



Final Examination
2018/2019 Academic Session

June 2019

JIF320 – Electricity and Magnetism
(Keelektrikan dan Kemagnetan)

Duration : 3 hours
(Masa : 3 jam)

Please check that this examination paper consists of **SEVEN (7)** pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **TUJUH (7)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini].*

Instructions : Answer **ALL** questions. You may answer **either** in Bahasa Malaysia or in English.

Arahan : Jawab **SEMUA** soalan. Anda dibenarkan menjawab soalan **sama ada** dalam Bahasa Malaysia atau Bahasa Inggeris].

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai].

Useful Information

Universal gravitational constant $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$

$1 \text{ Pa} = 1 \text{ N m}^{-2}$

$1 \text{ atm} = 1.013 \times 10^5 \text{ Pa}$

Molar gas constant $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$

Permeability constant $\mu_0 = 4\pi \times 10^{-7} \text{ wb A}^{-1} \text{ m}^{-1}$ (or H m^{-1})

Permittivity constant $\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$

Planck's constant $h = 6.6 \times 10^{-34} \text{ J s}$

$c = 3 \times 10^8 \text{ m s}^{-1}$

$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$

Electron rest-mass $m_e = 9.11 \times 10^{-31} \text{ kg}$

Mass of proton = 1.007276 amu

Mass of neutron = 1.008665 amu

Avogadro's number = $6.022 \times 10^{23} \text{ mol}^{-1}$

$1 \text{ amu} = 1.66 \times 10^{-27} \text{ kg} = 931 \text{ MeV}$

1. (a). Write down the equation of the Coulomb's force acting on one of two point charges, q_1 and q_2 in a vector form. Interpret the meaning of the subscripts of the vector and the unit vector.

Tuliskan persamaan daya Coulomb yang bertindak pada salah satu daripada dua cas titik, q_1 dan q_2 dalam bentuk vektor. Jelaskan maksud subskrip vektor dan subskrip vektor unit.

(8 marks/markah)

- (b). Figure 1 shows two point charges at the corners of a square. Given that $q = 1.0 \times 10^{-8}$ C and $a = 5.0$ cm.

Rajah 1 menunjukkan dua cas titik pada penjuru suatu segiempat sama. Diberikan $q = 1.0 \times 10^{-8}$ C dan $a = 5.0$ cm.

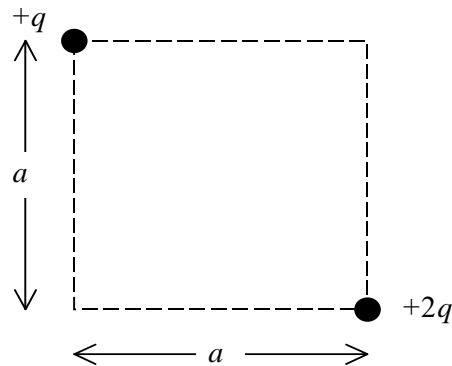


Figure 1
Rajah 1

Calculate the

Hitung

- (i). magnitude and direction of the force acting on point charge $+q$,
magnitud dan arah daya yang bertindak pada cas titik $+q$,
- (ii). magnitude and direction of the electric field at the center of the square.

magnitud dan arah medan elektrik di pusat segiempat tersebut.

(12 marks/markah)

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2. (a). Explain Gauss' s law using, equations and suitable diagrams.

Jelaskan hukum Gauss dengan perkataan, persamaan dan rajah yang bersesuaian.

(8 marks/markah)

- (b). A thin metallic sphere has a radius a and carrying charge, q_a . An identical concentric sphere has a radius, b ($b > a$) and is carrying charge, q_b . Use Gauss' Law to determine the electric field, E at the radial points, r where

Suatu sfera logam nipis mempunyai jejari, a dan membawa cas, q_a . Suatu sfera sepusat seiras mempunyai jejari b , ($b > a$) dan membawa cas, q_b . Gunakan hukum Gauss untuk menentukan medan elektrik, E pada titik-titik jejarian, r berikut

(i). $r < a$,
 $r < a$,

(ii). $a < r < b$.
 $a < r < b$.

(12 marks/markah)

3. (a). Define Kirchoff's laws.
Takrifkan hukum Kirchoff.

(6 marks/markah)

- (b). Determine the current passing through the resistor $2R$ in terms of ε and R as shown in Figure 2. Assume ammeter A has no internal resistance.

Tentukan arus yang melalui perintang $2R$ dalam sebutan ε dan R seperti yang pada Rajah 2. Andaikan ammeter A tidak mempunyai rintangan dalaman.

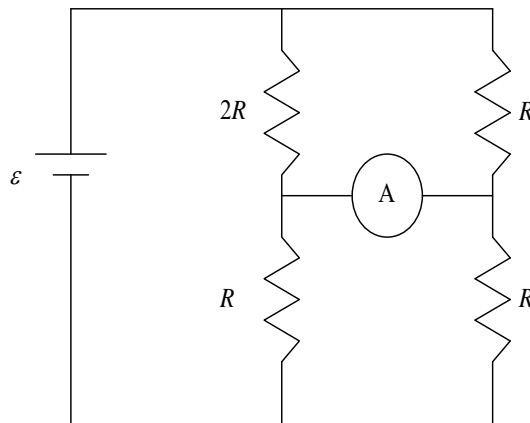


Figure 2

Rajah 2

(14 marks/markah)

4. (a). Explain Ampere's law. Write down the Ampere's law equation for a conductor wire of infinite length and explain the meaning of the symbols used.

Jelaskan hukum Ampere. Tuliskan persamaan hukum Ampere bagi suatu dawai konduktor panjang tak terhingga dan jelaskan maksud simbol-simbol yang digunakan.

(6 marks/markah)

- (b). Prove that for unit vectors,

Buktikan bahawa bagi vektor unit,

(i). $\hat{i} \cdot \hat{i} = \hat{j} \cdot \hat{j} = \hat{k} \cdot \hat{k} = 1$

(ii). $\hat{i} \times \hat{i} = \hat{j} \times \hat{j} = \hat{k} \times \hat{k} = 0$

(14 marks/markah)

5. (a). Lenz's law states that: "The direction of an induced current is such as to oppose the cause producing it." Using proper diagram, clarify what it means.

Hukum Lenz dinyatakan sebagai: "Arah arus teraruh adalah sedemikian ia menentang asbab yang menghasilkannya." Dengan menggunakan gambar rajah yang bersesuaian, jelaskan maksud pernyataan ini.

(8 marks/markah)

- (b). A coil has an inductance of 53 mH and a resistance of 0.35 Ω .

Satu gelung mempunyai induktans 53 mH dan rintangan 0.35 Ω .

- (i). What is the time constant of the coil?

Berapakah pemalar masa gelung?

- (ii). If a 12 V emf is applied across the coil, how much energy is stored in the magnetic field at equilibrium?

Jika 12 V emf disambungkan merentasi gelung, berapakah tenaga disimpan di dalam medan magnet semasa keseimbangan?

- (iii). After how many time constants will be half of this equilibrium energy be stored in the magnetic field?

Selepas berapakah pemalar masa keseimbangan tenaga disimpan dalam medan magnet menjadi separuh daripada tenaga tersimpan semasa keseimbangan?

(12 marks/markah)