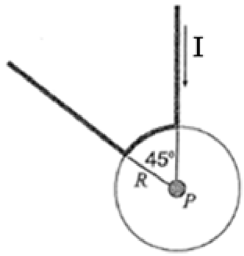
FIZ102E PHYSICS-II

***PART II.** Multiple Choice*

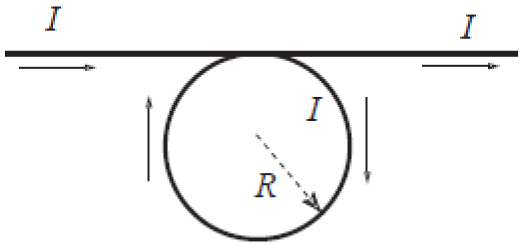
1) In the figure shown, a conductor consisting of a circular arch of 45^0 with radius R and two wires attached to this arc going radially outward (and effectively infinite in length) has a current I passing through it. What is the magnitude of the magnetic field at point P, the center of the arc?

a) $(\mu_0 I)/(16R)$ b) $(\mu_0 I)/(8R)$ c) 0 d) $(\mu_0 I)/(2R)$ e) $(\mu_0 I)/(4\pi R)$



2) An infinitely long insulated wire carrying a current *I* is bent into the shape shown (straight line plus circle of radius *R* with the currents in the direction shown). The magnitude of the field *B* at the center of the circle is:

a) $\frac{\mu_0 I}{2R}(1+\pi)$ b) $\frac{\mu_0 I}{2\pi R}$ c) $\frac{\mu_0 I}{2R}$ **d) $\boldsymbol{\frac{\mu_0 I}{2\pi R}(1+\pi)}$** e) $\frac{\mu_0 I\pi}{2R}$



3) Consider a charged circular loop of radius R and linear charge density λ (charge per unit length) glued down to the loop. Suppose the loop is rotating with angular velocity ω about the axis normal to the loop and going through its center. The loop acts as a magnetic dipole with magnetic dipole moment μ given by

a) $\mu=\lambda\omega\pi R^2$ **b) $\boldsymbol{\mu=\lambda\omega\pi R^3}$** c) $\mu=2\lambda\omega\pi R^2$ d) $\mu=\lambda\pi R^2$ e) $\mu=2\lambda\omega\pi R^3$

4) A charged particle, q, is moving with speed v perpendicular to a uniform magnetic field. A second identical charged particle is moving with speed 2v perpendicular to the same magnetic field. The time to complete one full circular revolution for the first particle is T_1. The time to complete one full circular revolution for the particle moving with speed 2v is

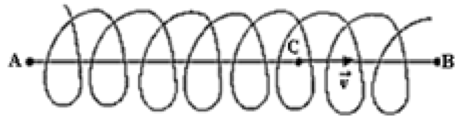
a) $\boldsymbol{T_1}$ b) $\frac{T_1}{2}$ c) $\frac{T_1}{4}$ d) $2T_1$ e) $4T_1$

5) The magnetic field of a solenoid (long compared to its radius) is used to keep a proton in a perfectly circular orbit. The solenoid has n windings per meter of length and has a radius of r. If the proton with charge q has a velocity **v**, what is the minimum current needed to keep the proton orbiting within the confines of the solenoid in a plane perpendicular to the solenoid axis?

a) $i=\frac{\mu_0 nv}{qr}$ b) $i=\frac{mv}{qr\mu_0}$ c) $i=\frac{mv^2}{qr^2\mu_0 n}$ d) $i=\frac{mv}{qr}$ **e) $\boldsymbol{i=\frac{mv}{qr\mu_0 n}}$**

6) A solenoid carries a current I. An electron is injected with velocity **v** along the axis AB of the solenoid. When the electron is at C, it experiences a force that is

a) zero b) not zero and along AB c) not zero and along BA d) not zero and perpendicular to the page e) none of these is correct



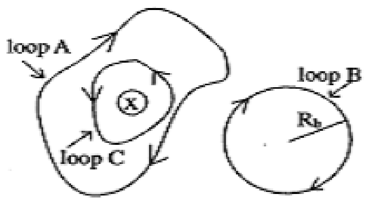
7) Two parallel conductors each of 0.50 m length, separated by 5.0×10^{-3} m and carrying 3.0 A in opposite directions, will experience what type and magnitude of mutual force? (magnetic permeability in empty space $\mu_0 = 4\pi \times 10^{-7}$ T.m/A).

a) repulsive, 0.6×10^{-4} N b) attractive, 0.06×10^{-4} N **c) repulsive, 1.8×10^{-4} N**
d) attractive, 1.8×10^{-4} N e) repulsive, 3.6×10^{-4} N

8) Consider a very long wire carrying a steady state current I going into the page as indicated in the figure below. Three oriented loops are also shown in the figure below. Which statement is correct?

