P510/2
PHYSICS
Paper 2
2½ hrs

Uganda Advanced Certificate of Education
MID TERM I EXAMINATIONS 2020
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.

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, e	=	$1.6 \times 10^{-19} C$.
Electron mass	=	$9.11 \times 10^{-31} kg$.
Plank's constant, h	=	$6.6 \times 10^{-34} Js$.
Permeability of free space μ_o	=	$4.0\pi \times 10^{-7} Hm^{-1}$.
Permittivity of free space ε_o	=	$8.85 \times 10^{-12} Fm^{-1}$.
The constant $\frac{1}{4\pi\varepsilon_0}$	=	$9.0 \times 10^{9} F^{-1} m$.
One electron volt (eV)	=	$1.6 \times 10^{-19} J$.
Avogadro's number N_A	=	$6.02 \times 10^{23} mol^{-1}$.
Resistivity of Nichrome wire at 25°C	=	$1.2 \times 10^{6} \Omega m$.
Specific heat capacity of water	=	$4.2 \times 10^{3} Jkg^{-1}K^{-1}$

Turn Over

SECTION A

1. (a) State the laws of reflection of light. (02marks)

   (b) Derive the relation $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ for convex mirror, where U is the object distance, V is the image distance and F is the focal length of the mirror. (04marks)

   (c) With the aid of a well labeled diagram, describe how a sextant can be used to navigate the angle of elevation of a star. (06marks)

   (d) A convex lens of focal length 10cm is arranged coaxially with a concave lens of focal length 18cm. the lens system is used to focus an object placed 24cm from the convex lens on the side remote from the concave lens. The final image is formed on a screen placed 18.6cm from the concave lens.

   Calculate;

   (i) separation between the lenses. (05marks)

   (ii) magnification. (03marks)

2. (a) Define the following terms as applied to optical instruments.

   (i) Visual angle (01mark)

   (ii) Angular magnification. (01mark)

   (b) A small object is placed at a distance of 30.0cm from a converging lens of focal length 10.0cm. Calculate the distance from the first lens where a second converging lens of focal length 40.0cm must be placed in order to produce an erect image of the same size as the object. (05marks)

   (b) Draw a diagram to show the formation of an image by a compound microscope in normal adjustment and use it to derive an expression for the magnifying power. (06marks)

   (c) What is meant by the following?

   (i) Total internal reflection. (01mark)

   (ii) Critical angle. (01mark)

   (d) Briefly explain why an observer sees a spectrum of colours through rain drops when it is raining on a sunny day. (02marks)

   (e) State the advantages of reflecting telescopes over refracting ones. (03marks)

SECTION B

3. (a)(i) Distinguish between free oscillations and damped oscillations. (02marks)

   (ii) What is meant by resonance as applied to sound. (01mark)

   (b) Describe how you would determine the velocity of sound in air using a resonance tube and several turning forks of different frequencies. (05marks)

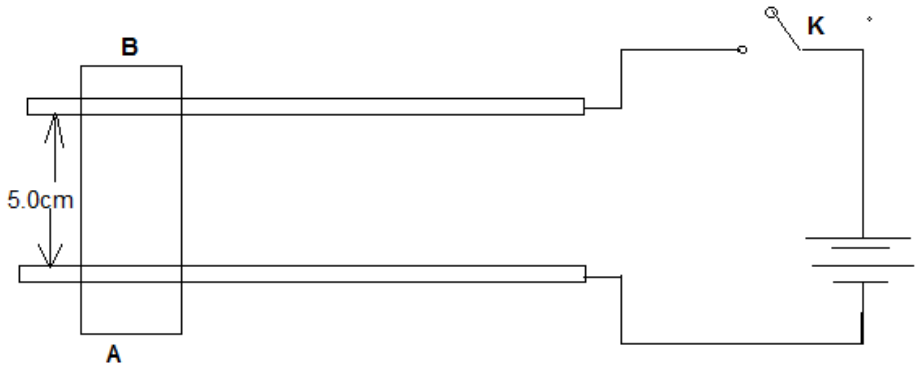
   (c) A uniform tube 80cm long is filled with water and a loudspeaker connected to a signal generator is held over the open end of the tube. With the signal generator set at 600HZ, the water level in the tube is lowered until resonance is first obtained when the length of the air column is 69.8cm long. Calculate the

