Q1.
A string fixed at both ends is oscillating in a standing wave pattern with four loops. The time for a particle to go from maximum upward displacement to maximum downward displacement is 0.025 s. What is the fundamental frequency of the string?

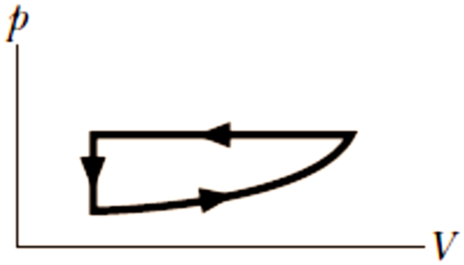
A) 5.0 Hz
B) 10 Hz
C) 2.5 Hz
D) 7.5 Hz
E) 15 Hz

Q2.
A sound wave travelling in a medium is given by
$s(x,t) = 6.00\times10^{-6}\cos[0.900\,x - 315\,t]$ (SI units)
If the bulk modulus of the medium is 1.40×10^6 N/m^2, what is the pressure amplitude of the wave?

A) 7.56 Pa
B) 10.0 Pa
C) 4.62 Pa
D) 5.00 Pa
E) 9.24 Pa

Q3.
For one complete cycle as shown in the *p*-*V* diagram in **FIGURE 1**, the heat (Q) and work (W) are

Fig#



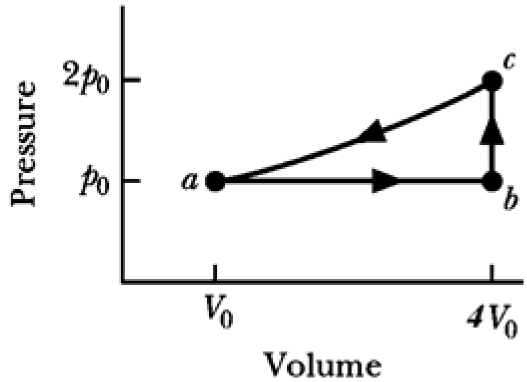
A) Q < 0 , W < 0
B) Q < 0 , W > 0
C) Q > 0 , W < 0
D) Q > 0 , W > 0
E) Q = 0 , W < 0

Q4.
An ideal gas is compressed at a constant pressure of 25.0 N/m^2 from a volume of 3.00 m^3 to a volume of 1.80 m^3. In the process, 75.0 J is lost by the gas as heat. What is the change in the internal energy of the gas?

A) – 45.0 J
B) – 105 J
C) + 105 J

D) + 45.0 J
E) + 75.0 J
Q5.
One mole of an ideal monatomic gas is taken through the cycle shown in **FIGURE 2**. What is the change in the entropy of the gas for process $c \rightarrow a$?

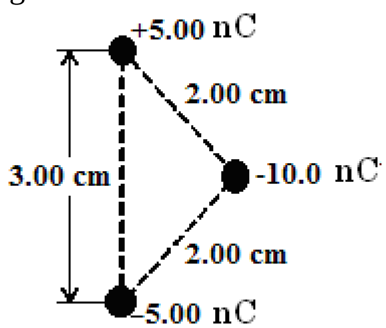
Fig#



A) – 37.4 J/K
B) + 37.4 J/K
C) – 14.4 J/K
D) + 14.4 J/K
E) + 20.2 J/K

Q6.
Three fixed point charges are arranged as shown in **FIGURE 3**. What is the net electrostatic force on the – 10.0 nC charge exerted by the other two charges?

Fig#



A) 1.69 mN, upward
B) 3.25 mN, downward
C) 3.25 mN, to the right
D) 3.25 mN, to the left
E) 8.63 mN, downward

Q7.
What electric field balances the weight of a particle of mass 6.4 g that has been charged to – 3.0 nC?

A) 2.1×10^{7} N/C, downward
B) 2.4×10^{6} N/C, upward
C) 4.5×10^{6} N/C, upward
D) 6.4×10^{6} N/C, downward
E) 3.3×10^{7} N/C, downward

Sec# Electric fields - A point Charge in an Electric Field
Grade# 50

Q8.
A hollow conducting sphere with an outer radius of 0.250 m and an inner radius of 0.200 m has a uniform surface charge density of + 6.37μC/m^2. A charge of – 0.500 μC is then introduced into the cavity inside the sphere. What is the new charge density on the outer surface of the sphere?

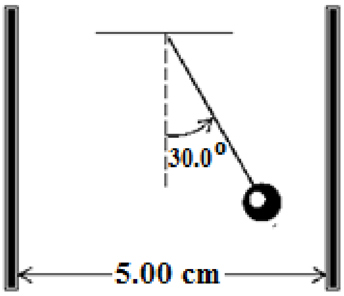
A) + 5.73 μC/m^2
B) + 7.00 μC/m^2
C) – 5.73 μC/m^2
D) – 7.00 μC/m^2
E) + 6.37 μC/m^2

Q9.
An infinite line of charge has a uniform linear charge density of + 2.00×10^{-8} C/m. Point A is a distance of 2.00 m from the line and point B is a distance of 3.00 m from the line. What is the magnitude of the potential difference between points A and B?

