P510/2
PHYSICS
PAPER 2
July/August 2015
$2^1/_2$hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

- *Answer* **five** *questions, taking at least* ***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.*
- *Non-programmable scientific calculators may be used.*
- *Mathematical tables and squared paper will be provided.*

Assume where necessary;

Acceleration due to gravity, g,	$= 9.81 ms^{-2}$
Speed of sound in air	$= 330 ms^{-1}$
Speed of light in vacuum, c,	$= 3.0 \times 10^{8} ms^{-1}$
Electronic charge, e,	$= 1.6 \times 10^{-19} C$
Electron mass	$= 9.11 \times 10^{-31} kg$
Plank's constant, h,	$= 6.63 \times 10^{-34} Js$
Permeability of free space, μ_o.	$= 4.0\pi \times 10^{-7} Hm^{-1}$
Permittivity of free space, ε_0,	$= 8.85 \times 10^{-12} Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	$= 9 \times 10^{9} F^{-1} m$
One electron volt, (eV)	$= 1.6 \times 10^{-19} J$
Avogadro's number, N_A	$= 6.02 \times 10^{23} mol^{-1}$
Specific heat capacity of water	$= 4200 Jkg^{-1} k^{-1}$

Turn Over

SECTION A

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

(ii) Show, with the aid of a ray diagram that the radius of curvature of a concave mirror is twice the focal length of the mirror. (4 marks)

(b) A concave mirror forms an image half the size of the object. The object is then moved towards the mirror until the image size is three quarters that of the object. If the image is moved by a distance of 0.8cm, calculate the:-

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

(ii) new position of the object. (2 marks)

(c) Describe how you would determine experimentally the angle of minimum deviation produced by a prism. (4 marks)

(d) A ray of light propagating in a liquid is incident on a prism of refracting angle 60^0 and refractive index 1.50 at an angle of 40^0. If the ray passes symmetrically through the prism, find the refractive index of the liquid. (3 marks)

(e) State **two** applications of total internal reflection. (2 marks)

2. (a) With the aid of ray diagrams, explain the following as applied to lenses.

(i) **Conjugate points.** (2 marks)

(ii) **Spherical aberration.** (2 marks)

(b) An object, O, placed in front of a converging lens forms a real image I on the screen. The distance between the object and its real image is'd' while that of the image from the lens is x.
Derive the expression for the least possible distance between the object and its image. (5marks)

(c) Give the properties of the lenses in an achromatic combination. (3marks)

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

(i) the separation of the lenses. (3 marks)

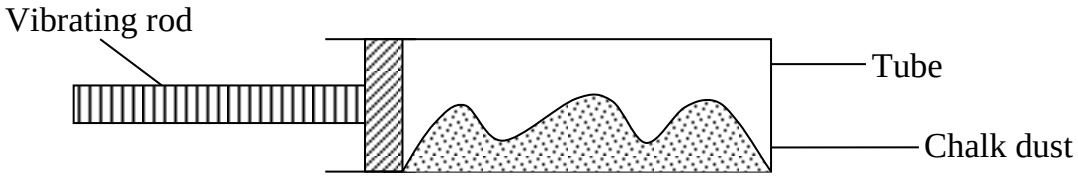
(ii) the magnifying power of the lenses. (3 marks)

(e) State **two** differences between a compound microscope and an astronomical telescope. (2 marks)

SECTION B

3. (a) What is meant by the following terms as applied to sound?
   (i) **Resonance.** (1 mark)
   (ii) **Fundamental frequency.** (1 mark)

   (b) In an experiment to determine the speed of sound in air in a tube, chalk dust settled in heaps as shown in the diagram below:-



   If the frequency of the vibrating rod is $220H_Z$ and the distance between three consecutive heaps is 1.50m, calculate the speed of sound in air. (3 marks)

   (c) (i) State the **principle of superposition of waves.** (1 mark)
   (ii) Explain using the principle of superposition of waves the formation of beats. (3 marks)

   (d) (i) Describe an experiment to show how the fundamental frequency varies with tension in a given wire. (4marks)
   (ii) A string of length 50cm and mass 5.0g is stretched between two points. If the tension in the string is 100N, find the frequency of the second harmonic. (3 marks)

   (e) (i) What is meant by **Doppler effect?** (1 mark)
   (ii) A car sounds its horn as it travels at a steady speed of $20ms^{-1}$ along a straight road between two stationary observers X and Y. Observer X hears a frequency of $560H_z$ while Y hears a lower frequency. Calculate the frequency heard by Y assuming the speed of sound in air is $330ms^{-1}$ (3 marks)

4. (a) What is a **diffraction grating?** (1 mark)
   (b) Describe how the wavelength of monochromatic light can be measured using a diffraction grating. (7 marks)
   (c) Two glass slides in contact at one end are separated by a sheet of paper 16cm from the line of contact to form an air – wedge. When the air-wedge is illuminated normally by light of wavelength 5.8×10^{-7}m, interference fringes of separation 2.0 mm are found in reflection. Find the thickness of the paper. (4 marks)

Turn Over

(d) (i) What is meant by **interference of waves?** (1 mark)

(ii) State **three** differences between constructive and destructive interference. (3 marks)

