The University of Jordan
Faculty of Science
Department of Physics
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General Physics-2 (0302102)
Suggested Multiple-Choice Problems
Electric Fields and Gauss Law
2nd Semester 2013/2014

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1. A particle (m = 50 g, q = 5.0 μC) is released from rest when it is 50 cm from a second particle (Q = –20 μC). Determine the magnitude of the initial acceleration of the 50-g particle.

a. 54 m/s^2
b. 90 m/s^2
c. 72 m/s^2
d. 65 m/s^2
e. 36 m/s^2

2. Three point charges, two positive and one negative, each having a magnitude of 20 μC are placed at the vertices of an equilateral triangle (30 cm on a side). What is the magnitude of the electrostatic force on the negative charge?

a. 80 N
b. 40 N
c. 69 N
d. 57 N
e. 75 N

3. Charge of uniform density 4.0 nC/m is distributed along the x axis from $x = -2.0$ m to x = +3.0 m. What is the magnitude of the electric field at the point x = +5.0 m on the x axis?

a. 16 N/C
b. 13 N/C
c. 19 N/C
d. 26 N/C
e. 5.0 N/C

4. A charge of 50 nC is uniformly distributed along the y axis from y = 3.0 m to y = 5.0 m. What is the magnitude of the electric field at the origin?

a. 18 N/C
b. 50 N/C
c. 30 N/C
d. 15 N/C
e. 90 N/C

5. Two charged particles, Q_1 and Q_2, are a distance r apart with $Q_2 = 5Q_1$. Compare the forces they exert on one another when $\mathbf{F}_1$ is the force Q_2 exerts on Q_1 and $\mathbf{F}_2$ is the force Q_1 exerts on Q_2.

a. $\mathbf{F}_2 = 5\mathbf{F}_1$.
b. $\mathbf{F}_2 = -5\mathbf{F}_1$.
c. $\mathbf{F}_2 = \mathbf{F}_1$.
d. $\mathbf{F}_2 = -\mathbf{F}_1$.
e. $5\mathbf{F}_2 = \mathbf{F}_1$.

6. A 40-μC charge is positioned on the x axis at x = 4.0 cm. Where should a –60-μC charge be placed to produce a net electric field of zero at the origin?

a. –5.3 cm
b. 5.7 cm
c. 4.9 cm
d. –6.0 cm
e. +6.0 cm

7. A charge of 25 nC is uniformly distributed along a circular arc (radius = 2.0 m) that is subtended by a 90-degree angle. What is the magnitude of the electric field at the center of the circle along which the arc lies?

a. 81 N/C
b. 61 N/C
c. 71 N/C
d. 51 N/C
e. 25 N/C

8. Charge Q is distributed uniformly along a semicircle of radius a. Which formula below gives the correct magnitude of the force on a particle of charge q located at the center of the circle?

a. $F = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{\pi a}$.

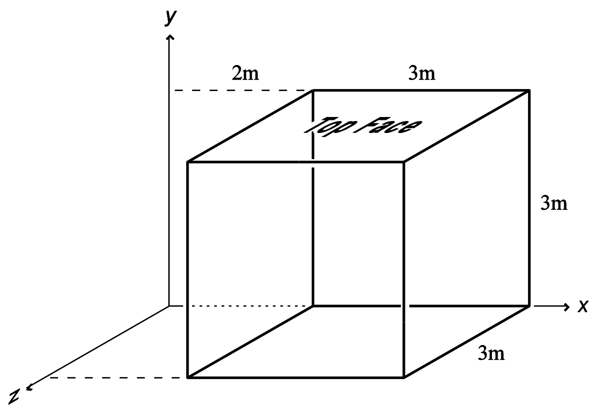
b. $F = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{\pi a^2}$.

c. $F = \frac{1}{4\pi\varepsilon_0}\frac{2qQ}{\pi a}$.

d. $F = \frac{1}{4\pi\varepsilon_0}\frac{2qQ}{\pi a^2}$.

e. $F = \frac{1}{4\pi\varepsilon_0}\frac{2qQ}{a^2}$.

9. The electric field in the region of space shown is given by $E = (8\mathbf{i} + 2y\mathbf{j})$ N/C where y is in m. What is the magnitude of the electric flux through the top face of the cube shown?



a. 90 N · m^2/C
b. 6.0 N · m^2/C
c. 54 N · m^2/C
d. 12 N · m^2/C
e. 126 N · m^2/C

10. A long nonconducting cylinder (radius = 12 cm) has a charge of uniform density (5.0 nC/m^3) distributed throughout its column. Determine the magnitude of the electric field 5.0 cm from the axis of the cylinder.

a. 25 N/C
b. 20 N/C
c. 14 N/C
d. 31 N/C
e. 34 N/C

11. An astronaut is in an all-metal chamber outside the space station when a solar storm results in the deposit of a large positive charge on the station. Which statement is correct?

a. The astronaut must abandon the chamber immediately to avoid being electrocuted.
b. The astronaut will be safe only if she is wearing a spacesuit made of non-conducting materials.
c. The astronaut does not need to worry: the charge will remain on the outside surface.
d. The astronaut must abandon the chamber if the electric field on the outside surface becomes greater than the breakdown field of air.
e. The astronaut must abandon the chamber immediately because the electric field inside the chamber is non-uniform.

12. If the electric field just outside a thin conducting sheet is equal to 1.5 N/C, determine the surface charge density on the conductor.

a. 53 pC/m^2
b. 27 pC/m^2
c. 35 pC/m^2
d. 13 pC/m^2
e. 6.6 pC/m^2

13. The total electric flux through a closed cylindrical (length = 1.2 m, diameter = 0.20 m) surface is equal to –5.0 N · m^2/C. Determine the net charge within the cylinder.

a. –62 pC
b. –53 pC
c. –44 pC
d. –71 pC
e. –16 pC

14. A charge of 0.80 nC is placed at the center of a cube that measures 4.0 m along each edge. What is the electric flux through one face of the cube?

a. 90 N · m^2/C
b. 15 N · m^2/C
c. 45 N · m^2/C
d. 23 N · m^2/C
e. 64 N · m^2/C

15. An uncharged spherical conducting shell surrounds a charge $-q$ at the center of the shell. The charges on the inner and outer surfaces of the shell are respectively

a. $-q, -q$.
b. $-q, +q$.
c. $+q, -q$.
d. $+q, +q$.
e. $+q, 0$.

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Electric Potential and Capacitors
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1. A charged particle (q = –8.0 mC), which moves in a region where the only force acting on the particle is an electric force, is released from rest at point A. At point B the kinetic energy of the particle is equal to 4.8 J. What is the electric potential difference $V_B - V_A$?

a. –0.60 kV
b. +0.60 kV
c. +0.80 kV
d. –0.80 kV
e. +0.48 kV

2. Points A [at (2, 3) m] and B [at (5, 7) m] are in a region where the electric field is uniform and given by **E** = (4**i** + 3**j**) N/C. What is the potential difference $V_A - V_B$?

a. 33 V
b. 27 V
c. 30 V
d. 24 V
e. 11 V

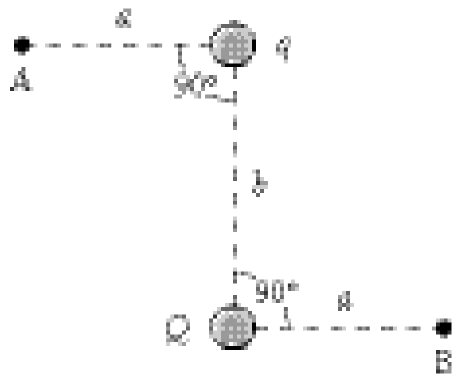
3. A proton (mass = 1.67 × 10^{-27} kg, charge = 1.60 × 10^{-19} C) moves from point A to point B under the influence of an electrostatic force only. At point A the proton moves with a speed of 50 km/s. At point B the speed of the proton is 80 km/s. Determine the potential difference $V_B - V_A$.

a. +20 V
b. –20 V
c. –27 V
d. +27 V
e. –40 V

4. Points A [at (3, 6) m] and B [at (8, –3) m] are in a region where the electric field is uniform and given by **E** = 12**i** N/C. What is the electric potential difference $V_A - V_B$?

a. +60 V
b. –60 V
c. +80 V
d. –80 V
e. +50 V

5. Point charges q and Q are positioned as shown. If q = +2.0 nC, Q = –2.0 nC, a = 3.0 m, and b = 4.0 m, what is the electric potential difference $V_A - V_B$?



a. 8.4 V
b. 6.0 V
c. 7.2 V
d. 4.8 V
e. 0 V

6. Identical 2.0-μC charges are located on the vertices of a square with sides that are 2.0 m in length. Determine the electric potential (relative to zero at infinity) at the center of the square.

a. 38 kV
b. 51 kV
c. 76 kV
d. 64 kV
e. 13 kV

7. Identical 4.0-μC charges are placed on the y axis at y = ±4.0 m. Point A is on the x axis at x = +3.0 m. Determine the electric potential of point A (relative to zero at the origin).

a. –4.5 kV

b. –2.7 kV

c. –1.8 kV

d. –3.6 kV

e. –14 kV

8. Particle A (mass = m, charge = Q) and B (mass = m, charge = 5 Q) are released from rest with the distance between them equal to 1.0 m. If Q = 12 μC, what is the kinetic energy of particle B at the instant when the particles are 3.0 m apart?

a. 8.6 J
b. 3.8 J
c. 6.0 J
d. 2.2 J
e. 4.3 J

9. Four identical point charges (+4.0 μC) are placed at the corners of a square which has 20-cm sides. How much work is required to assemble this charge arrangement starting with each of the charges a very large distance from any of the other charges?

a. +2.9 J
b. +3.9 J
c. +2.2 J
d. +4.3 J
e. +1.9 J

10. A charge of +3.0 μC is distributed uniformly along the circumference of a circle with a radius of 20 cm. How much external energy is required to bring a charge of 25μC from infinity to the center of the circle?

a. 5.4 J
b. 3.4 J
c. 4.3 J
d. 2.7 J
e. 6.8 J

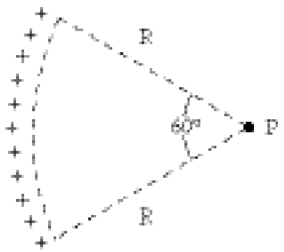
11. A charge per unit length given by $\lambda(x) = bx$, where b = 12 nC/m^2, is distributed along the x axis from x = +9.0 cm to x = +16 cm. If the electric potential at infinity is taken to be zero, what is the electric potential at the point P on the y axis at y = 12 cm?

a. 5.4 V
b. 7.2 V
c. 9.0 V
d. 9.9 V
e. 16 V

12. A charge Q is uniformly distributed along the x axis from $x = a$ to $x = b$. If Q = 45 nC, a = –3.0 m, and b = 2.0 m, what is the electric potential (relative to zero at infinity) at the point, x = 8.0 m, on the x axis?

a. 71 V
b. 60 V
c. 49 V
d. 82 V
e. 150 V

13. Charge of uniform density (3.5 nC/m) is distributed along the circular arc shown. Determine the electric potential (relative to zero at infinity) at point P.



