P510/2

PHYSICS

PAPER TWO

2hours 30minutes

MOCK EXAMINATIONS 2024

UGANDA ADVANCED CERTIFICATE OF EDUCATION
PHYSICS P510/2
2½ Hours

INSTRUCTIONS TO CANDIDATES

*Answer **five** questions, including at least **one** from each section, but **not more** than **one** from any of the sections A and B.*

Where necessary assume the following constants:

Acceleration due to gravity,	g	=	$9.81ms^{-2}$
Speed of light in vacuum,	c	=	$3.0 \times 10^{8}ms^{-1}$
Speed of sound in air	v	=	$340ms^{-1}$
Electronic Charge,	e	=	$1.6 \times 10^{-19}C$
Electronic mass,	m_e	=	$9.1 \times 10^{-31}kg$
Permeability of free space,	μ_0	=	$4.0\pi \times 10^{-7}Hm^{-1}$
Permittivity of free space,	ε_0	=	$8.85 \times 10^{-12}\ Fm^{-1}$
The Constant,	$\frac{1}{4\pi\varepsilon_0}$	=	$9.0 \times 10^{9}F^{-1}m$

SECTION A

1. (a) Define principal focus of a concave lens and power *of* a lens. (2mks)

(b) (i) Describe an experiment to determine the focal length of a concave lens using a concave mirror. (5mks)

(ii) Explain why monochromatic light is usually preferred in experiments when using lenses. (2mks)

(c) A concave lens of focal length 30cm is arranged coaxially with a convex lens of focal length 18cm, placed 4cm apart. An object 3cm high is placed 40cm in front of the concave lens, on the side remote from the convex lens. Find the:

(i) position of the final image (5mks)

(ii) height of the image. (2mks)

(d) With the aid of a diagram describe how a prism binocular works. (4mks)

2. (a)(i) Define refractive index and limiting angle of prism. (2mks)

(ii) Derive the expression for the refractive index of a material of a prism in terms of the refracting angle, A, and minimum deviation, D. (3mks)

(b) When light is incident on a prism of refractive index 1.52, at an angle of incidence 38^0, the emergent ray makes angle 51.7^0 with the normal on the opposite face. Find the

(i) Angle of incidence for minimum deviation. (3mks)

(ii) Limiting angle of prism made of the material. (2mks)

(c) Describe how the refractive index of a liquid may be determined using an air cell. (5mks)

(d)(i) Define principle focus of a concave mirror. (1mk)

(ii) With the aid of a diagram, describe an experiment to determine the focal length of a convex mirror using a plane mirror. (4mks)

SECTION B

3. (a) (i) What is Doppler effect? (1mk)

(ii) An observer moving away from a stationary source of sound of frequency, f, towards a tall wall hears beats at a frequency, f_b. If the velocity of sound in air at the time is V, derive the expression for the velocity of the observer. (4mks)

(iii) Describe one application of Doppler Effect. (3mks)

(b) (i) What is sound? (1mk)

(ii) Explain the main factors that determine the velocity of sound in air. (3mks)

(c) Explain how beats are formed. (3mks)

(d) When two stopped pipes of lengths 62cm, with end corrections of 1.2cm and 1.8cm respectively are sounding their fundamental notes, beats are formed. If the velocity of sound in air is $340ms^{-1}$, find the beat period. (5mks)

4. (a) What is meant by interference and diffraction with reference to light? (2mks)

(b)(i) With the aid of a diagram, explain how Newton's rings are formed. (5mks)

(ii) Explain the change in spacing of rings in b (i) above when the air film is replaced with water. (2mks)

(c) An air wedge is formed using two flat glass plates of length 150mm in contact at one end and separated by a thin wire at the other end. When the wedge is illuminated almost normally with monochromatic light of wavelength 570nm, 20 fringes are counted in a distance of 1.85mm. Find the diameter of the wire. (4mks)

(d) Describe how the wavelength of light may be determined using a transmission grating. (5mks)

(e) Find the angular position for the second order image when light of wavelength 548nm, is made incident normally on a grating of 600 lines per mm (2mks)

SECTION C

5. (a) (i). Define the term magnetic flux density and a tesla. (2mks)

(ii) Sketch the magnetic field pattern around a vertical current carrying straight wire in the earth's magnetic field and use it to explain a neutral point in a magnetic field (3mks)

b) Two long straight conductors carrying currents I_1 and I_2 in opposite directions are placed at a distance d in vacuum.

