UACE PHYSICS PAPER 2008 GUIDE

Instructions to the 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) will not be marked.

Mathematical tables and squared paper will be provided

Non programmable calculators may be used.

Assume where necessary

Acceleration due to gravity, g	$9.81ms^{-2}$
Electron charge, e	$1.6 \times 10^{-19}C$
Electron mass	$9.11 \times 10^{-31}kg$
Plank's constant, h	$6.6 \times 10^{-34}Js$
Speed of light in the vacuum, c	$3.0 \times 108ms^{-1}$
Specific heat capacity of water	$4.200Jkg^{-1}K^{-1}$
Avogadro's number, N_A	$6.02 \times 10^{23}mol^{-1}$
The constant, $\frac{1}{4\pi\varepsilon_0}$	$9.0 \times 10^{9}F^{-1}m$
Permittivity of free space, μ_0	$4.0\pi \times 10^{-7}Hm^{-1}$
Permittivity of free space, ε_0	$8.85 \times 10^{-12}Fm^{-1}$
One electron volt	$1.6 \times 10^{-19}J$
Resistivity of Nichrome wire at 25^0C	$1.2 \times 10^{-6}\Omega m$

SECTION A

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

(ii) Show that the image formed in a plane mirror is as far behind the mirror as the object is in front. (04marks)

Consider an object A placed in front of a mirror **M**.

(b) (i) Draw a ray diagram to show how a concave mirror forms a real image of a real object placed perpendicular to its principal axis. (01mark)

(ii) Describe an experiment, including a graphical analysis of the results to determine the focal length of a concave mirror using the No-parallax method. (06marks)

(c) A concave mirror M of focal length 20.0cmis placed 90cm in front of a convex mirror, N, of focal length 12.5cm. An object is placed on the common axis of M and N at a point 25.0 cm in front of M.

(i) Determine the distance from N of the image formed by reflection, first in M and then in N. (05marks)

(ii) find the magnification of the image formed in (c)(i) above (02marks)

2. (a) What is meant by reversibility of light as applied to formation of a real image by a convex lens? (02marks)

(b) (i) Draw a ray diagram to show the action of an astronomical telescope in normal adjustment. (03marks)

(ii) Derive the expression for magnifying power of the telescope in (b)(i) above in terms of the focal length, f_0 and f_e of the objective and eyepiece respectively.

(iii) The objective and eyepiece of an astronomical telescope have focal length of 75.0cm and 2.5cm respectively. Find the separation of the two lenses if the final image is 25cm from eyepiece. (04marks)

(c) (i) What is the significance of the eye-ring of an astronomical telescope? (02marks)

(ii) State two advantages of a reflecting telescope over refractive telescope. (02marks)

(d) Explain why chromatic aberration is not observed in a simple microscope. (04marks)

3. (a) State three differences between sound and light waves. (03marks)

(b) Distinguish between free and damped oscillation? (02marks)

(c) (i) What is meant by resonance? (02marks)

(ii) Describe with aid of diagram, an experiment to investigate the variation of frequency of stretched string with length. (06marks)

(d) (i) Calculate the frequency of beats heard by stationary observer when a source of sound of frequency 80Hz is receding with a speed of $5.0ms^{-1}$ towards a vertical wall. (speed of sound in air = $340ms^{-1}$) (05marks)

4. (a) State Huygens' Principle. (01 mark)

(b) Monochromatic light propagating in air is incident obliquely onto a plane boundary with a dielectric of refractive index, n.

(i) Use Huygens' principle to show that speed, V, of light in the dielectric is given by $V = \frac{c}{n}$ where c is the speed of light. (06marks)

(ii) If the wavelength of the light is 600nm in air, what will it be in a dielectric of refractive index 1.50? (04marks)

(c) (i) What is meant by interference of waves? (01mark)

(ii) State the conditions necessary for interference fringes to be observed, (02mark)

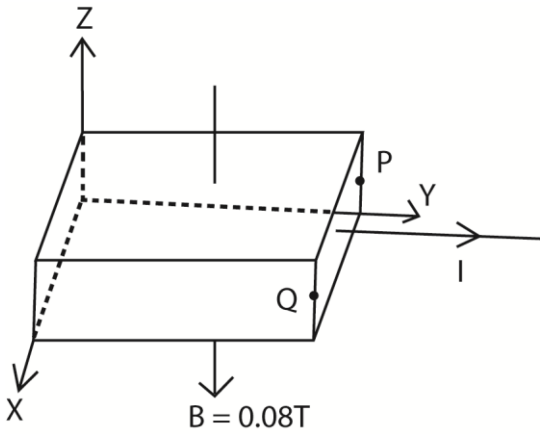
(iii) Explain the term path difference with reference to interference of two wave-motions.