a. 61 V
b. 42 V
c. 52 V
d. 33 V
e. 22 V

14. A charge of 10 nC is distributed uniformly along the *x* axis from *x* = –2 m to *x* = +3 m. Which of the following integrals is correct for the electric potential (relative to zero at infinity) at the point *x* = +5 m on the *x* axis?

a. $\int_{-2}^{3} \frac{90dx}{x}$
b. $\int_{-2}^{3} \frac{90dx}{5-x}$
c. $\int_{-2}^{3} \frac{18dx}{x}$
d. $\int_{-2}^{3} \frac{18dx}{5-x}$
e. $\int_{-2}^{3} \frac{90dx}{5+x}$

15. Two large parallel conducting plates are 8.0 cm apart and carry equal but opposite charges on their facing surfaces. The magnitude of the surface charge density on either of the facing surfaces is 2.0 nC/m^2. Determine the magnitude of the electric potential difference between the plates.

a. 36 V
b. 27 V
c. 18 V
d. 45 V
e. 16 V

16. A solid conducting sphere (radius = 5.0 cm) has a charge of 0.25 nC distributed uniformly on its surface. If point A is located at the center of the sphere and point B is 15 cm from the center, what is the magnitude of the electric potential difference between these two points?

a. 23 V
b. 30 V
c. 15 V
d. 45 V
e. 60 V

17. Charge of uniform density 90 nC/m^3 is distributed throughout the inside of a long nonconducting cylindrical rod (radius = 2.0 cm). Determine the magnitude of the potential difference of point A (2.0 cm from the axis of the rod) and point B (4.0 cm from the axis).

a. 1.9 V
b. 1.4 V
c. 2.2 V
d. 2.8 V
e. 4.0 V

18. The electric field in a region of space is given by $E_x = (3.0x)$ N/C, $E_y = E_z = 0$, where x is in m. Points A and B are on the x axis at $x_A = 3.0$ m and $x_B = 5.0$ m. Determine the potential difference $V_B - V_A$.

a. –24 V
b. +24 V
c. –18 V
d. +30 V
e. –6.0 V

19. Equipotentials are lines along which

a. the electric field is constant in magnitude and direction.
b. the electric charge is constant in magnitude and direction.
c. maximum work against electrical forces is required to move a charge at constant speed.
d. a charge may be moved at constant speed without work against electrical forces.
e. charges move by themselves.

20. When a negative charge is released and moves along an electric field line, it moves to a position of

a. lower potential and lower potential energy.
b. lower potential and higher potential energy.
c. higher potential and lower potential energy.
d. higher potential and higher potential energy.
e. decreasing magnitude of the electric field.

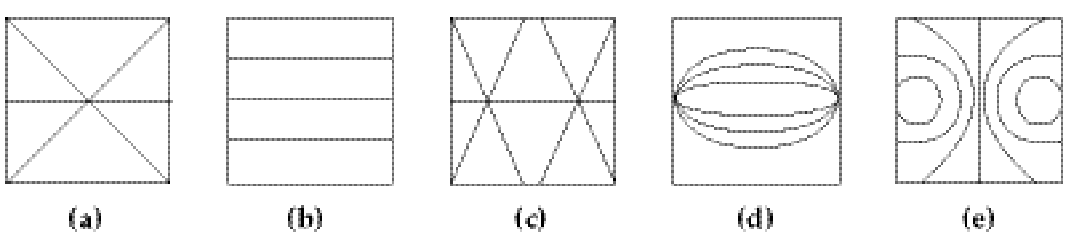
21. A charge is placed on a spherical conductor of radius r_1. This sphere is then connected to a distant sphere of radius r_2 (not equal to r_1) by a conducting wire. After the charges on the spheres are in equilibrium,

a. the electric fields at the surfaces of the two spheres are equal.
b. the amount of charge on each sphere is $q/2$.
c. both spheres are at the same potential.
d. the potentials are in the ratio $\frac{V_2}{V_1} = \frac{q_2}{q_1}$.
e. the potentials are in the ratio $\frac{V_2}{V_1} = \frac{r_2}{r_1}$.

22. The electric potential inside a charged solid spherical conductor in equilibrium

a. is always zero.
b. is constant and equal to its value at the surface.
c. decreases from its value at the surface to a value of zero at the center.
d. increases from its value at the surface to a value at the center that is a multiple of the potential at the surface.
e. is equal to the charge passing through the surface per unit time divided by the resistance.

23. Which of the following represents the equipotential lines of a dipole?



Answer: (e)

24. A series of 3 uncharged concentric shells surround a small central charge q. The charge distributed on the outside of the third shell is

a. $-3q$.

b. $-(\ln 3)q$.

c. $+q$.

d. $+(\ln 3)q$.

e. $+3q$.

25. A series of n uncharged concentric spherical conducting shells surround a small central charge q. The potential at a point outside the nth shell, at distance r from the center, and relative to $V = 0$ at ∞, is

a. $-\frac{nk_eq}{r}$.

b. $-\frac{(\ln n)k_eq}{r}$.

c. $+\frac{k_eq}{r}$.

d. $+\frac{(\ln n)k_eq}{r}$.

e. $+\frac{nk_eq}{r}$.

26. The electric field in the region defined by the y-z plane and the negative x axis is given by $E = -ax$, where a is a constant. (There is no field for positive values of x.) As $-x$ increases in magnitude, relative to $V = 0$ at the origin, the electric potential in the region defined above is

a. a decreasing function proportional to $-|x^2|$.

b. a decreasing function proportional to $-|x|$.

c. constant.

d. an increasing function proportional to $+|x|$.

e. an increasing function proportional to $+|x^2|$.

27. Two charges lie on the x axis, $+3q$ at the origin, and $-2q$ at $x = 5.0\text{ m}$. The point on the x axis where the electric potential has a zero value (when the value at infinity is also zero) is

a. 1.0 m.

b. 2.0 m.

c. 2.5 m.

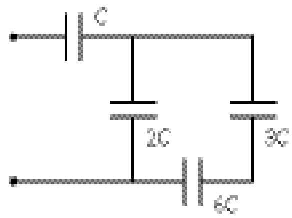
d. 3.0 m.

e. 4.0 m.

28. A nonconducting sphere of radius 10 cm is charged uniformly with a density of 100 nC/m^3. What is the magnitude of the potential difference between the center and a point 4.0 cm away?

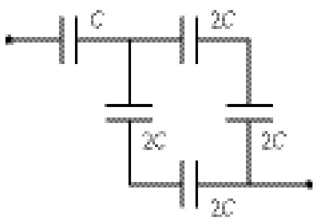
a. 12 V
b. 6.8 V
c. 3.0 V
d. 4.7 V
e. 2.2 V

29. Determine the equivalent capacitance of the combination shown when $C = 45\ \mu F$.



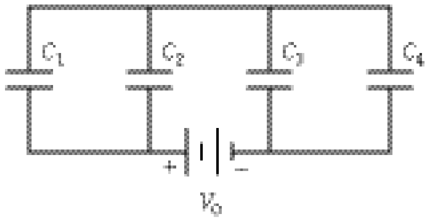
a. 28 μF
b. 36 μF
c. 52 μF
d. 44 μF
e. 23 μF

30. Determine the equivalent capacitance of the combination shown when $C = 24\ \mu F$.



a. 20 μF
b. 36 μF
c. 16 μF
d. 45 μF
e. 27 μF

31. What is the total energy stored by C_3 when C_1 = 50 μF, C_2 = 30 μF, C_3 = 36 μF, C_4 = 12 μF, and V_0 = 30 V?



a. 6.3 mJ
b. 25 mJ
c. 57 mJ
d. 1.6 mJ
e. 14 mJ

32. A 3.0-μF capacitor charged to 40 V and a 5.0-μF capacitor charged to 18 V are connected to each other, with the positive plate of each connected to the negative plate of the other. What is the final charge on the 3.0-μF capacitor?

a. 11 μC
b. 15 μC
c. 19 μC
d. 26 μC
e. 79 μC

33. A 25-μF capacitor charged to 50 V and a capacitor C charged to 20 V are connected to each other, with the two positive plates connected and the two negative plates connected. The final potential difference across the 25-μF capacitor is 36 V. What is the value of the capacitance of C?

a. 43 μF
b. 29 μF
c. 22 μF
d. 58 μF
e. 63 μF

34. When a capacitor has a charge of magnitude 80 μC on each plate the potential difference across the plates is 16 V. How much energy is stored in this capacitor when the potential difference across its plates is 42 V?

a. 1.0 mJ
b. 4.4 mJ
c. 3.2 mJ
d. 1.4 mJ
e. 1.7 mJ

35. A 15-μF capacitor and a 30-μF capacitor are connected in series, and charged to a potential difference of 50 V. What is the resulting charge on the 30-μF capacitor?

a. 0.70 mC
b. 0.80 mC
c. 0.50 mC
d. 0.60 mC
e. 0.40 mC

36. A 15-μF capacitor is charged to 40 V and then connected across an initially uncharged 25-μF capacitor. What is the final potential difference across the 25-μF capacitor?

a. 12 V
b. 18 V
c. 15 V
d. 21 V
e. 24 V

37. A capacitor of unknown capacitance C is charged to 100 V and then connected across an initially uncharged 60-μF capacitor. If the final potential difference across the 60-μF capacitor is 40 V, determine C.

a. 49 μF
b. 32 μF
c. 40 μF
d. 90 μF
e. 16 μF

38. A parallel plate capacitor of capacitance C_0 has plates of area A with separation d between them. When it is connected to a battery of voltage V_0, it has charge of magnitude Q_0 on its plates. It is then disconnected from the battery and the plates are pulled apart to a separation $2d$ without discharging them. After the plates are $2d$ apart, the magnitude of the charge on the plates and the potential difference between them are

a. $\frac{1}{2}Q_0$, $\frac{1}{2}V_0$
b. Q_0, $\frac{1}{2}V_0$
c. Q_0, V_0
d. Q_0, $2V_0$
e. $2Q_0$, $2V_0$

39. A parallel plate capacitor of capacitance C_0 has plates of area A with separation d between them. When it is connected to a battery of voltage V_0, it has charge of magnitude Q_0 on its plates. The plates are pulled apart to a separation $2d$ while the capacitor remains connected to the battery. After the plates are $2d$ apart, the magnitude of the charge on the plates and the potential difference between them are

a. $\frac{1}{2}Q_0, \frac{1}{2}V_0$

b. $\frac{1}{2}Q_0, V_0$

c. Q_0, V_0

d. $2Q_0, V_0$

e. $2Q_0, 2V_0$

40. A parallel plate capacitor of capacitance C_0 has plates of area A with separation d between them. When it is connected to a battery of voltage V_0, it has charge of magnitude Q_0 on its plates. While it is connected to the battery the space between the plates is filled with a material of dielectric constant 3. After the dielectric is added, the magnitude of the charge on the plates and the potential difference between them are

a. $\frac{1}{3}Q_0, \frac{1}{3}V_0$

b. $Q_0, \frac{1}{3}V_0$

c. Q_0, V_0

d. $3Q_0, V_0$

e. $3Q_0, 3V_0$

41. A parallel plate capacitor of capacitance C_0 has plates of area A with separation d between them. When it is connected to a battery of voltage V_0, it has charge of magnitude Q_0 on its plates. It is then disconnected from the battery and the space between the plates is filled with a material of dielectric constant 3. After the dielectric is added, the magnitudes of the capacitance and the potential difference between the plates are

a. $\frac{1}{3}C_0, \frac{1}{3}V_0$.

b. $C_0, \frac{1}{3}V_0$.

c. C_0, V_0.

d. $3C_0, \frac{1}{3}V_0$.

e. $3C_0, 3V_0$.

