



(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS - 2017/2018 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER

SUPPLEMENTARY/SPECIAL EXAMINATIONS

FOR THE DEGREE OF B.ED (SCIENCE) BSC (PHYSICS), BSC
(CHEMISTRY) & BSC (RENEWABLE ENERGY).

COURSE CODE: SPH 111

COURSE TITLE: FUNDAMENTALS OF PHYSICS II.

EXAM DURATION: 2 HOURS

DATE: 19/10/2018

TIME: 8-10AM

INSTRUCTIONS TO CANDIDATES

- Answer question one and any other two questions two (2) questions. Question one is compulsory and carries 30 marks, the other questions carry 20 marks each.
- The following physical quantities may be useful.
 - Mass of a proton = $1.67 \times 10^{-27} \text{Kg}$
 - Mass of an electron = $9.11 \times 10^{-31} \text{Kg}$
 - $e = 1.6 \times 10^{-19} \text{C}$
 - $\epsilon_0 = 8.85 \times 10^{-12} \text{C}^2/\text{N.m}^2$
 - $\mu_0 = 4\pi \times 10^{-7} \text{m/A}$
 - Refractive index of air, $\eta_{\text{air}} = 1.00$
 - Refractive index of water, $\eta_{\text{water}} = 1.33$
 - $R = 1.1 \times 10^{-7} \text{m}^{-1}$
 - $1 \text{a.m.u} = 931.5 \text{MeV}$

KIBU observes ZERO tolerance to examination cheating.

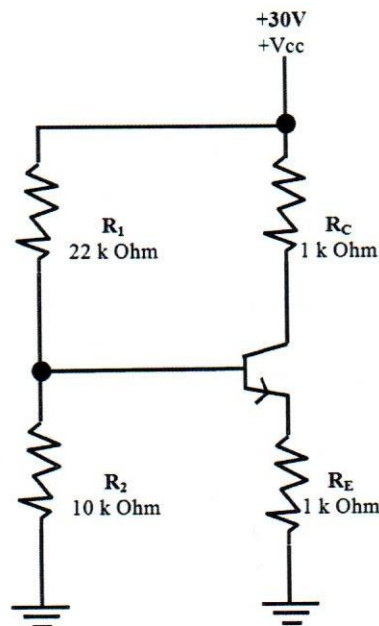
Question ONE (30 marks)

- a) (i) Define capacitance and state its SI units. (2 mark)
- (ii) Show that if a network has only two capacitors in series C_p and C_q then the total capacitance is $C_T = \frac{C_p C_q}{C_p + C_q}$. (3 marks)
- b) A proton in a circular orbit of radius $1.4 \times 10^{-1} \text{m}$ in a $3.5 \times 10^{-1} \text{T}$ magnetic field perpendicular to the velocity of the proton. Find the linear speed of the proton. (3 marks)
- c) A rectangular coil of area $4.59 \times 10^1 \text{ cm}^2$ consists of 25 turns of wire and carries a current of 15mA. A $3.5 \times 10^{-1} \text{T}$ magnetic field is applied to the plane of the loop. Calculate:
- (i) Magnitude of its magnetic dipole moment. (3 marks)
- (ii) The magnitude of the torque acting on the loop. (3 marks)
- d) Differentiate between intrinsic and extrinsic semiconductors (2 marks)
- e) Explain with a well labelled diagram the working of a CRO. (6 marks)
- f) 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)
- g) Two thin converging lenses L_1 and L_2 of focal length $f_1 = 10 \text{ cm}$ and $f_2 = 20 \text{ cm}$ respectively are separated by 20.0 cm. an object is placed 15.0 cm to the left of L_1 . Find the position of the final image magnification of the system. (4 marks)

Question TWO (20 marks)

- a) A parallel plate capacitor with air between the plates has an area $A = 0.0002 \text{m}^2$ and a plate separation of 1.00mm. find its capacitance (3 marks)

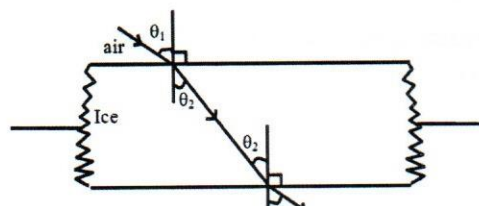
- b) Calculate the inductance of an air core solenoid containing 500 turns. If the length of the solenoid is 20cm and its cross-sectional area is $0.04m^2$ (3 marks)
- c) A certain current element has a current $I = 2.5 \sin \omega t$ and a potential difference $V = 45 \sin \omega t$ between the terminals. Find the average power and energy transferred in one period of a sine function. (3 marks)
- d) Determine $V_B, V_E, V_C, V_{CE}, I_B, I_E$ and I_C for the following circuit, given that $\beta = 100, \alpha = 1$ and $V_{BE} = 0.7V$ (4 marks)



- e) A series RLC Ac circuit has $R = 400 \Omega, L = 1.00H, C = 3.00 \mu F, \omega = 370 s^{-1}$ and $\Delta V_{max} = 150V$. Determine:
- The inductive reactance, the capacitive reactance and the impedance of the circuit.
 - The maximum current in the circuit.
 - The phase angle of the current and the voltage. (7 marks)

Question THREE (20 marks)

- a) Distinguish between Fresnel diffraction and Fraunhofer diffraction. (2 marks).
- b) Sketch the intensity of variation of the diffraction pattern as a function of distance across the screen. (3 marks)
- c) 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° , what is the angle of refraction in the water? (5 marks)



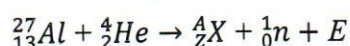
- d) A concave spherical mirror has a radius of curvature of 20.0 cm. Find the position the nature of image formed if an object is placed 40.0 cm in front of the mirror. (5 marks)
- e) Monochromatic light from helium-neon laser ($\lambda = 632.8 \text{ nm}$) is incident normally on a diffraction grating containing 6000 lines per centimetre. Find the angles at which the first and second order maximum are observed. (5 marks)

Question FOUR (20 marks)

- a) Define the following terms:

- (i) Radioactivity.
- (ii) Nuclear Fission.
- (iii) Nuclear Fusion.

- b) Consider the nuclear equation:



- (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).

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

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

- h) 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)

Question FIVE (20 marks)

- a) Two resistors A and B are connected in parallel across a 6.0V battery. The current through B is found to be 2.0A When the two resistors are connected in series to a 6.0V battery, a voltmeter connected across measures a voltage of 4.0V. Find the resistance of A and B. (4 marks)

- b) State two factors that affect capacitance of a parallel plate capacitor. (2 marks).

- c) An electron in a television picture tube moves towards the front of the tube with a speed of $8 \times 10^6 \text{ m/s}$ along x – axis surrounding the neck of the tube are coils of wires that create a magnetic field of magnitude 0.025T directed at an angle of 60° to the x-axis and lying in x-y plane. Calculate the magnetic force on the electron. (3 marks)

- d) A voltage of 12V is connected across a $2\mu\text{F}$ capacitor. Calculate the charge stressed stored on the capacitor. (3 marks)

- e) (i) State three properties of x-rays.
(ii) State three uses of x-rays

(3 marks)

(3 marks)