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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	PHYSICS III
COURSE CODE	:	DAS 24603
PROGRAMME	:	2 DAU / 3 DAU
EXAMINATION DATE	:	DECEMBER 2014/ JANUARY 2015
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS B) ANSWER **TWO (2)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

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SECTION A

Q1 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 $\boldsymbol{n_i} = 4$.

(i) Define de Broglie.

(3 marks)

(ii) Show the Bohr orbits and spectral series (at least five series).

(5 marks)

(iii) Calculate the wavelength, $\boldsymbol{\lambda}$ of the photon emitted by this electron if it jumps from $\boldsymbol{n_i} = 4$ to the final stage: $\boldsymbol{n_f} = 3$; $\boldsymbol{n_f} = 2$; $\boldsymbol{n_f} = 1$, respectively.

(7 marks)

(iv) Calculate the energy level, $\boldsymbol{E}$ of the photon emitted by this electron if it jumps from $\boldsymbol{n_i} = 4$ to the final stage: $\boldsymbol{n_f} = 3$; $\boldsymbol{n_f} = 2$; $\boldsymbol{n_f} = 1$, respectively.

(10 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.

(3 marks)

(iii) Calculate primary current.

(3 marks)

(b) A bar magnet is moved rapidly toward a 500 turn circular coil of wire. The radius of the coil is 3.05 cm and the resistance of its wire is 3.55Ω. 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.

(i) Define magnetic flux and give the formulae.

(3 marks)

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

(6 marks)

(iii) Determine the magnitude of the induced current.

(3 marks)

(iv) Determine the magnitude of the induced electromotive force (*emf*) in the coil if the field makes an angle of 60° with the plane of the coil.

(4 marks)

SECTION B

Q3 (a) Point charges q_1 and q_2 of +12 nC and – 12 nC, respectively, are placed 10.0 cm apart as shown in **Figure Q3(a).** This combination of two charges with equal magnitude and opposite sign is called an electric dipole.

(i) Compute the resultant electric field at a point *a*, the midway between the charges.

(4 marks)

(ii) Compute the resultant electric field at a point *b*, 4.0 cm to the left q_1.

(3 marks)

(iii) Show the vector of the resultant electric field at a point *c*.

(3 marks)

(b) **Figure Q3(b)** metal plate's capacitors with potential difference of 9.0 V. The separation between two plates is 4.5 mm of air. An electron is released from rest at the negative plate.

(i) Define potential difference.

(2 marks)

(ii) Calculate the electric field in the region between the plates.

(3 marks)

(iii) Calculate the work done by the electric field on the electron.

(3 marks)

(iv) Calculate the speed of the electrons as it reaches the positive plate.

(3 marks)

(v) Calculate the electric field and speed of the electron if the 9.0 V batteries are replaced by an 18.0 V battery.

(4 marks)

Given conservation of energy, $K_a + U_a = K_b + U_b$; $U = qV$; $q = -e$, $K_a = 0$

Q4 (a) The series combination of ~~four~~ six capacitors shown in **Figure Q4(a)** is connected across 12.0 V power supply.

(i) Define capacitance.

(2 marks)

(ii) Calculate the equivalent capacitance, C_{eq} on the capacitors.

(5 marks)

(iii) Calculate the magnitude of the charges on the capacitors.

(6 marks)

(iv) Calculate the potential differences across the capacitors.

(2 marks)

(v) Calculate the energy stored in the capacitors.

(2 marks)

(b) The plate of parallel – plate capacitors are 5.0 mm apart and 2.0 m^2 in area as ~~shown in **Figure Q4(b).**~~ Potential difference of 10.0 kV is applied across the capacitors. Calculate No Figure (No need to refer figure)

(i) the capacitance.

(3 marks)

(ii) the magnitude of the electric field between the plates.

(5 marks)

Q5 (a) **Figure Q5(a)** shows an electric circuit with 6 resistors. The circuits connect with the *emf* equal to 100.0 V.

(i) the the equivalent resistance, R_{eq} on the circuit.

