P510/1
Physics
Paper 2
July 2014
2 ½ hours

MWALIMU EXAMINATIONS BUREAU

UACE GOLD MOCK EXAMINATIONS 2014

S.6 PHYSICS PAPER 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES
*Answer **five** questions, including at least **one** from each section, but **not more** than **one** from any of the sections A and B.*
Where necessary assume the following constants:

Acceleration due to gravity,	g	=	$9.81ms^{-2}$
Speed of light in vacuum,	c	=	$3.0 \times 10^{8}ms^{-1}$
Speed of sound in air	v	=	$340ms^{-1}$
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) What is meant by *critical angle* and *deviation* as applied to light ? (2 Mks)

(b)(i) Describe how you would measure the angle of minimum deviation, D, of a ray of light passing through a glass prism, using optical pins. (6 Mks)

(ii) When light is incident on a prism of refractive index 1.52 at an angle of 43.0^0, it emerges at an angle 70.4^0. Find the angle of incidence for which minimum deviation occurs. (5 Mks)

(iii) Explain why white light is dispersed by transparent material. (2 Mks)

(c) Derive the expression for the apparent displacement of an object placed a distance, h, below the surface of a transparent liquid of refractive index, n. (5 Mks)

2. (a)(i) With the aid of diagrams, explain the terms *chromatic* and *spherical aberrations*, in lenses. (4 Mks)

(ii) Explain why the image seen in a magnifying glass is almost free from chromatic aberration when the eye is close to the lens. (4 Mks)

(b) Describe how you can determine the focal length of a concave lens using a concave mirror. (5 Mks)

(c) A thin convex lens of focal length 10cm and a thin concave lens of focal length 15cm are placed coaxially, 40cm apart. An object, P, is placed 12cm from the convex lens on the side remote from the concave lens.

(i) Find the position of the final image. (5 Mks)

(ii) Assuming, P, above is a point object, sketch a ray diagram to show the image formation. (2 Mks)

SECTION B

3. (a) (i) What is meant by *Frequency* and *amplitude* in relation to vibrating air column in a pipe? (2 Mks)

(ii) With the aid of illustrating diagrams explain what is meant by *fundamental note* and *overtones* as applied to vibrating air columns in a stopped pipe. (4 Mks)

(b) Describe how you would establish that when air in a stopped tube is disturbed, it vibrates in more than one mode. (4 Mks)

(c)(i) What is Doppler Effect? (1 Mk)

(ii) A stationary observer hears beats at the rate of $3.7s^{-1}$ as a source of sound moves towards him, and away from a vertical wall. If the velocity of the source is $9ms^{-1}$, calculate the frequency of the note emitted. (5 Mks)

(d) Describe **one** application of Doppler Effect. (4 Mks)

4. (a) (i)State the superposition principle as applied to wave motion. (1 Mks)

(ii) What are the conditions necessary for production of observable interference patterns due to light waves? (2 Mks)

(b) (i) Explain how coherent sources are produced by methods of *division of wave front* and *division of amplitude*. (6 Mks)

(ii) Explain why an oil film on a water surface appears coloured. (3 Mks)

(c) An air wedge is formed by placing two thin glass slides of length, *S*, in contact on one side, and separating the other with a sheet of paper of thickness, *t*. Find the expression for the fringe spacing when the wedge is illuminated with light of wavelength, λ. (4 Mks)

(d) Monochromatic light of wavelength 578nm is incident normally on a plane diffraction grating which has 600 lines per mm. Calculate the

(i) number of diffraction images observed. (2 Mks)

(ii) angular position of the second order diffraction maximum. (2 Mks)

SECTION C

5. (a)(i) Write the expression for the magnetic force acting on a conductor of length, L, carrying current of, I, in a direction making angle β with a magnetic field of flux density , B. Hence deduce the expression for the force acting on each conduction electron. (3 Mks)

(ii) Draw a sketch diagram of the magnetic field pattern around a wire carrying current in a direction perpendicular to a uniform magnetic field. (2 Mks)

(b) (i) Define magnetic field strength. (1 Mk)

(ii) Describe how you can determine the strength of the earth's effective magnetic field component in the horizontal, using a deflection magnetometer. (5 Mks)

(c) A circular coil of 10 turns and diameter 16.0cm carries current of, I. the coil is pl aced with its plane in the magnetic meridian. A small magnetic needle placed at the centre of the coil makes 30 oscillations per minute about a vertical axis. When the current is cut off, it makes 15 oscillations per minute. If the horizontal component of the earth's magnetic flux density is 1.5×10^{-5}T, calculate the magnitude of, I.
(Assume that the square of the frequency of oscillation is proportional to the magnetic flux density.) (6 Mks)

(d) Explain the major difference between a moving coil and a ballistic galvanometer. (3 Mks)

6.(a) Describe an experiment to demonstrate mutual induction. (3 Mks)

(b)

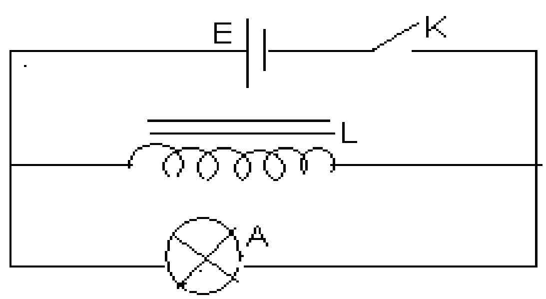

Figure 1

Figure 1 shows a 5W, 3V bulb A in parallel with an iron cored inductor, L, connected across a battery of e.m.f, 3V.

