UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	PHYSICS III
COURSE CODE	:	DAS 24603
PROGRAMME	:	2 DAU
EXAMINATION DATE	:	DECEMBER 2015/ JANUARY 2016
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	SECTION A : ANSWER **ALL** QUESTIONS SECTION B : ANSWER **TWO (2)** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

SECTION A

Q1 (a) Hydrogen's line spectrums are formed by a series of lines and each line in a given series corresponds to a different value of $\boldsymbol{n}$. An electron in a hydrogen atoms is in the initial state $n_i = 5$.

(i) Calculate the wavelength, λ and of the photon emitted by this electron if it jumps from $n_i = 5$ to the final stage: $n_f = 4$; $n_f = 3$; $n_f = 2$, respectively.

(6 marks)

(ii) Calculate the energy level, $\boldsymbol{E}$ of the photon emitted by this electron if it jumps from $n_i = 5$ to the final stage: $n_f = 4$; $n_f = 3$; $n_f = 2$, respectively.

(6 marks)

(b) The photoelectric effect plays an important historical role in confirming the photon theory of light. Practical application such as burglar alarms, automatics door openers, photocell circuit and others.

(i) Differentiate the photoelectric effect, Compton effect and pair production.

(6 marks)

(ii) Calculate the minimum energy, $\boldsymbol{E}$ of the photon can produce an electron-positron.

(3 marks)

(ii) Determine the photon's wavelength, λ.

(4 marks)

Q2 (a) A transformer connected to a 120 V ac line to supply 13,000 V for a neon sign. To reduce a shock hazard, a fuse is to be inserted in the primary circuit and is to blow when the rms current (root mean square current) in the secondary circuit exceeds 8.50 mA.

(i) Calculate the ratio of secondary to primary turns of the transformers.

(3 marks)

(ii) Determine the power must be supplied to the transformer when the rms secondary current is 8.50 mA.

(2 marks)

(iii) Calculate primary circuit.

(2 marks)

(b) A bar magnet is moved rapidly toward a 500 turn circular coil of wire. As the magnet moves, the average value of $B \cos \theta$ over the area of the coil increases from 0.0125 T to 0.450 T in 0.250 s. If the radius of the coil is 3.05 cm and the resistance of its wire is 3.55 Ω.

(i) Define magnetic flux.

(2 marks)

(i) Determine the magnitude of the induced electromotive force (*emf*) and induced current in the coil if the field is perpendicular to the plane of the coil.

(8 marks)

(ii) if the field makes an angle of 60° with the plane of the coil , determine the magnitude of the induced electromotive force (*emf*) and induced current in the coil.

(8 marks)

SECTION B

Q3 (a) A long horizontal wire carries a current of 48.0 A. A second wire made of 1.00 mm diameter copper wire and parallel to the first as shown in **Figure Q3** is kept suspensionly magnetically 5.0 cm below. Determine the

(i) magnitude of the force per unit length of the current in the wire
(3 marks)

(ii) magnitude of the magnetic field through at the center of each two sides wire if the current flow in the same directions.
(4 marks)

(iii) magnitude of the magnetic field through at the center of each two sides wire if the current flow in the opposite directions.
(4 marks)

(iv) new force that act on wire of 10.0 A if the wire 12.0 A is replace with the wall.
(3 marks)

(b) A long copper strip 1.8 cm wide and 1.0 mm thick is placed in a 1.2 T magnetic field. When a steady currect of 15.0 A passes through it, the Hall emf is measured to be 1.02 μV.

(i) Define drift velocity and its SI unit.
(3 marks)

(ii) Determine the drift velocity of the electrons, v.
(3 marks)

(iii) Determine the density of free electrons in the copper, n.
(5 marks)

Q4 (a) **Figure Q4 (a)** shows an electric circuit with 7 resistors. The circuits connect with an *emf* equal to 200.0 V. If the magnitude of the resistance on the circuit is 235.0 Ω. Compute the $\boldsymbol{R_6}$ and the current on the circuit, $\boldsymbol{I}$.
(16 marks)

(b) A copper wire has a diameter of 2.00 mm and carries current of 3.0. There are 10^{29} conduction electrons per cubic meter in copper.

(i) Define critical current density, J_c and its SI unit.
(3 marks)

(ii) Determine the drift velocity in the wire, v.
(3 marks)

(iii) Determine current density, J_c
(3 marks)

Q5 (a) A parallel plate capacitor has a plate area A = 250 cm2 and separation d = 2.00 mm. The capacitor is charged to a potential difference V = 150.0 V Then the battery is disconnected and a dielectric sheet (κ = 3.50) of the same area but thickness l = 1.00 mm is places between the plate.

(i) Define capacitors and capacitance.

(4 marks)

(ii) Determine the initial capacitance, c_o of the air filled capacitors.

(3 marks)

(iii) Determine the charge on each plate before the dielectric is inserted.