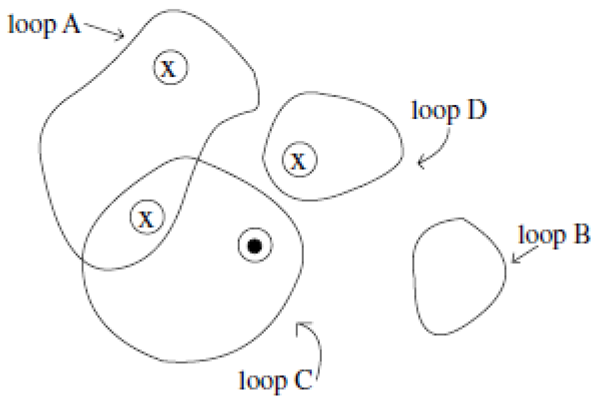
a) $\oint_B \vec{B}.\vec{dl} = \mu_0 I$ b) $\oint_A \vec{B}.\vec{dl} = -\mu_0 I$ c) The magnetic field at every point around loop B is $\frac{\mu_0 I}{2\pi R_b}$

d) $\oint_A \boldsymbol{\vec{B}.\vec{dl}} > \oint_B \boldsymbol{\vec{B}.\vec{dl}} > \oint_C \boldsymbol{\vec{B}.\vec{dl}}$ e) $\oint_A \vec{B}.\vec{dl} = 0$



9) Consider four equal currents going into or out of the page as indicated in the figure below. Rank the line integral of the magnetic field $\oint \vec{B} \cdot \vec{dl}$ (from greatest to least) taken in the clockwise direction.

(a) $A = B = C = D$
(b) $A > C > B > D$
(c) $D > B > C > A$
(d) $B = C > D > A$
(e) $A > D > C = B$



10) Which oneof the following line integrals is correct? Note: The direction of the loops orientation is shown in the diagram.

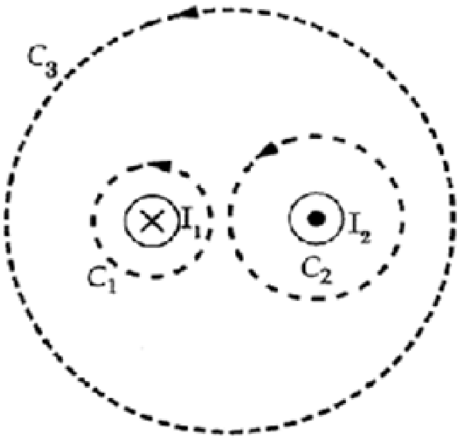
A) $\oint_{C1} \vec{B}\cdot d\vec{l} = \mu_0 I_1$

B) $\oint_{C2} \vec{B}\cdot d\vec{l} = -\mu_0 I_2$

C) $\oint_{C1} \vec{B}\cdot d\vec{l} = -\mu_0 I_2$

D) $\oint_{C3} \vec{B}\cdot d\vec{l} = \mu_0 (I_2 - I_1)$

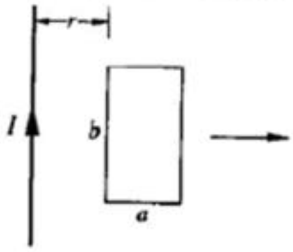
E) $\oint_{C3} \vec{B}\cdot d\vec{l} = \mu_0 (I_1 - I_2)$



11) A long straight wire of radius R carries a current density J=kr A/m^2 where k is a constant. The magnetic field for r>R is

a) $\boldsymbol{\mu_0 kR^3/3r}$ b) $2\pi\mu_0 kR^3/3r$ c) $2\pi\mu_0 kR^2/r$ d) $2\pi\mu_0 kR/2$ e) none of the

12) A rectangular loop of wire with dimensions shown is coplanar with a long wire carrying current I. The distance between the wire and the left side of the loop is r. The loop is pulled to the right as indicated.



What are the directions of the induced current in the loop and the magnetic forces on the left and the right sides of the loop as the loop is pulled?

	Induced Current	Force on Left Side	Force on Right Side
(A)	Counterclockwise	To the left	To the right
(B)	Counterclockwise	To the left	To the left
(C)	Counterclockwise	To the right	To the left
(D)	Clockwise	To the right	To the left
(E)	Clockwise	To the left	To the right

Electromagnetism ⇒}Faraday Law

The induced current would act, according to Lenz Law, to oppose the change. In this case, since the field is decreasing (the wire is being pulled away from the field), the induced current would act to increase the field. On the side closest to the long wire, it would thus point in the same direction as the current from the long-wire. This eliminates all but choices (D) and (E).

