P510/2
PHYSICS
Paper 2
2½ Hrs

UACE INTERNAL MOCK

PHYSICS EXAMINATION

AUGUST 2018
PHYSICS Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

Answer **FIVE** questions, including **ONE** from each of sections **A** & **B** and at least **ONE** but not more than **TWO** from each of the sections **C** and **D**.

Assume where necessary:

Acceleration due to gravity, g	=	$9.81\ ms^{-2}$
Speed of light in vacuum, c	=	$3.0 \times 10^{8}\ ms^{-1}$
Electron charge, e	=	$1.6 \times 10^{-19}\ C$
Electron mass, m_e	=	$9.11 \times 10^{-31}\ kg$
Permeability of free space, μ_0	=	$4\pi \times 10^{-7}\ Hm^{-1}$
Permittivity of free space, ε_0	=	$8.85 \times 10^{-12}\ Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	=	$9.0 \times 10^{9}\ F^{-1}$
One electron-volt (eV)	=	$1.6 \times 10^{-19}\ J$
Avogadro's number, N_A	=	$6.02 \times 10^{23}\ mol^{-1}$

SECTION A

1.(a) Define the following terms as applied to a convex lens.

(i) Principal axis (1)

(ii) Focal plane (1)

(b) A finite object is placed between the principal focus and optical Centre of a converging lens.

(i) Draw a ray diagram to indicate the image formed. (2)

(ii) Use the ray diagram to derive the lens formula. (5)

(c) Describe an experiment to determine the focal length of a concave lens using a plane mirror, a converging lens and an illuminated object. (5)

(d) A point object is placed 20cm in front of a diverging lens and on the other side of the lens is a concave mirror, coaxial with it and of focal length 20cm .If the final image coincides with the object, calculate the focal length of concave lens. (4)

(e) Explain why parabolic mirrors are used in car head lamps. (2)

2.(a) What is the eye ring of a telescope? (1)

(b) Give one advantage and one disadvantage of each the following telescopes in their use as optical instruments.

(i) Terrestrial telescope. (2)

(ii) Galilean telescope. (2)

(c)(i) Draw a ray diagram and use it to derive an expression for angular magnification of a compound microscope in normal use. (5)

(ii) How can high magnification be achieved? (1)

(d) Describe an experiment to determine the focal length of a convex mirror using a convex lens. (4)

(e) A slide projector is required to produce a real image 684mm wide from an object 36mm wide. If the distance of the object from the screen is to be 2000mm, calculate:

(i) The distance of the lens from the object, (3)

(ii) The focal length of the lens required. (2)

SECTION B

3(a) Define

(i) An overtone. (1)

(ii) Ultra sound **(1)**

(b)(i) State one application of ultrasound (1)

(ii) Explain why the same note played on different instruments sounds different. (3)

(c) A wire of length 400mm and mass $1.2\times10^{-3}kg$ is under a tension of 120N.What is

(i) The fundamental frequency of vibration. (3)

(ii) The frequency of the third harmonic (2)

(d) Describe an experiment to determine the velocity of sound in air by the dust tube method. (5)

(e)(i) Explain reverberation as applied to sound waves. (2)

(ii) Explain how reverberation may be minimized in a large hall. (2)

4.(a) Distinguish between *sound waves* and *light waves*. (3)

(ii) State two conditions necessary for interference patterns to be formed. (2)

(b) A Plano convex lens is placed on top of a glass plate. When a travelling microscope is focused on the lens, alternate dark and bright rings are observed.

(i) Explain the formation of rings. (5)

(ii) The space between the glass plate and the lens is filled with a liquid whose refractive is higher than that of the lens but less than that of the glass plate. Explain what happens to the appearance of the rings. (3)

(d)In young's double slit experiment, the double slits are separated by 0.75mm and the screen is 80cm from the slits.

(i) Find the fringe width. (3)

(ii) One of the slits is covered with a glass material of thickness 3.6mm and refractive 1.5 .Calculate the displacement of the central band. (3)

SECTION C

5.