1. A light bulb is rated at 30 W when operated at 120 V. How much charge enters (and leaves) the light bulb in 1.0 min?

a. 17 C
b. 15 C
c. 14 C
d. 13 C
e. 60 C

2. What maximum power can be generated from an 18-V *emf* using any combination of a 6.0 Ω resistor and a 9.0 Ω resistor?

a. 54 W
b. 71 W
c. 90 W
d. 80 W
e. 22 W

3. If 5.0×10^{21} electrons pass through a 20 Ω resistor in 10 min, what is the potential difference across the resistor?

a. 21 V
b. 32 V
c. 27 V
d. 37 V
e. 54 V

4. A wire (length = 2.0 m, diameter = 1.0 mm) has a resistance of 0.45 Ω. What is the resistivity (in Ω.m) of the material used to make the wire?

a. 5.6×10^{-7}
b. 1.2×10^{-7}
c. 1.8×10^{-7}
d. 2.3×10^{-7}
e. 7.1×10^{-7}

5. Most telephone cables are made of copper wire of either 24 or 26 gauge. If the resistance of 24-gauge wire is 137 Ω /mile and the resistance of 26-gauge wire is 220 Ω /mile, what is the ratio of the diameter of 24-gauge wire to that of 26-gauge wire?

a. 1.6
b. 1.3
c. 0.62
d. 0.79
e. 0.88

6. A conductor of radius *r*, length *l* and resistivity ρ has resistance *R*. What is the new resistance if it is stretched to 4 times its original length?

a. $\frac{1}{16}R$
b. $\frac{1}{4}R$
c. R
d. $4R$
e. $16R$

7. A small bulb is rated at 7.5 W when operated at 125 V. Its resistance (in ohms) is

a. 0.45.
b. 7.5.
c. 17.
d. 940.
e. 2100.

8. A small bulb is rated at 7.5 W when operated at 125 V. The tungsten filament has a temperature coefficient of resistivity $\alpha = 4.5\times10^{-3}/°C$. When the filament is hot and glowing, its temperature is seven times room temperature (20 °C). What is the resistance of the filament (in ohms) at room temperature?

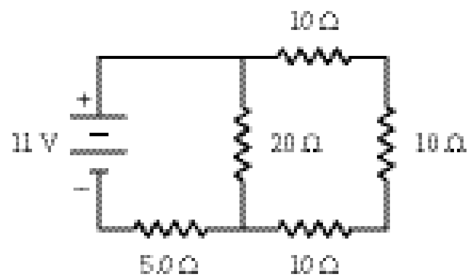
a. 1280.
b. 1350.
c. 1911.
d. 4530.
e. 5630.

9. The electron density in copper is 8.49×10^{28} electrons/m^3. The electron charge is $e = 1.6 \times 10^{-19}$ C. When a 1.00 A current is present in a copper wire with a 0.40 cm^2 cross-section, the electron drift velocity (in m/s), with direction defined relative to the current density, is

a. -1.84×10^{-6}.
b. $+1.84\times10^{-6}$.
c. -1.84.
d. -5.43×10^{5}.
e. $+5.43\times10^{5}$.

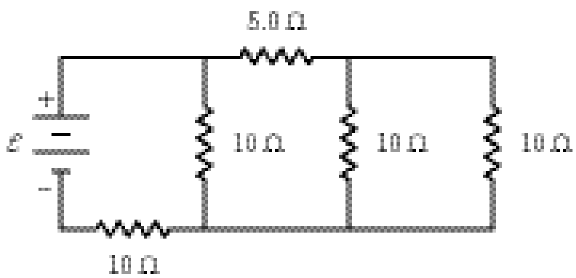
10. What is the magnitude of the potential difference across the 20 Ω resistor?

a. 3.2 V
b. 7.8 V
c. 11 V
d. 5.0 V
e. 8.6 V



11. At what rate is thermal energy generated in the 5 Ω resistor when $\varepsilon = 24$ V?

a. 13 W
b. 3.2 W
c. 23 W
d. 39 W
e. 51 W



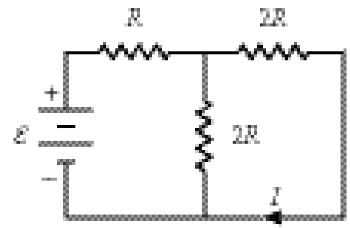
12. When a 20-V *emf* is placed across two resistors in series, a current of 2.0 A is present in each of the resistors. When the same emf is placed across the same two resistors in parallel, the current through the *emf* is 10 A. What is the magnitude of the greater of the two resistances?

a. 7.2 Ω
b. 7.6 Ω
c. 6.9 Ω
d. 8.0 Ω
e. 2.8 Ω

13. A resistor of unknown resistance and a 15 Ω resistor are connected across a 20-V *emf* in such a way that a 2.0 A current is observed in the emf. What is the value of the unknown resistance?

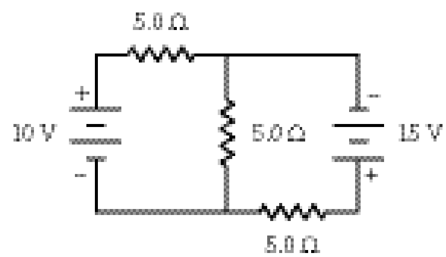
a. 75 Ω
b. 12 Ω
c. 7.5 Ω
d. 30 Ω
e. 5.0 Ω

14. Determine ε when $I = 0.50$ A and $R = 12$ Ω .



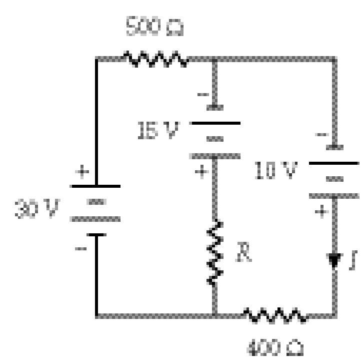
a. 12 V
b. 24 V
c. 30 V
d. 15 V
e. 6.0 V

15. Determine the current in the 10-V *emf.*



a. 2.3 A
b. 2.7 A
c. 1.3 A
d. 0.30 A
e. 2.5 A

16. Determine the magnitude and sense (direction) of the current in the 500 Ω resistor when $I = 30$ mA.

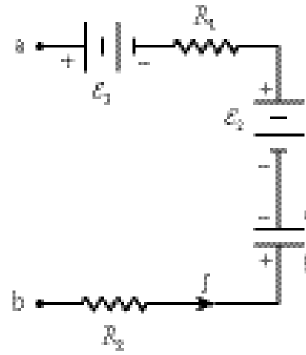


a. 56 mA left to right
b. 56 mA right to left
c. 48 mA left to right
d. 48 mA right to left
e. 26 mA left to right

17. What is the potential difference $V_B - V_A$ when the I= 1.5 A in the circuit segment below?

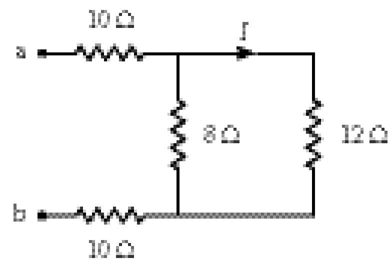
a. +22 V
b. –22 V
c. –38 V
d. +38 V
e. +2.0 V

18. If $\varepsilon_1 = 4.0$ V, $\varepsilon_2 = 12.0$ V, $R_1 = 4\ \Omega$, $R_2 = 12\ \Omega$, $C = 3\ \mu$F, $Q = 18\ \mu$C, and $I = 2.5$ A, what is the potential difference $V_a - V_b$?



a. –30 V
b. 30 V
c. 5.0 V
d. –5.0 V
e. –1.0 V

19. If $I = 0.40$ A in the circuit segment shown below, what is the potential difference $V_a - V_b$?



a. 31 V
b. 28 V
c. 25 V
d. 34 V
e. 10 V

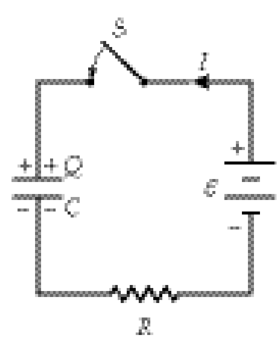
20. In an *RC* circuit, how many time constants must elapse if an initially uncharged capacitor is to reach 80% of its final potential difference?

a. 2.2
b. 1.9
c. 1.6
d. 3.0
e. 5.0

21. How many time constants must elapse if an initially charged capacitor is to discharge 55% of its stored energy through a resistor?

a. 0.60
b. 0.46
c. 0.52
d. 0.40
e. 1.1

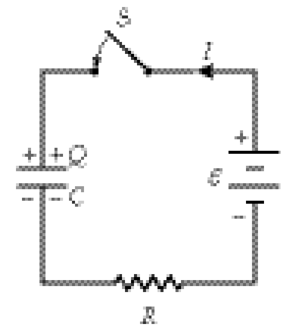
22. At $t = 0$ the switch S is closed with the capacitor uncharged. If $C = 30\ \mu$F, $\varepsilon = 30$ V, and $R = 5.0$ k Ω , at what rate is energy being stored in the capacitor when $I = 2.0$ mA?



a. 32 mW
b. 40 mW
c. 44 mW
d. 36 mW

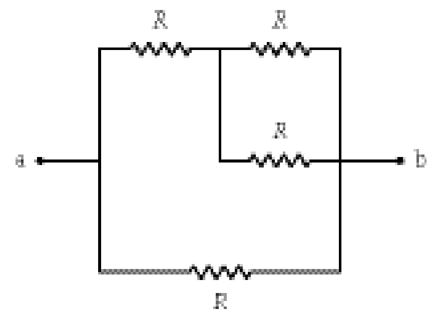
e. 80 mW

23. At $t = 0$ the switch S is closed with the capacitor uncharged. If $C = 40\ \mu F$, $\varepsilon = 50$ V, and $R = 5.0\ k\ \Omega$, how much energy is stored by the capacitor when $I = 2.0$ mA?



