Candidates Name: …….. Signature: …...........................

P510/2
Physics
Paper 2
July/August 2024
2½ hours

INSPIRING MINDS, ACHIEVING BRILLIANCE

TEA EXAMINATION BOARD

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 not be provided.
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- Non-programmable scientific calculators may be used.

Assume where necessary;

- Acceleration due to gravity, g	=	$9.81ms^{-2}$
- 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 a vacuum, C	=	$3.0 \times 10^{8}ms^{-1}$
- Avogadro's number, NA	=	$6.02 \times 10^{23}mol^{-1}$
- Gas constant, R	=	$8.31Jmol^{-1}k^{-1}$
- Charge to mass ratio, e/m	=	$1.8 \times 10^{11}Ckg^{-1}$
- The constant $1/4\pi\varepsilon_o$	=	$9.0 \times 10^{9}F^{-1}m$
- 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

1a(i) State the laws of reflection of light. (02marks)

(ii) A ray of light is incident on a plane mirror. The mirror is them rotated through an angle, Ϫ keeping the direction of the incident ray constant. Show that the reflected ray is turned through an angle 2Ϫ (03marks)

b(i) Define refractive index of a medium. (01mark)

(ii) An optical pin held above a concave mirror containing water of refractive index 1.33, coincides with its image at a distance of 12cm above the mirror. When the water is replaced by a little quantity of a certain liquid, the point of coincidence of the object and the image becomes 13.3cm. Calculate the refractive index of the liquid. (03marks)

(c) A small object is placed 20cm infront of a concave mirror of focal length 15cm. A parallel sided glass block of thickness 6cm and refractive index 1.5 is placed between the mirror and the object. Find the shift in the position of the image. (05marks)

(d) Monochromatic light incident on a block material placed in a vacuum is refracted through an angle Ϫ . If the block has refractive index, n and is of thickness, **t,** show that light takes a time of $\frac{nt\sec Ϫ}{C}$ to emerge from the block where **C** is the speed of light in vacuum. (03marks)

(e) A converging lens of focal length 15cm is placed 20cm from a light source. The image of the source then coincides with the source when a convex mirror is placed 30cm behind the lens. Find the focal length of the mirror. (03marks)

2(a) Define Principal focus and power of a lens. (02marks)

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

(i) position of the final image. (05marks)

(ii) height of the final image. (02marks)

(c)(i) Define angular magnification of an optical instrument. (01mark)

(ii) Describe with the aid of a diagram the structure and action of an astronomical telescope in normal adjustment. (04marks)

(d) A compound microscope consists of two converging lenses of focal lengths, 1.0cm and 5.0cm respectively. An object is placed 1.1cm from the objective lens and the microscope is adjusted so that the final image is formed 30cm from the eye piece. Calculate the;-

(i) separation of the lenses. (03marks)

(ii) magnifying power of the lenses. (03marks)

SECTION B

3(a) What is meant by the following terms as applied to sound?

(i) Resonance (01mark)

(ii) Fundamental frequency. (01mark)

(b) Describe an experiment to determine the end correction of a resonance tube of known frequency. (05marks)

(c) A wire of length 60cm and density $8.0gcm^{-3}$ is stretched between two points. If the wire is set to vibrate at a fundamental frequency of 20Hz, calculate the;
(i) velocity of the wave along the wire (03marks)
(ii) tension per unit area of cross section of the wire. (03marks)

(d) Explain why the quality of a note from an open pipe is preferred to that given by a closed pipe. (03marks)

(e)(i) What is meant by Doppler Effect? (01mark)
(ii) A police car moving at a speed of $20ms^{-1}$ sounds a siren of 800Hz as it approaches a stationary observer. Calculate the apparent frequency heard by the observer if the speed of sound in air is $330ms^{-1}$. (03marks)

4(a) What is meant by the following terms;
(i) Un polarized light, (01mark)
(ii) Plane polarized light? (01mark)
(b)(i) Describe how plane polarized light is produced by double refraction. (03marks)
(ii) Explain briefly one application of polarized light. (02marks)

(c)(i) Explain the formation of fringes by transmission gratings. (04marks)
(ii) Light of wave length 5.0×10^{-7}m falls on a grating with 600 lines per mm. Determine the highest order of diffraction that can be observed. (03marks)

(d)(i) What is meant by interference of waves? (01mark)
(ii) State the conditions necessary for interference fringes to be observed. (02marks)
(iii) Explain the term path difference with reference to interference of two wave motions. (03marks)

SECTION C

5a(i) Define self induction and mutual induction. (02marks)
(ii) Give the causes of power loss in an a.c transformer and state how each can be minimized. (04marks)
(iii) Explain why the current in the primary coil of a transformer increases when the secondary is connected to the load. (02marks)
(b) What is meant by the following as applied to the earth's magnetic field?
(i) Magnetic meridian (01mark)
(ii) Magnetic variation (01mark)
(c) An air craft of wing span 20m is moving horizontally from west to east at a velocity of $250ms^{-1}$ in a plane where the angle of dip is 40^o. The e.m.f induced across the tips of the wings is 0.006V. Find the magnetic flux density of the earth's field. (04marks)
(d) Describe the structure and mode of action of the deflection magnetometer. (06marks)

6(a) Define;
(i) the testa (01mark)
(ii) magnetic flux (01mark)
(iii) magnetic flux linkage (01mark)
(b) Two infinitely long straight wires carrying currents I_1 and I_2 respectively are placed

parallel to each other in a vacuum at a distance **d** metres apart. Derive an expression for the force per metre between the wires. (05marks)

(c) Explain;