(10 marks)

(ii) the magnitude of the current of the circuit.

(3 marks)

(b) A copper wire has a diameter of 2.00 mm^2 and carries current of 6.0 A in the wire. There are 10^{29} conduction electrons per cubic meter in copper and given electron charge is -1.6×10^{19} C.

(i) Define critical current density, $J_{c.}$

(3 marks)

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

(3 marks)

(iii) Determine current density.

(3 marks)

(iv) If given the drift velocity in the wire with 2.0m length is 3.0×10^{-8} ms^{-1}, find the critical density in the wire, $J_{c.}$

(3 marks)

Q6 A electric wire carrying a 30.0 A current has a length l = 12.0 cm between the pole faces of a magnet at an angle $\theta = 60°$ as shown in **Figure Q6(i).** The magnetic field is approximately uniform at 0.90 T. Ignored the field beyond the pole pieces.

(i) Define magnetic field. (2 marks)

(ii) Calculate the magnitude of the force on one wire.

(3 marks)

(iii) If the electric wire in the wall of a building carries a same DC current vertically upward, calculate the magnetic field due to this current at a 10.0 cm distance from the wire as shown in **Figure Q6(a)(ii)**.

(5 marks)

(iv) If the wall is replaces with a wire with 10.0 cm apart and carry current in same directions, calculate the magnitude directions of the magnetic field halfway between the two wires for current in the same directions, as shown in **Figure Q6(iii)(a).**

(5 marks)

(v) From question Q6(iv), calculate current in the opposite directions, as shown in **Figure Q6(iii)(b)**

(5 marks)

(vi) Calculate the magnitude of the force on both wire.

(5 marks)

- END OF QUESTION -

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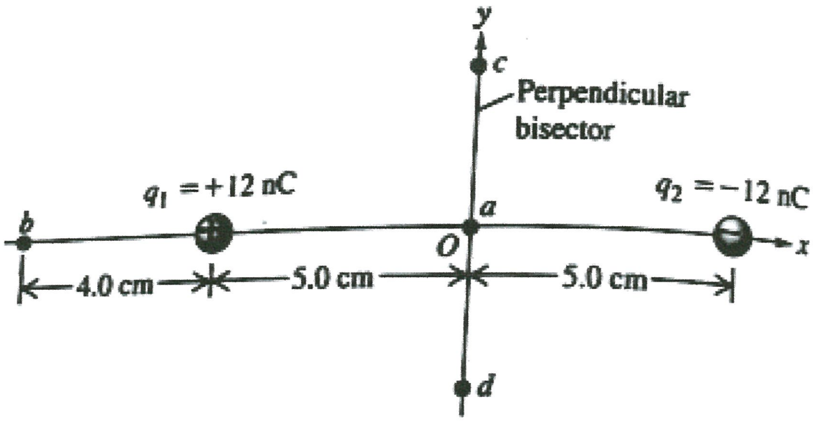

FIGURE Q3(a)

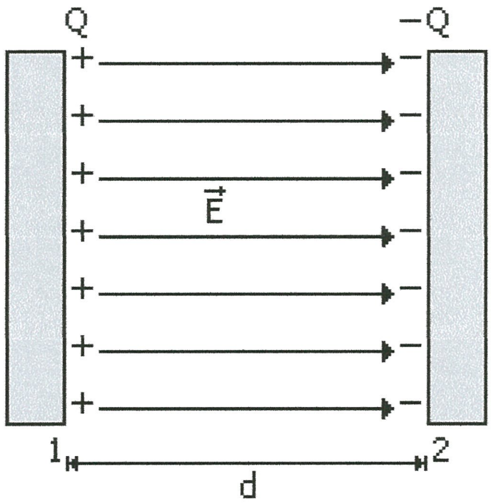

FIGURE Q3(b)

