Uganda Advanced Certificate of Education

Physics P510/2
Paper 2
2 Hours 30 Minutes

Instructions to Candidates

- *Answer **five** questions, taking atleast one from each of the section, **A, B,C** and **D** but not more than **one** question should be chosen from either **A** or **B**.*
- *Any additional question(s) answered will not be marked.*
- *Mathematical tables and square paper are provided.*
- *Non-programmable scientific calculators may be used.*

Assume where necessary,

Acceleration due to gravity, g	=	$9.81 ms^{-2}$
Speed of light in vacuum, c	=	$3.0 \times 10^{8} ms^{-1}$
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	=	8.85×10^{-12} Constant
The Constant, $\frac{1}{4\pi\varepsilon_0}$	=	$9.0 \times 10^{9} F^{-1}m$
One electron volt eV	=	$1.6 \times 10^{-19} J$

SECTION A

1. a) Define the following terms as applied to a concave lens.
   i) Principal focus (1mark)
   ii) radii of curvature (2marks)

   b) A point object is placed at a distance U infront of a diverging lens of focal length f to form an image at a distance V from the lens. Derive an expression that relates u, v and f. (4marks)

   c) Describe an experiment to determine the focal length of a concave lens using a plane mirror, converging lens and illuminated object. (4marks)

   d) What is meant by a
   i) Visual angle (1mark)
   ii) Near point (1mark)

   e) A person with a normal near point distance of 25cm wears spectacles with diverging lens of focal length 20cm inorder to correct the far point distance to infinity. Calculate the near point distance when viewing using the spectales (3marks)

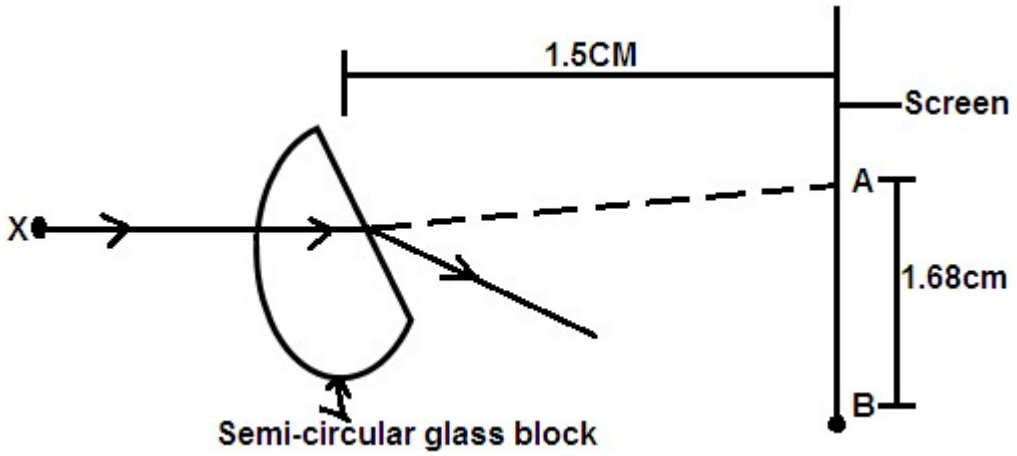
   f) Draw a ray diagram to show the formation of an image of a distance object in a terrestrial telescope in normal adjustment (3marks)

(ii) State two disadvantages of the terrestrial telescope. (2marks)

2. a) What is meant by the term?
i) Refraction (1mark)
ii) Absolute refractive index. (1mark)

b) Describe an experiment to determine the refractive index of liquid using a travelling microscope. (5marks)

c) The figure shows monochromatic light X incident towards A on a vertical screen.



