P510/2

Physics

Paper 2

July-August 2022

2 ½ Hours

UGANDA MUSLIM TEACHERS' ASSOCIATION

UMTA JOINT MOCK EXAMINATIONS 2022

UGANDA ADVANCED CERTIFICATE OF EDUCATION

Physics

Paper 2

2 Hours 30 Minutes

INSTRUCTIONS TO CANDIDATES:

*Answer only **five** questions, including at least **one** question but not more than **two** questions from each of the sections **A**, **B**, **C** and **D**.*
*Any additional question(s) answered will **not** be marked.*
Mathematical tables and squared paper will be provided where need be.
Non-programmable scientific calculators may be used.
Begin each question on a fresh page of the answer sheets / booklet provided.

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,	=	$340\ ms^{-1}$
Electronic charge, e	=	$1.6 \times 10^{-19} C$
Electronic mass, m_e	=	$9.11 \times 10^{-31} kg$
Permeability of free space, μ_o	=	$4.0\pi \times 10^{-7} H\ m^{-1}$
Permittivity of free space, ε_0	=	$8.85 \times 10^{-12} Fm^{-1}$
The Constant, $\frac{1}{4\pi\varepsilon_o}$	=	$9.0 \times 10^{9} F^{-1} m$
Planck's constant, h	=	$6.6 \times 10^{-34} Js$
Avogadro's number, NA	=	$6.02 \times 10^{23}\ mol^{-1}$
One electrons volt (eV)	=	$1.6\,X\,10^{-19}$
Specific heat capacity of water	=	$4.2\,X\,10^{3}\ Jkg^{-1}\ k^{-1}$
Resistivity of Nichrome wire at 25°C	=	$1.2\,X\,10^{-6}\Omega m$

SECTION A

1(a) (i) State the laws of reflection of light. (2marks)

(ii) Light is reflected successively, once in each of two mirrors inclined at angle **Φ**, to each other. Determine the deviation produced by the reflections terms of **Φ**. (3marks)

(b) Describe an accurate method for finding the focal length of a convex mirror. (5marks)

(c) A concave mirror forms a real image which is three times the linear size of a real object. When the object is displaced through a distance, **x**, the real image formed is now four times the linear size of the object. If the distance between the two image positions is 20cm, find the

(i) focal length of the mirror. (3marks)

(ii) distance **x** (2marks)

(d) Explain why

(i) Parabolic mirrors are used in car head lamps. (2marks)

(ii) The rays from the sun can still be seen by an observer on earth shortly after sun set. (3marks)

2(a) State the laws of refraction of light. (2marks)

(b) Light consisting of blue and red light is incident from air on to a glass block. The two colours emerge from the glass block, into air at points **O** and **P** respectively, as shown in **fig. 1**

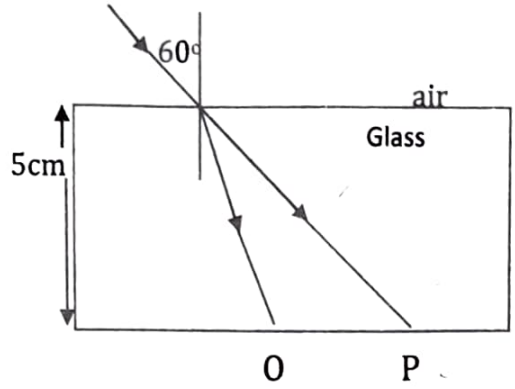


Fig.1

The speeds of blue & red light in the glass are 1.88 X $10^8 ms^{-1}$ and 1.9 4x $10^8 ms^{-1}$, respectively. Find the distance **OP**. (5marks)

(c) The objective and eye piece of a compound d microscope have focal length 2.0cm and 2.5cm respectively. An object of height 0.1cm is placed at a distance of 2.4cm from the objective. The position of the eyepiece is adjusted so that the virtual image of the object is formed 22.5cm from the eyepiece.