(i) Explain what you would observe when switch K is closed, then opened. (4 Mks)

(ii) What would you observe if E was replaced with an a.c voltage source then K is closed? (1 Mks)

(c) (i) Explain why a metal swinging with its plane perpendicular to a uniform magnetic field heats up after some time. (3 Mks)

(ii) Describe one application of the phenomenon in c(i) above. (4 Mks)

(d) Derive the expression for the e.m.f induced between the rim and the axle of a metal disc of radius, *a* rotating at an angular speed, ω, in a uniform magnetic field of flux density, *B*. Hence find the e.m.f induced when $B = 1.8 \times 10^{-4}$T, $a = 30$cm, and the disc makes 150 revolutions per minute. (5 Mks)

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

(ii) Explain why a capacitor apparently conducts a.c while it does not conduct d.c. (3 Mks)

(b)(i) A source of sinusoidal voltage $V = V_0 \sin\omega t$ is connected across a pure capacitor of capacitance C. Derive the expression for the capacitive reactance. (3 Mks)

(ii) Draw a sketch graph to show the variation of capacitive reactance with time. (1 Mk)

(b) (i) Describe how a thermocouple ammeter works. (4 Mks)

(ii) Explain why the device in b(i) above is preferred to a moving iron ammeter for measuring high frequency a.c. (3 Mks)

(c) A transformer which has 500 turns in the primary and turns in the secondary is connected to a 240V supply. If the transformer is 90% efficient, find the current in the primary, when a device of 4Ω is connected in the secondary. (5 Mks)

SECTION D

8. (a) (i) Define *electrical resistivity* of a material. (1 Mks)

(ii) Explain one factor on which the resistance of a conductor. (2 Mks)

(b) Describe how you can determine the temperature coefficient of resistance of a material in form of a wire using a metre bridge. (6 Mks)

(c) When a coil P is connected across the left hand gap of a metre bridge is heated to a temperature of 20^0C, the balance point is found to be 50.5cm from the left hand end of the slide wire. When the temperature is raised to 80^0C, the balance point is 53.4cm from the left hand end. Find the temperature coefficient of resistance of P. (6 Mks)

(d) (i) Derive the expression for the power dissipated in a resistor of resistance R when connected across a battery of e.m.f, V. (3 Mks)

(ii) Explain why a conductor heats up when current is passed through it. (2 Mks)

9. (a) (i) Define electric potential at a point. (1 Mk)

(ii) Explain how a conductor can be charged negatively by induction. (3 Mks)

(iii) Explain how the presence of a neutral conductor near a positively charged sphere may reduce the potential of the sphere. (3 Mks)

(b)

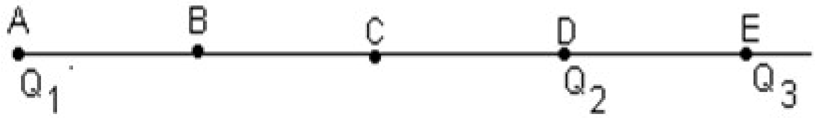

Figure 2

In Figure 2 above ABCD and E are points on a straight line at equal spacing of 15.0cm. Charges of +29.0μC, -14.0μC and +48.0μC respectively are placed at points

A, D and E respectively. Find the energy required to move a point charge of +35.0μC from point C to B. (7 Mks)

(c) (i) What is an equi-potential surface? (1 Mk)

(ii) Draw the electric field pattern between a negative point charge and a positively charged plane conductor, and on the same diagram show the equi potential surfaces. (3 Mks)

(d) Explain why it may not be safe to touch a lightning conductor when it is raining. (2 Mks)

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

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

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

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

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

(i) capacitance of the first capacitor, (2 Mks)

(ii) energy stored in the capacitor network after they were joined. (3 Mks)

(d)

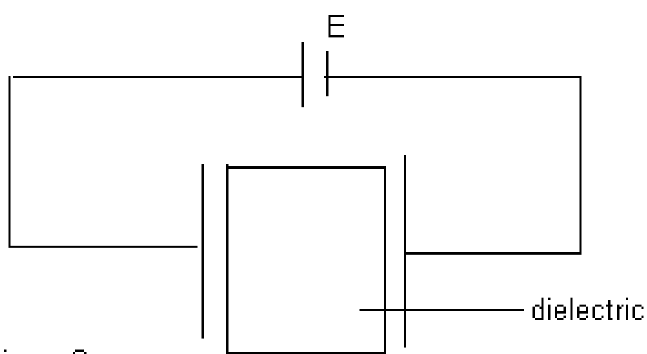

Figure 3

Figure 4 shows a capacitor with a dielectric between its plates , connected across a source of voltage supply. When the capacitor is fully charged, the dielectric is smartly withdrawn from the space between the plates. Explain the change in the amount of charge stored in the capacitor.

The End