A) 146 V
B) 645 V
C) 59.8 V
D) 50.4 V
E) 103 V

Q10.
A small sphere, with mass 2.00 g and charge 8.90 nC, hangs by a string between two large parallel vertical plates that are 5.00 cm apart, as shown in **FIGURE 4**. The plates are insulating and have uniform surface charge densities + σ and – σ. What potential difference causes the string to be deflected by an angle of 30.0^{o} from the vertical?

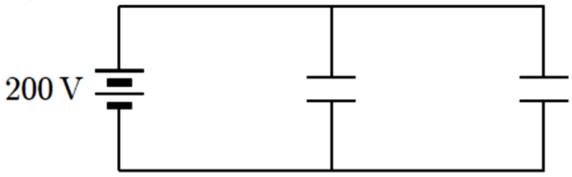
Fig#



A) 6.36×10^4 V
B) 3.83×10^4 V
C) 2.63×10^4 V
D) 2.01×10^4 V
E) 7.13×10^4 V

Q11.
To store a total energy of 0.0500 J in the two identical capacitors shown in **FIGURE 5**, each should have a capacitance of

Fig#



A) 1.25 μF
B) 2.50 μF
C) 5.00 μF
D) 3.75 μF
E) 6.00 μF

Q12.
A cylindrical conducting wire has resistance *R*. It is reformed to twice its original length with no change of volume. Its new resistance is

A) 4*R*
B) *R*
C) 2*R*
D) 8*R*
E) *R*/2

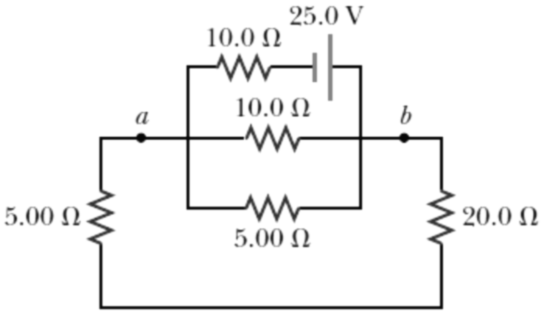
Q13.
Two resistors of resistances *R* and 2*R* are connected in parallel to an ideal battery. If the power dissipated in resistor *R* is *P*, then the power dissipated in resistor 2*R* is

A) *P*/2

B) 2*P*
C) *P*
D) *P*/4
E) *4*P

Q14.
Consider the circuit shown in **FIGURE 6**. Find the potential difference $V_a - V_b$.

Fig#



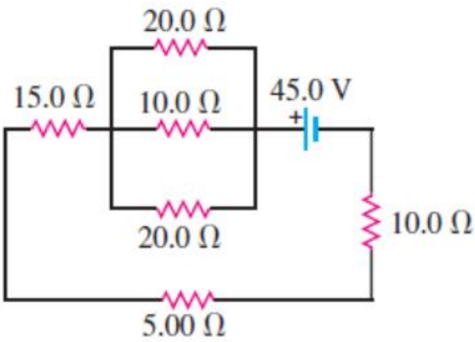
A) – 5.68 V
B) + 5.68 V
C) + 44.3 V
D) + 19.3 V
E) – 19.3 V

Q15.
An emf source with $\mathscr{E}$ = 100 V, a resistor with resistance R = 90.0 Ω, and a capacitor with capacitance C = 5.00 μF are connected in series. As the capacitor charges, what is the charge on the capacitor when the current in the resistor is 0.800 A?

A) 140 μC
B) 360 μC
C) 500 μC
D) 110 μC
E) 230 μC

Q16.
For the circuit shown in **FIGURE 7**, what is the current in the upper 20.0 Ω resistor?

Fig#

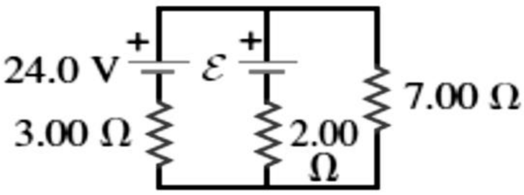


A) 0.321 A
B) 0.643 A
C) 0.429 A
D) 1.29 A
E) 0.571 A

Q17.

In **FIGURE 8**, the two batteries are ideal. What must be the emf $\boldsymbol{\varepsilon}$ if the current in the 7.00 Ω resistor is 1.50 A?

