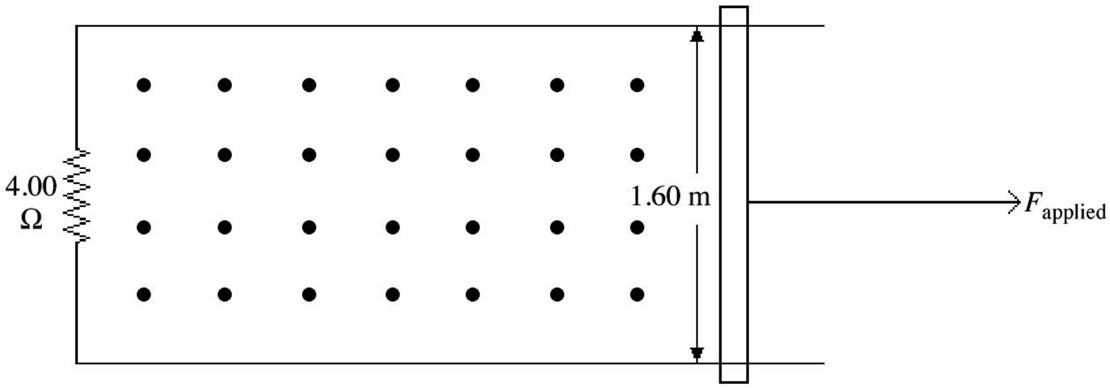
1) A conducting bar moves along frictionless conducting rails connected to a 4.00-Ω resistor as shown in the figure. The length of the bar is 1.60 m and a uniform magnetic field of 2.20 T is applied perpendicular to the paper pointing outward, as shown.



Magnetic field is outward (●)

(i) What is the applied force required to move the bar to the right with a constant speed of 6.00 m/s?

Answer: (i)
- A) 74.4 N
- B) 111. N
- C) 18.6 N
- D) 8.45 N
- E) 11.6 N

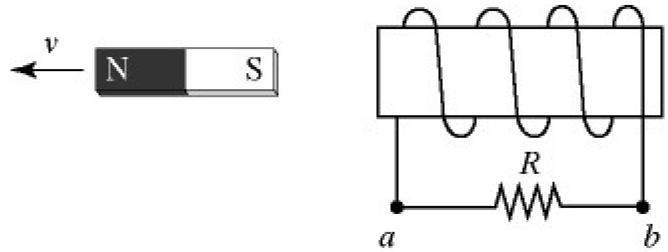
(ii) At what rate is energy dissipated in the 4.00 Ω resistor?

Answer: (ii)
- A) 445 W
- B) 112 W
- C) 18.6 W
- D) 27.9 W
- E) 21.1 W

Answers: (i) 18.6 N (ii) 112 W

LO 36/49/60

2) In the figure, a bar magnet moves away from the solenoid. The induced current through the resistor *R* is

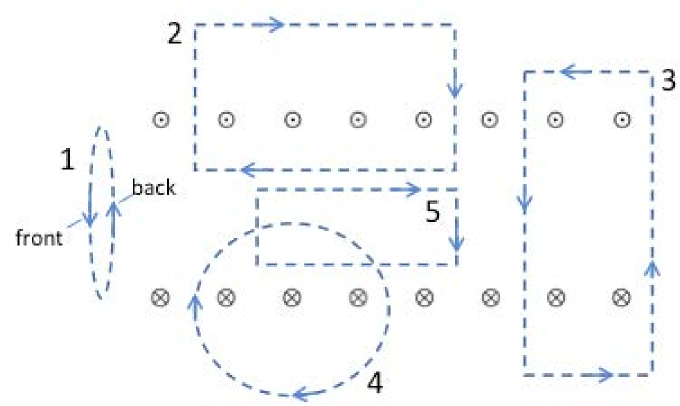


A) from *a* to *b*.
B) from *b* to *a*.
C) There is no induced current through the resistor.
D) Can be in either direction, sign changes depending on the magnitude of R and strength of the magnet.

