aid of a diagram an absolute method of determining resistance. (5marks)

7a)i) What is meant by **peak value** of a sinusoidal current. (1mark)

ii) A source of sinusoidal voltage of amplitude **Vo** and frequency **f** is connected across a capacitor of capacitance **C**. Derive an expression for the instantaneous current which flows. (3marks)

iii) With reference to the circuit in a (ii), sketch using the same axes graphs to show the variation of voltage **V** and current **I** with time. (2marks)

b)i) Explain why an alternating current apparently flows through a capacitor where as a direct current does not. (3marks)

ii) Explain the advantages of **a.c** over **d.c** in power transmission. (2marks)

c) With the aid of a diagram describe how a **half wave rectifier type** of meter works. (4marks)

d) A sinusoidal voltage **$V=480Sin100\pi t$** is connected across a **40Ω** resistor. Find the;

i) amplitude of the current through the resistor. (2marks)

ii) average power developed in the resistor. (3marks)

SECTION D

8a) State **Ohms** law. (1mark)

b) Describe with the aid of a circuit diagram, an experiment to determine the relationship between the **resistance** and the **length** of a wire. (6marks)

c) A dry cell gives a balance length of **84.8cm** on a potentiometer wire when a resistor of resistance **15Ω** is connected across the terminals of the cell, a balance length of **75.0cm** is obtained. Find the internal resistance of the cell. (4marks)

d) A battery of Emf **18.0V** and internal resistance **3.0Ω** is connected to a resistor of resistance **8Ω.** Calculate the

i) power generated (2marks)

ii) efficiency (2marks)

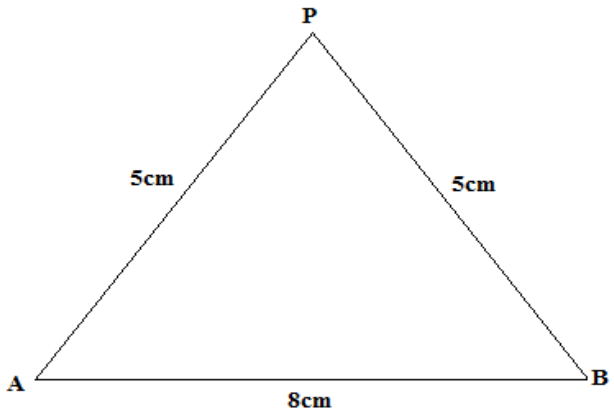
e) If the **8Ω** resistor in d is replaced by a **variable resistor**. Sketch the graph to show the variation of power and efficiency with the load. (3marks)

f) Explain why a metal wire gets **hot** when **current** is passed through it. (3marks)

9a) Define **electric potential** (1mark)

b) Obtain an expression for the electric potential at a point a distance **r** from a point charge **Q,** situated in a vacuum. (4marks)

c) Two point charges A and B of charges **+ 0.10µc** and **+ 0.05µc** are separated by a distance of **8.0cm** along the horizontal as shown in figure below. Find the electric field intensity at P. (9marks)



d) Sketch the **electric pattern** due to the charge distribution in c) above. (2marks)

e) Explain how a **lighting conductor** works. (4marks)

10a) Sketch the electric field lines between two large parallel metal plates across which a p.d is applied. (1mark)

b)i) Describe with the aid of a diagram how you would investigate the **factors** which affect the capacitance of a **parallel plate** capacitor. (7marks)

ii) Calculate the capacitance of a parallel capacitor whose plates are **10cm** by **15cm** separated by an air gap of **5mm**. (2marks)

c) A hollow spherical conductor of diameter **21.4cm** carrying a charge **of 6.9 x 10^{-10}C** is raised to a potential of **50V**. Find the permittivity of the surrounding medium. (3marks)

d)i) Show that the effective capacitance **C** of two capacitances $\mathbf{C_1}$ and $\mathbf{C_2}$ connected in series is given by

$$C = \frac{C_1 C_2}{C_1 + C_2}$$ (4marks)

ii) A **20µF** capacitor is charged to **40v** and then connected across an unchanged **60µF** capacitor. Calculate the **potential difference** across the **6.0µF** capacitor after connection. (3marks)

END