**P510/2**
**PHYSICS**
**JULY 2017**
$2\frac{1}{2}$ *hours*

# Uganda Advanced Certificate of Education

## PHYSICS MOCK EXAMINATION

## Paper 2

## 2Hours 30Minutes

**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 A or B.

Any additional questions will not be marked.

Non-programmable scientific calculators may be used.

*Assume where necessary*

*Acceleration due to gravity, g* $= 9.81 ms^{-2}$

*Speed of light in a vacuum, c* $= 3.0 \times 10^{8} ms^{-1}$

*Electron charge* $= 1.6 \times 10^{-19} C$

*Permeability of free space,* $\mu_o$ $= 4.0\pi \times 10^{-7} Hm^{-1}$

*Permittivity of free space,* $\varepsilon_o$ $= 8.85 \times 10^{-12} Fm^{-1}$

*The constant* $\frac{1}{4\pi\varepsilon_o}$ $= 9.0 \times 10^{9} F^{-1} m$

*Velocity of sound in air at* $0^{O}C$ $= 330 ms^{-1}$

## SECTION A

1.(a) Define **refractive index** of a material. What is the refractive index of a material through which light travels at $2\times10^{8}\,ms^{-1}$. (2)

(b) Show that the refractive index, n, *of* the material of glass prism is given by $n=\dfrac{\sin\left(\dfrac{A+D_m}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$,where A is the refracting angle of the prism and $D_m$ is the angle of minimum deviation for light passing through the prism. (3)

(c) Describe an experiment to determine the refractive index of glass using a triangular prism and optical pins. (5)

(d) A thin equiconvex lens of glass of refractive index 1.50 whose surfaces have a radius of curvature 24.0cm is placed on a horizontal plane mirror. When the space between the lens and the mirror is filled with a liquid a pin held 40.0cm vertically above the lens is found to coincide with its own image. Calculate the refractive index of the liquid. (5)

(f) In an experiment to determine focal length of a lens, after tabulating results, a student plotted graph of magnification $m$ against image distance, $v$.Explain how the student used the graph to find the focal length, without calculating the slope. (3)

(f) Explain the advantage of using prisms instead of plane mirrors in periscopes. (2)

2.(a) Define the terms

(i) Power of accommodation. (1)

(ii) angular magnification, as applied to optical instruments. (1)

(b) Explain one disadvantage a Galilean telescope has over an astronomical telescope. (2)

(c) An astronomical telescope has an objective with a focal length of 100cm and a diameter of 5cm.If the eyepiece has a focal length of 20cm and the telescope is used in normal adjustment, calculate the

(i) Magnifying power (2)

(ii) Diameter of the eye ring (2)

(iii) Separation of the lenses. (2)

(d) Give two advantages of a prism binoculars as an optical instrument. (2)

(e)(i) Define chromatic aberration. (1)

(ii) Give two properties of lenses used to make an achromatic doublet. (2)

(f) Describe an experiment to determine focal length of a diverging lens using a concave mirror. (5)

**SECTION B**

3.(a) State the principle of superposition of waves? (1)

**(b)** Distinguish between Progressive and stationary waves. (3)

(c )(i) Describe an experiment to determine the velocity of sound in air by the dust tube method. (6)

(ii) Explain why changes of pressure have no effect on the velocity of sound in air at constant temperature. (3)

(d)(i) What is meant by the terms resonance and fundamental frequency? (2)

(ii) A steel wire of length 40cm and diameter 0.025cm vibrates transversely in unison with a tube, open at both ends and of effective length 60cm, when each is sounded in its fundamental mode at $27^0C$.Find the tension in the wire. (5)

**4**.(a) Distinguish between interference and diffraction of light. (2)

(b)(i) Explain what is meant by path-difference as applied to interference of two wave motions. (3)

(ii) In Young's double slit experiment, the $4^{th}$ bright fringe is formed 3.4mm away from the centre of the fringe system when the wavelength of light used is $6.3\times10^{-7}m$. Calculate the distance of the screen from the slits if the separation of the two slits is 0.62mm. (3)

(ii) Explain why light is considered to be a transverse wave, while sound is not.(2)

