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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE NAME	:	BASIC PHYSICS II
COURSE CODE	:	DAS 14403
PROGRAMME	:	1 DAC
EXAMINATION DATE	:	APRIL/MAY 2011
DURATION	:	2 ½ HOURS
INSTRUCTIONS	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF NINE (9) PAGES

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Q1 a) Elaborate the Compton effect with the aid of suitable diagram, where the equation for Compton effect was given as follows:

$$\lambda' = \lambda + \frac{h}{m_e c}(1 - \cos\Phi) \text{ ....equation Q1(a).}$$

(5 marks)

b) What is the wavelength of an electron that has been accelerated through a potential difference of 240 V? In Q 1 (c), the electron was given 10 per cent (10%) of the photon energy or 20 keV, what is the wavelength of the excited electron? Compare between these two electrons.

(6 marks)

c) In the Compton Effect, through what angle must a 200 keV photon be scattered by initially stationary free electron so that the photon will lose 10 per cent (10%) of its energy?

(9 marks)

Q2 a) Define the Faraday's law.

(3 marks)

b) A proton is moving in x-axis with a speed of 5.0×10^6 m/s. The proton runs across a magnetic field of 0.40 T at an angle of 45^0 as shown in Figure Q2 (b). Find;

i) the magnitude and direction of the force acting on the proton.
ii) the acceleration experience by the proton.

(6 marks)

c) A uniform magnetic field of 13 T is directed into the page as shown in Figure Q2 (c). Two oppositely charged plates, **a** and **b**, are separated by 2.5 mm and located so that the uniform electric field between them is perpendicular to the magnetic field. While it is between charged plates, an ion with a charge of +e (1.6×10^{-19} C), a mass of 1.6×10^{-25} kg and speed of 3.0×10^4 m/s travels in a straight line without being deflected.

i) What is the electric field in the region between the plates? Give your answer in vector notation.
ii) What is the potential difference, V_b-V_a, between the charged plates?
iii) Beyond point c on the ion's path, there is no electric field and its motion is only affected by the uniform magnetic field. What is the magnitude of the force acting on the ion, when it enters the region beyond point **c**?

(11 marks)

Q3 a) Draw the electric field lines for two identical charges separated at a distance *r*. Identify the area where the electric field is strong and give your opinion to the reason for the electric field is stronger compared to other area.

(4 marks)

b) Charge Q_1 = +4.0 μC is located at (0,3) cm; charge Q_2 = +2.0 μC is located at (1,0) cm; and charge Q_3 = -3.0 μC is located at (2,2) cm.

i) Find the electric potential at point A (x=0, y=1) cm due to the three charges.

ii) A point charge Q_4 = -5.0 nC moves from a great distance to point A. What is the change in electric potential energy?

(6 marks)

c) One charge, Q_a = +2 μC, is located at the origin. A second charge, Q_b = -3 μC is located at x=1.0 m, y=2.0 m. Point D is located on the y-axis at y=2.0m.

i) Calculate the contribution E_a to the electric field at D due to Q_a and contribution E_b to the electric field at D due to Q_b.

i) Draw the vectors representing E_a and E_b.

ii) Calculate the total electric field at D. Express your answer in unit vector notation.

iii) What would be the magnitude of the force on a charge qc=-0.15 μC placed at point D.

(10 marks)

Q4 a) The Figure Q4 (a) shows capacitors connected together in a circuit with a 12 volts battery.

i) Obtain the total capacitance for the configuration in the figure.

ii) Determine the total charge stored and the total electric potential energy stored by the capacitance configuration above.

iii) Determine the potential difference between points A and B.

(10 marks)

b) A copper wire has a cross-sectional area of 5.0×10^{-7} m^2 and a length of 10.0 m. An aluminum wire of exactly the same dimensions is welded to the end of the copper wire. the ends of this long copper-aluminum wire are connected to a 3.0-volt battery. Neglect the resistance of any other wires in the figure.
Determine

i) the total resistance of the circuit.

ii) the total current in the wire.

(4 marks)

c) In the Figure Q4 (c) assume all resistance of R1,R2,R3,R4,R5 and R6 are 1.2 kΩ.
What is the equivalent resistance of the circuit connected to the battery?

(6 marks)

Q5 a) Define Lenz's law and explain its application in transformer.

(4 marks)

b) An aluminum can of radius 3 cm is inside a 100-turn and 10 cm long solenoid of wire.The electrical current inside the solenoid goes from 0 A to 100 A in a time interval of $2x10^{-5}$ seconds.

i) What is the magnitude and direction (in or out of the paper in the picture) of the magnetic field inside the solenoid when the current is 100 A?

ii) What is the magnitude (the absolute value) of the induced EMF around the circumference of the can? Hint: consider the can as a 1 loop coil.

iii) If the resistance encountered by the current moving around the circumference of the can is R=0.1 W, what is the current flowing on the surface of the can?

iv) What is the magnitude and direction of the magnetic force acting on the induced current in the can? Will the can be smashed or blown up? Hint: consider the force on a current with length equal to the circumference of the can.