(3 marks)

(b) The series combination of five capacitors shown in **Figure Q5 (b)** is connected across 12.0 V power supply.

(i) Determine the equivalent capacitance of the capacitors, C_{eq}.

(5 marks)

(ii) Determine the magnitude of the charges on each capacitor.

(6 marks)

(iii) Determine the potential difference across the capacitors.

(2 marks)

(iv) Determine the energy stored in the capacitors.

(2 marks)

Q6 (a) Three charged particles are placed at the corners of an equilateral triangle of side 3.0 m. The charge q_1 is + 6.0 μC, q_2 is – 4.0 μC and q_3 is – 4.0 μC as shown in **Figure Q6 (a)**.

(i) State Coulomb's Law

(3 marks)

(ii) Calculate the magnitude and direction of the net force on charge q_1 due to the other two charges.

(14 marks)

(b) Two point charges are separated by a distance of 10.0 cm. One has charge of – 25 μC and the other + 50 μC as shown in **Figure Q6 (b)**.

(i) Calculate the magnitude of the electric field at a point P in between them that is 2.0 cm from the negative charge.

(5 marks)

(ii) If an electron is placed at rest at P, calculate its acceleration.

(3 marks)

- END OF QUESTION -

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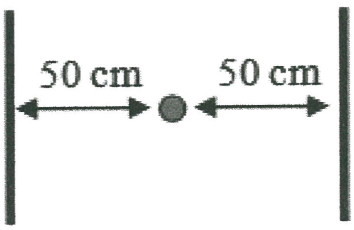

Figure Q3

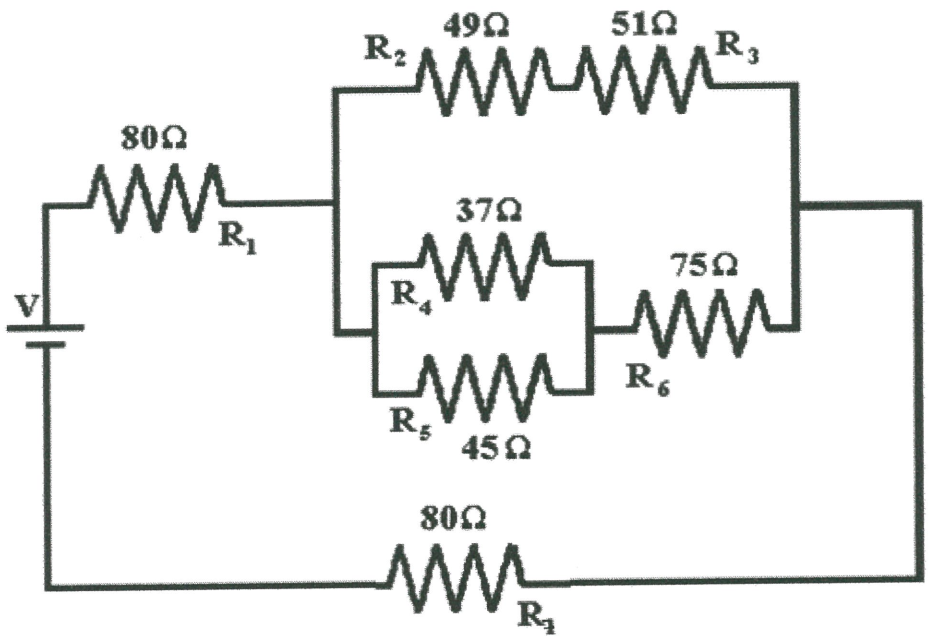

Figure Q4 (a)

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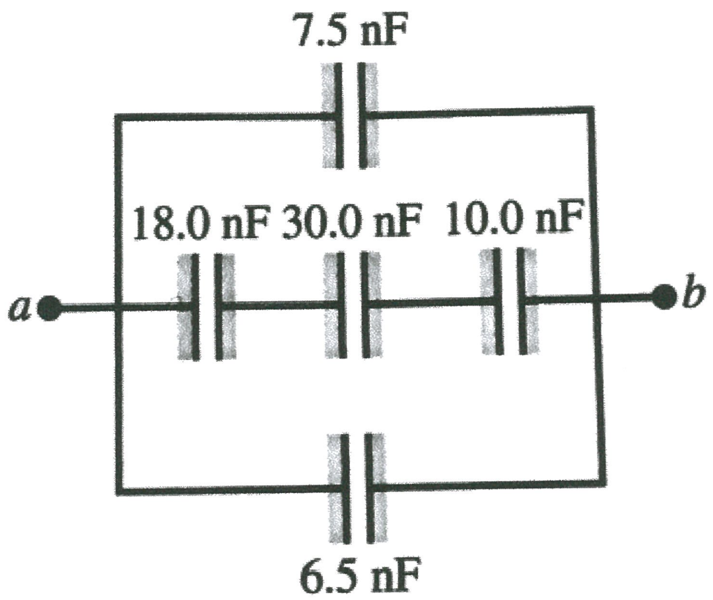

