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Name-Surname :
Number :
Department :
Signature :

FIZ 138 PHYSICS II
2010-2011 SPRING SEMESTER
SECOND MIDTERM
20.05.2011

1. The duration of the exam is 100 minutes.
2. There are 30 questions with equal weight in this exam.
3. This question booklet is type "**M**" booklet. Check to see that all pages are type "**M"**
4. Use the appropriate box in the answer page.
5. Five wrong answers nullify a correct answer.
6. If need be, use the back page of the booklet for calculation.
7. Please fill in identity information both the booklet and answer sheet.
8. It is not allowed to use calculator.

GIVENS:

$|e|= 1.6\text{x}10^{-19}$ C
$g=10$ m/s^2
$k=(1/4\pi\varepsilon_0)=9\text{x}10^9$ N.m^2/C^2
$\varepsilon_o=9.0\text{x}10^{-12}$ C^2/N.m^2
$\mu_o=4\pi\text{x}10^{-7}$ T.m/A
$\pi=3$
$m_p=1.7\text{x}10^{-27}$ kg
$m_e=9\text{x}10^{-31}$ kg
1 eV$=1.6\text{x}10^{-19}$ J
$\sin30^o=\cos60^o=0.5$
$\cos30^o=\sin60^o=0.87$
$\sin45^o=\cos45^o=0.7$
$\cos37^o=\sin53^o=0.8$
$\sin37^o=\cos53^o=0.6$
$\sqrt{3}=1.7$; $\sqrt{2}=1.4$;
$e^{-1}=0.37$
$ln2=0.7$
1 tesla$=10^4$ gauss

Number	**Prefix**	**Abbr.**
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^{-2}	centi	c
10^{-3}	mili	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

Formulas

$\mathbf{J} = \text{n e } \mathbf{v}_\text{d}$ $\quad U_E = \frac{1}{2}CV^2$ $\quad q = C\varepsilon(1-e^{-t/\tau_C})$ $\quad \mathbf{F}_B = q\,\mathbf{v}\times\mathbf{B}$

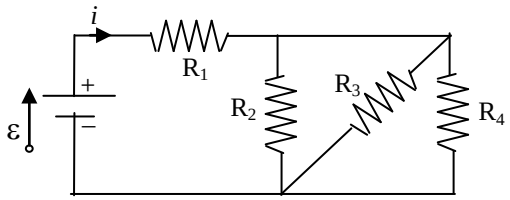
$d\mathbf{F}_\text{B} = \text{i}\,d\mathbf{l}\times\mathbf{B}$ $\quad \boldsymbol{\tau} = \boldsymbol{\mu}\times\mathbf{B}$ $\quad U_B = -\boldsymbol{\mu}\cdot\mathbf{B}$ $\quad d\mathbf{B} = \frac{\mu_0 i}{4\pi}\frac{d\mathbf{l}\times\mathbf{r}}{r^3}$

$\oint \mathbf{B}\cdot d\mathbf{l} = \mu_0 i$ $\quad B = \mu_0 in$ $\quad B = \frac{\mu_0 i}{2\pi r}$ $\quad \Phi_B = \int \mathbf{B}\cdot d\mathbf{S}$

$\oint \mathbf{E}\cdot d\mathbf{l} = -\frac{d\Phi_B}{dt}$ $\quad L = \frac{N\Phi_B}{i}$ $\quad \varepsilon_L = -L\frac{di}{dt}$ $\quad i = \frac{\varepsilon}{R}(1-e^{-t/\tau_L})$

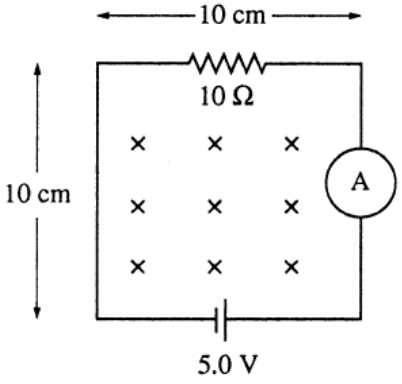
$U_B = \frac{1}{2}Li^2$

1. What is the power delivered (in W) by the battery in the circuit given? Take $R_1 = 200\ \Omega$; $R_2 = R_3 = R_4 = 900\ \Omega$ and $\varepsilon = 10$ V.