Fig#



A) 4.50 V
B) 8.60 V
C) 6.30 V
D) 1.20 V
E) 3.80 V

Q18.
A charged particle moves through a region in which there is a uniform magnetic field. If the magnitude of the acceleration of the particle is one-fourth of the largest magnitude, what is the angle between the particle’s velocity and the magnetic field?

A) 14.5^{o}
B) 75.5^{o}
C) 27.5^{o}
D) 62.5^{o}
E) 22.5^{o}

Q19.

An electron moves with constant velocity $\vec{v} = 3.0 \times 10^{6}\ \hat{i}$ (m/s) through crossed electric and magnetic fields. If the electric field $\vec{E} = 6.0 \times 10^{3}\ \hat{j}$ (V/m), what is the magnetic field (in units mT)?

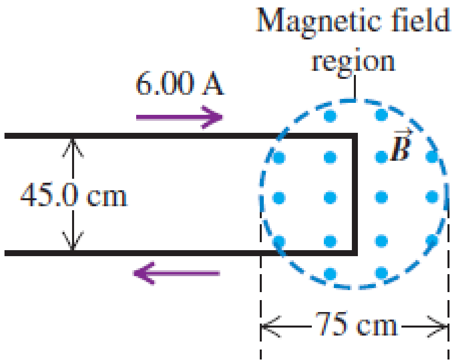
A) $+2.0\ \hat{k}$
B) $-2.0\ \hat{k}$
C) $-2.0\ \hat{j}$
D) $+2.0\ \hat{j}$
E) $-12\ \hat{i}$

Q20.
What magnitude of uniform magnetic field, applied perpendicular to a beam of electrons moving at 1.6×10^{6} (m/s) is required to make the electrons travel in a circular orbit of radius 5.0 mm?

A) 1.8 mT
B) 4.6 mT
C) 2.4 mT
D) 5.5 mT
E) 1.2 mT

Q21.
A long wire carrying a 6.00 A current reverses direction by means of two right-angle bends, as shown in **FIGURE 9**. The part of the wire where the bend occurs is in a magnetic field of magnitude 0.70 T confined to a circular region of diameter 75 cm. What is the net magnetic force on the wire?

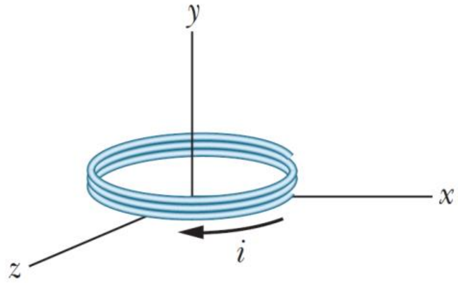
Fig#



A) 1.9 N, to the left
B) 1.9 N, to the right
C) zero
D) 1.6 N, to the right
E) 1.6 N, to the left

Q22.
The coil in **FIGURE 10** is parallel to the *xz* plane and carries a current of 2.0 A in the direction indicated. It has 3.0 turns and an area of 5.0×10^{-4} m^2. The coil lies in a uniform magnetic field given by $\vec{B} = 2.0\,\hat{i} - 3.0\,\hat{j}\,(\text{mT})$. What is the orientation energy of the coil?

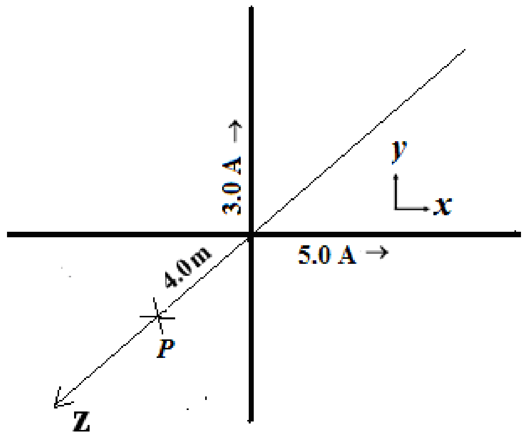
Fig#



A) – 9.0 µJ
B) + 9.0 µJ
C) – 6.0 µJ
D) + 6.0 µJ
E) Zero

Q23.
Two long straight wires cross each other perpendicularly without touching, as shown in **FIGURE 11**. Find the net magnetic field due to the two wires at point ***P***, which is along the positive *z* axis.

