INTI
International College Penang

FINAL
Examination Paper

(COVER PAGE)

Session	:	APRIL 2018
Programme	:	Foundation In Science (CFSI)
Course	:	**PHY1204 : PHYSICS 2**
Date of Examination	:	31st July 2018 (Tuesday)
Time	:	8:00 AM – 10:00AM Reading Time : NIL
Duration	:	2 HOURS
Special Instructions	:	

This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided.

Materials permitted :

Non-Programmable Scientific Calculator

Materials provided :

Physics Booklet

Examiner(s)	:	**Dr. Beh Boon Chun**
Moderator	:	Assoc. Prof. Dr Khoo Bee Bee

*This paper consist of **8** printed pages, including the cover page.*

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FOUNDATION IN SCIENCE (CFSI)
PHY1204: PHYSICS 2
FINAL EXAMINATION: APRIL 2018 SESSION

This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Carnot engine operates between 235°C and 115°C, absorbing 6.30 x 10^4 J per cycle at the higher temperature.

(i) What is the efficiency of the engine? (3 marks)

(ii) How much work per cycle is this engine capable of performing? (3 marks)

(b) Four particles form a square as shown in Figure Q1(b). The particles have charges $q_1 = -q_2 = 100$ nC and $q_3 = -q_4 = 200$ nC, and distance a = 5.0 cm.

(i) What are the x components of the net electrostatic force on particle 3? (3 marks)

(ii) What are the y components of the net electrostatic force on particle 3? (3 marks)

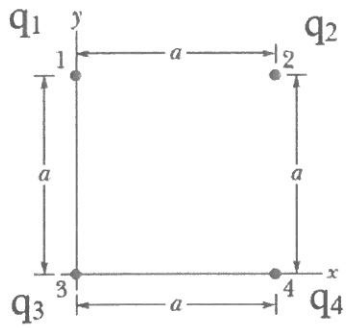

Figure Q1(b)

(c) Determine the direction and magnitude of the electric field at the point P in Figure Q1(c). The charges are separated by a distance $2a$, and point P is a distance x from the midpoint between the two charges. Express your answer in terms of Q, x, a, and k where k is a constant with a value of 8.99 x 10^9 N m^2/C^2. (3 marks)

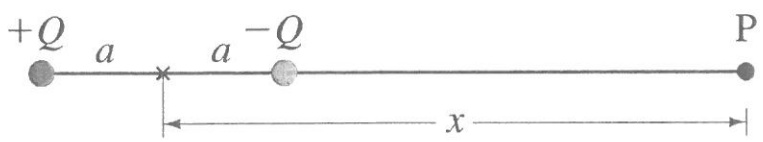

Figure Q1(c)

(d) Two objects, O_1 and O_2 have charges +1.0 μC and -2.0 μC respectively as indicated in Figure Q1(d), and a third object, O_3 is electrically neutral.

(i) What is the electric flux through the surface A_1 that encloses all the three objects? (2 marks)

(ii) What is the electric flux through the surface A_2 that encloses the third object only? (2 marks)

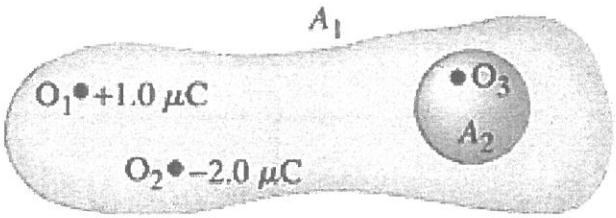

Figure Q1(d)

(e) When an electron moves from A to B along an electric field line in Figure Q1(e), the electric field does 3.94 x 10^{-19} J of work on it. What are the electric potential differences

(i) $V_B - V_A$ (3 marks)

(ii) $V_C - V_A$, and (2 marks)

(iii) $V_C - V_B$? (1 mark)