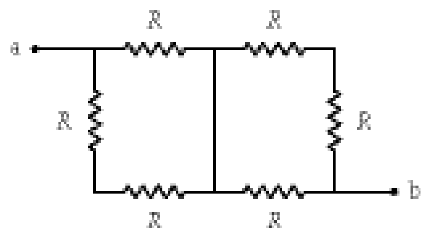
a. 20 mJ
b. 28 mJ
c. 32 mJ
d. 36 mJ
e. 40 mJ

24. What is the equivalent resistance between points a and b when $R = 30\ \Omega$?



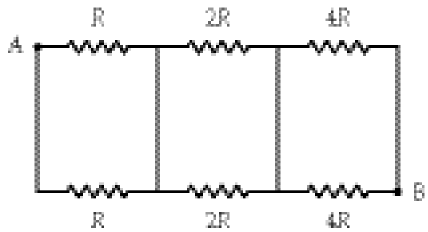
a. 27 Ω
b. 21 Ω
c. 24 Ω
d. 18 Ω
e. 7.5 Ω

25. What is the equivalent resistance between points a and b when $R = 12\ \Omega$?



a. 20 Ω
b. 16 Ω
c. 24 Ω
d. 28 Ω
e. 6.0 Ω

26. What is the equivalent resistance between points A and B in the figure when $R = 20\ \Omega$?

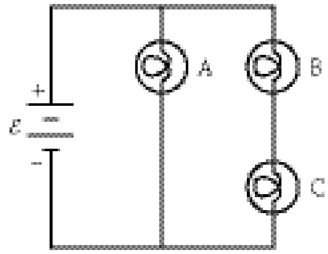


a. 77 Ω
b. 63 Ω
c. 70 Ω
d. 84 Ω
e. 140 Ω

27. In a loop in a closed circuit, the sum of the currents entering a junction equals the sum of the currents leaving a junction because

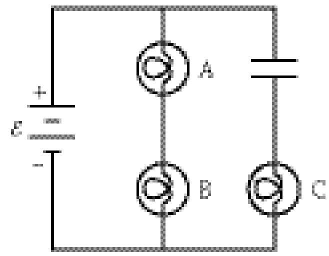
a. the potential of the nearest battery is the potential at the junction.
b. there are no transformations of energy from one type to another in a circuit loop.
c. capacitors tend to maintain current through them at a constant value.
d. current is used up after it leaves a junction.
e. charge is neither created nor destroyed at a junction.

28. The circuit below contains three 100W light bulbs. The *emf* ε = 110 V. Which light bulb(s) is(are) brightest?



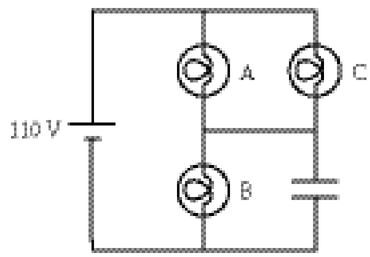
a. A
b. B
c. C
d. B and C
e. All three are equally bright.

29. The circuit below contains three light bulbs and a capacitor. The *emf* ε = 110V. The capacitor is fully charged. Which light bulb(s) is (are) dimmest?



a. A
b. B
c. C
d. A and B
e. All three are equally bright (or dim).

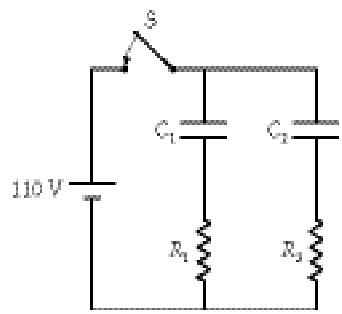
30. The circuit below contains three light bulbs and a capacitor. The emf is 110 V and the capacitor is fully charged. Which light bulb(s) is (are) brightest?



a. A
b. B
c. C
d. A and B
e. A and C

31. The capacitors are completely discharged in the circuit shown below.

The two resistors have the same resistance *R* and the two capacitors have the same capacitance *C*. After the switch is closed, the current



a. is greatest in C_1.
b. is greatest in C_2.
c. is greatest in R_1.
d. is greatest in R_2.
e. is the same in C_1, C_2, R_1 and R_2.

The University of Jordan Faculty of Science Department of Physics Dr. Hanan Sa'adeh	General Physics-2 (0302102) Suggested Multiple-Choice Problems Magnetic Fields 2nd Semester 2013/2014

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1. A particle (q = 5.0 nC, m = 3.0 μg) moves in a region where the magnetic field has components B_x = 2.0 mT, B_y = 3.0 mT, and B_z = –4.0 mT. At an instant when the speed of the particle is 5.0 km/s and the direction of its velocity is 120° relative to the magnetic field, what is the magnitude of the acceleration of the particle?

a. 33 m/s^2
b. 17 m/s^2
c. 39 m/s^2
d. 25 m/s^2
e. 45 m/s^2

2. An electron moving in the positive x direction experiences a magnetic force in the positive z direction. If B_x = 0, what is the direction of the magnetic field?

a. negative y direction
b. positive y direction
c. negative z direction
d. positive z direction
e. negative x direction

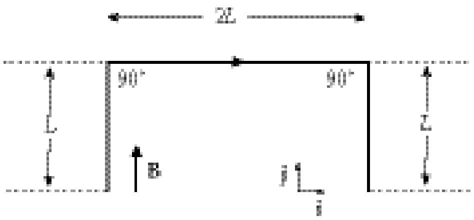
3. A positively charged particle has a velocity in the negative z direction at point P. The magnetic force on the particle at this point is in the negative y direction. Which one of the following statements about the magnetic field at point P can be determined from this data?

a. B_x is positive.
b. B_z is positive.
c. B_y is negative.
d. B_y is positive.
e. B_x is negative.

4. A segment of wire carries a current of 25 A along the *x* axis from *x* = –2.0 m to *x* = 0 and then along the *y* axis from *y* = 0 to *y* = 3.0 m. In this region of space, the magnetic field is equal to 40 mT in the positive *z* direction. What is the magnitude of the force on this segment of wire?

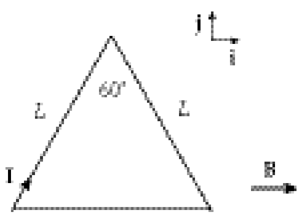
a. 2.0 N
b. 5.0 N
c. 1.0 N
d. 3.6 N
e. 3.0 N

5. A straight wire is bent into the shape shown. Determine the net magnetic force on the wire when the current *I* travels in the direction shown in the magnetic field **B**.



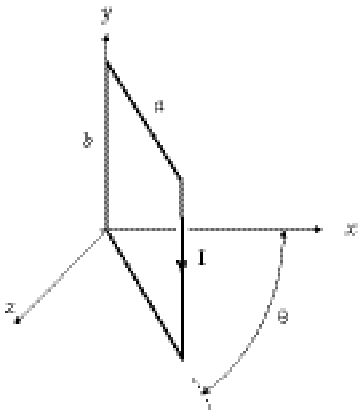
a. 2*IBL* in the –z direction
b. 2*IBL* in the +z direction
c. 4*IBL* in the +z direction
d. 4*IBL* in the –z direction
e. zero

6. A straight wire is bent into the shape shown. Determine the net magnetic force on the wire (The magnetic field is uniform and along the positive x axis).



a. Zero
b. *IBL* in the +z direction
c. *IBL* in the –z direction
d. 1.7 *IBL* in the +z direction
e. 1.4 *IBL* in the –z direction

7. The figure shows the orientation of a rectangular loop consisting of 80 closely wrapped turns each carrying a current I. The magnetic field in the region is (40 **i**) mT. The loop can turn about the y axis. If $\theta = 30°$, $a = 0.40$ m, $b = 0.30$ m, and $I = 8.0$ A, what is the magnitude of the torque exerted on the loop?



a. 2.5 N · m
b. 1.5 N · m
c. 3.1 N · m
d. 2.7 N · m
e. 0.34 N · m

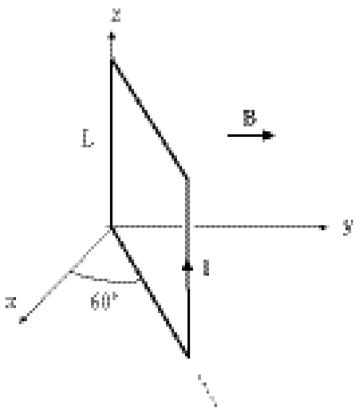
8. A current of 4.0 A is maintained in a single circular loop having a circumference of 80 cm. An external magnetic field of 2.0 T is directed so that the angle between the field and the plane of the loop is 20°. Determine the magnitude of the torque exerted on the loop by the magnetic forces acting upon it.

a. 0.41 N · m
b. 0.14 N · m
c. 0.38 N · m
d. 0.27 N · m
e. 0.77 N · m

9. A circular loop (radius = 0.50 m) carries a current of 3.0 A and has unit normal vector of (2**i** – **j** + 2**k**)/3. What is the x component of the torque on this loop when it is placed in a uniform magnetic field of (2**i** – 6**j**)T?

a. 4.7 N · m
b. 3.1 N · m
c. 19 N · m
d. 9.4 N · m
e. 12 N · m

10. A square loop (L = 0.20 m) consists of 50 closely wrapped turns, each carrying a current of 0.50 A. The loop is oriented as shown in a uniform magnetic field of 0.40 T directed in the positive y direction. What is the magnitude of the torque on the loop?



- **a.** 0.21 N · m
- **b.** 0.20 N · m
- **c.** 0.35 N · m
- **d.** 0.12 N · m
- **e.** 1.73 N · m

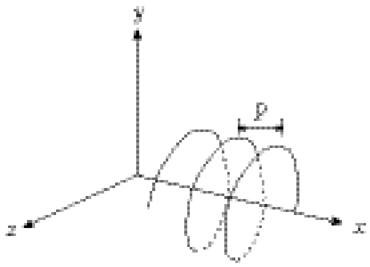
11. A rectangular coil (0.20 m × 0.80 m) has 200 turns and is in a uniform magnetic field of 0.30 T. When the orientation of the coil is varied through all possible positions, the maximum torque on the coil by magnetic forces is 0.080 N · m. What is the current in the coil?

- **a.** 5.0 mA
- **b.** 1.7 A
- **c.** 8.3 mA
- **d.** 1.0 A
- **e.** 42 mA

12. An electron moves in a region where the magnetic field is uniform and has a magnitude of 80 μT. The electron follows a helical path which has a pitch of 9.0 mm and a radius of 2.0 mm. What is the speed of this electron as it moves in this region?