(a) Briefly explain with the aid of a simple diagram, the structure and mode of operation of a deflection magnetometer. (3)

(b) Describe how you can determine the horizontal component of the earth's magnetic flux density using a deflection magnetometer. (5)

(c) A coil of N 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 through the coil, the compass needle deflects through 40^o.When the current is reversed, the needle deflects through 43^o in the opposite direction. If the horizontal component of the earth's magnetic field is $8.85\times10^{-5}T$ determine;

(i) The number of turns N of the coil. (4)

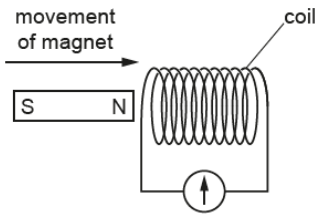
(ii) Calculate the magnetic flux density of the earth at that place given that the angle of dip in the place is 18^o. (2)

(d) A circular coil of 24 turns and 14cm diameter has its plane vertical, and its axis lies in an east to west direction. Calculate the magnitude and direction of the resultant magnetic flux density at the centre of the coil if the earth's horizontal flux density is $1.6\times10^{-5}T$, and the coil carries a current of 0.5A. (3)

(e) (i)State four ways in which current sensitivity of a moving coil galvanometer can be increased. (2)

(ii)Give one disadvantage of moving coil galvanometers. (1)

6.(a)(i)State the *laws of electromagnetic induction*. (2)



(ii) The figure above shows the north pole of a magnet moved towards a coil connected to a centre zero galvanometer. State and explain the observation. (3)

(b) What are eddy currents? (1)

(ii) State and explain one useful application of eddy currents. (3)

(b) A rectangular coil of wire having 100 turns, with dimensions $30cm \times 30cm$ is rotated at a constant speed of 600revolutions per minute in a magnetic field of 0.1T, the axis of rotation being in the plane of the coil and perpendicular to the field. Calculate the induced e.m.f. (4)

(c) Describe with the aid of a diagram the mode of operation of a dc motor. (5)

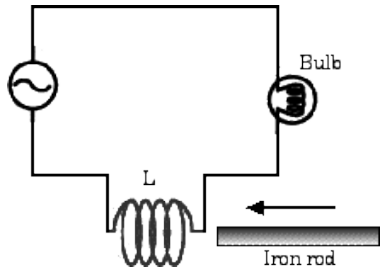
(d) State *two applications* of direct current that cannot be performed by alternating current. (2)

7.(a) Define the terms *reactance* and *impedance* as applied to ac circuits.(2)

(b)(i) Derive an expression for amplitude of the current that flows round a circuit in which a capacitor is connected to an alternating voltage supply. (4)

(ii) using the expression above explain how amplitude of current varies with frequency. (2)

(c) An air cored coil, a bulb and an a.c source are connected as shown below. When a solid iron core is introduced into the coil, the bulb becomes dimmer and the core hot. Explain the observations. (6)



(d)(i) Calculate the resonant frequency for a series LCR circuit in which $L = 0.01H$, $C = 1.0\mu F$ and $R = 20\Omega$. (2)

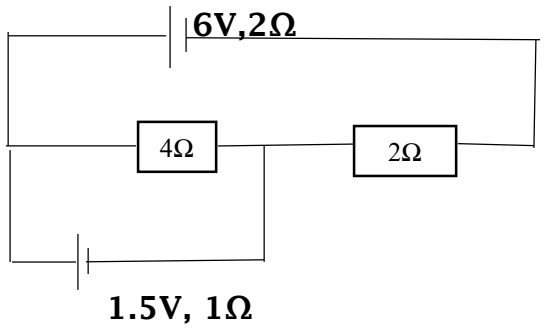
(ii) If the root mean square voltage supply is 12V, what current flows at resonance? (2)

SECTION D

8.(a) Define *electrical power* and *electromotive force of a cell.* (2)

(b) (i) State Kirchhoff's laws**.** **(2)**

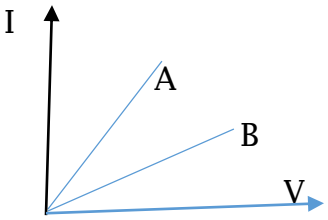
(ii)