Answer: A
LO 47/56/57/58

3) The figure below shows a solenoid winding in cross section, with the current I flowing out of the page on the top of the coil and into the page at the bottom of the coil. The dashed figures are loops with arrows showing the direction of circulation for calculating the $\int \vec{B} \cdot \vec{dl}$. Loops 2 – 5 are all in the plane of the page, while loop 1 faces the solenoid with the circulation indicated by the labels front and back as shown. Considering the $\int \vec{B} \cdot \vec{dl}$ taken around each of the five closed loops, for which of the loop(s) will the integral yield a **positive nonzero** result?

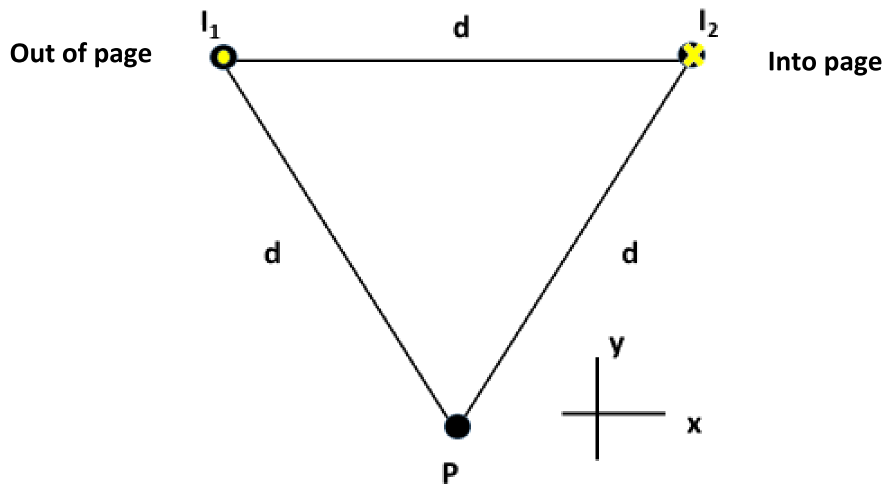
A) All of them
B) None of them
C) Loop 1 only
D) Loop 2 only
E) Loop 3 only
F) Loop 4 only
G) Loops 2,5
H) Loops 2,4



Answer: F
LO 47,54

4) The figure shows two long, parallel current-carrying wires. The wires carry equal currents $I_1 = I_2 = 20\ A$ in the directions indicated and are located a distance $d = 0.5$ m apart. Calculate the magnitude and direction of the magnetic field at the point P that is located an equal distance d from each wire.

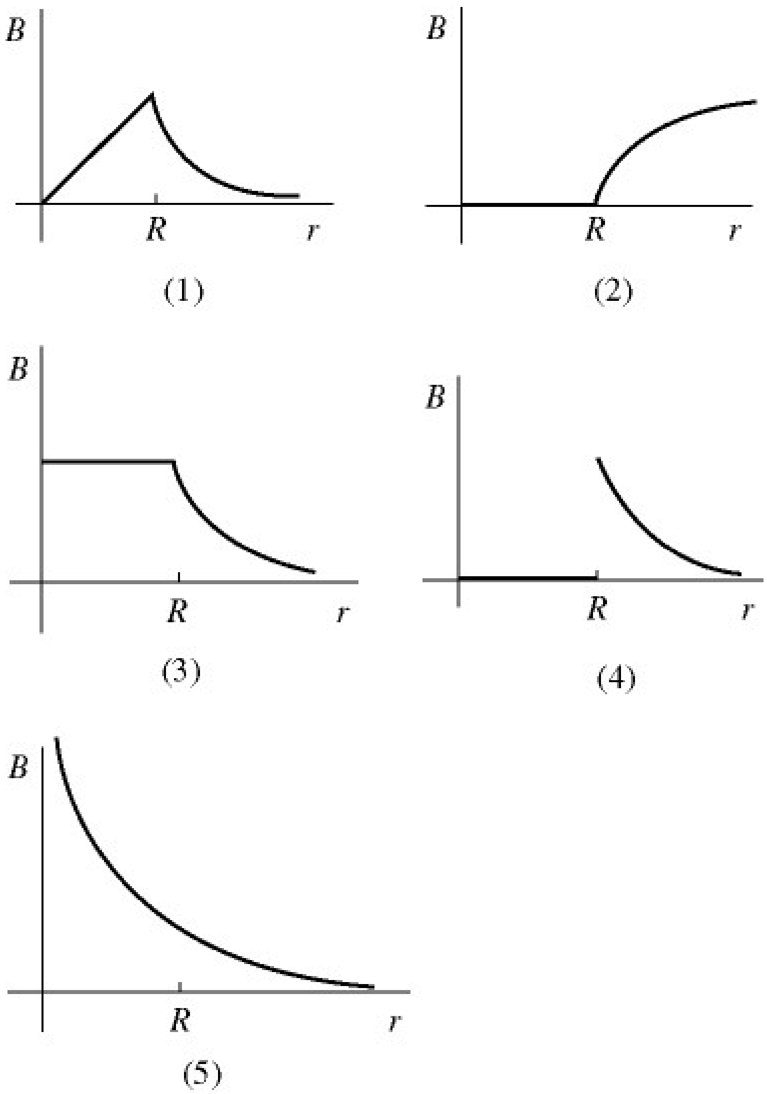
$(\mu_0 = 4\pi \times 10^{-7}\ \mathrm{T \cdot m/A})$