(i) Explain why the conductors repel each other. (3mks)

(ii) Derive an expression for the force per meter between the wires. (2mks)

c) Two straight parallel wires A and B carry currents of 3 A and 5A respectively in opposite directions. Given that the wires are 0.2m apart in air, find the distance from wire A where the resultant magnetic flux density is zero. (3mks)

d) (i) with the aid of a labelled diagram, describe how a moving coil galvanometer works. (5mks)

(ii) How can the moving coil galvanometer be converted to measure charge instead of current? (2mks)

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

(ii) Describe an experiment to demonstrate Faraday's law of electromagnetic induction. (4mks)

(b) A coil of 80 turns is wound round the middle of a long solenoid of 750 turns per metre and radius 10.0cm. A sinusoidal current $I = 7\sqrt{2}\sin(150\pi t)$, is passed through the solenoid. Find the e.m.f induced across the terminals of the coil. (4mks)

(c) (i) What is meant by mutual induction? (1mk)

(ii) Two coils P and Q are placed co- axially near each other as shown in figure below. R is a rheostat of large value while E is a strong battery.

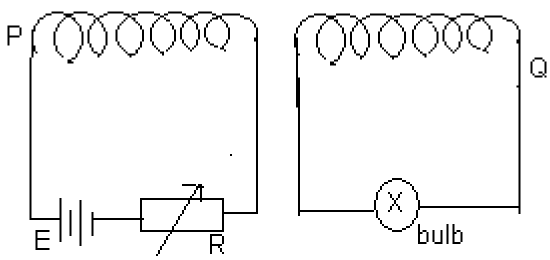

Figure 1

Explain why when the resistance, R, is varied very fast, the bulb lights up. (2mks)

(c)(i) Describe how an a.c transformer works. (5mks)

(ii) Explain the importance of transformers in power transmission (2mks)

7. (a) (i) Describe how a hot wire ammeter works. (5mks)

(ii) Explain why the instrument in a(i) above is suitable for measuring alternating current while a moving coil galvanometer is not. (3mks)

(b) Define reactance and state its unit. (2mks)

(c) Show that current leads voltage by phase angle 90^0 when a sinusoidal voltage is applied across a capacitor; hence find the expression for reactance of the capacitor. (4mks)

(d) A 240V, 60Hz alternating voltage is applied across an inductor of 0.2H and negligible resistance. Find the maximum value of current that flows through the inductor. (3mks)

(e)

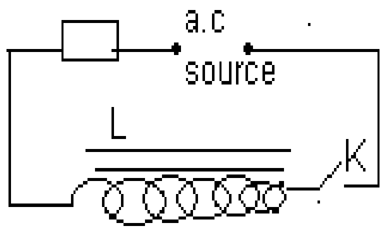

Figure 2

An iron cored coil L is connected in series with a resistor and switch K, across a strong a.c. source as above. Switch K is closed and after some time it is opened. Explain why a spark occurs at the switch. (3mks)

SECTION D

8. (a) Define terminal P.d of a battery and *one volt*. (2mks)

(b) Derive the expression for electrical energy dissipated in a resister of resistance, *R*, when a P.d of, *V*, is maintained across it for a time, *t*. (3mks)

(c)