(c) Two slits X and Y are separated by a distance $a$ and illuminated with light of wavelength $\lambda$.Derive the expression for the separation between successive fringes on a screen placed a distance D from the slit. (5)

(d) Explain with the aid of a diagram, how Newton's rings are formed. (5)

## SECTION C

5.(a) Define the following:

(i) Magnetic flux (1)

(ii) Magnetic flux density, (1)

(iii) Angle of dip (1)

(b) A conductor of length $l$ moving with a velocity $v$ cuts through flux at an angle $\theta$ to a uniform magnetic field. Derive an expression for the e.m.f induced in it. (4)

(b) Describe with the aid of a diagram, an absolute method of measuring resistance. (6)

(c)

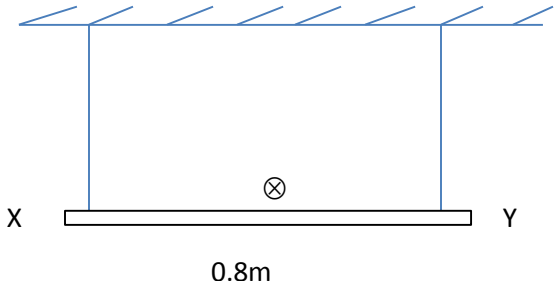



**Figure 1**

In **Figure 1** above, XY is a straight conductor of length 0.8m and mass $3.0\times10^{-2}kg$. The conductor is suspended by a pair of threads in a uniform magnetic field of flux density $4.5\times10^{-2}T$. Determine the magnitude and direction of the current required to remove the tension in the suspension threads. (4)

(c) Explain why a wire carrying current in a magnetic field, moves. (3)

**6**.(a)(i) Define eddy currents. (1)

(ii) Explain how eddy currents are put to good use in a car speedometer. (3)

(iii) Explain the effect of eddy currents in a dynamo and how this is overcome.(3)

(b) A copper disc of radius 0.06m with its plane perpendicular to a uniform magnetic field spins at 900 revolutions per minute about an axis through its centre. A potential difference of $4.5\times10^{-5}V$ is shown on a voltmeter connected between the axle and the rim. Calculate the flux density of the field. (4)

( C) With the aid of a diagram explain how an a.c generator works. (5)

(d) What is self-induction? (1)

(ii) Describe an experiment to demonstrate self-induction. (3)

7.(a) Define reactance of a capacitor. (1)

(ii) Draw a sketch graph to show variation of reactance of a capacitor with frequency when the capacitance is constant. (1)

(ii) A capacitor of capacitance $2\mu F$ has a current of $1\times10^{-3}A$(r.m.s) flowing through it. The voltage across the capacitor is 0.156V.Calculate the frequency of the source. (4)

(b) Explain how alternating current can be converted into fairly steady direct current by use of diodes. (4)

(c) The diagram in **Figure 2** shows bulb connected to a battery in series with a capacitor.

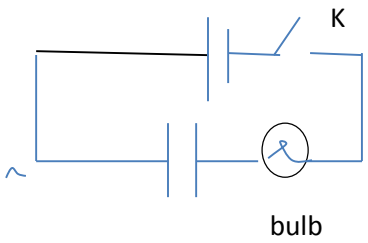



**Figure 2**

State and explain what is observed when

(i) switch K is closed. (2)

(ii) The battery is replaced with a source of alternating current and the switch closed. (3)

(d) With the aid of labelled diagram explain how a hot wire instrument works.(5)

## SECTION D

8.(a)(i) Define the **ohm** and **state ohm's law**. (2)

(ii) Explain why potential difference between terminals of a battery is not always equal to its e.m.f. (2)

(b) Describe an experiment to determine the resistance of a resistor using a circuit that includes a rheostat. (5)

(c) In a simple metre bridge the resistors A and B have values 5Ω and 3Ω respectively. When A is shunted by a length of wire the balance point is found to be 0.527m from A.What is the resistance of the shunt? (3)

If the shunt wire is 0.75m long and 0.25mm, in diameter what is the resistivity of the material of the wire? (3)

