BOWEN UNIVERSITY, IWO, OSUN STATE NIGERIA

COLLEGE OF AGRICULTURE ENEGINEERING AND SCIENCE

PHYSICS PROGRAMME

2022/2023 SECOND SEMESTER

PHY 214 CLASSICAL MECHANICS II (2 CREDITS)

DATE: 19th June, 2023 TIME: 2hrs

INSTRUCTION: ATTEMPT THREE QUESTIONS. QUESTION 1 IS COMPULSORY

Plank's constant	h	6.6×10^{-34} J.s
Stefan-Boltzman constant	σ	5.67×10^{-8} Watts.m^{-2}K^{-4}
Wien's displacement constant	b	2.898×10^{-3} m.k
Speed of light	c	3.00×10^{8} ms^{-1}
Electron rest mass	m_e	9.11×10^{-31} Kg
Neutron rest mass	m_n	1.649×10^{-27} Kg
Rydberg constant	R	1093700 m^{-1}
1eV	e	1.6×10^{-19} J
Gravitational Constant	G	6.67×10^{-11} m^{3}kg^{-1}s^{-2}
Latent heat of vaporization	L_v	2256 kJkg^{-1}
Latent heat of fusion of water	L_{fw}	338 kJkg^{-1}
STP		1.01×10^{5} Pa
Velocity of sound in air		330 ms^{-1}
Density of water	ρ	1×10^{3} kg/m^3
Permittivity of free space	ε	$8.8542 \times 10^{-12}\ C^2/N.m^2$

1. (a) Consider a charge '**q**' moving with velocity '**v**' in a uniform magnetic field '**B**'. If the charge moves perpendicular to the field, show that the frequency f of the rotation of the charge in the magnetic field is

$$f = \frac{qB}{2\pi m_e}$$

where all symbols have their usual meaning. **(15 marks)**

(b) An electron that has velocity $\vec{V} = (2.5 \times 10^6\ m/s)i + (3.5 \times 10^6\ m/s)j$ moves through a magnetic field $\vec{B} = (0.030T)i - (0.15T)j$.

Find the magnitude of the force on the electron. **(5 marks)**

2. (a) State the Coulomb's law of Electrostatic Force **(5 marks)**

(b) Three charges lie along the x-axis, the positive charge $q_1 = 15\mu C$ is at $x = 2.0\ m$, and the positive charge $q_2 = 6.0\mu C$ is at the origin. Where must a negative charge q_3 be placed on the $x - axis$ so that the resultant electric force on it is zero.? **(15 marks)**

3. (a) List four (4) properties of electromagnetic waves **(4 marks)**

(b) Aluminized Mylar film is a highly reflective, lightweight material that could be used to make sails for spacecraft driven by the light of the Sun. Suppose a sail with area $1.00\ km^2$ is orbiting the sun at a distance of $1.5 \times 10^{11} m$. The sail has mass of $5.00 \times 10^3 kg$ and is tethered to a payload of mass $2.00 \times 10^4 kg$.

(i) If the intensity of sunlight is $1.34 \times 10^3 W$ and the sail is oriented perpendicular to the incident light, what radial force is exerted on the sail? **(5 marks)**

(ii) About how long would it take to change the radial speed of the sail by $1.00\ km/s$? **(5 marks)**

(iii) Calculate the peak electric and magnetic fields of the laser light. **(6 marks)**

4. (a) With the aid of a well labeled diagram, explain a geometric construction that describe Young's double slit experiment. **(10 marks)**

(b) A screen is separated from a double-slit source by 1.20 m. The distance between the two slits is 0.030 0 mm. The second-order bright fringe ($m = 2$) is measured to be 4.50 cm from the centerline. Determine;

(i) the wavelength of the light and, **(5 marks)**

(ii) the distance between adjacent bright fringes. **(5 marks)**