Now, since the rectangular loop wire can*not* induce a force on itself, the force is due to the field from the long wire. To the left of the loop, the long wire has a field pointing into the page, and thus the force there is left-wards. One can check again that choice (E) is right by right-hand-ruling the field on the right side of the loop. Since the field due to the long wire is again into the page, the force here is towards the right (since the current runs down the page on the right side of the loop).

above

13) Consider a solenoid with radius R and length L ($R \ll L$). The magnetic field at the center of the solenoid is B_0. A second solenoid is constructed that has twice the radius, twice the length, and carries twice the current as the original solenoid, but has the same number of turns per meter. The magnetic field at the center of the second solenoid is

(A) $B_0/4$. (B) $B_0/2$. (C) B_0. (D) $2B_0$. (E) $4B_0$.

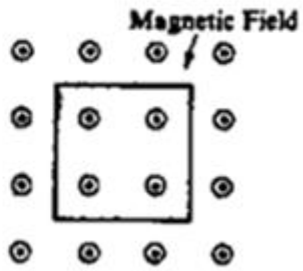
$B = \mu_0 n i$

14) Consider a charged circular loop of radius R and linear charge density λ (charge per unit length) glued down to the loop. Suppose the loop is rotating with angular velocity ω about the axis normal to the loop and going through its center. The loop acts as a magnetic dipole with magnetic dipole moment μ given by

1. $\mu = \lambda \pi R^2$ 2. $\mu = \lambda \omega \pi R^2$ 3. $\mu = 2\lambda \omega \pi R^2$

4. $\mu = \lambda \omega \pi R^3$ 5. $\mu = 2\lambda \omega \pi R^3$ 6. I don't know

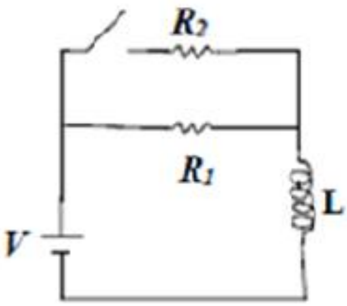
15) A square loop of wire of side 0.5 meter and resistance 10^{-2} ohm is located in a uniform magnetic field of intensity 0.4 tesla directed out of the page as shown. The magnitude of the field is decreased to zero at a constant rate in 2 seconds. As the field is decreased, what are the magnitude and direction of the current in the loop? (Neglect the self inductance of the loop.)



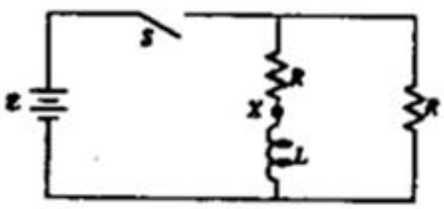
(a) zero (b) 5 A, counterclockwise (c) 5 A, clockwise
(d) 20 A, counterclockwise (e) 20 A, clockwise

16) The switch in the circuit below has been opened a very long time. What is the current through resistor R_2 immediately after the switch is closed?

(A) V / R_1.
(B) $V\left[\frac{R_1+R_2}{R_1 R_2}\right]$.
(C) $V / (R_1 + R_2)$
(D) V / R_2.
(E) 0.



17) Questions 1-3 relate to the circuit shown in which the switch S had been open for a long time.



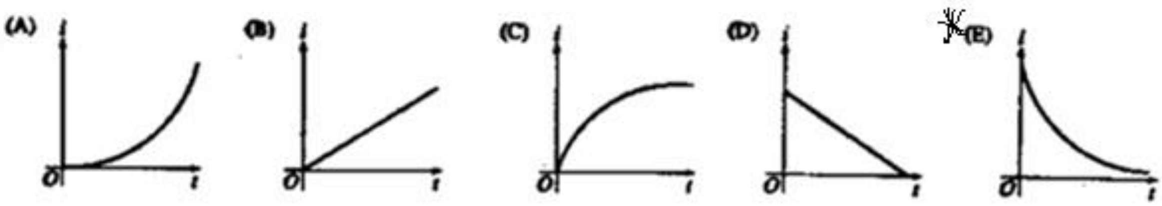
1. What is the instantaneous current at point X immediately after the switch is closed?