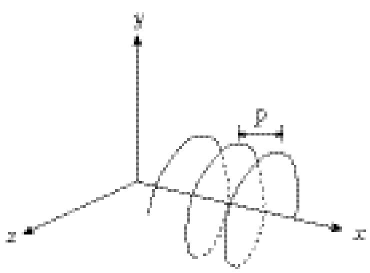
- **a.** 48 km/s
- **b.** 28 km/s
- **c.** 20 km/s
- **d.** 35 km/s
- **e.** 8.0 km/s

13. A uniform magnetic field of 0.50 T is directed along the positive *x* axis. A proton moving with a speed of 60 km/s enters this field. The helical path followed by the proton shown has a pitch of 5.0 mm. Determine the angle between the magnetic field and the velocity of the proton.



a. 39°
b. 51°
c. 44°
d. 34°
e. 71°

14. A charged particle (m = 2.0 g, q = –50 μC) moves in a region of uniform field along a helical path (radius = 4.0 cm, pitch = 8.0 cm) as shown. What is the angle between the velocity of the particle and the magnetic field?



a. 27°
b. 72°
c. 63°
d. 18°
e. 58°

15. A particle (m = 3.0 μg, q = 5.0 μC) moves in a uniform magnetic field given by (60**j**)mT. At t = 0 the velocity of the particle is equal to (30**j** – 40**k**) m/s. The subsequent path of the particle is

a. circular with a 50-cm radius.
b. helical with a 6.3-cm pitch.
c. circular with a period of 31 ms.
d. helical with a 40-cm radius.
e. none of the above

16. A 500-eV electron and a 300-eV electron trapped in a uniform magnetic field move in circular paths in a plane perpendicular to the magnetic field. What is the ratio of the radii of their orbits?

a. 2.8
b. 1.7
c. 1.3
d. 4.0
e. 1.0

17. A proton moves around a circular path (radius = 2.0 mm) in a uniform 0.25-T magnetic field. What total distance does this proton travel during a 1.0-s time interval? $(m = 1.67 \times 10^{-27}\ \text{kg},\ q = 1.6 \times 10^{-19}\ \text{C})$

a. 82 km
b. 59 km
c. 71 km
d. 48 km
e. 7.5 km

18. Two single charged ions moving perpendicularly to a uniform magnetic field (B = 0.4 T) with speeds of 5000 km/s follow circular paths that differ in diameter by 5.0 cm. What is the difference in the mass of these two ions?

a. 2.6×10^{-28} kg
b. 6.4×10^{-28} kg
c. 3.2×10^{-28} kg
d. 5.1×10^{-28} kg
e. 1.1×10^{-28} kg

19. What is the kinetic energy of an electron that passes undeviated through perpendicular electric and magnetic fields if E = 4.0 kV/m and B = 8.0 mT?

a. 0.65 eV
b. 0.71 eV
c. 0.84 eV
d. 0.54 eV
e. 1.4 eV

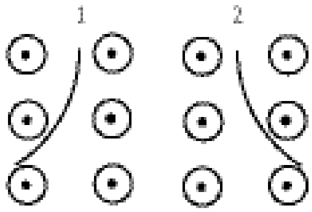
20. A velocity selector uses a fixed electric field of magnitude *E* and the magnetic field is varied to select particles of various energies. If a magnetic field of magnitude *B* is used to select a particle of a certain energy and mass, what magnitude of magnetic field is needed to select a particle of equal mass but twice the energy?

a. 0.50 *B*
b. 1.4 *B*
c. 2.0 *B*
d. 0.71 *B*
e. 1.7 *B*

21. Equal charges, one at rest, the other having a velocity of 10^4 m/s, are released in a uniform magnetic field. Which charge has the largest force exerted on it by the magnetic field?

a. The charge that is at rest.
b. The charge that is moving, if its velocity is parallel to the magnetic field direction when it is released.
c. The charge that is moving if its velocity makes an angle of 45° with the direction of the magnetic field when it is released.
d. The charge that is moving if its velocity is perpendicular to the magnetic field direction when it is released.
e. All the charges above experience equal forces when released in the same magnetic field.

22. A magnetic field is directed out of the page. Two charged particles enter from the top and take the paths shown in the figure. Which statement is correct?



a. Particle 1 has a positive charge and particle 2 has a negative charge.
b. Both particles are positively charged.
c. Both particles are negatively charged.
d. Particle one has a negative charge and particle 2 has a positive charge.
e. The direction of the paths depends on the magnitude of the velocity, not on the sign of the charge.

The University of Jordan
Faculty of Science
Department of Physics
Dr. Hanan Sa'adeh

General Physics-2 (0302102)
Suggested Multiple-Choice Problems
Sources of the Magnetic Field
2nd Semester 2013/2014

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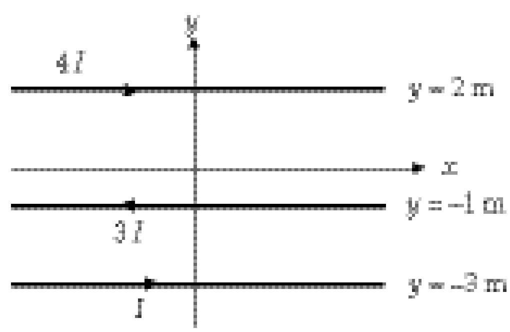
1. One long wire carries a current of 30 A along the entire *x* axis. A second long wire carries a current of 40 A perpendicular to the *xy* plane and passes through the point (0, 4, 0) m. What is the magnitude of the resulting magnetic field at the point *y* = 2.0 m on the *y* axis?

a. 4.0 μT
b. 5.0 μT
c. 3.0 μT
d. 7.0 μT
e. 1.0 μT

2. A 2.0-cm length of wire centered on the origin carries a 20-A current directed in the positive *y* direction. Determine the magnetic field at the point *x* = 5.0 m on the *x*-axis.

a. 1.6 nT in the negative *z* direction
b. 1.6 nT in the positive *z* direction
c. 2.4 nT in the negative *z* direction
d. 2.4 nT in the negative *z* direction
e. None of the above

3. Three long wires parallel to the *x* axis carry currents as shown. If *I* = 20 A, what is the magnitude of the magnetic field at the origin?



a. 37 μT
b. 28 μT
c. 19 μT
d. 47 μT
e. 58 μT

4. Two long parallel wires carry unequal currents in the same direction. The ratio of the currents is 3 to 1. The magnitude of the magnetic field at a point in the plane of the wires and 10 cm from each wire is 4.0 μT. What is the larger of the two currents?

a. 5.3 A
b. 3.8 A
c. 4.5 A
d. 3.0 A
e. 0.5 A

5. Two long straight wires carry currents perpendicular to the *xy* plane. One carries a current of 50 A and passes through the point x = 5.0 cm on the x axis. The second wire has a current of 80 A and passes through the point y = 4.0 cm on the y axis. What is the magnitude of the resulting magnetic field at the origin?

a. 200 μT
b. 600 μT
c. 450 μT
d. 300 μT
e. 400 μT

6. Two very long parallel wires carry currents in the positive x direction. One wire (current = 15 A) is coincident with the x axis. The other wire (current = 50 A) passes through the point (0, 4.0 mm, 0). What is the magnitude of the magnetic field at the point (0, 0, 3.0 mm)?

a. 3.8 mT
b. 2.7 mT
c. 2.9 mT
d. 3.0 mT
e. 0.6 mT

7. Each of two parallel wires separated by 8.0 mm carries a 20-A current. These two currents are oppositely directed. Determine the magnitude of the magnetic field at a point that is 5.0 mm from each of the wires.

a. 2.0 mT
b. 1.6 mT
c. 1.3 mT
d. 1.8 mT
e. 1.0 mT

8. Two long parallel wires separated by 5.0 mm each carry a current of 60 A. These two currents are oppositely directed. What is the magnitude of the magnetic field at a point that is between the two wires and 2.0 mm from one of the two wires?

a. 2.0 mT
b. 10 mT
c. 8.0 mT
d. 1.6 mT
e. 7.2 mT

9. A long straight wire carries a current of 40 A in a region where a uniform external magnetic field has a 30-μT magnitude and is parallel to the current. What is the magnitude of the resultant magnetic field at a point that is 20 cm from the wire?

a. 70 μT
b. 40 μT
c. 10 μT
d. 50 μT
e. 36 μT

10. Two long parallel wires carry unequal currents in opposite directions. The ratio of the currents is 3 to 1. The magnitude of the magnetic field at a point in the plane of the wires and 10 cm from each wire is 4.0 μT. What is the larger of the two currents?

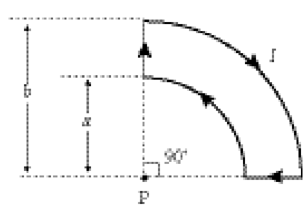
a. 0.5 A
b. 1.0 A
c. 1.5 A
d. 2.0 A
e. 3.0 A

11. A segment of wire of total length 2.0 m is formed into a circular loop having 5.0 turns. If the wire carries a 1.2-A current, determine the magnitude of the magnetic field at the center of the loop.

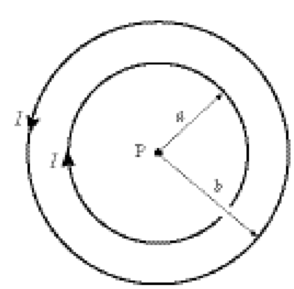
a. 79 μT
b. 69 μT
c. 59 μT
d. 89 μT
e. 9.4 μT

12. If a = 1.0 cm, b = 3.0 cm, and I = 30 A, what is the magnitude of the magnetic field at point P?

a. 0.62 mT
b. 0.59 mT
c. 0.35 mT
d. 0.31 mT
e. 0.10 mT

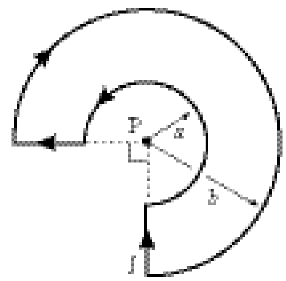


13. What is the magnitude of the magnetic field at point P in the figure if a = 2.0 cm, b = 4.5 cm, and I = 5.0 A?



a. 87 μT, into the paper
b. 87 μT, out of the paper
c. 0.23 mT, out of the paper
d. 0.23 mT, into the paper
e. 23 μT, into the paper

14. What is the magnitude of the magnetic field at point P if $a = R$ and $b = 2R$?



a. $\frac{9\mu_0 I}{16R}$

b. $\frac{3\mu_0 I}{16R}$

c. $\frac{\mu_0 I}{4R}$

d. $\frac{3\mu_0 I}{4R}$

e. $\frac{3\mu_0 I}{8R}$

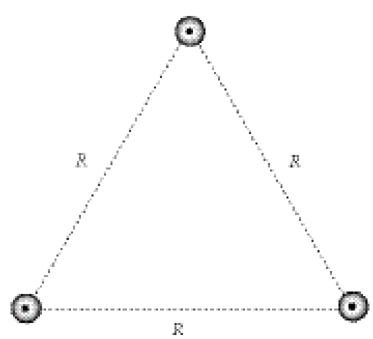
15. Three long, straight, parallel wires each carry a current of 10 A in the positive *x* direction. If the distance between each wire and the other two is 10 cm, what is the magnitude of the magnetic force on a 20-cm length of either of the wires?

a. 57 μN
b. 40 μN
c. 69 μN
d. 50 μN
e. 20 μN

16. Two long parallel wires are separated by 2.0 cm. The current in one of the wires is three times the other current. If the magnitude of the force on a 2.0-m length of one of the wires is equal to 60 μN, what is the greater of the two currents?

a. 2.0 A
b. 1.0 A
c. 3.0 A
d. 9.0 A
e. 1.5 A

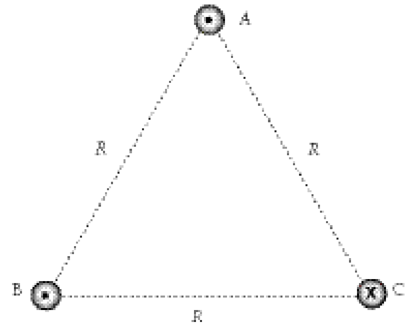
17. The figure shows a cross section of three parallel wires each carrying a current of 5.0 A out of the paper. If the distance R = 6.0 mm, what is the magnitude of the magnetic force on a 2.0-m length of any one of the wires?



a. 2.5 mN

b. 3.3 mN
c. 2.2 mN
d. 2.9 mN
e. 1.7 mN

18. The figure shows a cross section of three parallel wires each carrying a current of 20 A. The currents in wires A and B are out of the paper, while that in wire C is into the paper. If the distance R = 5.0 mm, what is the magnitude of the force on a 2.0-m length of wire A?



a. 23 mN
b. 64 mN
c. 32 mN
d. 46 mN
e. 55 mN

19. Two long parallel wires lie in the *xz* plane. One wire passes through the point (–2 m, 0, 0) and the other through the point (+2 m, 0, 0). The wires carry equal currents in the positive *z* direction.