(i) Find the separation of the objective & eye piece. (5marks)

(ii) What is the size of the image. (3marks)

(d) Describe how you would determine the refraction index of a glass block using real and apparent depth method. (5marks)

SECTION B

3(a) (i) Define the term Doppler effect and mention a condition when Doppler effect in sound is not applicable. (2marks)

(ii) A police man on duty detects a drop of 15% in the pitch of the horn of a car as it crosses him. Given that the speed of sound in air is $330 ms^{-1}$, calculate the speed of the car. (4marks)

(b) (i) State a condition for the formation of beats in sound and derive an expression for beat frequency. (4marks)

(ii) The first overtone of an open pipe beats with the first overtone of a closed pipe with a beat frequency of 2.2Hz. The fundamental frequency of a closed pipe is 110Hz. Find the length of the pipes. (4marks)

(C) Explain the following;

(i) Thick and big curtains are preferred in big halls (2marks)

(ii) When you start filling an empty bucket with water, the pitch of sound produced goes on changing. (2marks)

(d) Distinguish between musical sound and noise. (2marks)

4(a) Distinguish between longitudes and transverse waves.

(2marks)

(b) (i) Describe one method of producing plane polarized light by reflection. (4marks)

(ii) Mention the practical application of plane polarized light and describe one of them. (4marks)

(c) What are coherent sources? (2marks)

(d)

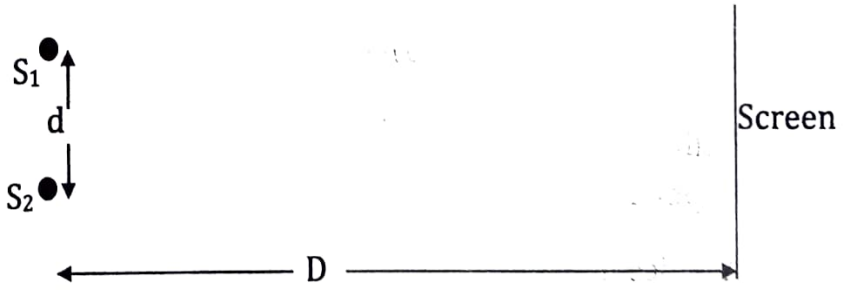


Fig. 2

Fig. 2 above shows two coherent sources S_1, S_2, a distance d apart. The sources produce light of wave length **λ**, which form an interference pattern on the screen, a distance **D** away.

(i) Show that the fringe width **ω**, is given by

$$\omega = \frac{XD}{d}$$ (4marks)

(ii) If $\lambda = 5.64 \times 10^{-7}$m, $d = 4.2 \times 10^{-4}$m and D= 1.5m. Find the angular position of the second dark fridge on the screen (4marks)

SECTION C

5(a) Define:

(i) The Tesla. (1mark)

(ii) Magnetic moment of a coil. (1mark)

(b) (i) Write the expression for the force on a charge of **Q** Coulombs moving with a velocity Vms^{-1} at an angle **β** to a uniform magnetic field of this density **B** tesla. (1mark)

(ii) Use the expression in b (i) above to deduce the force on a conductor carrying current in a magnetic field. (3marks)

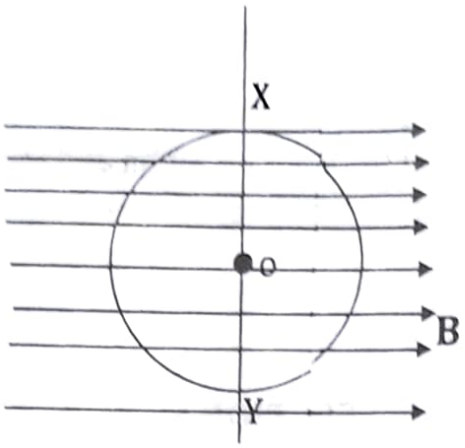
(c) A horizontal wire of length 6cm and mass 1.5×10^{-2}g carrying a current of 3A is placed in the middle of a circular coil of diameter 10cm at right angles to its axis. The coil has 100 turns. If the force on the wire is vertically upwards, calculate the current flowing in the coil that maintains the wire in equilibrium. (4marks)

(d) A metal slab carrying a current **I** is placed at right angles to a uniform horizontal magnetic field.