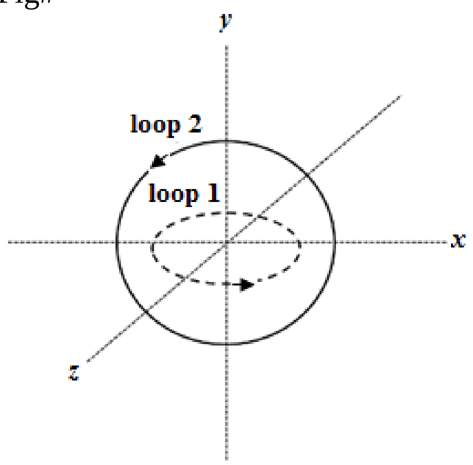
Fig#



A) $+0.15\,\hat{i} - 0.25\,\hat{j}$ (µT)
B) $+0.15\,\hat{i} + 0.25\,\hat{j}$ (µT)
C) $-0.15\,\hat{i} - 0.25\,\hat{j}$ (µT)
D) $-0.15\,\hat{i} + 0.25\,\hat{j}$ (µT)
E) $+0.29\,\hat{k}$ (µT)

Q24.
Two concentric circular loops are placed with their planes perpendicular to each other, as shown in **FIGURE 12**. Loop 1 (in the *xz* plane) has radius 2.0 cm and carries a current of 4.0 A. Loop 2 (in the *xy* plane) has radius 3.0 cm and carries a current of 5.0 A. What is the magnitude of the magnetic field at the center of the loops?

Fig#



A) 0.16 mT
B) 0.25 mT
C) 0.51 mT
D) 0.46 mT
E) 0.33 mT

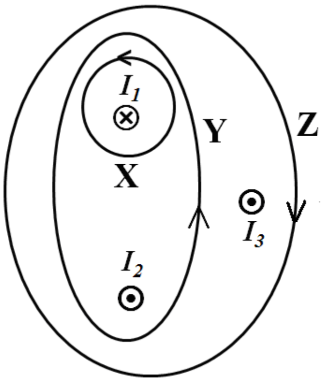
Q25.
Three parallel infinitely-long current-carrying wires are placed as shown, in cross section, in **FIGURE 13**. If net magnetic force on I_2 zero, what should be the current I_3?

Fig#

A) $I_3 = I_1/2$, into the page
B) $I_3 = I_1/2$, out of the page
C) $I_3 = 2I_1$, out of the page
D) $I_3 = 2I_1$, into the page
E) No current can cancel the magnetic force on I_2.

Q26.
FIGURE 14 shows, in cross section, three long wires that carry currents perpendicular to the page. The currents have magnitudes I_1 = 4.0 A, I_2 = 6.0 A, and I_3 = 3.0 A. Three paths (X, Y, Z) are drawn. Rank these paths according to the value of the line integral $\oint \vec{B} \cdot d\vec{s}$, greatest first.

Fig#



A) Y, X, Z
B) Z, X, Y
C) Z, Y, X
D) Y, Z, X
E) X, Z, Y

Q27.
Inside an ideal solenoid carrying current, the magnetic field

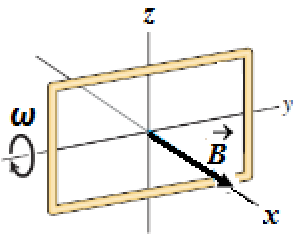
A) is uniform.
B) is zero.
C) decreases with distance from the axis of the solenoid.
D) increases with distance from the axis of the solenoid.
E) is perpendicular to the axis of the solenoid.

Q28.
A loop of area 4.0 cm^2 and resistance 5.0 μΩ is perpendicular to a uniform magnetic field of magnitude 15 μT. The magnitude of the field drops uniformly to zero in 3.0 ms. How much thermal energy is produced in the loop by the change in field?

A) 2.4 nJ
B) 8.0 nJ
C) 6.9 nJ
D) 3.7 nJ
E) 5.3 nJ

Q29.
A conducting loop, of area A, is parallel to the yz plane, as shown in **FIGURE 15**. It is placed in a uniform magnetic field $\vec{B}$ and is rotated about the *y* axis with angular speed ω. What is the maximum induced emf in the loop if $A = 5.00\ cm^2$, $B = 0.350$ T and $\omega = 45.0$ rad/s?

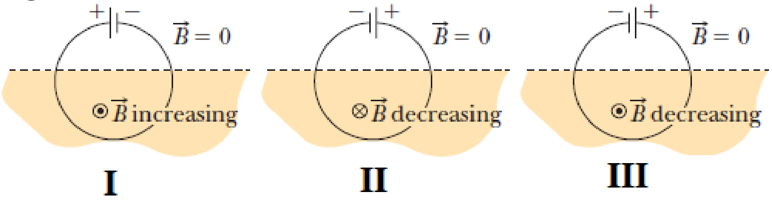
Fig#



A) 7.88 mV
B) 3.89 mV
C) 6.43 mV
D) 3.15 mV
E) 2.57 mV

Q30.
FIGURE 16 shows three situations in which a wire loop lies partially in a magnetic field, with a battery as part of the loop. The induced emf and the battery emf have the same direction in

Fig#



A) II only
B) I only
C) III only
D) II and III
E) I and II