(16 marks)

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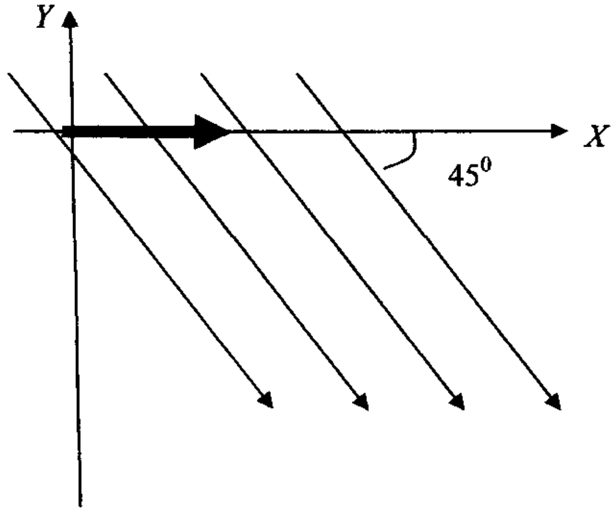

Figure Q2 (b)

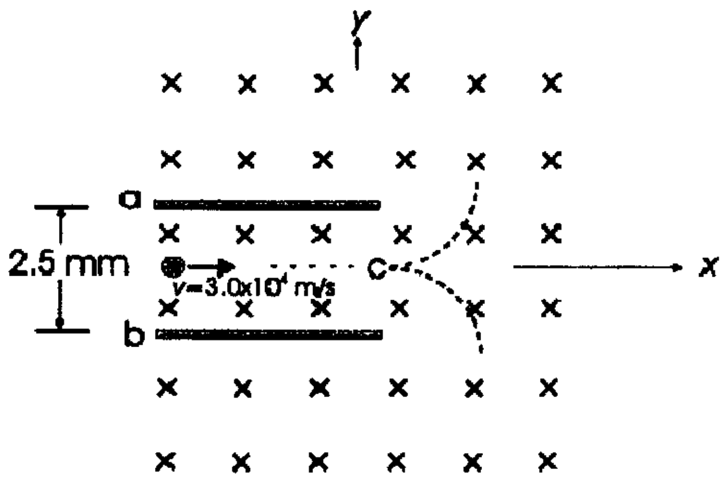

Figure Q2 (c)

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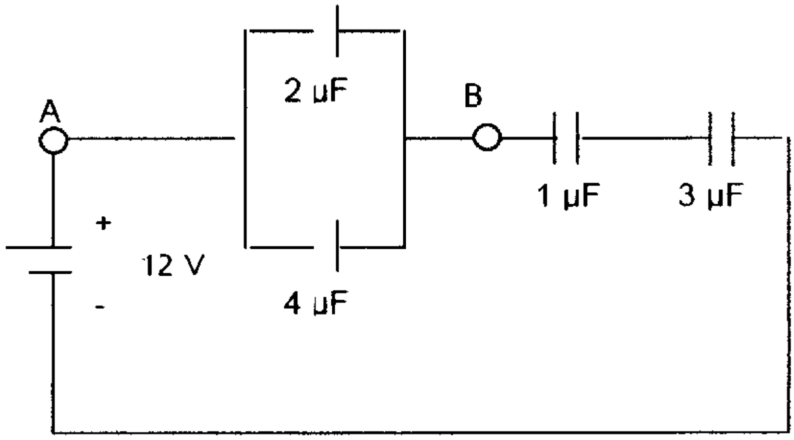

Figure Q4 (a)

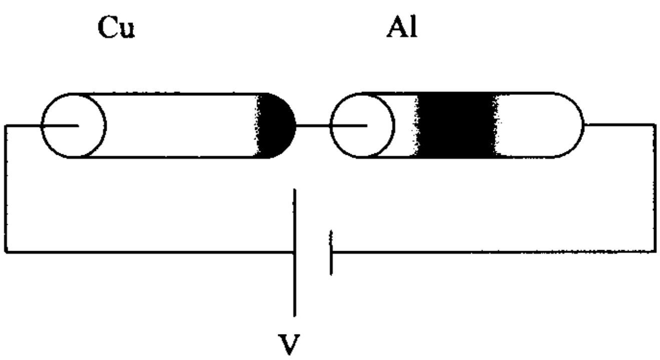

Figure not drawn to scale

Figure Q4 (b)

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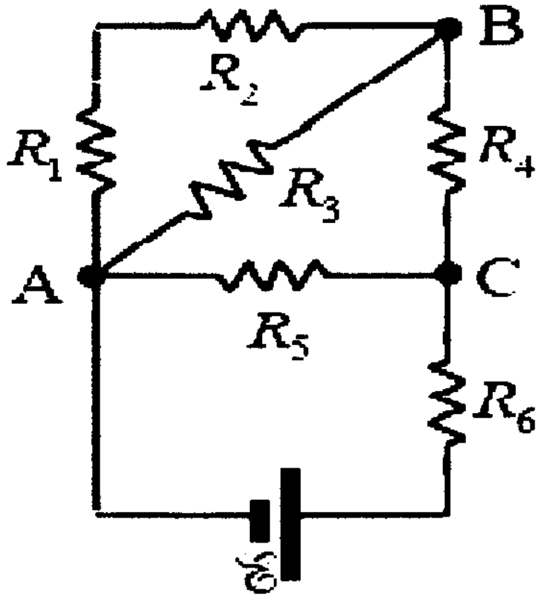