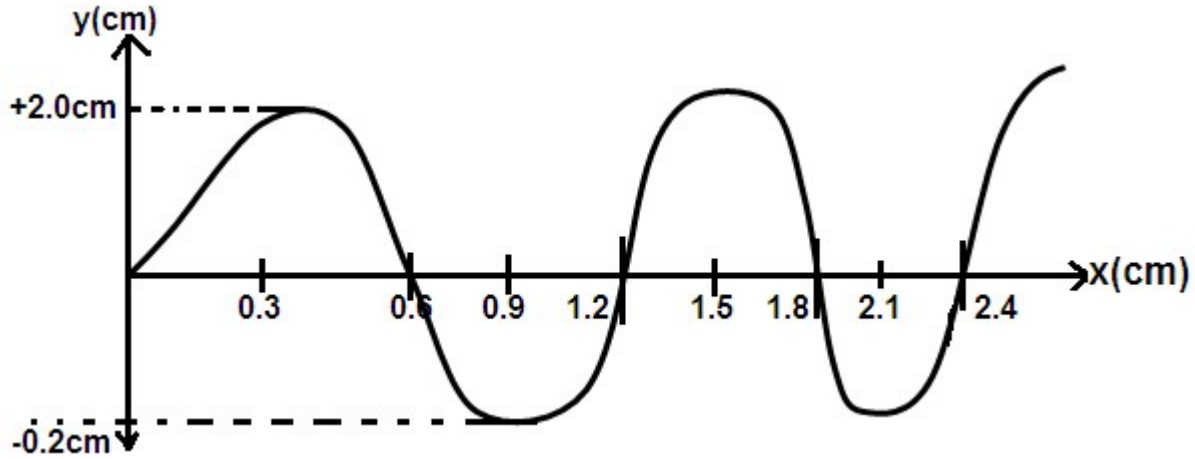
When the semicircular glass block is placed a cross the path of light with its flat face parallel to the screen, a bright spot is formed at A. when the glass block is rotated about a horizontal axis through , the bright spot moves down from A towards B and then just disappears at B a distance 1.6cm from A.
i) Find the refractive index of the material of the glass block. (4marks)
ii) Explain whether AB would be longer or shorter if a block of glass higher refractive was used. (2marks)
d(i) A ray of monochromatic light is incident at small angle of incidence on small –angled prism in air. Obtain the expression d = (n-1)A, for the deviation d, of the light by the prism where A is the refracting angle of the prism and n the refractive index.(4marks)
(ii) Calculate the minimum deviation produced by 60^{o} glass prism if the refractive index of the glass is 1.50. (3marks)
iii) State any two applications of total internal reflection. (1marks)

SECTION B

3. a(i) Define the term wave front and A ray in reference to a progressive wave. (2marks)

(ii) Draw a sketch diagram showing reflection of a circular wave by plane reflector. (2marks)

b) The figure below shows a wave travelling in the positive x-direction away from the origin with a velocity of $9ms^{-1}$.



i) What is the period of the wave? (3marks)

ii) Show that the displacement equation for the wave is $y = 2\sin \frac{5}{3}\pi(9t - x)$. (3marks)

c) What is meant by Doppler effect?

d) One species of bats locates obstacles by emitting high frequency sound waves and detecting the reflected waves. A bat flying at a steady speed of $5ms^{-1}$ emits sound of frequency 78.0KHZ and is reflected back to it.

i) Derive the equation for the frequency of the sound waves reaching the bat after reflection. (5marks)

ii) Calculate the frequency of the sound received by the bat given that the speed of sound in air is $340ms^{-1}$. (2marks)

e(i) What is meant by intensity of sound note? (1mark)

(ii) distinguish between loudness and pitch of a sound note. (1mark)

4. a) What is meant by the following terms

i) unpalarised light? (1mark)

ii) plane polarized light? (1mark)

b(i) Describe briefly how plane polarized light is produced by double refraction. (3marks)

(ii) Explain briefly one application of polarized light (2marks)

c) Explain

(i) How two coherent sources are obtained using abiprism. (3marks)

ii) Why interference effects are not observed in thick films. (3marks)

d) IN young double slit experiment, the slits are separated by 0.28mm and the screen is 4m away. The distance between the fourth Bright fringe and the central fringe is 1.2cm. determine the wave length of the light used in the experiment. (4marks)

e) Explain the effect of increasing the number of narrow slits in diffraction grating on the intensity of diffraction fringes. (3marks)

SECTION C

5. a) Define the following terms as applied to alternating voltage.
i) Root mean square value (1mark)
ii) Peak value (1mark)

b(i) An alternating voltage is applied a cross a capacitor of capacitance C. show that the current in the circuit leads the voltage by $\frac{\pi}{2}$. (3marks)
ii) Find the expression for the capacitive reactance in terms of frequency f, and capacitance C. (2marks)
iii) A capacitor of 0.1μF is in series with an a.c source of frequency 500HZ. If the r.m.s value of the current flowing is 6mA, calculate the voltage a cross the capacitor. (3marks)
c) A bulb is connected in series with an inductive coil and ad.c source as shown.