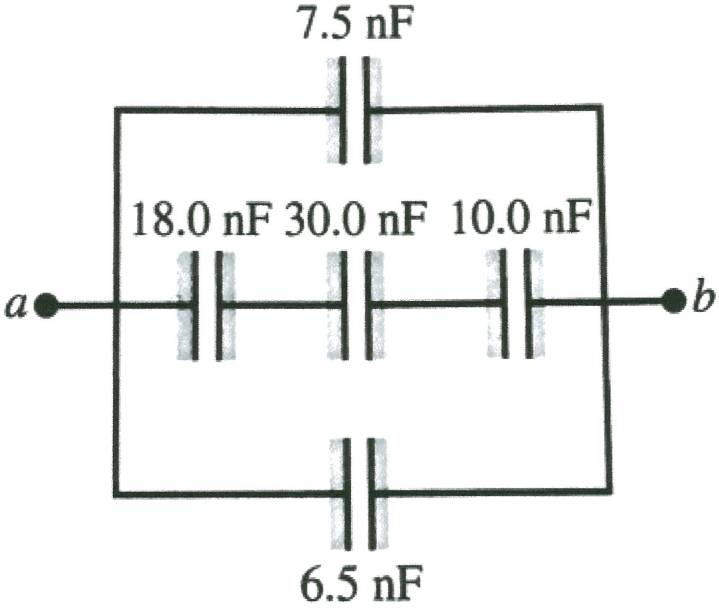

FIGURE Q4(a)

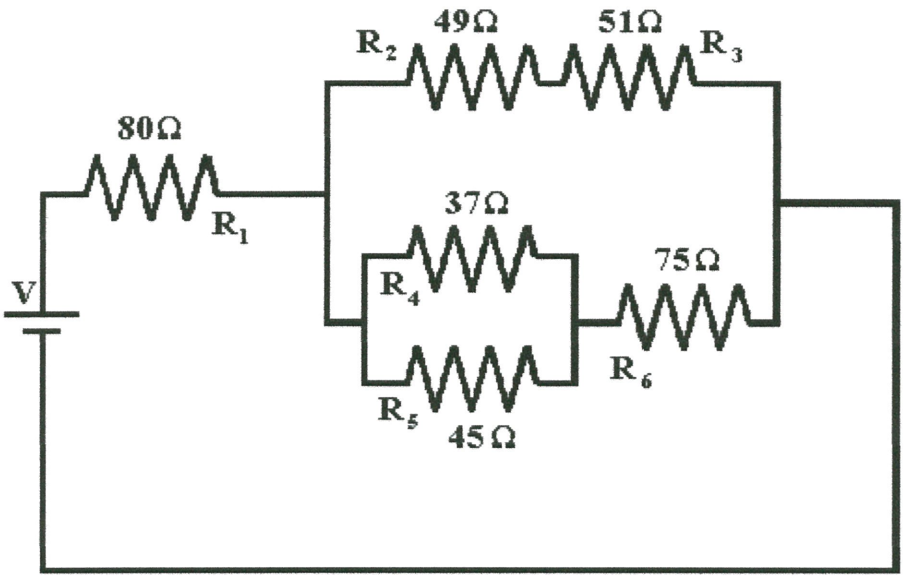

FIGURE Q5(a)

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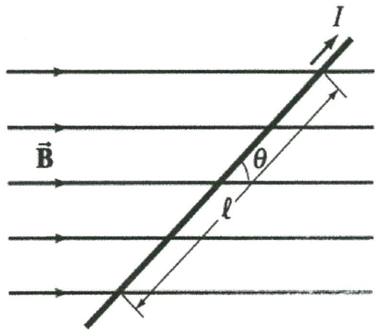

FIGURE Q6(i)

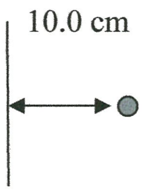

FIGURE Q6(ii)

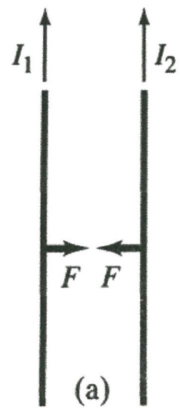

FIGURE Q6(iii)(a)