(a) 0 (b) $\frac{\varepsilon}{R}$ (c) $\frac{\varepsilon}{2R}$ (d) $\frac{\varepsilon}{LR}$ (e) $\frac{\varepsilon R}{2R}$

2. When the switch has been closed for a long time, what is the energy stored in the inductor?

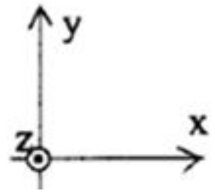
(a) $\frac{L\varepsilon}{2R}$ (b) $\frac{L\varepsilon^2}{2R^2}$ (c) $\frac{L\varepsilon^2}{4R^2}$ (d) $\frac{LR^2}{2\varepsilon^2}$ (e) $\frac{\varepsilon^2 R^2}{4L}$

3. After the switch has been closed for a long time, it is opened at time $t = 0$. which of the following graphs best represents the subsequent current i at point X as a function of time t?



18) If the magnetic field in an EM wave is in the positive x-direction and the electric field in the wave is in the positive y-direction, the wave is traveling in the

Definition of coordinate system



A) x-y plane.
B) x-direction.
C) negative z-direction.
D) positive z-direction.
E) direction halfway between the x- and y-directions.

19) Which of the following equations implies that it is impossible to isolate a magnetic pole?

A) $\oint \vec{E} \bullet d\vec{A} = \frac{q}{\varepsilon_0}$. B) $\oint \vec{E} \bullet d\vec{l} = -\frac{d\Phi_B}{dt}$. C) $\oint \vec{B} \bullet d\vec{A} = 0$. D) $\oint \vec{B} \bullet d\vec{l} = \mu_0 I + \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$.

20) If the current through an inductor is doubled, the magnetic energy density of the magnetic field

A) remains the same B) is doubled. C) is halved. D) is quadrupled E) is quartered.

21) In an electromagnetic wave, what does a short wavelength mean?

a. The wave has high energy. b. The wave has low energy.
c. Energy is not related to wavelength of electromagnetic waves.

23) The intensity of an EM wave propagating in vacuum is given as I. If the amplitude of the electric field component of this wave is doubled, what would be the new intensity?

a) 2I b) I/2 c) I/4 d) I e) 4I

24) The electric field of an electro-magnetic wave is given by $E_y = 25 \sin(2.4 \times 10^6 \pi (x - 3.0 \times 10^8 t))$. What is the wavelength of the wave?

A) 4.8×10^7 m B) 2.1×10^{-8} m C) 2.1×10^{-7} m D) 8.3×10^{-7} m E) 7.5×10^{-6} m

25) A 60.0-W light bulb emits spherical electromagnetic waves uniformly in all directions. If 50.0% of the power input to such a light bulb is emitted as electromagnetic radiation, what is the radiation intensity at a distance of 2.00 m from the light bulb?

A) 15 W/m^2 B) 4.8 W/m^2 C) 2.4 W/m^2 D) 0.60 W/m^2 E) 1.2 W/m^2

26) If the current through an inductor is doubled, the magnetic energy density of the magnetic field

A) remains the same B) is doubled. C) is halved. D) is quadrupled E) is quartered.

27) Which of the following is true about plane waves?

a) They are spherical waves that have traveled a long distance.

b) They increase in power as they cover more distance.

c) They increase in power as they travel from a medium with a lower index of refraction to one with a higher index.

d) Their frequency increase as they travel.

e) They do not exist in nature.

28) Identify whether each statement below about magnetism is true or false.

a. Effect on charges: (One is true, one is false.)

T F A magnetic field exerts a net force only on moving charged particles.

T F A magnetic field exerts a net force on any electrically charged particle.

b. Positive and negative charges: (One is true, one is false.)

T F A magnetic field has the same effect on positive and negative charges.

T F A magnetic field has opposite effects on positive and negative charges.

c. Field lines: (One is true, one is false.)

T F Magnetic field lines begin at north poles and end at south poles.

T F Magnetic field lines run in continuous closed loops, with no beginning or end.

d. Magnetic poles: (One is true, one is false.)

T F Some particles are magnetic north poles, and others are magnetic south poles.

T F Magnetic north and south poles can never be separated from each other.

29) What is light composed of?

a. Electric and magnetic fields.

b. Moving magnetic particles.

c. Moving electric charges.

d. Quarks.

e. Neutrinos.

30) In an electromagnetic wave, what does a short wavelength mean?

a. The wave has high energy.

b. The wave has low energy.

c. Energy is not related to wavelength of electromagnetic waves.

31) **"There are no currents and permanent magnets present, but there is a non-zero magneti field" what else must be present**

a) Electric charge b) constant electric field c) changing electric field d)it is imposible to have a magnetic field without a current e) none of them

32) The intensity of an EM wave propagating in vacuum is given as I. If the amplitude of the electric field component of this wave is doubled, what would be the new intensity?

a) 2I b) I/2 c) I/4 d) I e) 4I