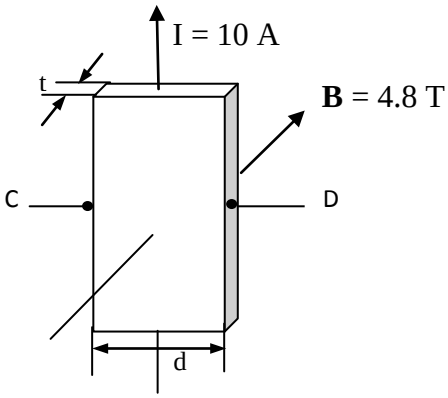
A) 2.0 B) 1.0 C) 3.0
D) 0.1 E) 0.2

2. The circuit shown in the figure is in a uniform magnetic field that is into the page and is decreasing in magnitude at the rate of 150 T/s. What will the ammeter read (in A)?



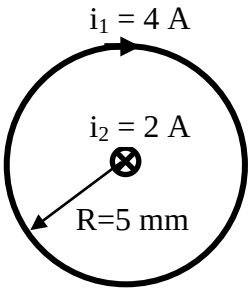
A) 0.15 B) 0.35 C) 0.50
D) 0.65 E) 0.80

3. A strip of copper having a thickness of t = 1 mm and width of d = 1 cm is placed in a uniform magnetic field **B** of magnitude 4.8 T, with **B** perpendicular to the strip. A current I = 10 A is then sent through the strip such that a Hall potential difference V_{CD} appears across the width of the strip. The number of charge carriers per unit volume for copper is 5×10^{28} electrons/m^3. What is the magnitude of Hall potential difference (in μV)?



A) 1 B) 3 C) 5 D) 6 E) 9

4. A circular loop of radius R = 5 mm carries a current i_1 = 4 A in clockwise direction and an infinitely long conducting wire carrying a current i_2 = 2 A, directed into the page, is located at the center of the circular loop (see figure). What is the magnitude of the magnetic force (in N) exerted on the circle by the infinitely long wire?



A) zero B) 1.6 C) 2.4 D) 3.2 E) 4.0

5. The magnetic moment of a compass needle is 0.01 A.m^2, where the magnetic field of the world is 60 μT, and directed to north. What is the work to be done (in μJ) to orient the compass needle, where it has the maximum potential energy?

A) 4.3 B) 3.2 C) 2.4 D) 1.2 E) 0.7

6. A copper wire of 1 mm radius carries a current of 6 A. What is the magnetic energy density (in J/m^3) at the surface of the wire?

A) 5.6 B) 4.8 C) 3.6 D) 1.2 E) 0.6

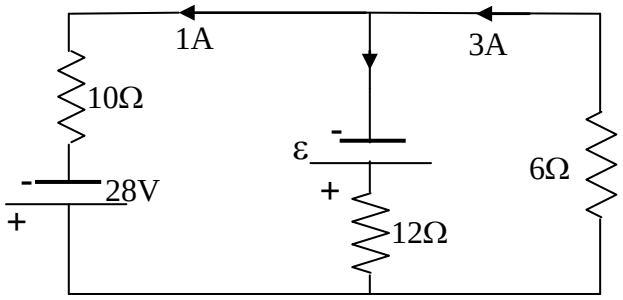
7. A coil with an inductance 40 mH and resistance 12 Ω is suddenly connected to an ideal battery of ε = 60 V. How much energy (in J) is stored in the magnetic field when the equilibrium current exists in the coil?

A) 1.5 B) 2.5 C) 0.5 D) 0.2 E) 3.2

8. An RLC series circuit has R = 4 Ω, X_C = 3 Ω, and X_L = 6 Ω. What is the impedance (in Ω) of this circuit?

A) 5 B) 7 C) 8 D) 13 E) 1

9. In the circuit shown, find the unknown emf ε (in V).



A) 6 B) 18 C) 36
D) 12 E) 42

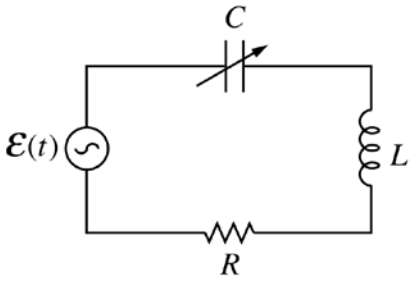
10. What is the magnetic field (in T) 6 m below a power line carrying 12000 A of current?

A) 8×10^{-4} B) 4×10^{-4} C) 3×10^{-3} D) 4×10^{4} E) 3×10^{3}

11. A 35 V ideal battery, a 50 Ω resistor, and a 150 mH inductor are connected in series with an open switch. The switch is suddenly closed. How long (in ms) after closing the switch will the current through the inductor reach one-half of its maximum value?

A) 2.1 B) 3.0 C) 4.1 D) 6.2 E) 2.7

12. An AC circuit consists of the elements shown in the figure, with R = 10 MΩ, L = 25 mH, and C an adjustable capacitance. The AC generator supplies a signal with an amplitude of 40 volts and angular frequency of 1000 rad/s. For what value of C (in μF) is the amplitude of the current maximized?