(i) Explain the origin of hall voltage. (3marks)

(ii) Deduce the magnitude of the hall voltage induced. (3marks)

(e)

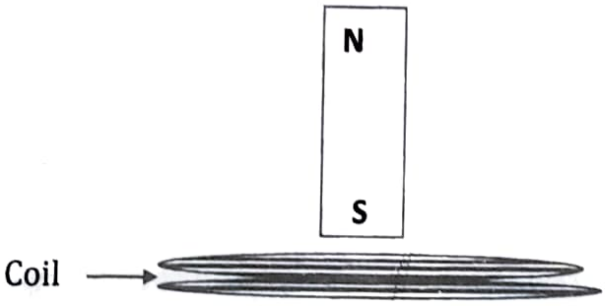


A circular loop of wire is placed in a uniform magnetic field of flux density **B**, with the axis of the wire as shown above. Explain what happens to the loop when a current starts to flow through it in a clockwise direction, if the loop is pivoted about XOY. (4marks)

6(a) State the laws of electromagnetic induction. (2marks)

(b) With the aid of a labeled diagram, describe the structure and made of operation of a d.c generator. (6marks)

(c) A bar magnet is dropped so that it falls vertically through a coil.



Sketch and explain the features for voltage produced across the coil versus time. (4marks)

(d) A Wheel of 50 metallic spoke each of 0.5m long is rotated with an angular speed of 12 radians per second in a plane normal to the earth's magnetic field. If the magnitude of the field is 0.5×10^{-4}T, calculate the emf induced between the axle and the rim of the wheel. (3marks)

(e) Explain the following observations.

(i) When a d.c motor is switched on, the initial current decreases to a steady value when the motor is running at a constant speed.

(3marks)

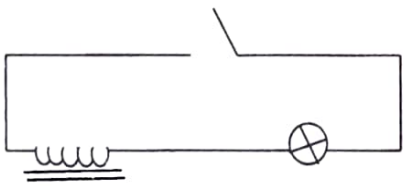
(ii) If the motion of a d.c motor is slowed down, the current rises and then falls again when the motor is allowed to run freely.

(2marks)

7(a) (i) Define the terms peak value and roof mean square value of an alternating current. (2marks)

(ii) A resistor of 300Ω is connected to 240 V A.C supply .Find the amplitude of the current through the resistor. (3marks)

(b)



Coil Bulb

A coil of many turns of wire, a bulb and a battery are connected in series as shown in the diagram in the fig. above.

(i) What is observed when switch **S** is closed and when it is opened (2marks)

(ii) Explain your observation in b(i) (4marks)

(c) A source of sinusoidal voltage of amplitude, V_0 and frequency, f is connected across a capacity of capacitance C. Derive an expression for the instantaneous current which flows. (3marks)

(d) A 50mH inductor is connected to a 220v, 50Hz, a.c supply. Determine the r.m.s value of current in the circuit. (2marks)

(e) (i) What is rectification as applied to a.c . (1marks)

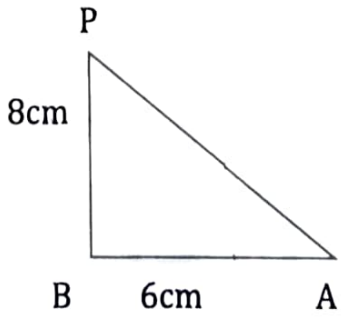
(ii) With the aid of diagram, describe how a half wave rectifier type of meterworks. (3marks)

SECTION D

8(a) Define electric field intensity. (1marks)

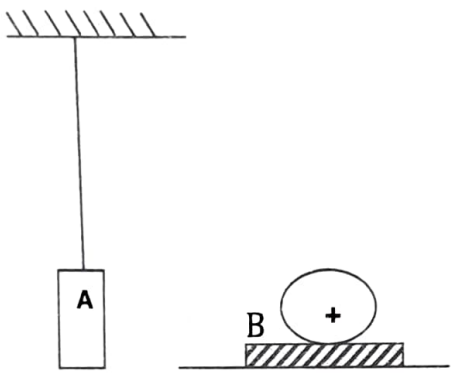
(b) (i) Find the electric field intensity at point **P** in the diagram below given that a +5μC charge is placed at a point A and a -3μC charge is placed at Band that the charges are situated in vacuum.

