# KIBABII UNIVERSITY

**2017/2018 ACADEMIC YEAR**

**FIRST YEAR SECOND SEMESTER**

**MAIN EXAMINATIONS**

**FOR THE DEGREE OF BACHELOR OF SCIENCE IN B.ED AND BSC (PHYSICS)**

**COURSE CODE: SPH**111

**COURSE TITLE:** FUNDAMENTALS OF PHYSICS II

**DATE:** **9/8/2018** **TIME: 2-4PM**

**INSTRUCTIONS TO CANDIDATES**

Answer question ONE and any other two questions

This paper consists of 4 printed pages. Please Turn over

The following physical quantities may be useful.

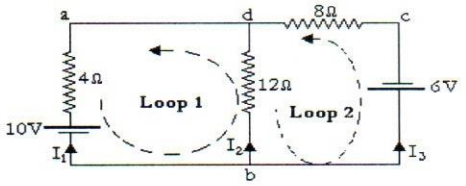
- *Mass of an electron* = $9.11 \times 10^{-31}$Kg
- $q_0 = e = 1.6 \times 10^{-19}$C
- $\varepsilon_0 = 8.85 \times 10^{-12} C^2/N.m^2$
- $\mu_0 = 4\pi \times 10^{-7} m/A$
- *Refractive index of air,* $\eta_{air} = 1.00$
- *Refractive index of water,* $\eta_{water} = 1.33$
- $R = 1.1 \times 10^{-7}\ m^{-1}$
- $1a.m.u = 931.5MeV$

**Question ONE (30 marks)**

a) A parallel plate capacitor with air between the plates has capacitance of $1.77\ x10^{-12}$F and area A = $0.0002m^2$ . Find the distance of separation between the plates. (3 marks)

b) Calculate the inductance of an air core solenoid containing 1000 turns. If the length of the solenoid is 0.2m and its cross-sectional area is $0.04m^2$ (3 marks)

c) Consider thecircuit below. Calculate the currents $I_1$, $I_2$ and $I_3$. (4 marks)




d) A series RLC AC circuit has R = 400 Ω, L = 1.00H, C = 3.00 $\mu F$, $\omega$ = 370 $s^{-1}$ and $\Delta V_{max}$ = 150V. Determine:

(i) The inductive reactance, the capacitive reactance and the impedance of the circuit.

(ii) The maximum current in the circuit.

(iii) The phase angle of the current and the voltage. (6 marks)

e) By considering a material whose magnetization is M exposed to a magnetic field H, show that $\mu_r = 1+\chi$ where symbols have their usual meanings. (4 marks)

**Question TWO (20 marks)**

a) (i) Define capacitance and state its SI units. (2 mark)

(ii) If the charge on a capacitor at any given time t is $Q = Q_0\left(1-e^{-\frac{t}{RC}}\right)$, where $R = 1k\Omega$ and $C = 10\mu F$, how long does it take for a capacitor to be charged to 80% of its maximum charge? (3 marks)

b)An electron in a TV picture tube moves towards the front of the tube with a speed of $8\times10^6\ m/s$ along the x-axis through a magnetic field of magnitude 0.025T, at an angle of $60^0$ . Calculate the magnetic force on the electron. (3 marks)

c) A rectangular coil of area 4.59 x$10^1 cm^2$ consists of 25 turns of wire and carries a current of 15mA. A 3.5 x $10^{-1}$T magnetic field is applied to the plane of the loop. Calculate: Magnitude of its magnetic dipole moment. (3 marks)

d) Differentiate between p-type and n-type semiconductors. (2 marks)

e) Give one use of a CRO. (1 mark)

f) State the laws of reflection of light. (2 marks)

g) (i) State Kirchhoff's current and voltage laws. (2 marks)

(ii) A 500cm long copper rod has a resistance of $1.8\Omega$. If the diameter of the copper rod is 0.5cm, what is the resistivity of the rod? (3 marks)

h) (i) Why is it that white light sources are not used in Young's double-slit experiment?