A) 8 µT downward
B) 8 µT upward
C) 4 µT downward
D) 4 µT upward
E) 4 µT to the right
F) 16 µT to the right
G) 16 µT downward
H) 16 µT to the left

Answer: B
LO 2/54X2

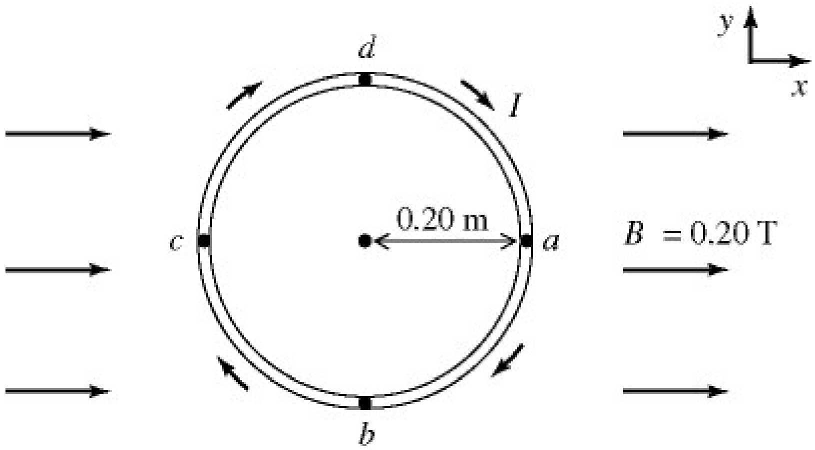
5) A very long, solid, conducting cylinder of radius R carries a current along its length uniformly distributed throughout the cylinder. Which one of the graphs shown in the figure most accurately describes the magnitude B of the magnetic field produced by this current as a function of the distance r from the central axis?



A) 1
B) 2
C) 3
D) 4
E) 5

Answer: A
LO 5/54

6) A rigid circular loop has a radius of 0.20 m and is in the *xy*-plane. A clockwise current *I* is carried by the loop, as shown. The magnitude of the magnetic moment of the loop is $0.75\ \text{A} \cdot \text{m}^2$. A uniform external magnetic field, *B* = 0.20 T in the positive *x*-direction, is present. Chose the closest answer from the lists below.



(i) What is the current in the loop?
Answer (i):

a) 0.6 A
b) 0.9 A
c) 0.09 A
d) 6.0 A
e) 3.0 A

(ii) Find the magnitude of the magnetic torque exerted on the loop.
Answer (ii):