A) 25 B) 40 C) 30 D) 60 E) 80

13. In an oscillating LC circuit, the total stored energy is U. What is the maximum energy stored in the capacitor during one cycle?

A) U/2 B) U/√2 C) U D) U/(2π) E) U/π

14. An initially uncharged 50 μF capacitor is connected through a 300 Ω resistor to a 12 V battery. How long after (in ms) the capacitor will be charged to $q_0/2$, where q_0 is the maximum charge of the capacitor?

A) 0.7 B) 6.5 C) 21.0 D) 15.0 E) 10.5

15. An LC circuit consisting of an L = 10 mH inductor oscillates at a frequency of 5 kHz. If the maximum current is 18 mA, what is the maximum value of charge (in μC) oscillating in the circuit?

A) 2 B) 9 C) 0.4 D) 5 E) 0.6

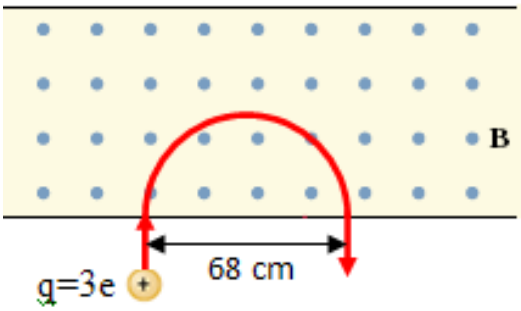
16. What is the total energy (in J) in a volume of 1 m^3 in which there is an electric field of 10^6 V/m and a magnetic field of 6 mT?

A) 4.5 B) 15 C) 19.5 D) 10.5 E) 24

17. An AC voltage generator producing 14 V (rms) at 100 rad/s is connected in series with a 20 Ω resistor, a 400 mH inductor, and a 500 μF capacitor. What is the *rms* current (in A)?

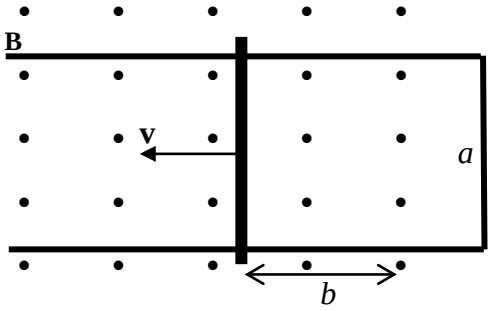
A) 0.14 B) 0.28 C) 0.60 D) 0.50 E) 0.70

18. A particle that has a charge of magnitude 3e and mass 12 times the proton mass enters a uniform magnetic field of 0.25 T. It is bent in a semicircle of diameter 68 cm, as shown in figure. Find the speed of particle (in m/s).



A) 1.0×10^6 B) 2.0×10^6 C) 4.0×10^6
D) 1.0×10^3 E) 2.0×10^3

19. A uniform magnetic field of magnitude 1.0 T is directed out of the page as shown in the figure. A bar rides on a pair of long, horizontal, conducting rails separated by a distance a = 0.25 m to the left direction with its position expressed by b = 4 + t^2, where b is in meters and t in seconds. What is the induced emf (in V) in the loop at t = 4 s?



A) 2 B) 4 C) 0.6 D) 0.8 E) 0

20. A sinusoidal voltage V (t) has an *rms* value of 100 V. What is its maximum value (in V)?

A) 100 B) 700 C) 70 D) 140 E) 200

21. At one instant an electron is moving in the xy plane, the components of its velocity being $v_x = 5 \times 10^5$ m/s and $v_y = 3 \times 10^5$ m/s. A magnetic field of 0.5 T is applied in the positive x direction. What is the magnetic force (in N) acting on the electron at that instant?

A) 0 B) $6.4\times10^{-14}\mathbf{k}$ C) $5.1\times10^{-14}\,\mathbf{j}$ D) $2.4\times10^{-14}\,\mathbf{k}$ E) $7.5\times10^{-14}\mathbf{i}$

22. Find the magnetic dipole moment (in $A \cdot m^2$) of a multi-turn coil of radius 1 cm, which is formed by winding a wire of length 3 m, carrying a current of 12 A.

