FINAL
Alternative Assessment

(COVER PAGE)

Session	:	**April 2022**
Programme	:	Foundation In Science (CFSI)
Course	:	**PHY1206: Physics 2**
Date of Examination	:	4 August 2022 (Thursday)
Time	:	9:00am – 11:30am Reading Time : Nil
Duration	:	2 hours + 30 minutes (uploading time)

Special Instructions :

This paper consists of **FOUR (4)** questions. Answer **ALL** questions.

All questions carry equal marks.

Materials permitted :

Non-Programmable Scientific Calculator

Materials provided :

Nil

Examiner(s)	:	**Sharuvindan Nair Rajendran**
Moderator	:	Dr. Ley Hood Hong

This paper consists of 6 printed pages, including the cover page.

FOUNDATION IN SCIENCE (CFSI)
PHY1206: PHYSICS 2
FINAL ALTERNATIVE ASSESSMENT: APRIL 2022 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer **All** questions. All questions carry equal marks.

Question 1

(a) A tank used for filling helium balloons has a volume of 0.400 m^3 and contains 3.00 mol of helium gas at 30.0°C. Assume the helium behaves like an ideal gas. Calculate

(i) the total translational kinetic energy of the gas molecules (4 marks)

(ii) the pressure of gas (in kPa) in the container (2 marks)

(b) Figure Q1(b) below shows 3 point charges, q_1= -10µC , q_2= +8µC , and q_3= +6µC arranged at the vertices of a right-angled triangle. The distance a =25 cm and b = 40 cm. What is the magnitude and direction of the electrostatic force acting on the third charge, q_3 due to q_1 and q_2 ? (7 marks)

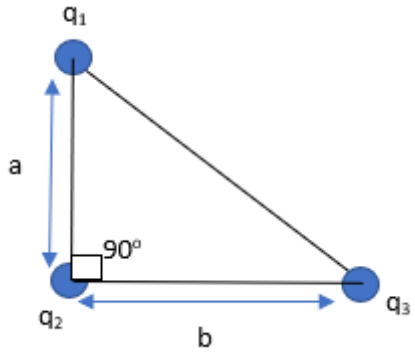

Figure Q1 (b)

(c) Four charged particles are at the corners of a square of side *a* as shown in Figure Q1(c) below.

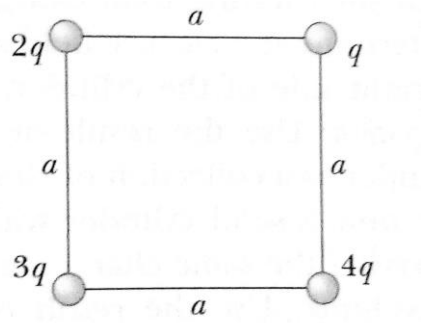

Figure Q1 (c)

(i) Determine the magnitude and direction of the electric field at the location of charge q. (4 marks)

(ii) What is the total electric force exerted on q? (2 marks)

(d) Two 2.00 μC charged particles are located on the x axis. One is at x = 1.00 m and the other is at x = -1.00 m.

(i) Determine the electric potential on the y axis at y=0.500m (4 marks)

(ii) Calculate the change in electric potential energy of the system as a third charged particle of $-3.00\mu C$ is brought from infinitely far away to a position on the y axis at y = 0.500m. (2 marks)

Question 2

(a) A 4.0 nC charged particle is located at the center of a cube of side 50.0 cm

(i) Calculate the electric flux through the entire surface of the cube (3 marks)

(ii) Calculate the electric flux through each face of the cube. (2 marks)

(iii) If the charge was not at the center of the cube, are there any difference to the answers in (a)(i) and (a)(ii)? Briefly explain your answer. (2 marks)

(b) An infinite nonconducting sheet has a surface charge density $\sigma = 6.80\ pC/m^2$.

(i) How much work is done by the electric field due to the sheet if a particle of charge $q = +1.60 \times 10^{-19}$ C is moved from the sheet to a point P at distance d = 4.00 cm from the sheet? (3 marks)

(ii) If the electric potential V is defined to be zero on the sheet, what is V at P? (2 marks)

(c) Four capacitors are connected as shown in Figure Q2 (c).