1. The magnetic field at (–3 m, 0, 0) is in the negative *y* direction.
2. The magnetic field at (–1 m, 0, 0) is in the positive *y* direction.
3. The magnetic field at (+1 m, 0, 0) is in the positive *y* direction.
4. The magnetic field at (+3 m,0,0) is in the negative *y* direction.

a. 1 and 2 are correct.
b. 1 and 4 are correct.
c. 2 and 3 are correct.
d. 3 and 4 are correct.
e. None of the above are correct.

20. A long straight wire (diameter = 2.0 mm) carries a current of 40 A. What is the magnitude of the magnetic field 1.5 mm from the axis of the wire?

a. 3.0 mT
b. 12 mT
c. 5.3 mT
d. 7.4 mT
e. 8.0 mT

21. A hollow cylindrical (inner radius = 1.0 mm, outer radius = 3.0 mm) conductor carries a current of 80 A parallel to its axis. This current is uniformly distributed over a cross section of the conductor. Determine the magnitude of the magnetic field at a point that is 2.0 mm from the axis of the conductor.

a. 8.0 mT
b. 3.0 mT
c. 5.3 mT
d. 16 mT
e. 1.2 mT

22. A hollow cylindrical (inner radius = 2.0 mm, outer radius = 4.0 mm) conductor carries a current of 24 A parallel to its axis. This current is uniformly distributed over a cross section of the conductor. Determine the magnitude of the magnetic field at a point that is 5.0 mm from the axis of the conductor.

a. 0.96 mT
b. 1.7 mT
c. 0.55 mT
d. 1.2 mT
e. 0.40 mT

23. A long hollow cylindrical conductor (inner radius = 2.0 mm, outer radius = 4.0 mm) carries a current of 24 A distributed uniformly across its cross section. A long wire which is coaxial with the cylinder carries an equal current in the opposite direction. What is the magnitude of the magnetic field 3.0 mm from the axis?

a. 0.82 mT
b. 0.93 mT
c. 0.70 mT
d. 0.58 mT
e. 0.40 mT

24. A long wire is known to have a radius greater than 4.0 mm and to carry a current uniformly distributed over its cross section. If the magnitude of the magnetic field is 0.285 mT at a point 4.0 mm from the axis of the wire and 0.200 mT at a point 10 mm from the axis, what is the radius of the wire?

a. 4.6 mm
b. 7.1 mm
c. 5.3 mm
d. 12 mm
e. 10 mm

25. A long wire carries a current of 3.0 A along the axis of a long solenoid (radius = 3.0 cm, n = 900 turns/m, current = 30 mA). What is the magnitude of the magnetic field at a point 2.0 cm from the axis of the solenoid? Neglect any end effects.

a. 34 μT
b. 64 μT
c. 30 μT
d. 45 μT
e. 4.0 μT

26. A solenoid 4.0 cm in radius and 4.0 m in length has 8000 uniformly spaced turns and carries a current of 5.0 A. Consider a plane circular surface (radius = 2.0 cm) located at the center of the solenoid with its axis coincident with the axis of the solenoid. What is the magnetic flux through this surface?

a. 63 μWb
b. 16 μWb
c. 0.25 mWb
d. 10 μWb
e. 5.0 μWb

27. A current-carrying 2.0-cm long segment of wire is inside a long solenoid (radius = 4.0 cm, n = 800 turns/m, current = 50 mA). The wire segment is oriented perpendicularly to the axis of the solenoid. If the current in the wire segment is 12 A, what is the magnitude of the magnetic force on this segment?

a. 22 μN
b. 16 μN
c. 18 μN
d. 12 μN
e. 0 μN

28. A long solenoid (n = 1200 turns/m, radius = 2.0 cm) has a current of a 0.30 A in its winding. A long wire carrying a current of 20 A is parallel to and 1.0 cm from the axis of the solenoid. What is the magnitude of the resulting magnetic field at a point on the axis of the solenoid?

a. 0.60 mT
b. 0.85 mT
c. 52 μT
d. 0.40 mT
e. 0.75 mT

29. A single circular (radius = R) loop of wire is located in the yz plane with its center at the origin. The loop has a clockwise current as seen from the point (+R, 0, 0). The direction of the magnetic field at the point

a. (0, 0, 0) is –**i** and at the point (+R, 0, 0) is –**i**.
b. (0, 0, 0) is –**i** and at the point (0, +2R, 0) is –**i**.
c. (0, 0, 0) is +**i** and at the point (+R, 0, 0) is +**i**.
d. (0, 0, 0) is +**i** and at the point (0, +2R, 0) is +**i**.
e. None of the above

30. A conducting rod with a square cross section (3.0 cm × 3.0 cm) carries a current of 60 A that is uniformly distributed across the cross section. What is the magnitude of the (line) integral $\oint \mathbf{B} \cdot d\mathbf{s}$ around a square path (1.5 cm × 1.5 cm) if the path is centered on the center of the rod and lies in a plane perpendicular to the axis of the rod?

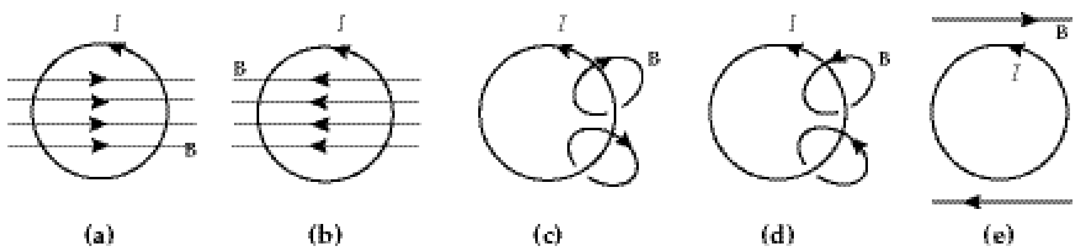
a. 14 μT · m
b. 75 μT · m
c. 19 μT · m
d. 57 μT · m
e. 38 μT · m

31. A current element (length = 1.0 cm) lies along the x axis with its center at x = 0 and carries a 20-A current in the positive x direction. Consider only the field of this current element and decide which combination of the following statements is correct.

1. The field at (0, 0, 1.0 m) is in the positive z direction.
2. The field at (0, 1.0 m, 0) is in the negative y direction.
3. The field at (1.0 m, 0, 0) is zero.
4. The field at (0,0,1.0 m) is in the negative y direction.

a. 3 and 4
b. 1 and 3
c. 2 and 4
d. 1 and 2
e. None of these

32. Which diagram correctly shows the magnetic field lines created by a circular current loop in which current flows in the direction shown? (c)



33. When the number of turns in a solenoid and its length are both doubled, the ratio of the magnitude of the new magnetic field inside to the magnitude of the original magnetic field inside is:

a. 0.25
b. 0.50
c. 1
d. 2
e. 4

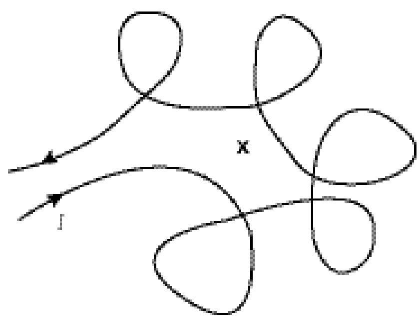
34. The reason the north pole of a bar magnet free to rotate points north is because

a. the south geographic pole of the earth is the earth's magnetic north pole.
b. the south geographic pole of the earth is the earth's magnetic south pole.
c. there is a net accumulation of negative magnetic charge at the earth's south geographic pole.
d. there is a net accumulation of positive magnetic charge at the earth's north geographic pole.
e. the north geographic pole of the earth is the earth's magnetic north pole.

35. At a point in space where the magnetic field is measured, the magnetic field produced by a current element

a. points radially away in the direction from the current element to the point in space.
b. points radially in the direction from the point in space towards the current element.
c. points in a direction parallel to the current element.
d. points in a direction parallel to but opposite in direction to the current element.
e. points in a direction that is perpendicular to the current element and perpendicular to the radial direction.

36. A long wire lies in a tangle on the surface of a table, as shown below. When a current is run through the wire as shown, the largest component of the magnetic field at X points



a. into the table.
b. out of the table.
c. parallel to the nearest segment of wire.
d. antiparallel to the nearest segment of wire.
e. along a circle which has its center at the center of the overall loop.

37. A toroid is made of 2000 turns of wire of radius 2.00 cm formed into a donut shape of inner radius 10.0 cm and outer radius 14.0 cm. When a 30.0-A current is present in the toroid, the magnetic field at a distance of 11.0 cm from the center of the toroid is

a. 0.0857 T.
b. 0.109 T.
c. 0.120 T.
d. 0.600 T.
e. 0.685 T.

38. The magnetic moment of an electron (charge = $-e$; mass = m_e) moving in a circular orbit of radius r with speed v about a nucleus of mass m_N is proportional to

a. r. **b.** v.

c. vr. **d.** evr. **e.** $m_N vr$.

39. Two solenoids are each made of 2000 turns of copper wire per meter. Solenoid I is 2 m long, while solenoid II is 1 m long. When equal currents are present in the two solenoids, the ratio of the magnetic field B_{I} along the axis of solenoid I to the magnetic field B_{II} along the axis of solenoid II, $B_{\mathrm{I}}/B_{\mathrm{II}}$, is

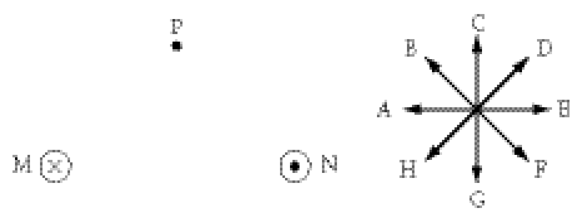
a. 1/4.
b. 1/2.
c. 1.
d. 2
e. 4.

40. Two solenoids of equal length are each made of 2000 turns of copper wire per meter. Solenoid I has a 5.00 cm radius; solenoid II a 10.0 cm radius. When equal currents are present in the two solenoids, the ratio of the magnitude of the magnetic field B_{I} along the axis of solenoid I to the magnitude of the magnetic field B_{II} along the axis of solenoid II, $B_{\mathrm{I}}/B_{\mathrm{II}}$, is

a. 1/4.
b. 1/2.
c. 1.
d. 2.
e. 4.

41. Equal currents of magnitude *I* travel into the page in wire M and out of the page in wire N. Eight directions are indicated by letters A through H.