(i) velocity of sound in air. (03marks)
(ii) fundamental frequency for the tube if it were open at both ends.
(02marks)
(d)(i) Explain Doppler effect. (02marks)
(ii) Acar travelling at $10ms^{-1}$ sounds its horn that sends sound waves frequently 500HZ and this heard in another car which is traveling behind the first one in the same direction with a velocity of $20ms^{-1}$. What frequency will be heard by
(i) the dinner of the second car? (04marks)
(ii) an observer standing some distance a head of the first car. (03marks)
(Velocity of sound in air = $330ms^{-1}$)

4. (a) State Huygens principle. (01mark)
(b) Monochromatic light propagating in air is incident obliquely onto a plane boundary with a dielectric of refractive index, n.
(i) Use Huygen's principle to show that the speed, V, of the light in the dielectric is given by
$v = \frac{c}{n}$ where C is speed of light. (06marks)
(ii) If the wave length of the light is 600nm in air, what will it be in a dielectric of refractive index 1.50? (03marks)
(c)(i) What is meant by interference of waves? (01mark)
(ii) State the conditions necessary for interference fringes to be observed.
(02marks)
(iii) Explain the term path difference with reference to interference of two wave motions. (03marks)
(d) Two glass slides in contact at one end are separated by a wire of diameter 0.04mm at the other end to form wedge. When the wedge is illuminated normally by light of wavelength $5.0x10^{-7}m$ interference fringes are observed. Find the number of fringes which can be observed.
(04marks)

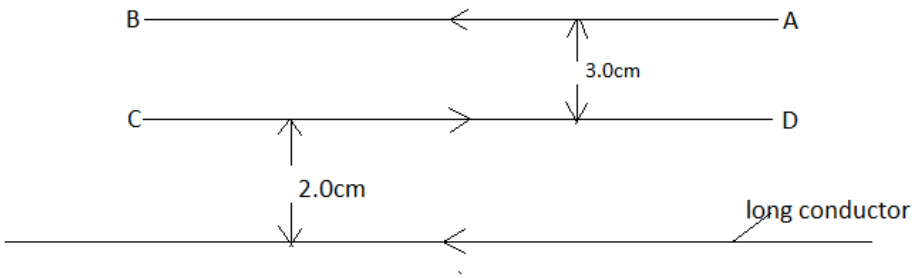
SECTION C

5. (a)(i) Write down the expression for the force on a change q coulombs moving with velocity, **u**, at an angle $\boldsymbol{\beta}$ to a uniform magnetic field of flux density **B**.
(ii) Use the expression in (a)(i) above to deduce the force on a conductor carrying a current in a magnetic field. (03marks)
(b) Figure below shows an aluminium bar **AB** resting on two horizontal aluminum rails connected to a battery through switch K. a magnetic field of flux density 0.10T, acts perpendicularly into the paper.



(i) Explain what happens to AB when switch K is closed? (03marks)
(ii) Calculate the angle to the horizontal to which the rails must be fitted to keep AB stationary if its mass is 5.0g, current in it is 4.0A and the direction of the field remains unchanged. (04marks)
(c)(i) With the aid of a labeled diagram, describe the structure and mode of operation of a moving coil galvanometer. (06marks)
(ii) Discuss the factors which affect the current sensitivity of a moving coil galvanometer. (03marks)

6. (a) Differentiate between self-induction and mutual induction. (02marks)
(b) State and explain two factors that affect the efficiency of an a.c transformer. (03marks)
(c)(i) With the aid of a diagram, describe how a simple d.c generator works. (04marks)
(ii) Differentiate between a d.c motor and a d.c generator. (01mark)
(d) Define the term magnetic moment. (01mark)
(e) The figure below shows two wires **AB** and **CD** of length 5.0cm each carrying a current of 20.0A in the direction shown. A long conductor carrying current of 10.0A in the direction shown and is placed parallel to the wire **CD**, 2.0cm below it.