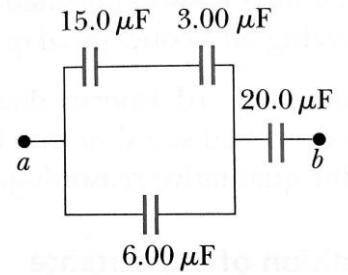

Figure Q2 (c)

(i) Find the equivalent capacitance between points a and b. (3 marks)

(ii) Calculate the charge on each capacitor, taking $\Delta V_{ab} = 20.0$ V (4 marks)

(d) High voltage transmission line made of aluminium can carry a current of 70.0 A. The resistance per unit length for the transmission line is 0.160 Ω/km and the density of aluminium is 2600 kg/m^3. Given the resistivity for aluminum is 2.75×10^{-8} Ω m, calculate the magnitude of current density and mass per unit length for an aluminium cable. (6 marks)

Question 3

(a) Figure Q3 (a) shows a circuit containing different branches. Calculate the currents, I_1, I_2, and I_3. (6 marks)

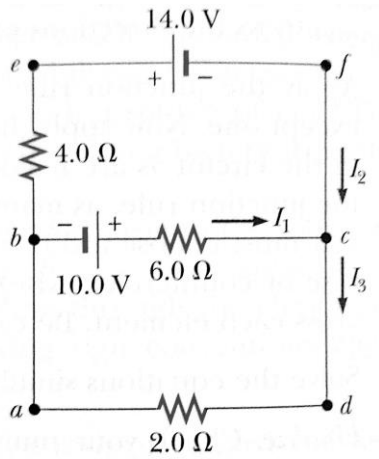

Figure Q3 (a)

(b) A resistor of 100 Ω is connected in series with a capacitor of 100 μF and they are connected to a battery which have emf of 12.0 V. Calculate

(i) the maximum charge the capacitor could acquire, (2 marks)

(ii) the time taken for the voltage across the capacitor to reach 10.0 V. (4 marks)

(c) An electron of kinetic energy 1.20 keV circles in a plane perpendicular to a uniform magnetic field. The orbit radius is 25.0 cm. Find

(i) the electron's speed, (2 marks)

(ii) the magnetic field magnitude, (2 marks)

(iii) the circling frequency, and (2 marks)

(iv) the period of the motion. (2 marks)

(d) One long wire lies along an x axis and carries a current of 30 A in the positive x direction. A second long wire is perpendicular to the xy plane, passes through the point (0, 4.0 m, 0), and carries a current of 40 A in the positive z direction. What is the magnitude of the resulting magnetic field at the point (0, 2.0 m, 0)? (5 marks)

Question 4

(a) A coil is connected in series with a 10.0 kΩ resistor. An ideal 50.0 V battery is applied across the two devices, and the current reaches a value of 2.00 mA after 5.00 ms.

(i) Find the inductance of the coil. (4 marks)

(ii) How much energy is stored in the coil at this same moment?. (2 marks)

(b) A series AC circuit contains the following components: 150 Ω resistor, an inductor of 250 mH, a capacitor of 2.00 μF, and a source with ΔV_{max} = 210 V operating at 50.0 Hz. Calculate

(i) the inductive reactance, (2 marks)

(ii) the capacitive reactance, (2 marks)

(iii) impedance, (2 marks)

(iv) maximum current (2 marks)

(v) phase angle between current and source voltage. (2 marks)

(c) A red laser light with wavelength 650 nm falls on two closely spaced slits, an interference pattern formed on the screen several meters away has bright red fringes spaced 6.00 mm apart near the center of the pattern. When the laser is replaced by a small laser pointer, the fringes are 6.50 mm apart. What is the wavelength of light produced by the laser pointer? (5 marks)

(d) A screen is placed 40.0cm from a single slit, which is illuminated by a 550 nm light. If the distance between the first and fifth minima in the diffraction pattern is 0.35mm, calculate

(i) the width of the slit (2 marks)

(ii) the angle θ of the first diffraction minimum (2 marks)

~ The End ~

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