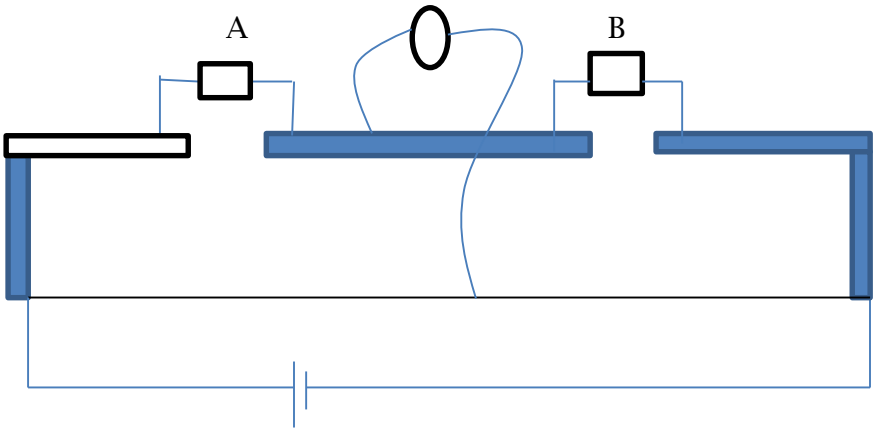



**Figure 3**

(d) Explain the effect on resistance of a conductor when it's cross sectional area is increased. (3)

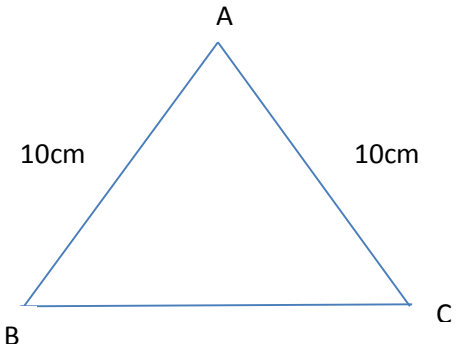
(e ) Why is a Wheatstone bridge unsuitable for comparing two resistances that are very small? (2)

9.(a) Define electric potential (1)

(ii) Derive an expression for the electric potential difference between two points A and B at distances $a$ and $b$ respectively from a single point positive charge $Q$. (4)

(b) Explain how you can show that the potential on a pear shaped charged conductor is the same at all points. (3)

( c) Three charges of magnitude $+2.0\times10^{-8}C$, $+3.0\times10^{-8}C$ and $-4.0\times10^{-8}C$ are placed at the vertices A,B and C respectively of a triangle as shown below.




Find

(i) the force exerted on the charge at B. (4)

(ii) Electric potential at a point D half way between B and C. (4)

(d) Describe an experiment to show that equal and opposite charges are produced when a body is electrified by rubbing. (4)

10.(a)(i)Define relative permittivity of a material. (1)

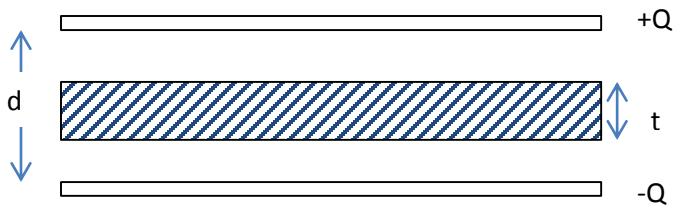
(ii) Describe an experiment to determine relative permittivity of a dielectric using the vibrating reed switch method. (5)

(b) In a vibrating reed experiment, two parallel plates have an area $0.12m^2$ and are separated 2mm by a dielectric. The battery of 150V charges and discharges the capacitor at a frequency of 50Hz and a current of $20\mu A$ is produced.

(i) Calculate the relative permittivity of the dielectric. (3)

(ii) What is the new capacitance if the dielectric is half withdrawn from the plates? (2)

(c) The figure below shows a charged capacitor with a dielectric of thickness $t$ between its plates.




Show that the effective capacitance is given by

$C = \dfrac{\varepsilon_0 \varepsilon_r A}{\varepsilon_r (d - t) + t}$ where $\varepsilon_r$ is the dielectric constant of the material. (5)

(d)(i) Describe and explain what happens when the terminals of a capacitor are connected to a battery of e.m.f V. (3)

(i) Hence draw a graph to show variation of p.d with time across the plates of the capacitor. (1)