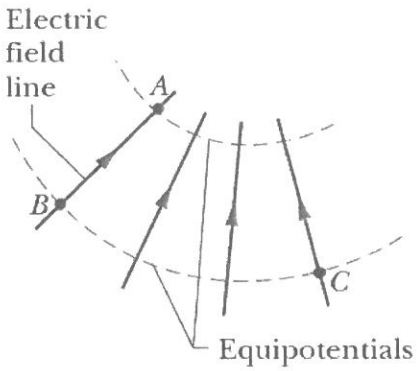

Figure Q1(e)

Question 2

(a) In Figure Q2(a), a 20.0 V battery is connected across capacitors of capacitances $C_1 = C_6 = 3.00\ \mu F$ and $C_3 = C_5 = 2C_2 = 2C_4 = 4.00\ \mu F$. Determine the

(i) the equivalent capacitance C_{eq} of the capacitors. (2 marks)

(ii) the charge stored by C_{eq}, (2 marks)

(iii) the potential difference across capacitor 1. (2 marks)

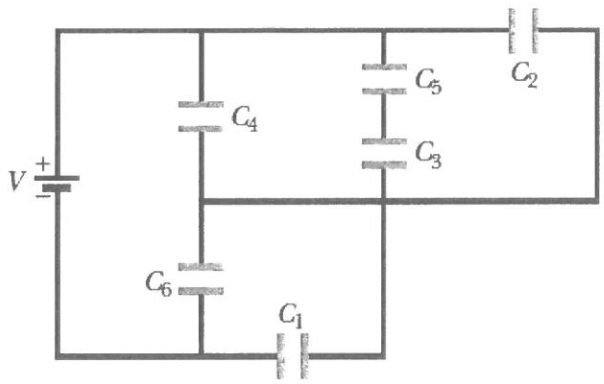

Figure Q2(a)

(b) An electric device draws a current of 6.50 A at 240 V.

(i) If the voltage drops by 15%, what will be the current, assuming nothing else changes? (2 marks)

(ii) If the resistance of the device were reduced by 15%, what current would be drawn at 240 V? (2 marks)

(c) In an RC series circuit, emf $\mathcal{E} = 12.0$ V, resistance $R = 1.40\ M\Omega$, and capacitance $C = 1.80\ \mu F$.

(i) Calculate the time constant. (2 marks)

(ii) Find the maximum charge that will appear on the capacitor during charging. (2 marks)

(iii) How long does it take for the charge to build up to 16.0 μC? (3 marks)

(d) An electron is projected vertically upward with a speed of 1.70×10^6 m/s into a uniform magnetic field of 0.480 T that is directed horizontally away from the observer. Describe the electron's path in this field. (4 marks)

(e) Two parallel straight wires 10.0 cm apart carry currents in opposite directions as shown in Fig Q2(e). Current I_1 = 5.0 A is out of the page, and I_2 = 8.0 A is into the page. Determine the magnitude and direction of the magnetic field halfway between the two wires. (4 marks)

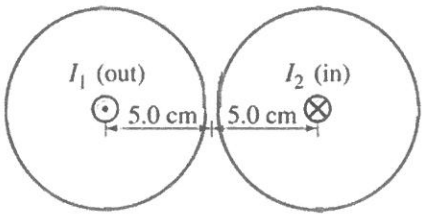

Figure Q2(e)

Question 3

(a) In Figure Q3(a), the magnetic flux through the loop increases according to the relation $\Phi_B = 6.0t^2 + 7.0t$, where Φ_B is in milliwebers and t is in seconds.

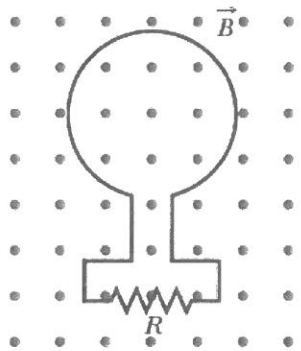

Figure Q3(a)

(i) What is the magnitude of the emf induced in the loop when t = 2.0 s? (3 mark)

(ii) Is the direction of the current through R to the right or left? (1 mark)

(b) At a given instant the current and self-induced emf in an inductor are directed as indicated in Figure Q3(b).