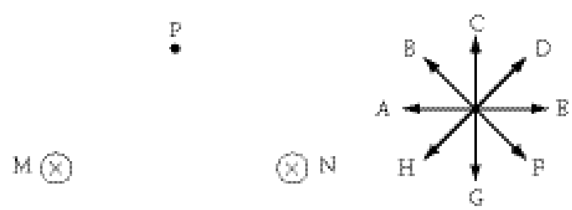
The direction of the magnetic field at point P is



a. C.
b. E.
c. F.
d. G.
e. H.

42. Equal currents of magnitude *I* travel into the page in wires M and N. Eight directions are indicated by letters A through H.

The direction of the magnetic field at point P is



a. B.
b. C.
c. D.
d. E.
e. F.

1. A coil is wrapped with 300 turns of wire on the perimeter of a circular frame (radius = 8.0 cm). Each turn has the same area, equal to that of the frame. A uniform magnetic field is turned on perpendicular to the plane of the coil. This field changes at a constant rate from 20 to 80 mT in a time of 20 ms. What is the magnitude of the induced emf in the coil at the instant the magnetic field has a magnitude of 50 mT?

a. 24 V
b. 18 V
c. 15 V
d. 10 V
e. 30 V

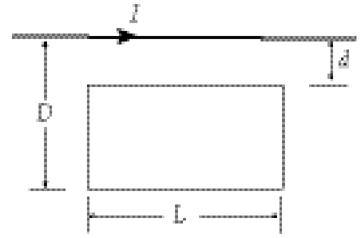
2. A 40-turn circular coil (radius = 4.0 cm, total resistance = 0.20 Ω) is placed in a uniform magnetic field directed perpendicular to the plane of the coil. The magnitude of the magnetic field varies with time as given by $B = 50 \sin(10\,\pi t)$ mT where t is measured in s. What is the magnitude of the induced current in the coil at 0.10 s?

a. 50 mA
b. 1.6 A
c. 0.32 A
d. zero
e. 0.80 A

3. A square loop (length along one side = 20 cm) rotates in a constant magnetic field which has a magnitude of 2.0 T. At an instant when the angle between the field and the normal to the plane of the loop is equal to 20° and increasing at the rate of 10°/s, what is the magnitude of the induced emf in the loop?

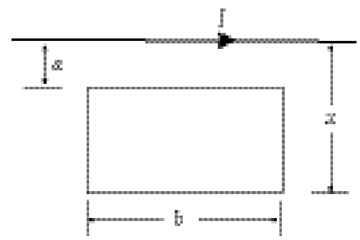
a. 13 mV
b. 0.27 V
c. 4.8 mV
d. 14 mV
e. 2.2 mV

4. A loop of wire (resistance = 2.0 mΩ) is positioned as shown with respect to a long wire which carries a current. If d = 1.0 cm, D = 6.0 cm, and L = 1.5 m, what current is induced in the loop at an instant when the current in the wire is increasing at a rate of 100 A/s?



a. 34 mA
b. 30 mA
c. 27 mA
d. 38 mA
e. 0.50 mA

5. A long straight wire is parallel to one edge and is in the plane of a single-turn rectangular loop as shown. If the loop is changing width so that the distance x changes at a constant rate of 4.0 cm/s, what is the magnitude of the emf induced in the loop at an instant when x = 6.0 cm? Let a = 2.0 cm, b = 1.2 m, and I = 30 A.



a. 5.3 μV
b. 2.4 μV
c. 4.8 μV
d. 2.6 μV
e. 1.3 μV

6. A rectangular wire loop (length = 60 cm, width = 40 cm) lies completely within a perpendicular and uniform magnetic field of magnitude of 0.5 T. If the length of the loop starts increasing at a rate of 20 mm/s at time t = 0, while the width is decreasing at the same rate, what is the magnitude of the induced emf at time t = 4.0 s?

a. 6.8 mV
b. 5.2 mV
c. 3.6 mV
d. 8.4 mV
e. 10 mV

7. A 5-turn square loop (10 cm along a side, resistance = 4.0 Ω) is placed in a magnetic field that makes an angle of 30° with the plane of the loop. The magnitude of this field varies with time according to $B = 0.5t^2$, where t is measured in s and B in T. What is the induced current in the coil at t = 4.0 s?

a. 25 mA
b. 5.0 mA
c. 13 mA
d. 43 mA
e. 50 mA

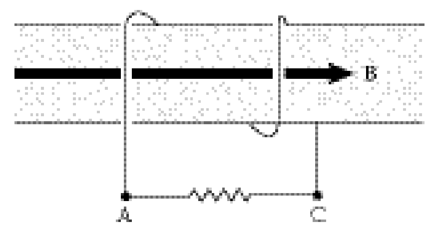
8. A square coil (length of side = 24 cm) of wire consisting of two turns is placed in a uniform magnetic field that makes an angle of 60° with the plane of the coil. If the magnitude of this field increases by 6.0 mT every 10 ms, what is the magnitude of the emf induced in the coil?

a. 55 mV
b. 46 mV
c. 50 mV
d. 60 mV
e. 35 mV

9. A long solenoid (n = 1500 turns/m) has a cross-sectional area of 0.40 m^2 and a current given by $I = (4.0 + 3.0t^2)$ A, where t is in seconds. A flat circular coil (N = 300 turns) with a cross-sectional area of 0.15 m^2 is inside and coaxial with the solenoid. What is the magnitude of the emf induced in the coil at t = 2.0 s?

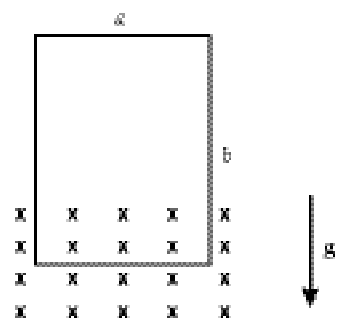
a. 2.7 V
b. 1.0 V
c. 6.8 V
d. 0.68 V
e. 1.4 V

10. The coil shown in the figure has 2 turns, a cross-sectional area of 0.20 m^2, and a field (parallel to the axis of the coil) with a magnitude given by $B = (4.0 + 3.0t^2)$ T, where t is in s. What is the potential difference, $V_A - V_C$, at t = 3.0 s?



a. –7.2 V
b. +7.2 V
c. –4.8 V
d. +4.8 V
e. –12 V

11. A conducting rectangular loop of mass M, resistance R, and dimensions $a \times b$ is allowed to fall from rest through a uniform magnetic field which is perpendicular to the plane of the loop. The loop accelerates until it reaches a terminal speed (before the upper end enters the magnetic field). If a = 2.0 m, B = 6.0 T, R = 40 Ω, and M = 0.60 kg, what is the terminal speed?

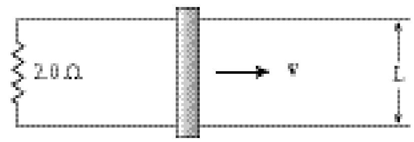


a. 1.6 m/s
b. 20 m/s
c. 2.2 m/s
d. 26 m/s
e. 5.3 m/s

12. A 20-cm length of wire is held along an east-west direction and moved horizontally to the north with a speed of 3.0 m/s in a region where the magnetic field of the earth is 60 μT directed 30° below the horizontal. What is the magnitude of the potential difference between the ends of the wire?

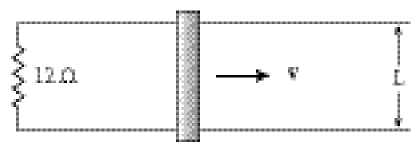
a. 36 μV
b. 18 μV
c. 31 μV
d. 24 μV
e. 21 μV

13. In the arrangement shown, a conducting bar of negligible resistance slides along horizontal, parallel, frictionless conducting rails connected as shown to a 2.0-Ω resistor. A uniform 1.5-T magnetic field is perpendicular to the plane of the paper. If L = 60 cm, at what rate is thermal energy being generated in the resistor at the instant the speed of the bar is equal to 4.2 m/s?



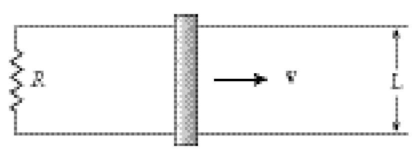
a. 8.6 W
b. 7.8 W
c. 7.1 W
d. 9.3 W
e. 1.8 W

14. A rod (length = 10 cm) moves on two horizontal frictionless conducting rails, as shown. The magnetic field in the region is directed perpendicularly to the plane of the rails and is uniform and constant. If a constant force of 0.60 N moves the bar at a constant velocity of 2.0 m/s, what is the current through the 12-Ω load resistor?



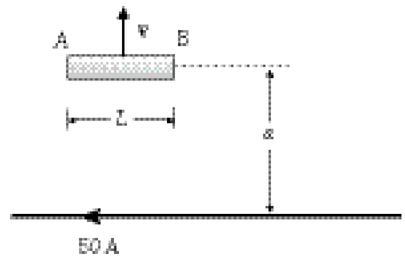
a. 0.32 A
b. 0.34 A
c. 0.37 A
d. 0.39 A
e. 0.43 A

15. A bar (L = 80 cm) moves on two frictionless rails, as shown, in a region where the magnetic field is uniform (B = 0.30 T) and into the paper. If v = 50 cm/s and R = 60 mΩ, what is the magnetic force on the moving bar?



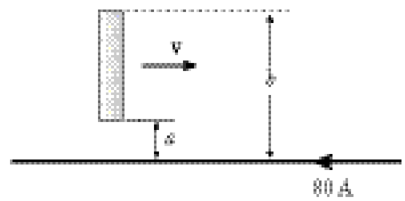
a. 0.48 N to the right
b. 0.48 N to the left
c. 0.32 N to the left
d. 0.32 N to the right
e. None of the above

16. A conducting bar moves as shown near a long wire carrying a constant 50-A current. If *a* = 4.0 mm, *L* = 50 cm, and *v* = 12 m/s, what is the potential difference, $V_A - V_B$?



a. +15 mV
b. –15 mV
c. +20 mV
d. –20 mV
e. +10 mV

17. A conducting bar moves as shown near a long wire carrying a constant 80-A current. If *a* = 1.0 mm, *b* = 20 mm, and *v* = 5.0 m/s, what is the potential difference, $V_a - V_b$?



a. –0.24 mV
b. +0.24 mV
c. –0.19 mV
d. +0.19 mV
e. –0.76 mV

18. A conducting rod (length = 80 cm) rotates at a constant angular rate of 15 revolutions per second about a pivot at one end. A uniform field (*B* = 60 mT) is directed perpendicularly to the plane of rotation. What is the magnitude of the emf induced between the ends of the rod?

a. 2.7 V
b. 2.1 V
c. 2.4 V
d. 1.8 V
e. 3.3 V

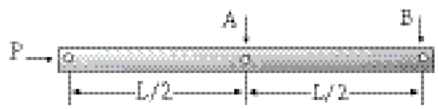
19. A metal blade (length = 80 cm) spins at a constant rate of 10 radians/s about a pivot at one end. A uniform magnetic field of 2.0 mT is directed at an angle of 30° with the plane of the rotation. What is the magnitude of the potential difference between the two ends of the blade?

a. 5.5 mV
b. 6.4 mV
c. 3.2 mV
d. 11 mV
e. 13 mV

20. A conducting rod (length = 2.0 m) spins at a constant rate of 2.0 revolutions per second about an axis that is perpendicular to the rod and through its center. A uniform magnetic field (magnitude = 8.0 mT) is directed perpendicularly to the plane of rotation. What is the magnitude of the potential difference between the center of the rod and either of its ends?

