FINAL
Alternative Assessment

(COVER PAGE)

Session	:	**August 2020**
Programme	:	Foundation in Science (CFSI)
Course	:	**PHY1206: Physics 2**
Date of Examination	:	16 December 2020 (Wednesday)
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 Calculator

Materials provided :

Nil

Examiner(s)	:	**Dr. Beh Boon Chun**
Chief Moderator	:	Mr. Dinash Kandasamy

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

FOUNDATION IN SCIENCE (CFSI)
PHY1206: PHYSICS 2
FINAL ALTERNATIVE ASSESSMENT: AUGUST 2020 SESSION

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

Question 1

(a) 2.0 moles of an ideal gas at pressure of 4.2 x 10^6 Pa was contained inside a 8.00 L vessel. Calculate

(i) the temperature of the gas and (3 marks)

(ii) the average kinetic energy of a gas molecule in the vessel. (3 marks)

(b) An equilateral triangle has three charged particles as shown in **Figure Q1(b)**. Determine the magnitude and direction of resultant electric force acting on 7.00 μC charge. (7 marks)

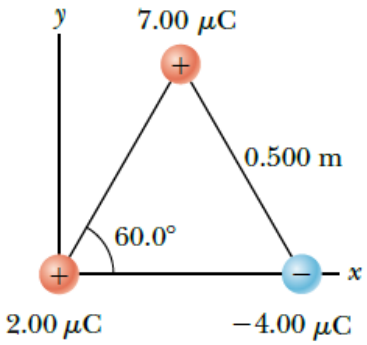

Figure Q1(b)

(c) **Figure Q1(c)** illustrates three identical charged particles (q = -4.8 μC) on the circumference of a circle of diameter 4.0 m. Show that the net electric field at the center of the circle is equal to zero. (5 marks)

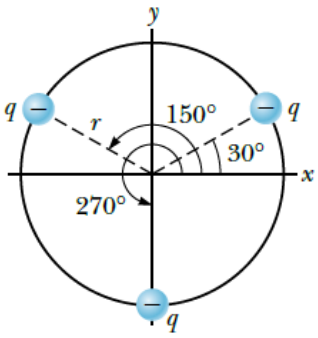

Figure Q1(c)

(d) A 3.2 x 10^{-9} C 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 **(d)(i)** and **(d)(ii)**? Briefly explain your answer. (2 marks)

Question 2

(a) Referring to **Figure Q2(a)**, calculate

(i) the net electric potential at the upper right corner of the rectangle and (3 marks)

(ii) the electric potential energy in moving the 4.00 μC charge to infinity. (3 marks)

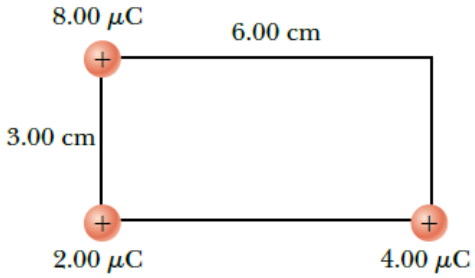

Figure Q2(a)

(b) After a 200 pF capacitor is charged to a potential difference of 40 V, the battery is removed. Then the charged capacitor is connected in parallel with another uncharged capacitor. If the potential difference across the charged capacitor now drops to 30 V, determine

(i) the capacitance of the uncharged capacitor and (4 marks)

(ii) the energy stored in the uncharged capacitor. (2 marks)

(c) 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)

(d) **Figure Q2(d)** illustrates that when the lights of a car are switched on, the ammeter reading is 10.0 A and the voltmeter connected across the lights reads 15.0 V. When the starting motor is turned on, the ammeter reading drops to 8.0 A and the light become slightly dim. If the internal resistance of the battery is 0.05 Ω, neglect the internal resistance in ammeter, compute

(i) the emf of the battery and (3 marks)

(ii) the current through the starting motor when the lights are on. (4 marks)

