P510/2
PHYSICS
PAPER 2
July/August 2017
$2^1/_2$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	$= 9.11 \times 10^{-31} kg$
Planck'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) What is meant by the term?

(i) **Refraction.** (01 mark)

(ii) **Absolute refractive index.** (01 mark)

(b) Describe an experiment to determine the refractive index of a liquid using a travelling microscope. (04marks)

(c) (i) Draw a ray diagram to show the formation of the image of a finite size real object by a concave lens. (02 marks)

(ii) An object is placed 20cm infront of a concave lens placed coaxially with a concave mirror of focal length 15cm. When the concave mirror is 20cm from the lens, the final image coincides with the object. Find the focal length of the concave lens. (04 marks)

(d) (i) What is meant by **critical angle?** (01 mark)

(ii) Explain how a mirage is formed. (04 marks)

(e) A plane mirror is placed 10cm infront of a convex mirror so that it covers about half the convex mirror surface.
A pin placed 25cm in front of a plane mirror gives an image which coincides with that of the pin in the convex mirror.
Find the focal length of the convex mirror. (03 marks)

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

(ii) Derive the equation; $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ as applied to a convex mirror. (05 marks)

(b)

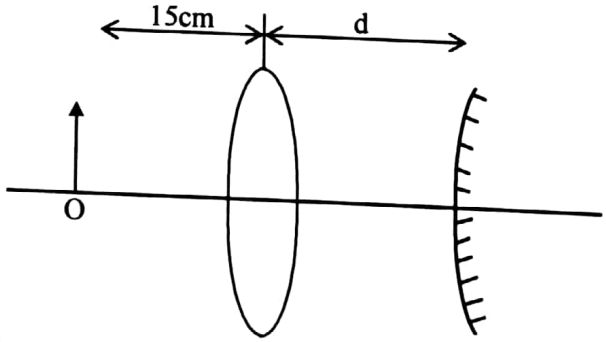

Fig. 1

An object, O is placed 15.0cm infront of a convex lens of focal length 10.0cm as shown in figure 1 above. Determine the distance, d, where a convex mirror of radius of curvature 20.0cm should be placed so that the image coincides with the object at O. (04 marks)

(c) (i) State the characteristics of the image formed by plane mirrors. (02marks)

(ii) Explain why prisms rather than plane mirrors are used in binoculars. (02 marks)

(d) Describe an experiment to determine the radius of curvature of a thin biconvex lens of known refractive index. (05 marks)

SECTION B

3. (a) (i) State the **principle of superposition of waves.** (01 mark)

(ii) Describe using the principle of superposition of waves the formation of stationary waves. (03 marks)

(b) A progressive wave $y = a \sin (wt - kx)$ is reflected at the barrier to interfere with the incoming wave. Show that the resultant wave is a stationary one. (04 marks)

(c) (i) What is **harmonic in sound?** (01 mark)

(ii) A string of length 100cm and mass 10.0g is stretched between two fixed points.
If the tension in the string is 200N, find the frequency of the third harmonic. (03 marks)

(d) Describe an experiment to determine the end-correction of a resonance - tube. (04 marks)

(e) (i) What is meant by **Doppler effect**? (01 mark)

(ii) Two observers X and Y are provided with sources of sound of frequency 800Hz. If X remains stationary while Y moves away at a velocity of $4.0ms^{-1}$, find the number of beats heard per second by X.
(Velocity of sound in air = $330ms^{-1}$) (03 marks)

4. (a) (i) What is meant by **diffraction of light?** (01 mark)

(ii) Light of wave length $6.0 \times 10^{-7}m$ is incident on a diffraction grating with 500 lines per cm. Find the diffraction angle for the first order image. (03 marks)

(b) With the aid of suitable sketches, explain the following:

(i) Division of waves front. (02 marks)

(ii) Division of amplitude. (02 marks)

(c) In young's double slit experiment, the slits are separated by 0.25mm and the screen is 4m away. The distance between the fourth bright fringe and the central fringe is 1.3 cm. Determine the wave length of the light used in the experiment. (04 marks)

(d) (i) What is meant by **plane polarized light?** (01 mark)