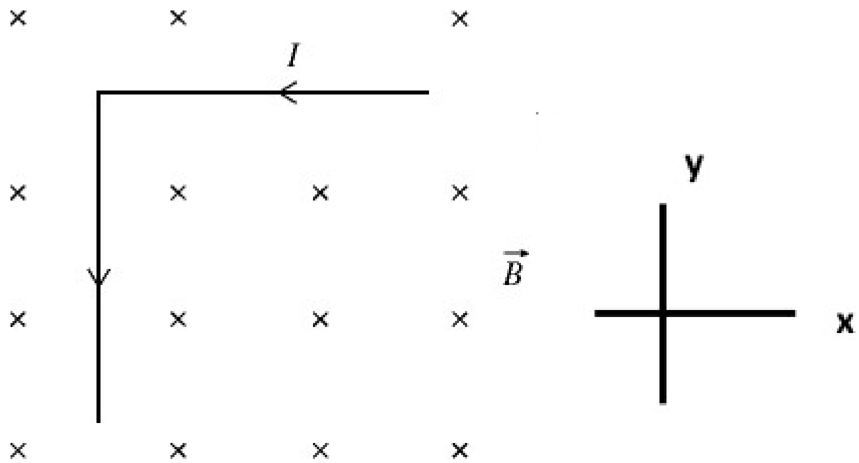
a) 0.10 N · m
b) 0.15 N · m
c) 0.20 N · m
d) 0.25 N · m
e) 0.30 N · m
f) 0 N · m

(iii) If the loop is released from rest, in what direction will points *a* and *c* initially move?
Answer (iii):

a) *a* moves into the plane and *c* moves out of the plane
b) *a* will be stationary and *c* moves out of the plane
c) *a* moves out of the plane and *c* moves into the plane
d) *c* will be stationary and *a* will move into the plane
e) the loop will not move

LO 50X3

7) An L-shaped metal machine part is made of two equal-length segments that are perpendicular to each other and carry a 4.50-A current as shown in the figure. The current is brought to this part on a wire lead on the right from above the part parallel to the magnetic field and exits the part on the left side on a wire heading out of the page that is parallel to the magnetic field. This part is in an external 1.20-T magnetic field that is oriented perpendicular to the plane of the part, as shown.



(i)What is the magnitude of the NET magnetic force that the field exerts on the part?

Answer (i)

A) 8.10 N
B) 11.5 N
C) 16.2 N
D) 22.9 N
E) 32.4 N

(ii) What is the direction of the NET magnetic force acting on the part?

Answer (ii)

A) in the positive x-direction
B) in the negative x-direction
C) in the positive y-direction
D) in the negative y-direction
E) 45^o degrees below the +x-direction
F) 45^o degrees above the +x-direction
G) 45^o degrees above the –x-direction
H) 45^o degrees below the –x-direction

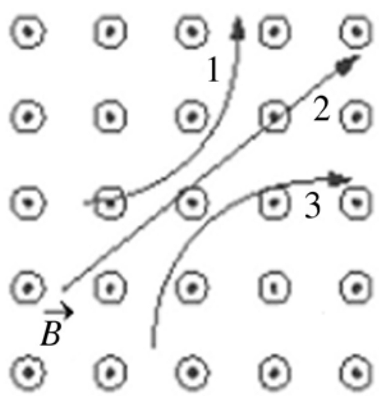
Answer: B
Answer: E
LO 2/49X2

8) An electron moving with a velocity $\vec{v} = 5 \times 10^7\ {}^{m}/_{s}\ \hat{\imath}$ enters a region of space where perpendicular electric and a magnetic fields are present. The electric field is $\vec{E} = 10^4\ {}^{V}/_{m}\ \hat{\jmath}$. What magnetic field will allow the electron to go through the region without being deflected?

A) $\vec{B} = +2.0 \times 10^{-4}\ \mathrm{T}\ \hat{\jmath}$
B) $\vec{B} = -2.0 \times 10^{-4}\ \mathrm{T}\ \hat{\jmath}$
C) $\vec{B} = +2.0 \times 10^{-4}\ \mathrm{T}\ \hat{k}$
D) $\vec{B} = -2.0 \times 10^{-4}\ \mathrm{T}\ \hat{k}$
E) $\vec{B} = +5.0 \times 10^{-4}\ \mathrm{T}\ \hat{k}$
F) $\vec{B} = +5.0 \times 10^{-4}\ \mathrm{T}\ \hat{\imath}$
G) $\vec{B} = +5.0 \times 10^{-4}\ \mathrm{T}\ \hat{\jmath}$

