Date: January 2016

Duration: 120 minutes

SUBJECT: PHYSICS 3	
Chair of Department of Physics: Signature: Full name: Phan Bao Ngoc	Lecturer: Signature: Full name: Phan Bao Ngoc

INSTRUCTIONS: This is a closed book examination. Use of cell phones, laptops, dictionaries is not allowed.

1/ (15 pts) Determine the angle between a uniform magnetic field of 1 mT and the velocity of a proton, if the proton has an acceleration of 3.0×10^9 m/s^2 and a speed of 6.0×10^4 m/s? ($p = 1.6\times10^{-19}$ C; $m_p = 1.67\times10^{-27}$ kg)

2/ (20 pts) Two concentric coils 1 and 2, lying in the same plane, carry currents $i_1 = 10$ A and $i_2 = 5$ A in the same direction (Figure 1). Coil 1 has 100 turns and a radius of 4.0 cm, coil 2 has 200 turns and a radius of 2.0 cm: (a) Calculate the magnitude of the net magnetic moment of the two-coil system; (b) If the current in coil 1 is then reversed, what is the magnitude of the net magnetic moment of the two-coil system.

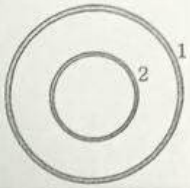

Figure 1

3/ (20 pts) Two wires carrying currents in the direction as shown in Figure 2. Wire 1 with $i_1 = 2.0$ A consists of a circular arc of radius R and two radial lengths. Wire 2 with $i_2 = 0.5$ A is long and straight at a distance R/2 from the center of the arc. For what value of arc angle ϕ (in degree) the net magnetic field B at point P due to the two currents is zero?

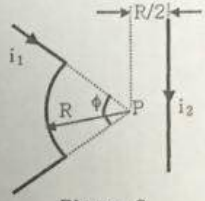

Figure 2

4/ (15 pts) A coil has 150 turns and each turn encloses an area of 1.0 m^2. Determine the rate of change of a magnetic field parallel to the axis of the coil in order to induce a current of 0.1 A in the coil. The resistance of the coil is 150 Ω.

5/ (15 pts) An LC circuit includes a capacitor of 25 μF. The circuit has a period of 5.0 ms. The peak current (the amplitude) is 25 mA. Determine: (a) the inductance; (b) the peak voltage.

6/ (15 pts) A series RLC circuit with L = 300 mH, C = 15 μF, and R = 50 Ω, is connected to an AC voltage source with amplitude 12.8 V and frequency 50 Hz. Find: (a) the current amplitude; (b) the phase difference between the voltage and the current; (c) sketch the phasor diagram of the circuit.

END OF QUESTION PAPER

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January 2016 - Nguyễn Trọng Nghĩa ~ my niece called me best uncle :D

Newton's second Law:

1) $|\vec{F}| = m|\vec{a}|$

$\Rightarrow |\vec{F}| = 1.67 \times 10^{-27} \times 3 \times 10^9 = 5 \times 10^{-18}$ (N)

We have

$|\vec{F}| = |q|vB \sin\phi$

$\Leftrightarrow \phi = \sin^{-1}\left(\frac{|\vec{F}|}{|q|vB}\right) = 0.55$ rad

2) a) Current in the same direction

$\hookrightarrow |w_{net}| = |w_1 + w_2|$

$= |100 \times 10 \times \pi 0.04^2 + 200 \times 5 \times \pi 0.02^2|$

$= 6.28$ (A.m²)

b) Current in opposite direction

$\hookrightarrow |w_{net}| = |w_1 - w_2|$

$= 3.78$ (A.m²)

3)

$\vec{B_1}$ is pointing out

$\vec{B_2}$ is pointing in

$B = B_1 - B_2$

$\Leftrightarrow 0 = \frac{\mu_0 \cdot i_1 \cdot \phi}{4\pi R} - \frac{\mu_0 i_2}{2\pi \frac{R}{2}}$

$\Leftrightarrow \frac{2\phi}{2} = \frac{0.5}{\frac{1}{2}} \Leftrightarrow \phi = 1$ rad $\Rightarrow \phi = 57.3°$

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4/

$\mathcal{E} = iR = 0.1 \times 150 = 15\ (V)$

$|\mathcal{E}| = N\left|\frac{d\Phi_B}{dt}\right| \Leftrightarrow 15 = 150 \cdot \frac{d\Phi_B}{dt}$

$\Leftrightarrow 0.1 = \frac{d(B.A)}{dt}$

$\Leftrightarrow 0.1 = A \cdot \frac{dB}{dt} \Rightarrow \frac{dB}{dt} = 0.1\ (T/s)$

5/

a/ $\omega = 2\pi f = \frac{2\pi}{T} = \frac{2\pi}{5 \times 10^{-3}} = 400\pi\ (rad/s)$

$\omega = \frac{1}{\sqrt{LC}} \Leftrightarrow (400\pi)^2 = \frac{1}{LC} \Rightarrow L = 0.025\ (H)$

b/ peak voltage across the capacitor or the inductor is:

$(iX_L \text{ or } iX_C) = 25 \times 10^{-3} \times \left(0.025 \times 400\pi \text{ or } \frac{1}{25 \times 10^{-6} \times 400\pi}\right)$

$= 0.8\ (V)$

The voltage across the whole circuit in an LC oscillator is always zero.

6/

a/ $\omega = 2\pi f = 100\pi$; $X_L = \omega L = 94.25\ (\Omega)$

$X_C = \frac{1}{\omega C} = 212.21\ (\Omega)$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

$= 128.12\ (\Omega)$

$i = \frac{\mathcal{E}}{Z} = 0.1\ (A)$

b/ $\tan\phi = \frac{X_L - X_C}{R}$

$\Rightarrow \phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right) = -67°$ which meant the current lead the voltage by $67°$