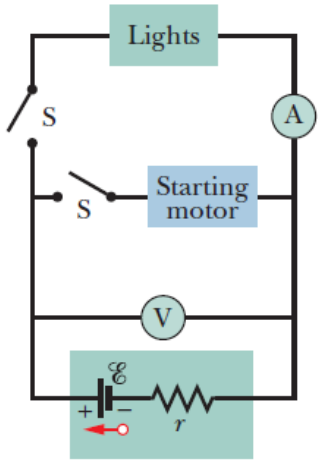

Figure Q2(d)

Question 3

(a) An electron with an energy of 150 eV enters a uniform magnetic field of 40.0 μT with its velocity perpendicular to the magnetic field. Calculate

(i) the frequency of revolution of the electron and (3 marks)

(ii) the radius of the path for the electron. (4 marks)

(b) Four long straight wires are perpendicular to the page and they form a square with sides length of 15.0 cm as shown in **Figure Q3(b).** Each wire carries a current of 9.0 A and has a length of 10 m. The currents are into the page in wire 2 and 3 and out of the page in wire 1 and 4. Determine the magnitude and direction of magnetic force acting on wire 4. (8 marks)

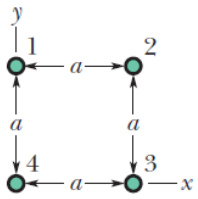

Figure Q3(b)

(c) A coil with 200 turns has magnetic flux of 50 x 10^{-9} Wb through each turn when the current is 2.50 mA.

(i) Determine the inductance of the coil. (2 marks)

(ii) Calculate the inductance and flux through each turn when the current is increased to 7.50 mA. (4 marks)

(iii) Calculate the magnitude of maximum emf $\mathscr{E}$ across the coil when the current through it is given by $i = (3.0\ \text{mA}) \cos(255t)$, with t in seconds. (4 marks)

Question 4

(a) A series RLC circuit consist of components $R = 2.5\ \Omega$, $C = 100\ \mu\text{F}$, $L = 80.0\ \mu\text{H}$ that are connected to a $V_{\text{rms}} = 120$ V and 60 Hz ac source. Calculate

(i) the impedance of the circuit, (4 marks)

(ii) the peak current of the circuit, (2 marks)

(iii) the phase angle, and (2 marks)

(iv) the average power of the circuit. (2 marks)

(b) **Figure Q4(b)** shows a block of crown glass immersed in water. A light ray is incident on the top face at an angle of $\theta_1 = 42.0°$ with the normal and exits the block at point P. The index of refraction for water and crown glass are 1.333 and 1.52 respectively.

(i) Determine the vertical distance y (in cm) from the top of the block to point P. (4 marks)

(ii) Calculate the angle of refraction θ_2 of the light ray leaving the block at point P. (3 marks)

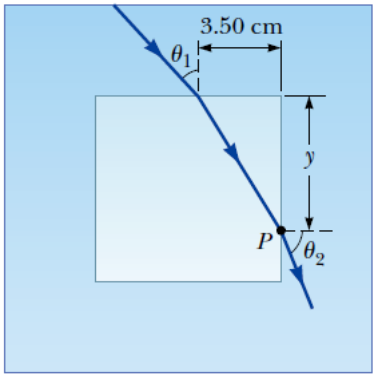

Figure Q4(b)

(c) A double slit with slit separation of 0.058 mm is placed 1.50 m from a screen.

(i) If yellow light of wavelength 588 nm strikes the double slit, determine the separation between the zeroth-order and first-order maxima (in cm) on the screen. (3 marks)

(ii) If blue light of wavelength 412 nm strikes the double slit, determine the separation between the second-order and fourth-order maxima (in cm) on the screen. (2 marks)

(iii) If the double slit used is changed to single slit and the distance between the single slit and the screen is maintained as 1.50 m, when the light from **(c)(i)** strikes the single slit, the position of the first dark band from the central maximum is 2.5 mm. Determine the slit width (in mm) of the single slit. (3 marks)

~ The End ~