i) What happens to the brightness of the bulb when an iron core is inserted in the coil? (1marks)
ii) Explain what happens to the brightness of the bulb when the d.c source is replaced with a.c and an iron core inserted in the coil. (3marks)

d(i) What is hysteresis loss? (1marks)
(ii) How can hysteresis loss be minimized in the a.c transformer?
iii) Explain why primary current in the a.c transformer increases when the secondary coil is connected to the load.

6 a(i) Draw a well labelled diagram to show the structure of the repulsion type moving Iron Ammeter. (2marks)
(ii) Explain how the ammeter in a(i) above is able to measure alternating current. (5marks)

b(i) Write down an expression for the magnetic flux density at the centre of flat circular coil of N turns each radius acm carrying current I. (1marks)

ii) Describe how you would determine the value of the earths' magnetic flux density at a place using a search coil. ((5marks)

c) A coil of 50 turns and radius 4cm is placed with its plane in the earths' magnetic meridian. A compass needle is placed at the centre of the coil. When a current of 0.1A passes through the coil, the compass needle deflects through 40^{o}. When the current is reversed, the needle deflects through 43^{o} in the opposite direction.

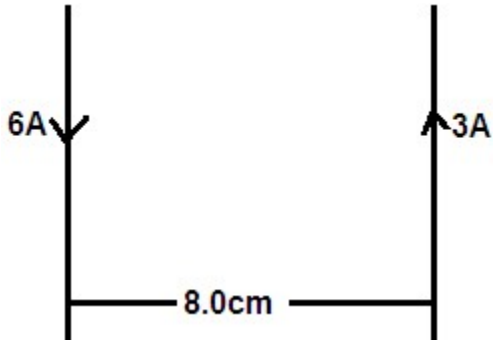
7. a) Define the term magnetic flux density. (1mark)

b) Write the expression for the

i) Magnetic flux density at a perpendicular distance R from along straight wire carrying current I in air.

ii) Force on a straight conductor of length I carrying current I at an angle to a uniform magnetic field of flux density B.

c) Two straight long and parallel wires of negligible cross-sectional area carry currents of 6.0A and 3.0A in opposite direction as shown.



If the wires are separated by a distance of 8.0cm, find the

i) Magnetic flux density at a point midway between the wires. (4marks)

ii) Force per metre between the wires (3marks)

d) Define

(i) Angle of DIP (1mark)

(ii) Angle of declination (1mark)

e) A straight conductor of length l is perpendicular to a magnetic field of flux density B. if the conductor moves with velocity U at an angle θto the magnetic field, derive the expression for e.m.f induced. (4marks)

f) An air craft of wing span 20m is moving horizontally from west to east at a velocity of 250ms-1 in a place where the angle of dip is 40^{o}. The emf induced a cross the tips of the wings is 6mv. Find the magnetic flux density of the earth field.

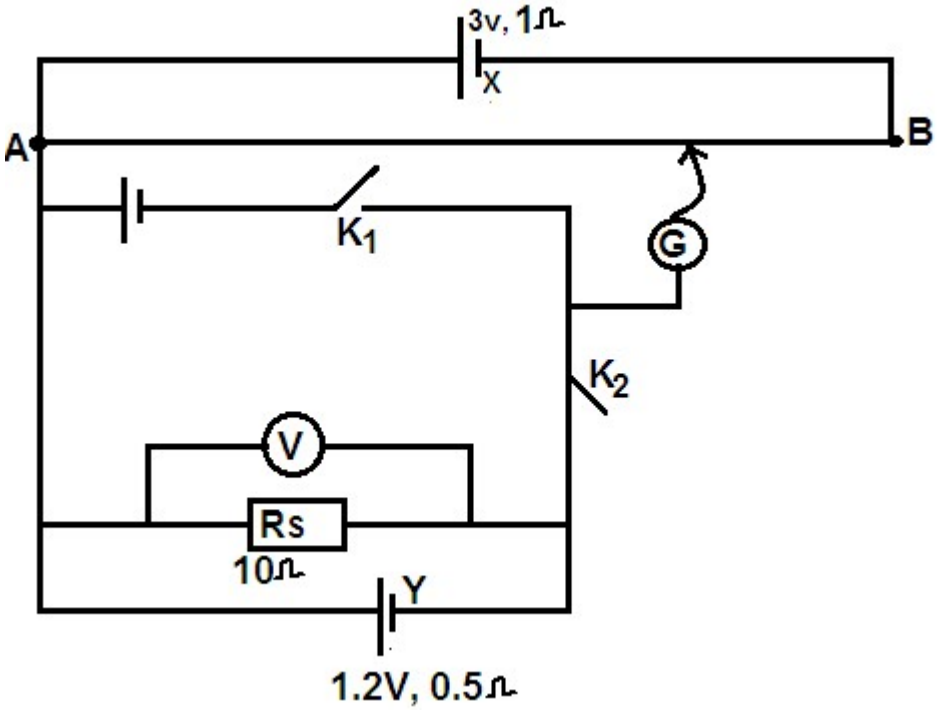
SECTION D.