(5marks)



(ii) The bob of a pendulum of mass 80mg and having a charge of $+2 \times 10^{-8}$ C is swinging in a uniform horizontal electric field of $2 \times 10^{4} Vm^{-1}$. Find the tension in the string of the pendulum and the angle it makes with the vertical. (4marks)

(c)



A light conducting foil A is suspended by light flexible insulating thread near a charged conductor B as shown above.

(i) What would be observed (1 mark)

(ii) Explain the observation in b(i) above (3marks)

(d) (i) Explain the effect of inserting a dielectric between the plates of a charged capacitor. (5marks)

(ii) List two functions of a dielectric in a capacitor (1mark)

9(a) Define;

(1) Current density (1mark)

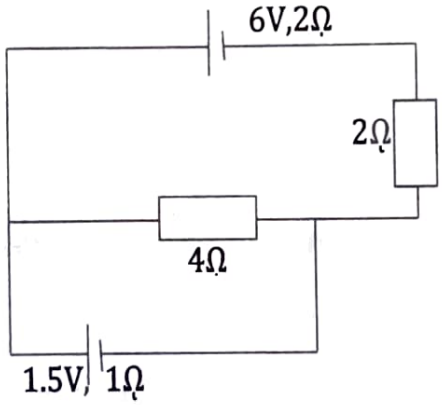
(ii) Electrical resistivity (1mark)

(b) (i) Describe an experiment you would use to determine resistivity of an electrical wire. (6mark)

(ii) When a coil **X** is connected a cross the left hand gap of a meter bridge and heated to a temperature of 30^0C, the balance point is found to be 51.5cm from the left end of the slide wire. When the temperature is raised to 100^0C, the balance point is 54.6cm from the left hand. Find temperature coefficient of resistance of **X**.

(5marks)

(c) (i) State Kirchhoff's law. (2marks)



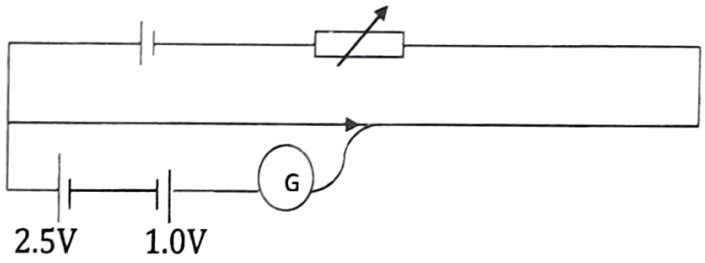
The fig. above shows a network of resistors and cells. Calculate the p.d a cross the 2Ω resistor. (5marks)

10(a) (i) Define internal resistance of a cell (1mark)

(ii) Describe an experiment to determine the internal resistance of a cell using a potentiometer. (5marks)

(b) State any two factors which affect the accuracy of a potentiometer wire. (2marks)

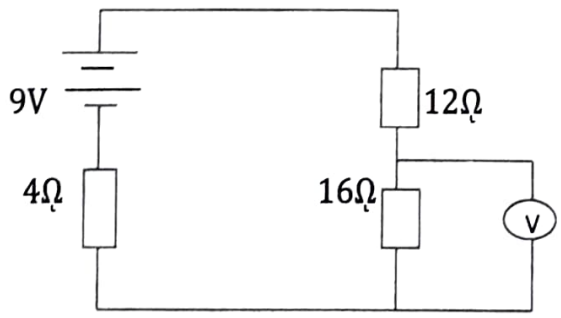
(c) A simple potentiometer circuit is set up as in figure below using a uniform wire AB, 1.0m long which has a resistance of 2.0Ω the driver cell has e.m.f of 4V negligible internal resistance. If the variable resistor R is given a value of 2.4Ω. what is the length AC? (4marks)



(d) Explain why electrical power is transmitted at high voltages and how it is transmitted from a power station to your home.

(4marks)

(e)



In the circuit above the voltmeter has a resistance of 400Ω. Find the reading of the voltmeter. (4marks)