(ii) Describe how polarised light is produced by double refraction. (05 marks)

(e) A liquid of refractive index 1.4 is used to produce polarized light by reflection. Calculate the angle of incidence of light on the liquid surface. (02 marks)

Turn Over

SECTION C

5. (a) Define the following terms;

(i) **Magnetic flux** (01 mark)

(ii) **The weber** (01 mark)

(b) (i) Describe with the aid of a labelled diagram the structure and working of a moving coil galvanometer. (05 marks)

(ii) Explain why the coil of the galvanometer in b(i) above is wound on an aluminium former and why it is placed between curved poles of a magnet. (03 marks)

(c) Describe an experiment to show the effect of length on the force on a current carrying conductor in a uniform magnetic field. (04 marks)

(d) The diagram in figure 2, below shows a cuboid of a conductor of length *l*, breadth b and thickness t, placed with its largest face PQVW perpendicular to the horizontal component of the Earth's magnetic field of flux density B_H. A current I is passed through it as shown.

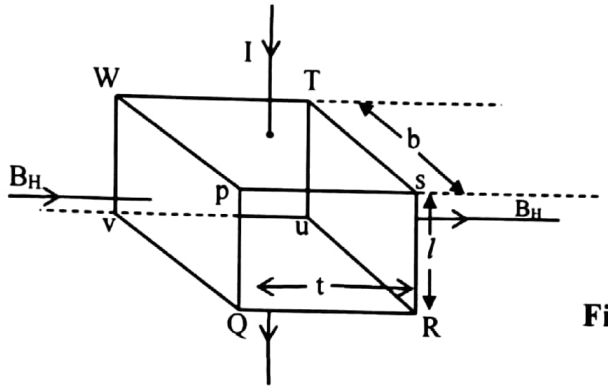

Fig. 2

(i) Account for the occurrence of a large potential difference across faces PQRS and UVWT and derive an expression for this voltage in terms of B_H, b and the average velocity of the charge carriers V. (04 marks)

(ii) If the magnetic field of flux density 2.0×10^{-4}T is applied and the breadth of the conductor is 5cm while the mean speed of the electrons is $4.0 \times 10^{-2} ms^{-1}$. Calculate the potential difference across PQRS and UVWT. (02 marks)

6. (a) (i) State **Lenz's law** of electromagnetic induction. (01 mark)

(ii) Describe an experiment to demonstrate Lenz's law of electromagnetic induction. (05 marks)

(b) (i) Define the term **magnetic flux density.** (01 mark)

(ii) A rectangular coil of 12 turns and dimensions 4cm by 2cm is suspended inside a long solenoid of 1200 turns per metre so that its plane lies along the axis of the solenoid and deflects through 40° when a current of 3.0A is passed through the solenoid.
Find the torsion constant of the suspension. (05 marks)

(c) Explain why the voltage at a generating power station must be stepped up to a very high value for long distance transmission. (03 marks)

(d) A transformer connected to an a.c supply of peak voltage 240V is to supply a peak voltage of 12V to a lightening system of resistance 6Ω. Calculate the:

(i) rms current supplied to the lighting system, (02 marks)

(ii) average power delivered to the lighting system. (03 marks)

7. (a) Define **root mean square value** of an alternating voltage. (01 mark)

(b) A resistor of resistance 200Ω is connected a cross an alternating voltage $V = 40 \sin 140\pi t$.

(i) Find the frequency of the alternating voltage. (02 marks)

(ii) Calculate the mean power dissipated in the resistor. (02 marks)

(c) (i) A sinusoidal alternating voltage of frequency 80Hz is applied across a coil of wire of inductance 0.6H and negligible resistance. Find the reactance of the coil at this frequency. (03 marks)

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

(d) Explain why an alternating current apparently flows through a capacitor whereas direct current does not. (03 marks)

(e) Describe with the aid of a labeled diagram the structure and action of a hot wire ammeter. (06 marks)

SECTION D

8. (a) (i) Define the term **work function** of a material. (01 mark)

(ii) With the aid of diagrams describe how two metal spheres can both be charged positively by induction. (04 marks)

(b) (i) Define an **equi-potential surface** and state its characteristics. (03 marks)