(d) Two glass slide in contact at one end are separated by a wire of diameter 0.04mm at the other end to form a wedge. Fringes are observed when light of wavelength 5.0×10^{-7}m is incident normal to the slides. Find the number of fringes which can be observed. (03marks)

SECTION B

5. (a)(i) What is a magnetic field? (01marks)

(b)



A magnetic field of flux density 0.08T is applied to a metal strip currying current, I, as shown above

(i) Account for the occurrence of potential difference (p.d) between points P and Q.

(ii) Calculate the electric field intensity between P and Q if the drift velocity of the conduction electrons is 4.0×10^{-4}m/s (03marks)

(c)(i) Describe with the aid of a diagram the structure and mode of action of moving coil galvanometer. (03marks)

(ii) Explain how the design of the moving coil galvanometer can be modified to produce a ballistic galvanometer. (03marks)

(d) A flat circular coil X of 30 turns and mean diameter 30cm is fixed in a vertical plane and carries a current of 3A.

Another coil Y of 2cm x 2cm and having 2000 turns is suspended in a vertical plane at the center of the circular coil. Initially the planed of the two coils coincides. Determine the torque on the coil Y when a current of 2.0A is passed through it. (04marks)

6. (a)(i) Describe an experiment to demonstrate the damping effect of eddy current, (04marks)

(ii) Give two practical applications of this effect. (01mark)

(b) What is meant by:

(i) self induction? (01mark)

(ii) mutual induction? (01mark)

(c) Discuss the factors which determine the maximum e.m.f generated by a dynamo. (04mark)

(d) A transformer has 2000 turns in the primary coil. The primary coil is connected to a 240V mains. A 12 V, 36W lap is connected to the secondary coil. If the efficiency of the transformer is 90%, determine the

(i) number of turns in the secondary coil (02marks)

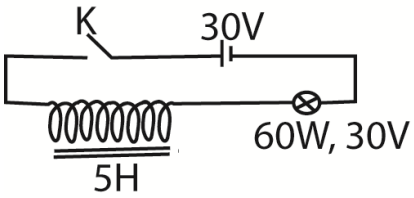
(ii) current flowing in the primary coil (03marks)

(e) Explain any two factors which lead to energy losses in the transformer.

7. (a) (i) Define root mean square value of alternating current. (01mark)

(ii) A resistor of 400Ω is connected to 240V a.c. supply. What is the peak value of current flowing through the resistor? (03marks)

(b)



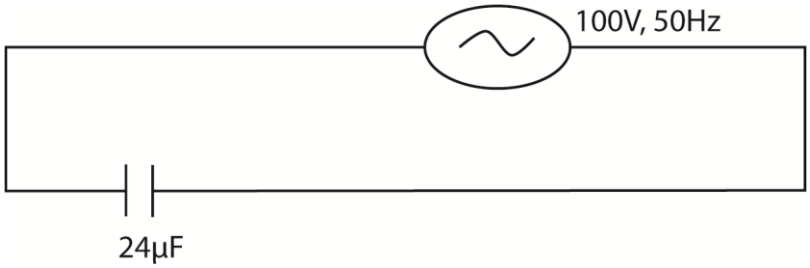
A 60W, 30V bulb, and a coil of inductance 5H are connected in series to a battery of 30V as shown above.

(i) What is observed when switch K is closed and when it is opened? (02marks)

(ii) Explain your observation in (b)(i) (04marks)

(c) With the aid of a labelled diagram, describe how a repulsive type of moving iron ammeter works. (05marks).