(i) why when a plate of copper is pushed into a strong magnetic field between the poles of a powerful electromagnet, considerable resistance to the motion is felt but no such effect is felt with a sheet of glass. (04marks)

(ii) how damping is achieved in a moving coil galvanometer. (03marks)

(d)(i) Write an expression for magnetic flux density, **B**, at the centre of a circular coil of **N** turns each of radius, **r** and carrying a current, **I**. (01mark)

(ii) A wire of length 7.85m is wound into a circular coil of radius 5.0cm. If a current of 2A passes through the coil, find the magnetic flux density at the centre of the coil. (04marks)

7(a) Define root mean square value and peak value of an alternating current. (02marks)

(b) A resistor of resistance 100Ω is connected across an alternating voltage $V = 30\ sin140\pi t.$

(i) Find the frequency of the alternating voltage. (01mark)

(ii) Calculate the mean power dissipated in the resistor. (03marks)

(c) Sketch on the same axes, the graphs showing variation of applied p.d and current when an inductor is connected to an a.c supply. (02marks)

(d) Explain why on average the power delivered to the capacitor in one cycle is zero. (03marks)

(e) A circuit consists of a $200\mu H$ indicator of resistance 10Ω in series with a variable capacitor and a 0.10V(r.m.s), 1.0MHz supply. Calculate the;

(i) capacitance to give resonance. (03marks)

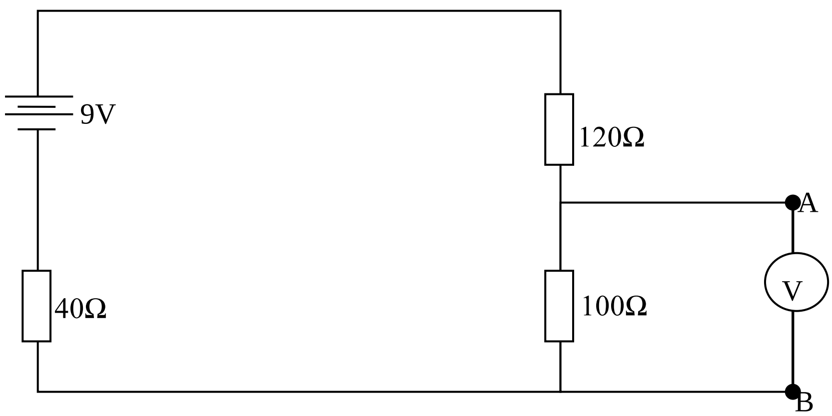
(ii) p.d a cross the inductor at resonance. (02marks)

(f) Describe with the aid of a labeled diagram the action of a thermocouple meter. (04marks)

SECTION D

8(a) Define potential difference and the coulomb. (02marks)

(b)



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

(i) Find the voltmeter reading. (04marks)

(ii) What is the p.d across the 100Ω when the voltmeter is removed? (02marks)

(iii) Explain why it is desirable to have a voltmeter of very high resistance. (02marks)

(c)(i) Define temperature coefficient of resistance. (01mark)

(ii) Describe an experiment to determine temperature coefficient of resistance of a conductor in form of a wire. (06 marks)

(iii) Explain why the resistance of a conductor increases when its temperature increases. (03marks)

9(a) Derive the balance condition of a what stone bridge. (04marks)

(b) What is meant by end correction of a metre bridge? (01mark)

(c) When a resistor of resistance 8Ω is connected on the left and another of 5Ω on the right hand gap of a metre bridge, the balance point is found to be 64.8cm from the left hand end of the slide wire. 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 (04marks)

(ii) contact resistance of the right hand end of the bridge wire given that the resistance of the wire is 6Ω. (02marks)

(d)(i) Describe how a potentiometer can be used to calibrate a voltmeter. (05marks)

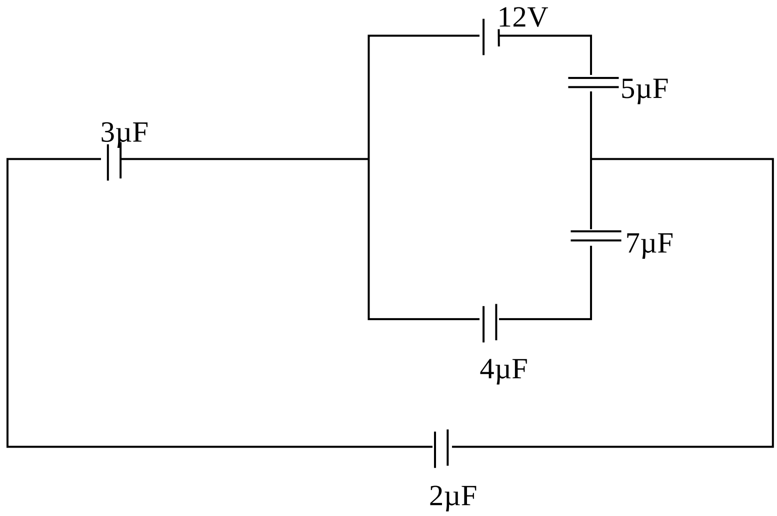
(ii) State two factors that may limit the accuracy when using a potentiometer. (02marks)

(iii) Explain what happens when the e.m.f of the cell in the test circuit is greater than that of the driver cell. (02marks)

10a(i) Define capacitance and state its S I unit. (02marks)

(ii) Describe an experiment to determine the capacitance of a capacitor using a ballistic galvanometer. (04marks)

(b)



The figure above sows a network of capacitors connected to d.c supply of e.m.f 12V. Calculate the;

(i) energy stored in the network. (04marks)

(ii) p.d across the 5μF capacitor. (04marks)

(c) Explain how a high potential is built up in a Vander Graaff generator. (06marks)

END