Name:……Index No:……/……

P510/2

PHYSICS

PAPER 2

July/August 2017

2½ hours

MWALIMU EXAMINATIONS BUREAU

UACE RESOURCE MOCK EXAMINATIONS 2017

S.6 PHYSICS

Paper 2

2 hours 30 minutes

INSTRUCTION TO CANDIDATES

*Answer any **five** questions, including at least **one** from each section, but **not** more than **one** from either section A or B.*

Where necessary assume the following constants:

Acceleration due to gravity,	g	=	$9.81 m s^{-2}$
Speed of light in vacuum,	c	=	$3.0 \times 10^{8} m s^{-1}$
Speed of sound in air,	v	=	$340 m s^{-1}$
Electronic charge,	e	=	$1.6 \times 10^{-19} C$
Electronic mass,	m_e	=	$9.1 \times 10^{-31} kg$
Permeability of free space,	μ_0	=	$4.0 \pi \times 10^{-7} Hm^{-1}$
Permittivity of free space,	ε_0	=	8.85×10^{-12} Constant
The Constant	$\frac{1}{4\pi\varepsilon_0}$	=	$9.0 \times 10^{9} F^{-1}m$

SECTION A

1. (a) (i) Define **principal focus** and **radii of curvature** of a convex lens. (2)

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

(b) A converging lens of focal length 18cm and a concave mirror of radius of curvature 48cm are arranged co-axially 8cm apart. If an object is placed 28cm in front of the lens on the side remote from the mirror

(i) Find the position of the final image. (6)

(ii) Using a point object, draw a ray diagram showing the image formation. (2)

(c) (i) Explain what is meant by **chromatic aberration**? (2)

(ii) Explain why chromatic aberration is not observed in a simple microscope. (3)

2. (a) (i) Define **refractive index** of a material. (1)

(ii) Describe how you can determine the refractive index of a glass block using a method of real and apparent depth. (5)

(b) (i) Derive an expression for the refractive index of a material of a prism in terms of the refracting angle, A, and the angle of minimum deviation, D. (5)

(ii) A double coloured light is made incident on a glass prism of angle 40^0. The refractive indices of the glass for the colours of light are 1.5215 and 1.5342 respectively. Calculate the angular separation of the emergent light when the angle of incidence is 15^0. (5)

(c) (i) With reference to a compound microscope, what is meant by **exit pupil**? (1)

(ii) State **three** differences between a compound microscope and an astronomical telescope. (3)

SECTION B

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

(ii) Explain how a stationary wave is formed. (3)

(iii) Describe an experiment in which the speed of sound in air can be obtained using Kundit's dust tube. (5)

(b) (i) What are **beats**? (1)

(ii) Derive an expression for beat frequency. (4)

(c) Explain the effect of end correction on the pitch produced by a closed pipe. (2)

(d) A steel wire of length 40.0 cm and diameter 0.025cm vibrates transversely in unison with a tube; open at both ends and of effective length 60.0cm, when each is sounding its fundamental note. The air temperature is 27^0C. Find the tension in the wire. (Assume the velocity of sound in air at 0^0C to be $331ms^{-1}$ and the density of steel is $7800kgm^{-3}$. (4)

4. (a) (i) What is **division of wave front** as applied to interference of waves? (2)

(ii) Two slits A and B are separated by a distance, a, and illuminated by light of wave length, λ. Derive the expression for the separation between the successive fringes on a screen placed a distance, D, from the slits. (5)

(iii) In Young's double slit experiment, the distance between the fourth and the eighth bright fringes is 0.32mm when the wavelength of the light used is $6.2x10^{-7}m$. Calculate the separation of the two slits if the distance from the slits to the screen is 80cm. (4)

(b) (i) What is **plane polarised light**? (1)

(ii) Describe how plane polarised light can be produced by double refraction. (4)

(c) (i) What is a **diffraction grating**? (1)

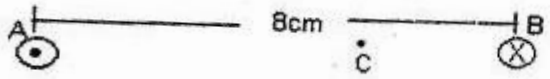
(ii) Sodium light of wavelength $5.893x10^{-7}m$ and $5.897x10^{-7}m$ falls normally on a diffraction grating which has 500 lines per mm. Find the angular separation of the two sodium lines in the first order beam. (3)

SECTION C

5. (a) (i) Write the expression for the force acting on a charge of, q, moving with velocity, v, in a direction making angle α with a uniform magnetic field of flux density, B. (1)

(ii) Hence define **one tesla**. (1)

(b)



In figure above A and B are current carrying wires placed 8cm apart in air. Current through A is 7A and that through B is 4A.