The figure above shows a network of resistors and cells in a circuit. Calculate the current produced by each of the cells. What is the power dissipated as heat in the 4Ω resistor. (6)

(b)Describe an experiment to determine the temperature coefficient of resistance of a conductor in form of a wire. (6)

(c)(i)The graph below shows the I-V characteristic of two conductors made of the same material and having the same thickness. Explain which of the two is longer, A or B. (3)



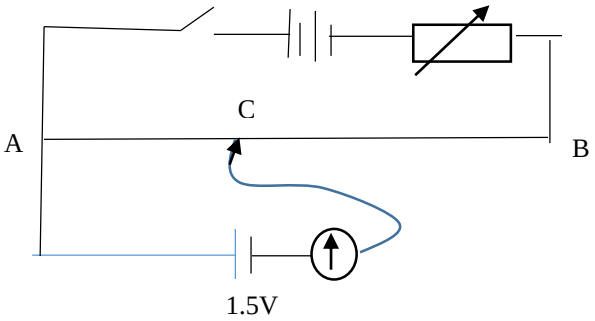
(ii)Draw an I-V characteristic for a *diode valve*. (1)

9.(a) Define *internal resistance* of a cell. (1)

(ii) Describe an experiment to determine the internal resistance of a cell using a slide wire potentiometer. (6)

(b) State any two factors which affect accuracy of a potentiometer wire.(2)

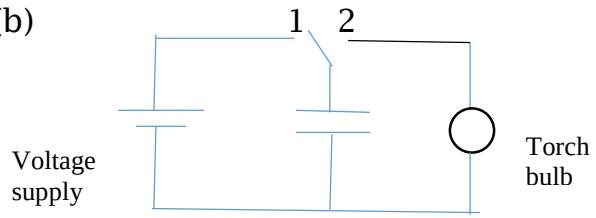
(c) A simple potentiometer circuit is set up as in figure below using a uniform wire AB, 1.0m long which has a resistance of 2.0Ω.The driver cell has e.m.f 4V and negligible internal resistance. If the variable resistor R is given a value of 2.4Ω .What is length AC? (4)



(d) Explain why electrical power is transmitted at high voltages and how it is transmitted from a power station to your home. (4)

10.(a)Define a *dielectric*. (1)

(b)

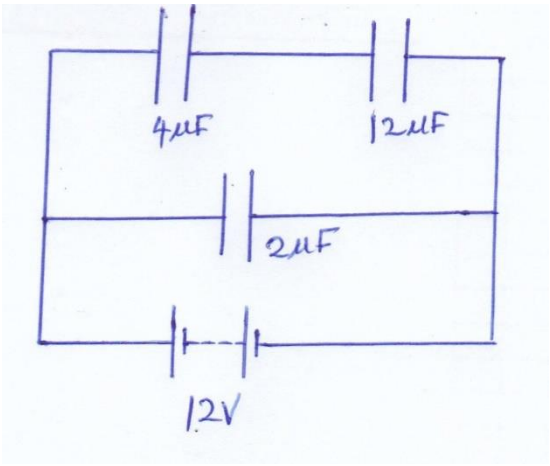


The circuit above shows a two way switch connected to a capacitor, a torch bulb, and voltage supply. The switch is first thrown to position 1 and then to position 2.Explain what is observed. (3)

(c) Describe an experiment to determine relative permittivity of a dielectric. (4)

(d) Explain the effect of doubling the separation of the plates of a parallel plate capacitor on the energy stored by the capacitor
(i) When the capacitor is isolated.
(ii)when the capacitor is connected to a battery.
In each case account for the energy changes which occur. (5)

(e) Three capacitors are connected to a 12V battery as shown below;



(i) Calculate the energy stored in the $2\mu F$ capacitor when fully charged. (4)

(ii) A dielectric material of dielectric constant 5 is inserted between the plates of the $2\mu F$ capacitor. What is the new total charge stored by all the capacitors? (3)

END