(d)



A 100V, 50Hz a.c. supply is connected across a capacitor of 24μF as shown in figure above,

(i) Calculate the reactance of the circuit (03marks)

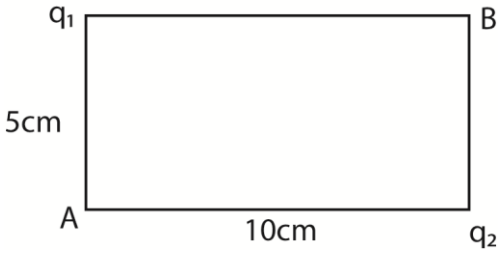
(ii) Sketch graphs to show the time-dependence of supplied voltage and the current in the circuit. (02marks)

SECTION C

8. (a)(i) State Coulomb's law of electrostatics (01mark)
(ii) Define the terms electric field intensity and electric potential at a point. (02marks)

(b) Sketch graphs of variation of electric potential and electric field intensity with distance from the center of a charged conducting sphere. (02marks)

(c) Charges q_1 and q_2 of -5.0μF and +2.0μF respectively are placed at two opposite corners of a rectangle of sides5cm and 10 cm as shown below.



Calculate the

(i) Electric potential at A (04marks)

(ii) Electric field intensity at A (05marks)

(d) (i) What is meant by corona discharge? (02marks)

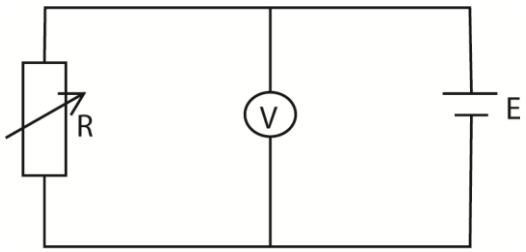
(ii) Explain how the lightning conductor works (04marks)

9. (a) Define current density and the ohm and state their units. (03marks)

(b) (i) sketch the current versus voltage characteristic for a gas discharge tube (01mark)

(ii) Explain the main features of the graph in (b)(i) above. (03marks)

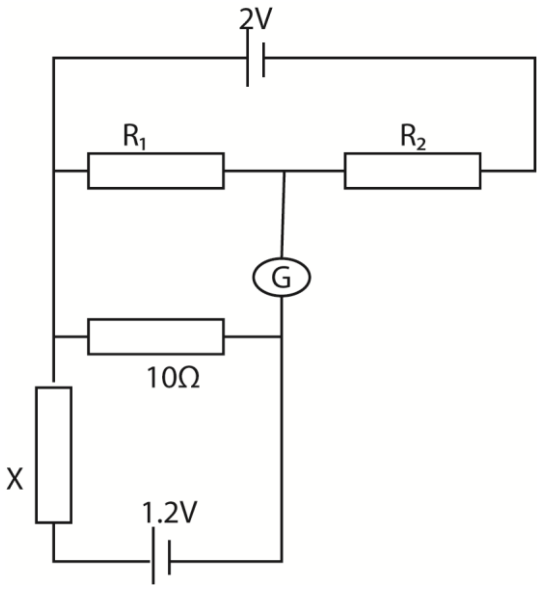
(c)



The figure above shows a cell of e.m.f, E and internal resistance, r, connected to a voltmeter, V, and variable resistor R.

Explain how the value of V varies with R. (04marks)

(d)



In the figure above, R1 and R2 are resistors of 10Ω and 90Ω respectively. If the cells have negligible internal resistances, find the value of X for which G shows no deflection. (04marks)

Current flowing in the driver circuit

Id = $\frac{2}{10+90} = \frac{2}{100} = 0.02A$

Current flowing in the test circuit, I1 = $\frac{1.2}{x+10}$

p.d across the 10Ω resistor = $\frac{1.2}{x+10}\ x\ 10 = 0.2$

x = 50Ω

(e) Describe how the internal resistance of a cell can be measured using a slide wire potentiometer. (05marks)

10. (a) (i) Define capacitance and state its units (02marks)

(ii) With the aid of a labelled diagram, describe an experiment to measure capacitance of a capacitor. (05marks)

(b) A capacitor is charged by a 30V d.c supply. When the capacitor is fully charged, it is found to carry charge of 5.0μC. Calculate the:

(i) capacitance of the capacitor. (02marks)

(ii) energy stored in the capacitor (03marks)

(c) Derive the expression for effective capacitance of three capacitors C_1, C_2 and C_3 respectively connected in series. (04marks)

(d) Describe briefly an experiment to show the effect of varying the distance of separation of the plates of a capacitor on capacitance. (04marks)

END

END