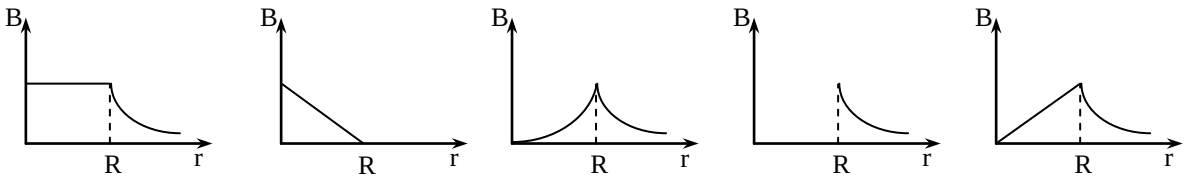
A) 0.12 B) 0.18 C) 0.24 D) 0.36 E) 0.42

23. Lines of the magnetic field produced by a long straight wire carrying a current:

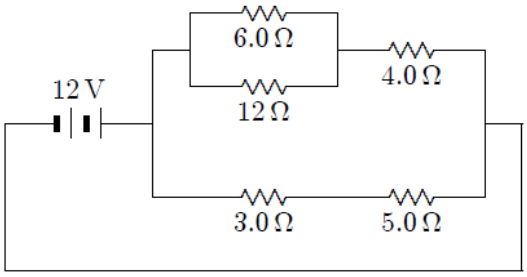
A) are concentric circles around the wire.
B) are in the direction of the current.
C) are opposite to the direction of the current.
D) leave the wire radially.
E) are magnetic lines similar to those produced by a bar magnet.

24. The current i, within a wire whose cross section has radius R is known to be distributed uniformly over that cross section. Which one of the figures shows the magnetic field as a function of the distance r from the wire's axis within the wire and outside the wire?

A) B) C) D) E)

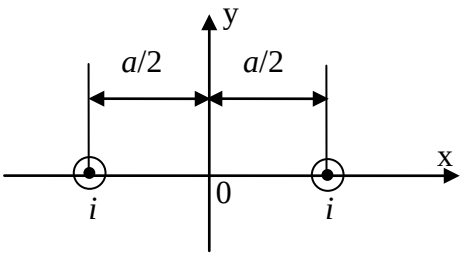


25. What is the current (in A) in the 5.0 Ω resistor in the circuit shown?



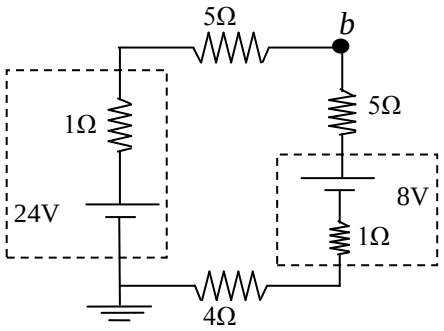
A) 0.42 B) 0.67 C) 1.5
D) 2.4 E) 3.0

26. The drawing shows two long, straight wires that are parallel to each other and carry a current of magnitude *i* toward you. The wires are separated by a distance *a*. Which one of the following expressions correctly gives the magnitude of the total magnetic field at the origin of the *x*-*y* coordinate system?



A) $\frac{\mu_0 i}{2a}$ B) $\frac{\mu_0 i}{\sqrt{2}a}$ C) $\frac{\mu_0 i}{2\pi a}$ D) $\frac{\mu_0 i}{\pi a}$ E) zero

27. Find the potential (in V) at point *b* in the circuit.

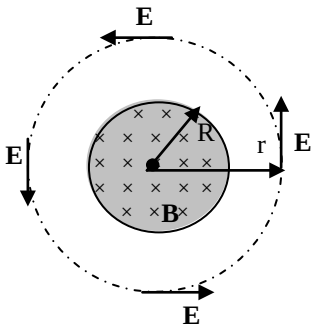


A) 2 B) 9 C) 18
D) 10 E) 24

28. At the instant when the current in a coil increasing at a rate of 0.064 A/s, the magnitude of the self-induced emf is 0.016 V. What is the inductance (in H) of the coil?

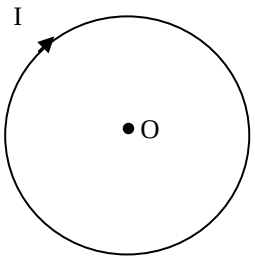
A) 0.250 B) 0.275 C) 0.500 D) 0.750 E) 1.250

29. A cylindrical region of radius R = 4 cm contains a uniform magnetic field parallel to its axis. If the electric field induced at a point r = 8 cm from the cylinder axis is 20×10^{-3} V/m, the magnitude of magnetic field must be changing (in T/s) at the rate:



A) 0 B) 1 C) 2
D) 4 E) 5

30. A circular wire of radius R = 2 cm lies in the plane of the page and carries a current I = 10 A in clockwise direction. In the figure point O marks the center of the circle. Find the magnitude (in G) and direction of the magnetic field at point O.



A) 3; ⊙ B) 3; ⊗ C) 1; ⊗ D) 6; ⊙ E) 0