Figure Q4 (c)

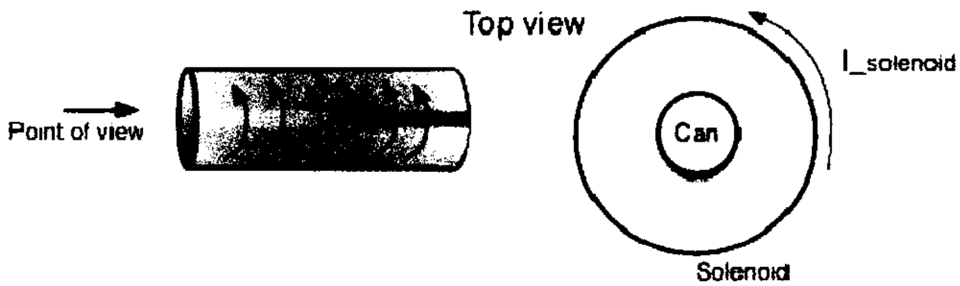

Figure 5 (c)

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List of Constant

1 unified atomic mass unit	$1u - 1.66 \times 10^{-27} kg$
	$- 931\ MeV/c^2$
Proton mass	$m_p = 1.67 \times 10^{-27} kg$
Neutron mass	$m_n = 1.67 \times 10^{-27} kg$
Electron mass	$m_e = 9.11 \times 10^{-31} kg$
Magnitude of the electron charge	$e = 1.60 \times 10^{-19}\ C$
Avogadro's number	$N_o = 6.02 \times 10^{23}\ mol^{-1}$
Universal gas constant	$R = 8.31\ J/(mol.K)$
Boltzmann's constant	$k_B = 1.38 \times 10^{-23}\ J/K$
Speed of light	$c = 3 \times 10^8\ m/s$
Planck's constant	$h = 6.63 \times 10^{-34}\ J.s$
	$= 4.14 \times 10^{-15}\ eV.s$
	$hc = 1.99 \times 10^{-25}\ J.m$
	$= 1.24 \times 103\ eV.\ nm$
Vacuum permittivity	$\epsilon_o = 8.85 \times 10^{-12}\ C^2/\ N.m$
Coulomb's law constant	$k = 1/4\pi\epsilon_o = 9.0 \times 109\ N.m^2/C^2$
Vacuum permeability	$\mu_o = 4\pi \times 10^{-7} (T.m)/A$
Magnetic constant	$k' = \mu_o/4\pi = 10^{-7}\ (T.m)/A$
Universal gravitational constant	$G = 6.67 \times 10^{11}\ m^3/kg.s^2$
Acceleration due to gravity at the Earth's surface	$g = 9.8\ m/s$
1 atmosphere pressure	$1\ atm = 1.0 \times 10^5\ N/m^2$
	$= 1.0 \times 10^5\ Pa$
1 electron volt	$1eV = 1.60 \times 10^{-19}\ J$

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List of Formula

Electrostatic force	$F_e = \dfrac{kq_1q_2}{r^2}$
Electrostatic field	$E = \dfrac{kq_1}{r^2}$
Electrostatic potential energy	$U_e = \dfrac{kq_1q_2}{r}$
Electrostatic potential	$V = \dfrac{kq_1}{r}$
Charge on a capacitor	$Q = VC$
Capacitance	$C = \dfrac{\varepsilon_0 A}{d}$
Energy stored in a capacitor	$U_C = \frac{1}{2} QV = \frac{1}{2} CV^2$
Current (definition)	$I = \dfrac{\Delta Q}{\Delta t}$
Resistance of a wire	$R = \dfrac{\rho l}{A}$
Ohm's Law	$V = IR$
Power in a circuit	$P = IV = \dfrac{V^2}{R} = I^2R$
Equivalent resistor for series	$R_{eq} = R_1 + R_2 + \ldots$
Equivalent resistor for parallel	$R_{eq} = \left(\dfrac{1}{R_1} + \dfrac{1}{R_2} + \ldots\right)^{-1}$
Equivalent capacitance for series	$C_{eq} = \left(\dfrac{1}{C_1} + \dfrac{1}{C_2} + \ldots\right)^{-1}$
Equivalent capacitance for parallel	$C_{eq} = C_1 + C_2 + \ldots$
Magnetic force on a moving charge in a magnetic field	$F_B = qvB\sin\theta$
Magnetic force on a current carrying wire in a magnetic field	$F_B = BIl\sin\theta$
Magnetic field around a current carrying wire	$B = \dfrac{\mu_0 I}{2\pi r}$
Magnetic flux	$\Phi_m = BA\cos\theta$
Average EMF generated by a changing magnetic field	$\varepsilon_{avg} = -\dfrac{\Delta\Phi_m}{\Delta t}$
EMF generated by a loop moving into or out of a magnetic field	$\varepsilon = Blv$