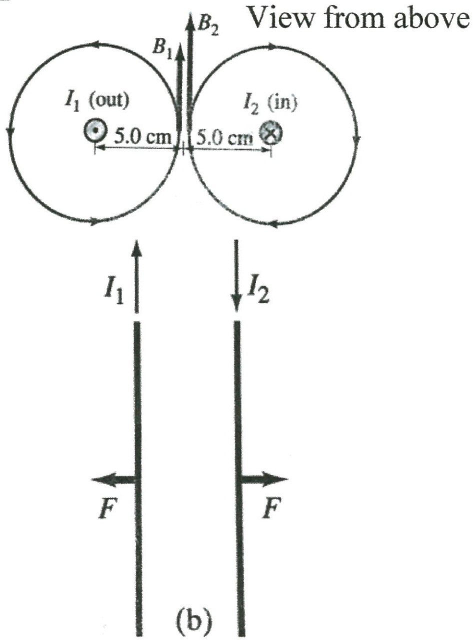

FIGURE Q6(iii)(b)

LIST OF CONSTANT

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LIST OF CONSTANTS

1. Gravity acceleration, $g = 9.81$ m/s^2
2. Rydberg constant, R = 1.097 x 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 x 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, ρ_{cooper} = 1.67 x 10^{-8} Ωm
10. Mass of electron, $e = 9.1 \, x \, 10^{-31} kg$
11. Mass of proton, $p = 1.673 \, x \, 10^{-27} kg$

FORMULAE

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$E = hf$	$V = IR$	$n = \frac{N}{L}$	$P = I^2R$
$A = \pi r^2$	$U = mgh$	$\Delta K = -\Delta U$	$K = \frac{ke^2}{2r}$
$\phi = hf_o$	$L = mvr = \frac{nh}{2\pi}$	$W_n = \Delta K$	$J = \frac{I}{A}$
$K = eV_s$	$R = \sqrt{R_x^2 + R_y^2}$	$W = F\Delta x$	$E = \frac{F}{q}$
$hf = K_{max} + \phi$	$\varepsilon = Blv \sin\theta$	$W = q\Delta V$	$B = \mu_o nI$
$L\,P = m \cdot v$	$F = Bqv \sin\theta$	$q = ne$	$\Delta\Phi = \Phi_2 - \Phi_1$
$F = \frac{\mu_0}{2\pi}(\frac{I_1}{d})l$	$\frac{V_s}{V_p} = \frac{N_s}{N_p}$	$B = \frac{\mu_o I}{2\pi d}$	$E = \frac{\sigma}{\varepsilon}$
$E = \frac{kQ}{d^2}$	$\varepsilon = BAN\,\omega \sin \omega t$	$K = \frac{1}{2}mv^2$	$I = \frac{Q}{t}$
$F = \frac{kq_1q_2}{d^2}$	$\varepsilon = -N\frac{d\Phi}{dt}$ 8	$v = \frac{BI}{neA}$	$C = \frac{Q}{V}$
$F = \frac{\mu_0}{2\pi}(\frac{I_1I_2}{d})l$	$\varepsilon = -L\frac{dI}{dt}$	$E = \frac{q}{4\pi\varepsilon_o(r)^2}$	$C = \frac{\varepsilon_r\varepsilon_o A}{d}$
$F = mv^2$	$\phi = \frac{hf_0}{e}$	$k = \frac{1}{4\pi\varepsilon_0}$	$U = -\frac{ke^2}{r}$
$v = \frac{L}{t}$	$v = \frac{LI}{ne}$	$v = \frac{I}{neA}$	$C = \frac{\varepsilon_o A}{d}$
$F = \frac{ke^2}{r}$	$\Phi = NBA\,kos\,\theta$	$\Phi = BA$	$f_o = \frac{\phi}{h} = \frac{hc}{h\lambda}$
$c = 3.0\,X\,10^8\,ms^{-1}$	$h = 6.63\,x\,10^{-34}\,Js$	$e = -1.6x10^{-19}\,C$	$\mu_o = 4\pi\,x10^{-7}Tm$