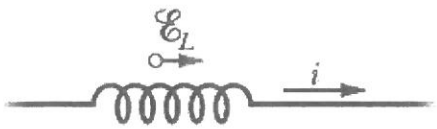

Figure Q3(b)

(i) Is the current increasing or decreasing? (1 mark)

(iii) The induced emf is 17 V, and the rate of change of current is 25 kA/s; find the inductance. (2 marks)

(c) A square loop of wire of side $l = 5.0$ cm is in a uniform magnetic field $B = 0.16$ T. What is the magnetic flux in the loop

(i) when B is perpendicular to the face of the loop and (2 marks)

(ii) when B is at an angle of 30° to the area A of the loop? (2 marks)

(iii) What is the magnitude of the average current in the loop if it has a resistance of 0.012 Ω and it is rotated from position (i) to position (ii) in 0.14 s? (3 marks)

(d) A coil has an inductance of 0.15 H and a resistance of 20 Ω. It is connected to a 220-V, 90-Hz line. Determine

(i) the reactance of the coil, (2 marks)

(ii) the impedance of the coil, (2 marks)

(iii) the current through the coil, (2 marks)

(iv) the phase angle between the current and supply voltage and (3 marks)

(v) the reading of a wattmeter connected in the circuit. (2 marks)

Question 4

(a) Electromagnetic waves and sound waves can have the same frequency.

(i) What is the wavelength of a 1.00-kHz electromagnetic wave? (2 marks)

(ii) What is the wavelength of a 1.00-kHz sound wave? (The speed of sound in air is 341 m/s.) (2 marks)

(b) In a plane radio wave the maximum value of the electric field component is 5.00 V/m. Calculate

(i) the maximum value of the magnetic field component and (2 marks)

(ii) the wave intensity. (2 marks)

(c) When the rectangular metal tank in Figure Q4(c) is filled to the top with an unknown liquid, observer O, with eyes level with the top of the tank, can just see corner E. A ray that refracts toward O at the top surface of the liquid is shown. If D = 90.0 cm and L = 1.50 m, what is the index of refraction of the liquid? (4 marks)

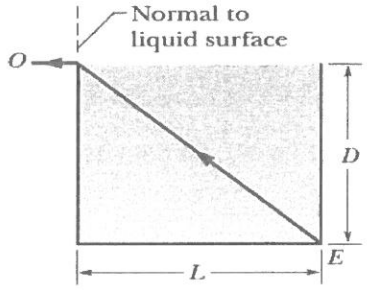

Figure Q4(c)

(d) A concave shaving mirror has a radius of curvature of 35.0 cm. It is positioned so that the (upright) image of a man's face is 2.50 times the size of the face. How far is the mirror from the face? (4 marks)

(e) An object is placed 10 cm from a 15-cm-focal-length converging lens. Determine the image position and size

(i) analytically and (4 marks)

(ii) using a ray diagram. (5 marks)

Question 5

(a) In a double-slit arrangement the slits are separated by a distance equal to 100 times the wavelength of the light passing through the slits.

(i) What is the angular separation in radians between the central maximum and an adjacent maximum? (3 marks)

(ii) What is the distance between these maxima on a screen 50.0 cm from the slits? (3 marks)

(b) In a double-slit experiment, the distance between slits is 5.0 mm and the slits are 1.0 m from the screen. Two interference patterns can be seen on the screen: one due to light of wavelength 480 nm, and the other due to light of wavelength 600 nm. What is the separation on the screen between the third-order (m = 3) bright fringes of the two interference patterns? (6 marks)

(c) The distance between the first and fifth minima of a single slit diffraction pattern is 0.35 mm with the screen 40 cm away from the slit, when light of wavelength 550 nm is used. Determine

(i) the slit width. (4 marks)

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

(d) What must be the ratio of the slit width to the wavelength for a single slit to have the first diffraction minimum at $\theta = 45.0°$? (2 marks)

(e) A plane wave of wavelength 590 nm is incident on a slit with a width of $a = 0.40$ mm. A thin converging lens of focal length +70 cm is placed between the slit and a viewing screen and focuses the light on the screen.

(i) How far is the screen from the lens? (1 mark)

(ii) What is the distance on the screen from the center of the diffraction pattern to the first minima? (4 marks)

-- THE END --

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