Answer: C
LO 2/46/48

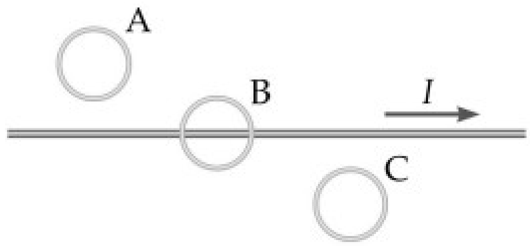
9) Three particles travel through a region of space where the magnetic field is out of the page, as shown in the figure. The electric charge of each of the three particles is, respectively,



A) 1 is neutral, 2 is negative, and 3 is positive.
B) 1 is neutral, 2 is positive, and 3 is negative.
C) 1 is positive, 2 is neutral, and 3 is negative.
D) 1 is positive, 2 is negative, and 3 is neutral.
E) 1 is negative, 2 is neutral, and 3 is positive.

Answer: E
LO 46X3

10) The long straight, thin wire in the figure carries a current I that is decreasing with time at a constant rate. The circular loops A, B, and C are stationary, and all lie in a plane containing the wire, with B sitting nearly touching the wire, but with no electrical contact. The induced emf in each of the loops A, B, and C is such that



A) no emf is induced in any of the loops.
B) a counterclockwise emf is induced in all the loops.
C) loop A has a clockwise emf, loop B has no induced emf, and loop C has a counterclockwise emf.
D) loop A has a counter-clockwise emf, loop B has no induced emf, and loop C has a clockwise emf.
E) loop A has a counter-clockwise emf, loops B and C have clockwise emfs.
F) Only loop B has a non-zero emf, the others are zero.
G) A clockwise emf is induced in all the loops.

Answer: D

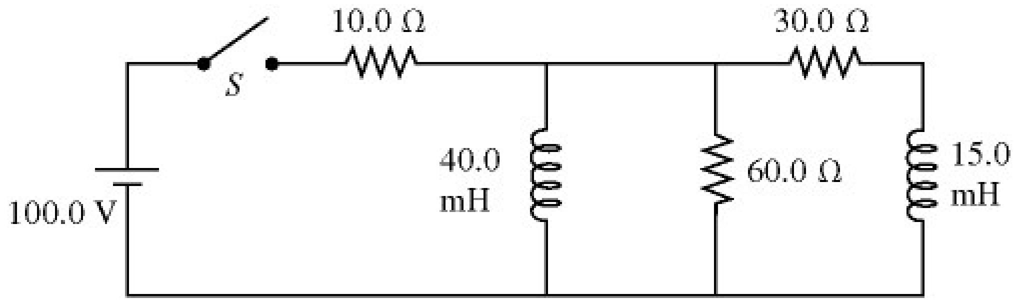
LO 56/57/58

11) A 200-μH solenoid inductor is wound on a form 0.80 m in length and 0.10 m in diameter. A single-turn coil is tightly wound around the solenoid at its center, with a resistance of 9.9 ohms. The mutual inductance of the coil and solenoid is 31 μH. At a given instant, the current in the solenoid is 540 mA, and is decreasing at the rate of 2.5 A/s. At the given instant, what is the magnitude of the induced current in the coil?

A) 51 μA
B) 8.1 μA
C) 9.4 μA
D) 11 μA
E) 13 μA
F) 25 μA
G) 7.8 μA

Answer: G
LO 36/62X2

12) For the circuit shown in the figure, the inductors have no appreciable resistance and the switch has been open for a very long time.



(i) The instant after closing the switch, what is the current through the 60.0-Ω resistor?

(a) 1.4 A
(b) zero
(c) 10 A
(c) 3.3 A
(d) 1.1 A
(e) 1.7 A

ans: (a) 1.4 A

(ii) The instant after closing the switch, what is the potential difference across the 15.0-mH inductor?

(a) 75 V
(b) 100 V
(c) zero
(c) the voltage will be infinite because of the sudden change caused by the switch.
(d) 50 V
(e) 86 V

ans: (e) 86 V

(iii) After the switch has been closed and left closed for a very long time, what is the potential drop across the 60.0-Ω resistor?

(a) 75 V
(b) 100 V
(c) zero
(c) 67 V
(d) 33 V
(e) 86 V

ans: (c) zero

LO 36X3/65X3