8. a(i) Define electro motive force of a battery (1mark)

(ii) A cell of emf E and internal resistance r drives current through a resistor of resistance R connected in series with it. Derive an expression for the efficiency of the circuit. (4marks)

b) Describe with the aid of a diagram, how you would standardize a slide wire potentiometer. (3marks)

c) AB is a uniform resistance wire length 1m and resistance 4Ω. X is a driver cell of emf 3V and internal resistance 1Ωand Es is a standard cell. Rs is a standard resistor of resistance 10Ωwhich is connected in series with cell Y of emf 1.2V and internal resistance 0.5Ω.



With switch K_1 closed and K_2 open, the balance length AC is 60cm while the voltmeter reading is 1.14v. With switch K_1 open and K_2 closed the balance length is 80cm. calculate the

(i) E.m.f, Es of the standard cell. (3marks)

(ii) Percentage error in the voltmeter reading (3marks)

d) Describe with aid of a circuit diagram how you would measure the temperature coefficient of resistance of a materials inform of wire (6marks)

9. a) State coulomb's law of electrostatics (1mark)

b) Derive the relation between electric field intensity E and electric potential V due to charge at a point. (4marks)

c) Two pith balls P and Q each of mass 0.1g are separately suspended from the same point by threads 30cm long. When the balls are given equal charges, they repel each other and come to rest 18cm apart. Calculate the magnitude of charge on eachball. (6marks)

d) Describe how you would investigate the distribution of charge on a pear shaped conductor. (4marks)

e) Explain how a charged body attracts an uncharged conductor. (3marks)

f) Describe how an electroscope can be used to distinguish a conductor from an Insulator. (2marks)

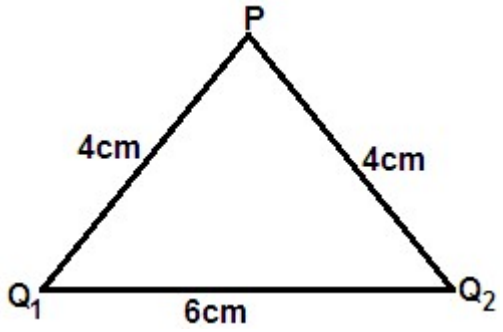
10. a) Define electric strength. (1marks)
b(i) Explain briefly how a capacitor in which potential difference is Vo a cross the plates can be fully discharged. (2marks)

(ii) Sketch a graph showing a variation of potential difference with time for the process in b(i) above.

C(i) Two capacitors of capacitances C1 and C2 are connected in series. Show that the effective capacitance C is given by;
$C = \frac{C_1 C_2}{C_1 + C_2}$ (4marks)

(ii) A 10.0μF capacitor charged to 200V is connected across an uncharged 50μF capacitor. Calculate the total energy stored in both capacitor before and after connection. (4marks

(iii) Account for the difference in the energies calculated in c(ii) above. (1marks)
d) In the figure Q_1 and Q_2 are point charges of magnitudes +5.0μC and -5.0μC respectively



Calculate the
i) Electric field intensity at P (3marks)
ii) Potential energy of a point charge Q_3 of 0.8μc placed at P. (4marks)

END