Figure Q5

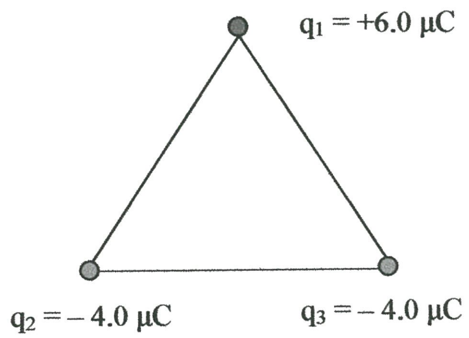

Figure Q6 (a)

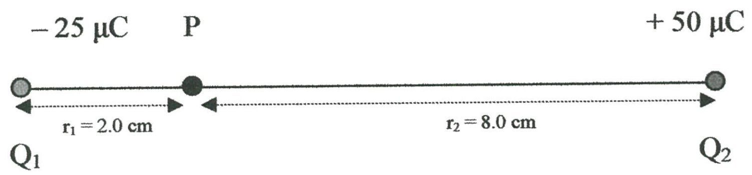

Figure Q6 (b)

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Formula

$E = hf$	$V = IR$	$n = \frac{N}{L}$	$F = \frac{\mu_0}{2\pi}(\frac{I_1 I_2}{d})l$
$A = \pi r^2$	$U = mgh$	$\Delta K = -\Delta U$	$F = \frac{\mu_0}{2\pi}(\frac{I_1}{d})l$
$\phi = hf_o$	$L = mvr = \frac{nh}{2\pi}$	$W_n = \Delta K$	$F = Bqv \sin\theta$
$K = eV_s$	$R = \sqrt{R_x^2 + R_y^2}$	$W = F\Delta x$	$\varepsilon = Blv \sin\theta$
$hf = K_{max} + \phi$	$E = \frac{F}{q}$	$W = q\Delta V$	$B = \mu_o nI$
$LP = m \cdot v$	$J = \frac{I}{A}\theta$	$q = ne$	$\Delta\Phi = \Phi_2 - \Phi_1$
$K = \frac{ke^2}{2r}$	$\frac{V_s}{V_p} = \frac{N_s}{N_p}$	$B = \frac{\mu_o I}{2\pi d}$	$E = \frac{q}{4\pi\varepsilon_o (r)^2}$
$E = \frac{kQ}{d^2}$	$C = \frac{\varepsilon_0 A}{d}$	$K = \frac{1}{2}mv^2$	$f_o = \frac{\phi}{h} = \frac{hc}{h\lambda}$
$F = \frac{kq_1 q_2}{d^2}$	$\varepsilon = -N\frac{d\Phi}{dt}$	$v = \frac{BI}{neA}$	$e = -1.6x10^{-19}\, C$
$P = I^2 R$	$\varepsilon = -L\frac{dI}{dt}$	$E = \frac{\sigma}{\varepsilon}$	$\Phi = NBA \, kos\, \theta$
$F = mv^2$	$\phi = \frac{hf_0}{e}$	$k = \frac{1}{4\pi\varepsilon_0}$	$\hbar = 6.63 \, x \, 10^{-34}\, Js$
$v = \frac{L}{t}$	$v = \frac{LI}{ne}$	$v = \frac{I}{neA}$	$\varepsilon = BAN\,\omega \sin \omega t$
$F = \frac{ke^2}{r}$	$C = \frac{\varepsilon_r \varepsilon_o A}{d}$	$\Phi = BA$	$c = 3.0\, X\, 10^8\, ms^{-1}$
$I = \frac{Q}{t}$	$U = -\frac{ke^2}{r}$	$C = \frac{Q}{V}$	$\mu_o = 4\pi\, x10^{-7} Tm$

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List of constants

1. Gravity acceleration, $g = 9.81\ m/s^2$
2. Rydberg constant, $R = 1.097 \times 10^7\ m^{-1}$.
3. Permeability of free space, $\mu_o = 4\pi\ x\ 10^{-7} Nm^{-1}$
4. Planck constant, $h = 6.63\ x\ 10^{-34} Js$
5. Speed of light in air, $c = 3 \times 10^8$ m/s
6. Charge of electron, $e = 1.602\ x\ 10^{-19} C$
7. Permittivity of free space, $\varepsilon_o = 8.854\ x\ 10^{-12} (Nm)^{-2} C^2$
8. Coulomb constant, $k = 9\ x\ 10^9 Nm^2 C^{-2}$
9. Resistivity of cooper, $\rho_{cooper} = 1.67 \times 10^{-8}\ \Omega m$
10. Mass of electron, $e = 9.1\ x\ 10^{-31} kg$
11. Mass of proton, $p = 1.673\ x\ 10^{-27} kg$