(i) Calculate the net force on the long wire. (06marks)
(ii) Sketch the magnetic field pattern between the long wire and the wire AB after removing the wire CD. Use the field pattern to define neutral point. (03marks)

7. (a) Define the following
(i) Peak value. (01mark)
(ii) root mean square (rms) value of an alternating voltage. (01mark)

(b) With the aid of a well labeled diagram, describe the structure and mode of operation of a hot wire ammeter. (06marks)

(c) A 6μF capacitor is connected across an a.c operating at a p.d of 240Vrms and frequency of 50HZ. Calculate

(i) Rms value of circuit current. (03marks)

(ii) Peak value of the supply Voltage. (03marks)

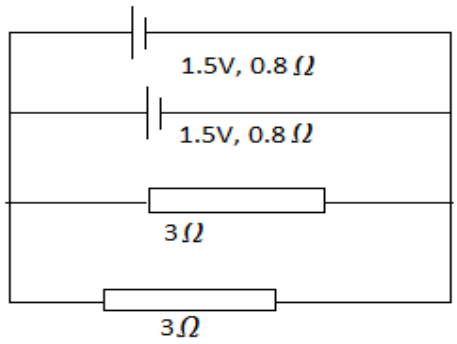
(iii) Maximum value of magnitude of charge stored by the capacitor.

SECTION D

8. (a)(i) Define e.m.f of a battery. (01mark)

(ii) Explain why a wire heats up when current passes through it. (03marks)

(b) Figure below shows a network of resistors connected to two identical cells of emf 1.5V and internal resistance 0.8Ω.



Calculate the current supplied by the cells. (04marks)

(c) Describe with the aid of a diagram how the resistivity of a wire can be determined using a potentiometer. (06marks)

(d) State and explain the two factors affecting the resistance of a conductor. (04marks)

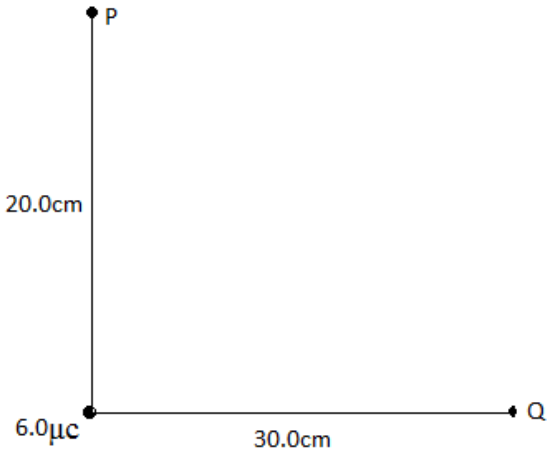
(e) Explain why the balance point of the metre bridge should be close to the middle of the bridge wire. (02marks)

9. (a) State coulumbs law of electrostatics. (01mark)

(b)(i) Describe how a conductor may be positively charged but remains at zero potential. (08marks)

(ii) Explain how the presence of a neutral conductor near a charged conducting sphere may reduce the potential of the sphere. (03marks)

(c) In the figure below, points P and Q are at distances 20.0cm and 30.0cm from a point charge of 6.0μc respectively.



Calculate;

(i) electric potential difference between **P** and **Q**.

(ii) energy required to bring a charge at +0.5μc from infinity to point **Q**.

(03marks)

(d) Describe with the aid of a diagram how a van de Graff generator can generate a high potential. (05marks)

10.(a)(i) Define a farad. (01mark)

(ii) Describe briefly the energy transformation that takes place when charging a capacitor using a dry cell. (02marks)

(b)(i) What is meant by relative permittivity? (01mark)

(ii) A parallel plate capacitor is charged to 100V and then isolated. When a sheet of a dielectric is inserted between the plates the p.d decreased to 30V. Calculate the dielectric constant of the dielectric.

(03marks)

(c) A 60μf capacitor is changed from 120V supply. It is then connected across the terminals of a 20μf. Capacitor. Calculate the difference in the initial and final energies stored in the capacitors hence comment on the difference.

(07marks)

(d)(i) Describe an experiment with the aid of a diagram to show that excess charge resides only on the outside of a hollow conductor.

(05marks)

(ii) State two uses of a dielectric in any capacitor. (01mark)

END