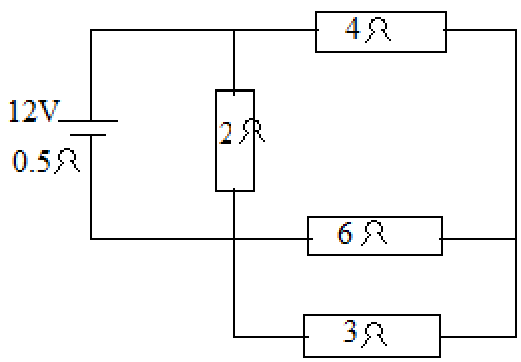

Figure. 3

Figure above shows a network of resistors of 2Ω, 3Ω, 4Ω and 6Ω, connected to a battery of 12V and internal resistance 0.5Ω. Find the

(i) Terminal P.d of the battery. (4mks)

(ii) Power dissipated in the 4Ω resistor. (3mks)

(d) (i) Describe how the resistance of a conductor can be determined using a potentiometer. (5mks)

(ii) Explain why the result in d(i) above may be more accurate than when using a voltmeter and ammeter. (3mks)

9. (a) (i) State Coulomb's law of electrostatics. (1mk)

(ii)

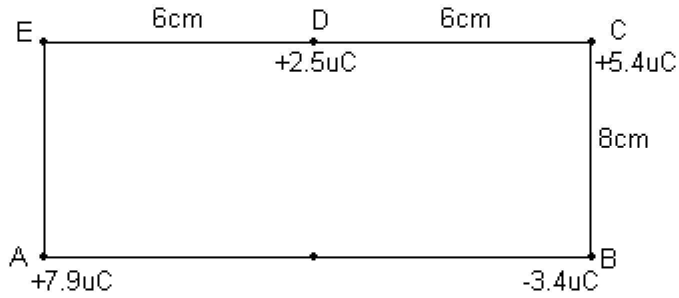

Figure. 4

Figure above shows three charges of +7.9μC, -3.4μC, +5.4μC and +2.5μC, are arranged on a rectangle. Find the force acting on the 2.5μC charge. (6)

(b) (i) Explain how a conductor can be charged negatively by induction. (3mks)

(ii) Explain how the presence of a neutral conductor near a negatively charged material can affect the potential of the material. (3mks)

(iii) Describe how a gold leaf electroscope can be used to detect charge a body. (3mks)

(c) Describe how a large potential is can be built in a Van der Graff generator (4mks)

10. (a) (i) Define relative permittivity and dielectric strength. (2mks)

(ii) Describe an experiment to determine how capacitance of a capacitor varies with area of overlap of the plates. (4mks)

(b) Two identical capacitors are connected in parallel and then charged to a P.d, V. The capacitors are then disconnected from the battery. Show that when a dielectric of constant, ε_r,

is inserted between the plates, of one of them, the pd across the capacitors reduces by $\left(\frac{\varepsilon_r - 1}{\varepsilon_r + 1}\right)$ V. (3mks)

(c)

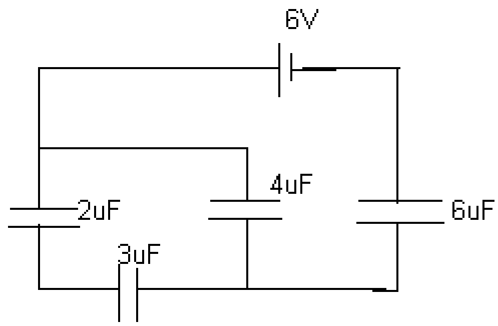

Figure. 5

Four capacitors of 2µF, 3µF, 4µF and 6µF are connected in a network as above across a battery of e.m.f 6V. Find the:

(i) Charge stored in the network. (4mks)

(ii) P.d across the 4µF capacitor. (3mks)

(d)(i) A capacitor is connected in series with a micro ammeter to a d.c voltage source through a switch. When the switch is closed the micro ammeter pointer deflects in one direction then it comes to zero. When a dielectric is now inserted between the capacitor plates, the pointer again deflects then it comes to zero. Explain this observation. (2mks)

(ii) Explain why the P.d across a charged capacitor increases when the plate separation is increased. (2mks)

END