P510/2
PHYSICS
Paper 2
July/Aug 2019
2½hours.

WESTERN JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

- Answer five questions, including at least one question from section A and B, but not more than two from each of the sections C and D.
- Any additional question(s) answered will not be marked.
- Assume where necessary
  Acceleration due to gravity, $g = 9.81ms^{-2}$
  Electron charge, $e = 1.6 \times 10^{-19}\ C$
  Speed of light in vacuum, $C = 3.0 \times 10^{8}ms^{-1}$
  Permeability of free space, $\mu_0 = 4\pi \times 10^{-10}Hm^{-1}$
  Permittivity of free space, $\varepsilon_0 = 8.85 \times 10^{-1}Fm^{-1}$
  The constant $\frac{1}{4\pi\varepsilon_0} = 9.0 \times 10^{9}F^{-1}m$

SECTION A

1.(a)(i)Distinguish between linear magnification and angular magnification as used in light. (02 marks)

(ii)Derive the expression for the magnifying power of a magnifying glass when the final image is formed at the near point. (04 marks)

(b)(i) Show that the radius of curvature of a convex mirror is twice the focal length of the mirror. (03 marks)

(ii) Describe an experiment to determine the focal length of a convex mirror using a convex lens(05 marks)

(c)(i) Explain why lenses of narrow aperture are preferred to lenses of wide aperture in optical instruments.(02 marks)

(ii) Find the separation of the eyepiece and objective of an astronomical telescope of magnifying power 20 and in normal adjustment, if its eyepiece has a focal length of 5cm. (04 marks)

2.(a)(i) Define radius of curvature of a concave mirror.(01 mark)

(ii) A concave mirror is placed at the base of a stand and a pin clamped above the mirror coincides with its image when it is 15cm above the mirror. When a liquid is placed in the mirror to a depth of 3cm, the pin coincides with its image when it is 12.6cm above the mirror. Calculate the refractive index of the liquid. (03 marks)

(b) Describe an experiment basing on Newton's formula to measure focal length of a convex lens.(06 marks)

(c)(i) What is meant by magnifying power of an optical instrument?(01 mark)

(ii) Derive an expression for the magnifying power of a compound microscope in normal adjustment. (05 marks)

(d)(i) Why should the objective and the eyepiece of a compound microscope have short focal lengths?(01 mark)

(ii) A compound lens consists of two lenses in contact having powers of +12.5D and -2.5D. Find the position and nature of the image of an object placed 15.0cm from the compound lens. (03 mark)

SECTION B

3. (a) Distinguish between progressive and stationary waves. (03 marks)

(b)(i) What are overtones? (01 mark)

(ii) Explain why a musical note played on one instrument sounds different from the same note played on another instrument. (03 marks)

(c) A stretched string of length, L is fixed at both ends and then set to vibrate in its allowed modes. Derive an expression for the frequency of the second overtone interms of the fundamental frequency.(04 marks)

(d) A wire of length 0.6m and mass 9 x10^{-4} kg is under tension of 135N. The wire is plucked such that it vibrates in its third harmonic. Calculate the frequency of the third harmonic. (05 marks)

(e) Describe the variation of pressure with displacement of air in a closed pipe vibrating with the fundamental frequency. (04 marks)

4 (a) Distinguish between path difference and phase difference as applied to waves. (02 marks)

(b) Derive an expression for refractive index of a light wave moving from one medium of velocity V_1 to another medium of velocityV_2. (04 marks)

(c)(i) Explain the term interference as applied to light waves. (01 mark)

(ii) Explain why the amplitude of a wave goes on decreasing as the distance from the source increases. (03 marks)

(d)(i) Describe an experiment to test the flatness of a surface using Newton's rings. (05 marks)
(ii) Explain why an oil layer on a water surface appears coloured on a rainy day. (02 marks)

(iii)Two glass slides are separated by a thin wire to form an air wedge. When the wedge is illuminated normally by light of wavelength 5.6×10^{-7} m, a total of 20 fringes occupying a distance of 15mm are obtained. Calculate the angle of the wedge. (03 marks)

SECTION C

5. (a)(i) Distinguish between self-induction and mutual induction. (02 marks)

(ii) An air cored inductor is connected in series with a switch and a d.c source. The switch is closed and left for some time. Explain why a spark is observed across the switch contacts when the switch is re-opened. (03 marks)

(b) Derive an expression for the peak value of the induced emf when a coil of N turns each of area, A rotates in the magnetic field of flux density, B at a frequency f with its plane making an angle θ with normal.(04 marks)

(c)(i) Write down the expression for the magnetic flux density along the axis of a solenoid of nturns per meter carrying current I.(01 mark)

(ii) Describe the absolute method of determining resistance. (06 marks)

(d)(i) Explain how eddy currents are produced. (02 marks)

(ii) Explain one application of eddy currents. (02 marks)

6. (a) Define the terms magnetic flux and an Ampere (02 marks)

(b) A solenoid of length, L and number of turns N is placed in vacuum. If a constant current*I* is passed through the solenoid,

(i) Sketch the magnetic field pattern for the solenoid. (02 marks)

(ii) Write down an equation for the flux density at its centre and at its ends.