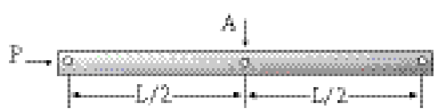
a. 16 mV
b. 50 mV
c. 8.0 mV
d. 0.10 mV
e. 100 mV

21. A conducting bar of length L rotates in a counterclockwise direction with a constant angular speed of +2.0 rad/s about a pivot P at one end, as shown. A uniform magnetic field (magnitude = 0.20 T) is directed into the paper. If L = 0.40 m, what is the potential difference, $V_A - V_B$?



a. +24 mV
b. –24 mV
c. +16 mV
d. –16 mV
e. +32 mV

22. A conducting bar of length L rotates with a constant angular speed of +2.0 rad/s about a pivot P at one end, as shown. A uniform magnetic field (magnitude = 0.20 T) is directed into the paper. If L = 0.40 m, what is the potential difference, $V_A - V_P$?



a. –12 mV
b. +8.0 mV
c. –8.0 mV
d. +12 mV
e. –16 mV

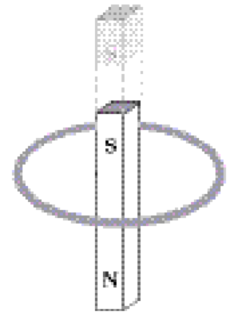
23. The magnetic flux through a loop perpendicular to a uniform magnetic field will change

a. if the loop is replaced by two loops, each of which has half of the area of the original loop.
b. if the loop moves at constant velocity while remaining perpendicular to and within the uniform magnetic field.
c. if the loop moves at constant velocity in a direction parallel to the axis of the loop while remaining in the uniform magnetic field.
d. if the loop is rotated through 180 degrees about an axis through its center and in the plane of the loop.
e. in none of the above cases.

24. A current may be induced in a coil by

- **a.** moving one end of a bar magnet through the coil.
- **b.** moving the coil toward one end of the bar magnet.
- **c.** holding the coil near a second coil while the electric current in the second coil is increasing.
- **d.** all of the above.
- **e.** none of the above.

25. A bar magnet is dropped from above and falls through the loop of wire shown below. The north pole of the bar magnet points downward towards the page as it falls. Which statement is correct?

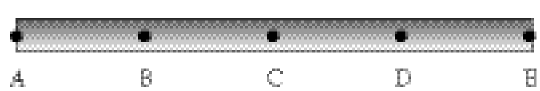


- **a.** The current in the loop always flows in a clockwise direction.
- **b.** The current in the loop always flows in a counterclockwise direction.
- **c.** The current in the loop flows first in a clockwise, then in a counterclockwise direction.
- **d.** The current in the loop flows first in a counterclockwise, then in a clockwise direction.
- **e.** No current flows in the loop because both ends of the magnet move through the loop.

26. Human brain activity produces weak variable electric currents. The way these are detected without surgery is by

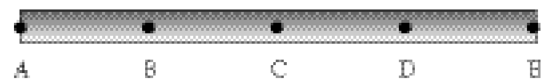
- **a.** measuring the force on a wire carrying a large electric current that is placed near the brain.
- **b.** measuring the force on a solenoid carrying a large electric current that is placed near the brain.
- **c.** measuring the magnetic fields they produce by means of small loops of wire of very low resistance placed near the brain.
- **d.** measuring the potential difference between the leaves of an electroscope that is placed near the brain.
- **e.** attaching the leads of an ohmmeter to a person's ears.

27. A metal rod of length L in a region of space where a constant magnetic field points into the page rotates clockwise about an axis through its center at constant angular velocity ω. While it rotates, the point(s) at highest potential is(are)



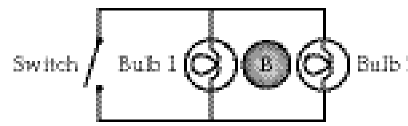
- **a.** A.
- **b.** B.
- **c.** C.
- **d.** D.
- **e.** A and E.

28. A metal rod of length *L* in a region of space where a constant magnetic field points into the page rotates clockwise about an axis through its center at constant angular velocity ω. While it rotates, the point(s) at lowest potential is(are)



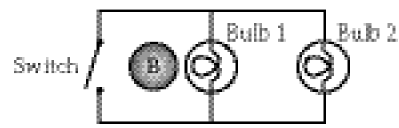
a. A.
b. B.
c. C.
d. D.
e. A and E.

29. Two bulbs are shown in a circuit that surrounds a region of increasing magnetic field directed out of the page. When the switch is closed,



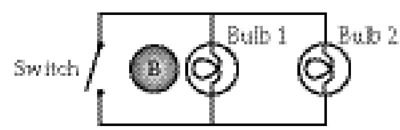
a. bulb 1 glows more brightly.
b. bulb 2 glows more brightly.
c. both bulbs continue to glow with the same brightness.
d. bulb 1 goes out.
e. bulb 2 goes out.

30. Two bulbs are shown in a circuit that surrounds a region of increasing magnetic field directed out of the page. When the switch is closed,



a. bulb 1 glows more brightly.
b. bulb 2 glows more brightly.
c. both bulbs glow equally brightly.
d. bulb 1 goes out.
e. bulb 2 goes out.

31. Two bulbs are shown in a circuit that surrounds a region of increasing magnetic field directed out of the page. When the switch is open,



a. bulb 1 is glowing; bulb 2 is dark.
b. bulb 2 is glowing; bulb 1 is dark.
c. both bulbs glow equally brightly.
d. both bulbs glow one half as brightly as they do with the switch closed.
e. both bulbs are dark.

The University of Jordan
Faculty of Science
Department of Physics
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General Physics-2 (0302102)
Suggested Multiple-Choice Problems
Inductance and Self Induction
2nd Semester 2013/2014

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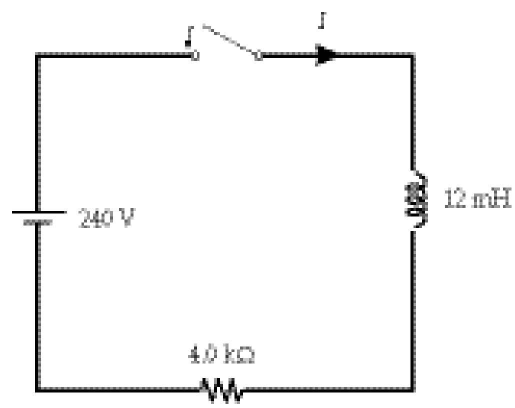
1. What is the inductance of a series *RL* circuit in which R = 1.0 KΩ if the current increases to one-third of its final value in 30 μs?

a. 74 mH
b. 99 mH
c. 49 mH
d. 62 mH
e. none of the above

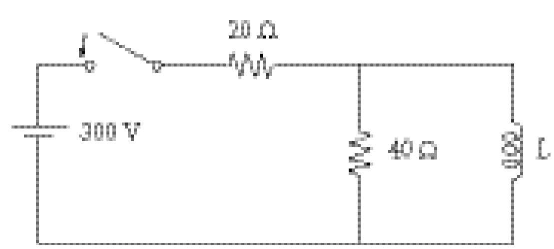
2. The switch in the figure is closed at t = 0 when the current I is zero. When I = 15 mA, what is the potential difference across the inductor?



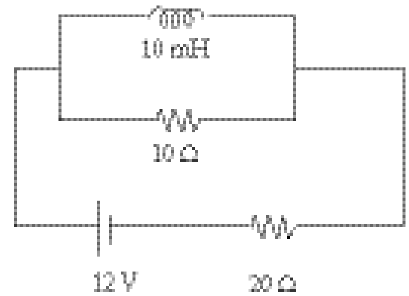
a. 240 V
b. 60 V
c. 0
d. 180 V
e. 190 V

3. There is no current in the circuit shown in the figure below until the switch is closed. The current through the 20-□ resistor the instant after the switch is closed is either [1] 15 A or [2] 5.0 A, and the current through the 20-□ resistor after the switch has been closed a long time is either [3] 5.0 A or [4] 15 A. Which combination of the above choices is correct?

a. [1] and [3]
b. [1] and [4]
c. [2] and [3]
d. [2] and [4]
e. None of these

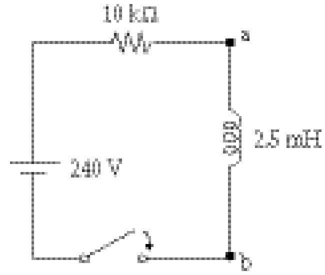


4. For the circuit shown, what is the rate of change of the current in the inductor when the current in the battery is 0.50 A?



a. 600 A/s
b. 400 A/s
c. 200 A/s
d. 800 A/s
e. 500 A/s

5. The figure shows an *LR* circuit with a switch and a 240-volt battery. At the instant the switch is closed the current in the circuit and the potential difference between points a and b, V_{ab}, are



a. 0 A, 0 V
b. 0 A, –240 V
c. 0 A, +240 V
d. 0.024 A, 0 V
e. 0.024 A, +240 V

6. When a switch is closed, completing an *LR* series circuit, the time needed for the current to reach one half its maximum value is _____ time constants.

a. 0.250
b. 0.500
c. 0.693
d. 1.00
e. 1.44

7. When a switch is closed, completing an *LR* series circuit, the time needed for the current to reach three-quarters its maximum value is _____ time constants.

a. 0.500
b. 0.693
c. 0.725
d. 1.33
e. 1.38

8. A circuit contains two inductors of 6.0 mH inductance in parallel placed in series with an inductor of 8.0 mH inductance. After one of the 6.0 mH inductors burns out, the repairman wants to replace all three inductors with one inductor of equivalent inductance. What inductance should he use?

a. 3.0 mH
b. 3.4 mH
c. 4.8 mH
d. 11 mH
e. 20 mH

9. The magnetic field in a superconducting solenoid is 3.0 T. How much energy per unit volume is stored in the solenoid, in J/m^3? $\mu_0 = 4\pi \times 10^{-7}$ T · A/m

a. 3.6×10^{6}
b. 11.3×10^{-6}
c. 7.2×10^{6}
d. 22.66×10^{-6}
e. none of the above

10. Find the magnetic energy stored in the air gap between two very large magnetic pole pieces, one North, one South, each with an area of 100 cm^2. Assume the 0.05 T magnetic field is uniform within the 2-cm gap.

a. 0.2 J
b. 2 J
c. 20 J
d. 199 J
e. none of the above

11. A 10-mH inductor is connected in series with a 10-ohm resistor, a switch and a 6-volt battery. What is the time constant of the circuit? How long after the switch is closed will the current reach 99 percent of its final value?

a. 1 ms, 4.6 ms
b. 1 s, 4.6 s
c. 2 ms, 9.2 s
d. 2 ms, 4.6 ms
e. none of the above