

BABCOCK UNIVERSITY
SCHOOL OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF BASIC SCIENCES
PHYSICS WITH ELECTRONICS UNIT
2021/2022 ACADEMIC SESSION (SECOND SEMESTER)
MID-SEMESTER EXAMINATIONS (FOR INFORMATION TECHNOLOGY DEPARTMENT)

NAME OF EXAMINER: Dr. S.O. Akintunde
COURSE CODE: PHYS 102
CREDIT UNIT: 3 Units

LEVEL: 100
COURSE TITLE: GENERAL PHYSICS II
TIME ALLOWED: 45 minutes

INSTRUCTION: Answer **ALL** questions.

USEFUL PHYSICAL CONSTANTS: $c = 3 \times 10^8 \text{ m/s}$, $g = 10 \text{ m/s}^2$, $\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$, $\mu_0 = 4\pi \times 10^{-7} \text{ T.m/A}$
 $e = 1.6 \times 10^{-19} \text{ C}$, $h = 6.626 \times 10^{-34} \text{ J.s}$, $k = 9.0 \times 10^9 \text{ N.m}^2/\text{C}^2$, a.m.u. = $1.66 \times 10^{-27} \text{ kg}$, $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$
 $k_B = 1.38 \times 10^{-23} \text{ J/K}$, $N_A = 6.02 \times 10^{23}/\text{mol}$, $R = 1.097 \times 10^7 \text{ m}^{-1}$, $G = 6.67 \times 10^{-11} \text{ N.m}^2/\text{kg}^2$,
 $m_e = 9.1 \times 10^{-31} \text{ kg}$, $m_p = 1.673 \times 10^{-27} \text{ kg}$, $m_n = 1.675 \times 10^{-27} \text{ kg}$, $\hbar = 1.054 \times 10^{-34} \text{ Js}$, $a_0 = 5.29 \times 10^{-11} \text{ m}$

QUESTION ONE

- 1a. State the principle of superposition of forces. (2 marks)
- b. Three point charges are arranged along the x -axis. Charge $q_1 = +3.00 \mu\text{C}$ is at the origin, and charge $q_2 = -5.00 \mu\text{C}$ is at $x = 0.200 \text{ m}$. Charge $q_3 = -8.00 \mu\text{C}$. Where is q_3 located if the net force on q_1 is 7.00 N in the negative x -direction. (5 marks)

QUESTION TWO

- 2a. State Gauss's law for electricity. (2 marks)
- b. A uniform spherical charge distribution of radius 10 cm has a total charge of 10^{-6} C . Determine: (i) the volume charge density of the distribution and (ii) the electric field at a distance 5 cm from the center of the sphere. (5 marks)

QUESTION THREE

- 3a. Define the time constant of a discharging capacitor. (2 marks)
- b. A capacitor with initial charge q_0 is discharged through a resistor. What multiple of the time constant τ gives the time the capacitor takes to lose: (i) the first one-third of its charge and (ii) two-third of its charge? (5 marks)

Total: 21 marks