(02 marks)

(iii) Describe an experiment to verify that the ratio of these flux densities is as predicted by the formulae. (05 marks)

(c) A coil of 500 turns and mean area $4.0 \times 10^{-2} m^2$ is rotated at a uniform rate of 600 revolutions per minute about an axis perpendicular to a uniform magnetic field of flux density o.2T. Calculate the maximum value of the *emf* induced in the coil. (04 marks)

(d) Two infinitely long straight wires carrying currents I_1 and I_2 respectively in the same direction are placed parallel to each other in a vacuum at a distance, d metres apart.

(i) Derive an expression for the force per metre between the wires. (04 marks)

(ii) Sketch the magnetic field pattern due to the currents flowing in the two wires above.(01 marks)

7.(a)(i) Distinguish between root-mean square value and peak valve of a sinusoidal voltage.
(02 marks)
(ii) What is the numerical relationship between the two quantities?(01 mark)

(b)(i) Describe with the aid of a labeled diagram, the structure and mode of operation of an a.c generator.(05 marks)

(ii) State the factors that determine the peak value of the induced *emf* in the generator above. (02 marks)

(c) Explain why a moving coil galvanometer cannot be used to measure alternating current. (04 marks)

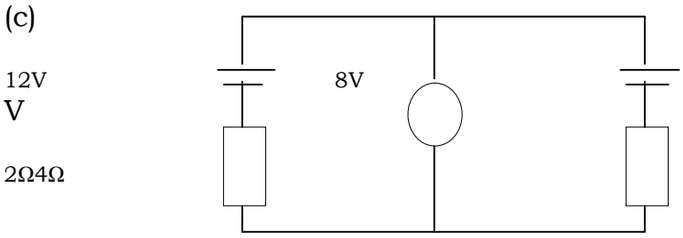
SECTION D

8.(a) Define current density and the *ohm* and state their units. (03 marks)

(b)(i) Sketch the current versus voltage characteristic for a gas discharge tube.
(01 mark)

(ii) Explain the main features of the graph in b(i)above(03 marks)

(c)



Resistors of 2Ω and 4Ω are connected in series with power supplies of 12V and 8V as shown in the figure above. Calculate

(i) The reading of the voltmeter (04 marks)

(ii) The power dissipated in the 4Ω resistor (02 marks)

(d)(i) Define temperature coefficient of resistance(01 mark)

(ii) Explain why semi-conductor have negative temperature coefficient of resistance.(02 marks)

(iii) Describe briefly how you would measure the temperature coefficient of resistance of a material inform of a wire.(04 marks)

9.(a) (i) Define electric potential difference.(01 mark)

(ii) Explain briefly what happens to the potential energy as two point charges of the same sign are brought closer. (02 marks)

(b) Two pith balls P and Q each of mass 0.1*g* are separately suspended from the same point by threads 30 cm long. When the balls are given equal charges, they repel each other and come to rest 18cm apart. Calculate the magnitude of the charge on each ball. (04 marks)

(c) Describe how you would investigate the distribution of charge on a pear- shaped conductor. (04 marks)

(d) (i) What is meant by corona discharge? (02 marks)

(ii) Describe how an electroscope can be used to distinguish a conductor from an insulator. (02 marks)

(e) (i) Sketch graphs of the variation of electric potential and electric field intensity with distance from the centre of a charged conducting sphere. (02 marks)

(ii) Define the term charge quantization. (01 mark)

(iii) State two properties of an equipotential surface. (02 marks)

10. (a)(i) Define the terms capacitance and dielectric constant. (02 marks)

(ii) State the factors on which the capacitance of a capacitor depends.
(03 marks)

(b) Derive the formula for the capacitance of a parallel plate capacitor.(04 marks)

(c) A parallel plate capacitor is charged to p.d of 300V. It is then connected in parallel with another uncharged capacitor of equal dimensions with a paper as a dielectric between its plates. Ifthep.d of the combination is 75V. Calculate the dielectric constant of the paper. (04 marks)

(d) Deduce an expression for the energy stored in a capacitor charged to a p.d V.
(03 marks)

(e) A 10.0 μF capacitor is charged to 500V, disconnected from the voltage supply and then connected in parallel with an uncharged 40μF capacitor. Calculate the total energy stored in both capacitors before and after connection. Comment on the two energies.(04 marks)

END