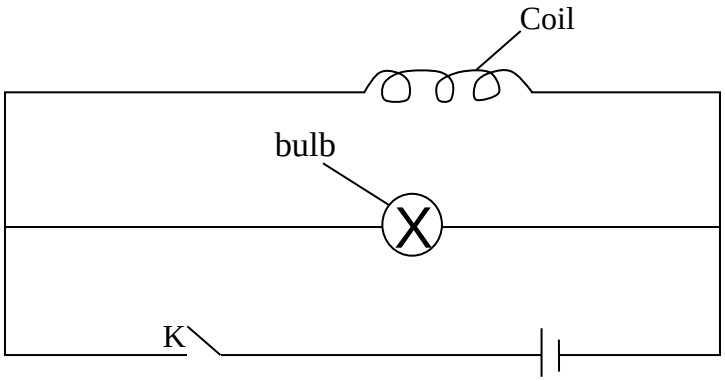
(e) In young's double – slit experiment, the 6^{th} bright fringe is formed 4mm away from the centre of the fringe system when the wave length of light used is 6.0×10^{-7}m. Calculate the separation of the two slits if the distance from the slits to the screen is 60cm. (4 marks)

SECTION C

5. (a) (i) Define the term **root-mean-square** value and **peak value** of an alternating current. (2 marks)

(ii) A sinusoidal alternating current I = 3 sin ($120\pi t$) amperes flows through a resistor of resistance 2.5Ω. Find the power dissipated in the resistor and sketch a graph of voltage and current through the resistor on the same axes against time. (4 marks)

(b) A coil of wire is connected in parallel with an electric bulb to a d.c source as shown in the figure below.



At the instant switch K is closed, the bulb flashes briefly for a short time and then goes off. Explain the observation. (4 marks)

(c) (i) Define the term **reactance.** (1 mark)

(ii) In an experiment to measure the reactance of a capacitor, the r.m.s current is measured to be 10mA.
The peak to peak voltage is measured to be 16V.
If the frequency is $10H_Z$; find the capacitance of the capacitor. (3 marks)

(d) (i) With the aid of a diagram, describe the structure and action of a moving-iron meter of attraction type. (5 marks)

(ii) State **one** advantage of this type of meter over an ordinary ammeter. (1 mark)

6. (a) (i) Draw a well labelled diagram to show the structure of the moving coil galvanometer. (2 marks)

(ii) Explain how the galvanometer in (a) (i) above is able to measure alternating current. (5 marks)

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

(ii) Describe how you would determine the value of the Earth's magnetic flux density at a place using a search coil. (6 marks)

(c) A coil of 50 turns and radius 4cm is placed with its plane in the earth's magnetic meridian. A compass needle is placed at the centre of the coil. When a current of 0.1A passes though the coil, the campass needle deflects through 40^0. When the current is reversed, the needle deflects through 43^0 in the opposite direction. Calculate the;

(i) horizontal component of the earth's flux density. (4 marks)

(ii) magnetic flux density of the earth's field at that place given that the angle of dip at the place is 15^0. (2 marks)

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

(b) Describe the structure and action of an a.c transformer. (5 marks)

(c) A metal rod of length 50cm moves with a velocity of $5ms^{-1}$ in a plane perpendicular to a uniform magnetic field of flux density 5×10^{-2} T. Find the:

(i) Magnetic force on an electron in the rod, (3 marks)

(ii) Electric field intensity in the rod, (3 marks)

(iii) Potential difference between the ends of the rod. (3 marks)

(d) Show that the total charge which passes through the coil depends on the resistance of the coil and the total flux linked. (4 marks)

SECTION D

8. (a) (i) Define **electromotive force** of a battery. (1 mark)

(ii) A cell of e.m.f, 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. (4 marks)

(b) Describe an experiment to determine the internal resistance of a cell. (4 marks)

(c) A battery of e.m.f, E and internal resistance, r is connected across a variable resistor, When the resistor is set at 21Ω, the current through it is 0.48A. When it is set at 36Ω, the current is 0.30A. Find E and r. (5 marks)

Turn Over

(d) (i) Define the terms electrical resistivity and temperature coefficient of resistance. (2 marks)

(ii) The resistivity of a certain wire is $1.6 \times 10^{-7}\Omega m$ at 30^0C and its temperature coefficient of resistance is $6.0 \times 10^{-3}K^{-1}$. Calculate the resistivity at 80^0C. (4 marks)

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

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

(c) Two pith balls P and Q each of mass 0.1g 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 charge on each ball. (6 marks)

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

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

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

10. (a) Define the following:

(i) **Capacitance,** (1 mark)

(ii) **Dielectric material.** (1 mark)

(b) Describe an experiment that can be used to show how capacitance of a capacitor depends on the permittivity of a dielectric. (4 marks)

(c) A 10.0μF capacitor charged to 300V is connected across an uncharged 60μF capacitor. Calculate the total energy stored in both capacitors before and after connection. (4 marks)

(d) Describe briefly how the sign of a charge on a given body can be determined using a gold leaf electroscope. (4 marks)

(e) Two point charges A and B of -17.6μC and -9.0μC respectively are placed in vacuum at a distance of 21cm apart. When a third charge, C is placed mid-way between A and B, the net force on B is zero.

(i) Determine the charge on C. (4 marks)

(ii) Sketch the electric field lines corresponding to the charge distribution. (2 marks.)

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