(ii) Explain why electric field lines are always normal to the surface of a charged conductor. (03 marks)

(c) (i) Define the term **charge density.** (01 mark)

(ii) Draw diagrams to show how charge is distributed on a positively charged metal sphere and a positively charged pear-shaped conductor; and explain why charge is distributed as drawn. (04 marks)

(d) An alpha particle of charge +2e having kinetic energy 1.0×10^{-12} J is incident head-on, on a gold nucleus of charge + 79e in a gold foil.
Calculate the distance of closest approach of the alpha particle to the gold nucleus. Take $e = 1.6 \times 10^{-19}$C. (04 marks)

9. (a) Define the following;

(i) **Capacitance,** (01 mark)

(ii) **dielectric-material.** (01 mark)

(b) The capacitance of a variable radio capacitor can be charged continuously from 12PF to 800PF by turning the dial from 0° to 120°. With the dial set at 120°, the capacitor is connected to a 8V battery. After charging, the capacitor is disconnected from the battery and the dial is turned to 0°.

Calculate the;

(i) Charge on the capacitor, (03 marks)

(ii) Energy stored in the capacitor with the dial set at 120°, (03 marks)

(iii) Work required to turn the dial from 120° to 0° if friction is neglected. (03 marks)

(c) A capacitor of capacitance, C, is charged by a battery and then later isolated. When the plates of the capacitor are taken apart, deduce what happens to the potential difference between the plates. (03 marks)

(d) Two capacitors of capacitances C_1 and C_2 are connected in series. Show that the effective capacitance, C is given by.

$$C = \frac{C_1 C_2}{C_1 + C_2}$$

(04 marks)

(e) Explain what happens if a conductor instead of a dielectric is placed between the plates of a charged capacitor. (02 marks)

10. (a) (i) Define the terms **temperature coefficient of resistance** and **electrical resistance.** (02marks)

(ii) Describe how you would determine temperature coefficient of resistance using a metre bridge. (06 marks)

(b) Explain the effect of temperature on resistivity of a conductor and a semi conductor. (05 marks)

(c) In figure 3 below, Y is an accumulator of e.m.f 2.5V and negligible internal resistance connected in series with a 2Ω resistor and slide wire AB of length 1.0m and resistance 8Ω. A cell X of e.m.f 2.5V and internal resistance 1.0Ω is connected in series with two resistors R1 and R2. Balance lengths of 42.8cm and 75.0cm are obtained when the galvanometer G is connected at U and V respectively.

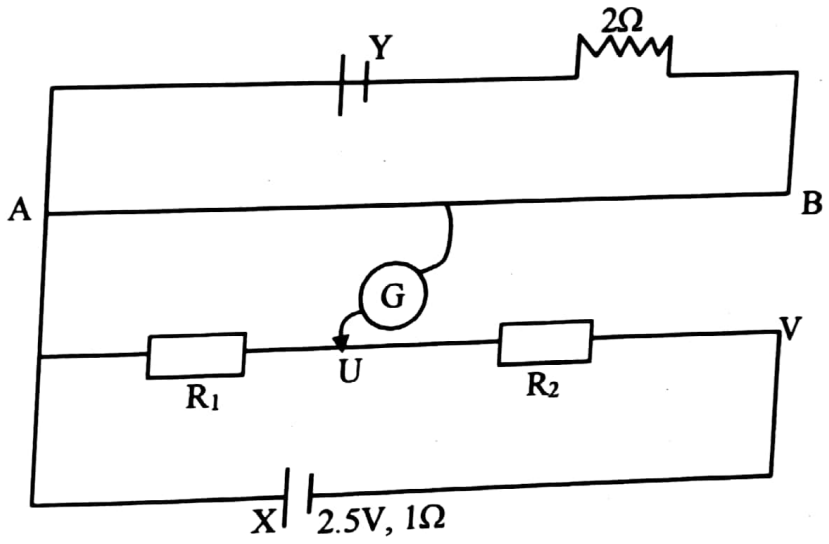

Fig. 3

Find the;

(i) Current flowing through R_1, (04 marks)

(ii) Resistance R_1 and R_2. (03 marks)

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