(1 mark)

(ii) A converging lens has two surfaces with radii of curvature $R_1 = 0.8$m and $R_2 = 0.4m$ to the left of the lens for which $\eta = 1.5$. Find the power of the lens. (3 marks)

i) When an R-L-C circuit is driven in resonance, what is the impedance? (1 marks)

j) (i) Define half-life. (1 mark)

(ii) How long does it take for 60% of a radioactive sample of half-life 3.8 days to decay?

(3 marks)

**Question THREE (20 marks)**

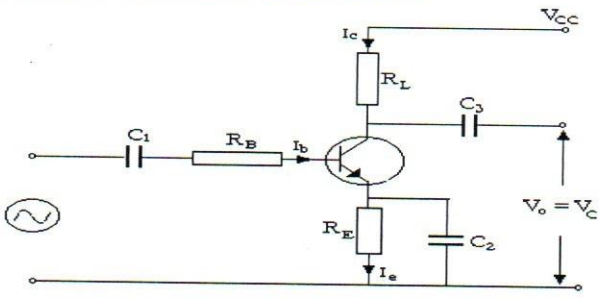
a) Explain with a well labelled diagram the working of a CRO. (6 marks)

b) Name any two donor impurities of germanium. (2 marks)

c) Explain why n-p-n transistors are widely used in high frequency applications as opposed to p-n-p transistors? (1 marks)

d) Sketch a circuit of a center tapped full-wave rectifier and explain how rectification is achieved. (6 marks)

d) Consider a transistor circuit below (5 marks)



where $R_B$=1MΩ, $V_{BB}$=30V, $V_{CC}$=30V, $R_E$=10KΩ, $R_C$=5KΩ and β=100. Calculate $I_e$, $I_c$, $I_b$, $V_C$, $V_E$ and $V_{CE}$.

**Question FOUR (20 marks)**

a) Distinguish between Fresnel diffraction and Fraunhoffer diffraction. (2 marks).

b) Light of wavelength 580 nm is incident on a slit of width 0.300 mm. The viewing screen is 2.00 m from the slit. Find the positions of the first dark fringes and the width of the central bright fringe. (4 marks)

c) Sketch the intensity of variation of the diffraction pattern as a function of distance across the screen. (3 marks)

d) A layer of ice, having parallel sides, floats on water. If the light is incident on the upper of the ice at an angle of $30.0^0$, what is the angle of refraction in the water? (3 marks)

e) A concave spherical mirror has a radius of curvature of 20.0 cm. Find the position the nature of image formed if an object is placed 40.0 cm in front of the mirror. (4 marks)

f) Monochromatic light from helium-neon laser ($\lambda = 632.8\ nm$) is incident normally on a diffraction grating containing 6000 lines per centimeter. Find the angles at which the first and second order maximum are observed. (4 marks)

**Question FIVE (20 marks)**

a) Define the following terms: (3 marks)

(i) Radioactivity.

(ii) Nuclear Fission.

(iii) Nuclear Fusion.

e) Consider the nuclear equation:

$$^{27}_{13}Al + ^{4}_{2}He \rightarrow ^{A}_{Z}X + ^{1}_{0}n + E$$

(i) Find the values of A and Z (2 marks)

(ii) Calculate the value of energy $E$ (3 marks)

(Mass numbers of *Al, He, X* and *n* are 26.98153 a.m.u, 4.002602 a.m.u, 29.97831 a.m.u and 1.0008665 a.m.u respectively).

f) An electron shifts from the N to L shell in ahydrogen atom resulting into emission of light. What is the wavelength of this light? (2 marks)

g) Electrons are accelerated from rest onto a target in an x ray tube by ap.d of 100KV. Find:

i)The velocity of the electrons on reacting the target.

ii) The energy converged to the target per second if the electron beam current is 15 mA.

iii) The energy of the X-rays produced if only 1% of incident energy is converted to X-rays. (5 marks)

h) (i) State three properties of x-rays. (3 marks)

(ii) State any two uses of x-rays (2 marks)