(i) Find the magnetic flux density at C, 3cm from B. (3)

(ii) Sketch the magnetic field pattern between A and B. (2)

(c) (i) Describe how you can determine the horizontal component of the Earth's magnetic field intensity, using the earth inductor, a compass needle and a resistance box. (5)

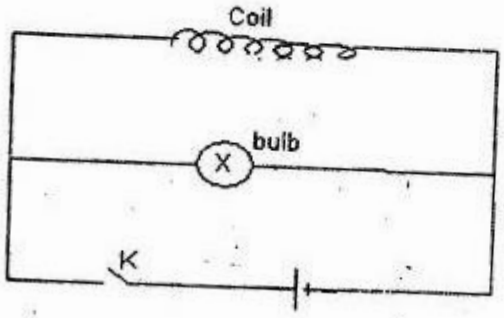
(ii) A vertical wire of length 15cm carries current of 5A in a place where the earth's total intensity is $56.4Am^{-1}$. If the angle of dip at the location is 47.8^0, find the force experienced by the wire. (4)

(d) Describe the design features in a moving coil galvanometer that ensure linear scale and high sensitivity. (4)

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

(ii) With the aid of a diagram, describe an experiment to demonstrate Lenz's law. (5)

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



In the circuit above, when switch K is closed, the bulb flashes briefly then it goes off. Explain the observation. (4)

(c) A solenoid of 1000 turns and length 5cm carries a current of 2A. Inside the solenoid is placed a circular metal disc of radius 4.0cm such that its plane is perpendicular to the axis of the solenoid. The disc is rotated at a frequency of 150 Hz. Calculate the e.m.f developed between the centre and rim of the disc. (4)

(d) Describe how an a.c transformer works. (5)

7. (a) A sinusoidal alternating voltage $V = 70 \text{ Sin } 130\pi t$, volts is applied across a resistor of resistance 120Ω. Determine the

(i) Frequency of the current which flows. (2)

(ii) Heat dissipated in the resistor in 3 minutes. (3)

(b) A coil of self inductance L and negligible resistance is connected across a source of alternating voltage $V = V_0 \text{ Cos } \omega t$.

(i) Find the expression for the current which flows in the coil. (3)

(ii) Sketch using the same axes, the time variation of the applied voltage and the current which flows in the coil. (2)

(c) (i) With the aid of a diagram, describe how the attraction type of ammeter works. (5)

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

(d) Explain why a resistor connected in series with a coil across an a.c voltage source heats up while the coil remains cold. (4)

SECTION D

8. (a) (i) Define **electromotive force** and **internal resistance** of a battery. (2)

(ii) Outline the principles of a slide wire potentiometer. (3)

(iii) Describe an experiment in which the emf of a thermocouple can be determined using a potentiometer. (5)

(b) Explain why a metal wire becomes hot when an electric current flows through it. (3)

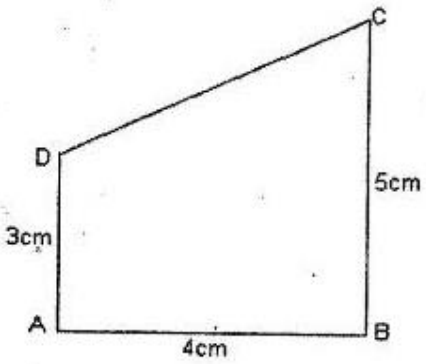
(c) When a coil Y is connected across the left hand gap of a meter bridge is heated to a temperature of 25^0C, The balance point is found to be 49.4cm from the left hand end of the slide wire. When the temperature is raised to 80^0C the balance point is 52.8cm from the left hand end. Find the temperature coefficient of resistance of Y. (6)

(d) List **two** limitations of a meter bridge. (1)

9. (a) (i) State **coulomb's law of electrostatics**. (1)

(ii) Derive the expression for the electric potential energy of two point charges of Q_1 and Q_2 placed a distance, x, apart. (4)

(b)



Two charges of + 4.6 × 10^{-9}C and -3.9 × 10^{-9}C are placed at the vertices A and B of a trapezium as in the diagram above. Find the:

(i) Electric field intensity at D. (4)

(ii) Work done to transfer charge of +1.5x10^{-9}C from C to D. (4)

(c) (i) Describe an experiment an experiment to show that the surface of a charged pear shaped conductor is an equipotential. (4)

(ii) Explain how an insulator gets charged by rubbing. (3)

10 (a) (i) Define **dielectric constant** and **dielectric field strength**. (2)

(ii) State two uses of a dielectric in a capacitor. (1)

(iii) With the aid of a diagram describe an experiment to determine capacitance of a capacitor. (4)

(b) Derive the expression for the energy stored in a capacitor of capacitance, C, carrying charge of Q. (4)

(c) A capacitor is charged by a 50V d.c source. When fully charged, it is found to carry charge of 12.0 μC. The capacitor is the connected across an uncharged capacitor of capacitance 9.0μF. Calculate the

(i) Capacitance of the first capacitor. (2)

(ii) energy stored in the capacitor net work after they were joined. (3)

(d) When a capacitor is connected across a voltage source, it charges fully with charge of Q.

(i) Show that when a dielectric of relative permittivity, ε_r, is inserted in it, the charge increases by $(\varepsilon_r - 1)Q$. (2)

(ii) Explain why the charge increases. (2)

END