Q1.
Standing waves pattern on a 6.00 m long string fixed at both ends is described by the wave function $y = 0.002 \sin(\pi x) \cos(100\pi t)$ where x and y are in meters and t is in seconds. How many loops are there in this standing wave pattern?

A) 6
B) 3
C) 2
D) 4
E) 5

Q2.
A loudspeaker emits sound waves isotropically in all directions. What is the speaker's power output if the sound level is 90 dB at a distance of 20 m from the loud speaker?

A) 5.0 W
B) 3.5 W
C) 1.5 W
D) 4.0 W
E) 2.5 W

Q3.
How many kg of ice at 0°C should be mixed with 1.8 kg of water at 80°C to bring the final temperature of the mixture to 10°C?

A) 1.4 kg
B) 2.1 kg
C) 2.4 kg
D) 3.5 kg
E) 1.1 kg

Q4.
2.00 L container of fixed volume holds 3.00 mol of an ideal gas. If 200 J of heat is added to the gas, what is the change in internal energy of the system?

A) 200 J
B) 150 J
C) 100 J
D) 170 J
E) 110 J

Q5.
A monatomic ideal gas expands adiabatically from a volume of 2.0 liters to 6.0 liters. If the initial pressure is P_0, what is the final pressure?

A) 0.16 P_0

B) 9.0 P_0
C) 6.2 P_0
D) 3.0 P_0
E) 0.55P_0

Q6.
What is the change in entropy of 108 g of silver at a temperature of 961 °C when it is completely melted ($L_{F\text{- silver}}$ = 8.82 ×10^4 J/kg, $T_{\text{Melting-silver}}$ = 961 °C).

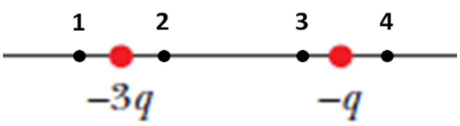
A) 7.72 J/K
B) 5.53 J/K
C) 3.21 J/K
D) 1.33 J/K
E) 6.11 J/K

Q7.
Coefficient of performance of an air conditioner is 2.80 and it operates on 800 W of power. Calculate the rate at which heat is discharged by the air conditioner to the outside air

A) 3.04×10^3 W
B) 2.11×10^3 W
C) 1.35×10^3 W
D) 1.00×10^3 W
E) 4.35×10^3 W

Q8.
Figure 1 shows two charged particles fixed on the x- axis. A third negatively charged particle can be placed at a certain point (1, 2, 3 or 4) on the x- axis so the net electrostatic force on it is zero. Which of the following answers can possibly be the correct position of the third particle?

Fig#



A) 3
B) 2
C) 1
D) 4
E) None of the any given location

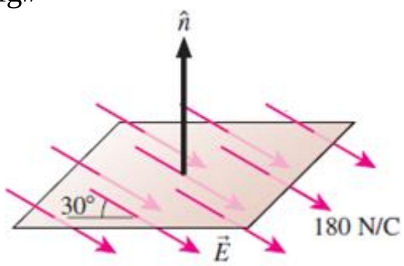
Q9.

An electron with a speed of 8.38×10^6 m/s enters a region of uniform electric field with velocity directed along the electric field. What is the magnitude of the electric field that will stop the electron momentarily at a distance of 0.100 m after entering this region?

A) 2.00×10^3 N/C
B) 1.14×10^3 N/C
C) 1.32×10^3 N/C
D) 2.42×10^3 N/C
E) 1.22×10^3 N/C

Q10.
What is the magnitude of the electric flux through a horizontal surface of area 225 cm^2 placed in an electric field that makes 30.0° angle with the surface as shown in **Figure 2?**

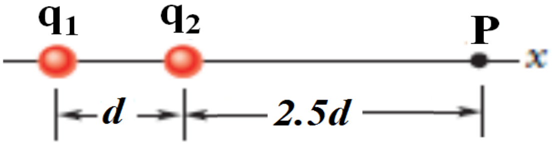
Fig#



A) +2.00 N.m^2/C
B) +3.55 N.m^2/C
C) −1.12 N.m^2/C
D) −2.00 N.m^2/C
E) −3.55 N.m^2/C

Q11.
Two particles of charges q_1 and q_2 are fixed in position, as shown in **Figure 3**. A third particle, of charge + 6.0 μC, is brought from infinity to point P. Three particle system has the same electric potential energy as the initial two-particle system. What is the charge ratio q_1/q_2? (Assume potential energy is zero at infinity)

Fig#



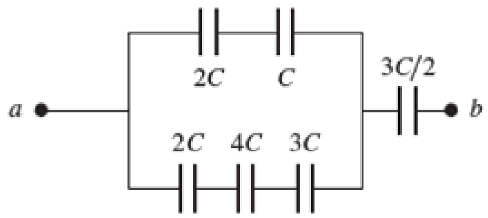
A) −1.4
B) −1.1
C) +1.2
D) −1.8
E) +1.9

Q12.
A solid conducting sphere of 10 cm radius has a net charge of 20 nC. If the potential at infinity is taken to be zero, what is the potential at the center of the sphere?

A) 1.8×10^3 V
B) 1.0×10^3 V
C) 2.6×10^3 V
D) 3.3×10^3 V
E) Zero

Q13.
Six capacitors are connected in a circuit as shown in **Figure 4**. Find the energy stored in the equivalent capacitance of the circuit between points ***a*** and ***b*** if C =1.50 μF and the potential difference V_{ab} =100 V.

Fig#



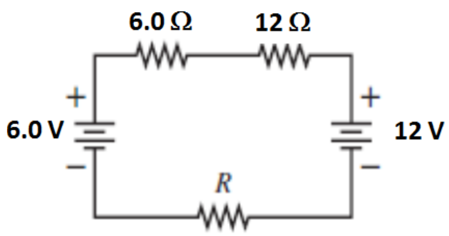
A) 5.79×10^{-3} J
B) 1.20×10^{-3} J
C) 2.53×10^{-3} J
D) 3.55×10^{-3} J
E) 4.20×10^{-3} J

Q14.
Magnitude of the drift velocity of conduction electrons in a copper wire is 7.84×10^{-4} m/s and the number of conduction electrons per unit volume is n = 8.46×10^{28} /m^3. What is the electric field in the wire? ($\rho_{Copper} = 1.72 \times 10^{-8}$ Ω.m)?

A) 1.83×10^{-1} V/m
B) 2.55×10^{-1} V/m
C) 3.01×10^{-1} V/m
D) 1.00×10^{-1} V/m
E) 3.31×10^{-1} V/m

Q15.
In the circuit shown in **Figure 5**, a current of 0.25 A is flowing through the resistor R. What is the power dissipated in resistor *R*?

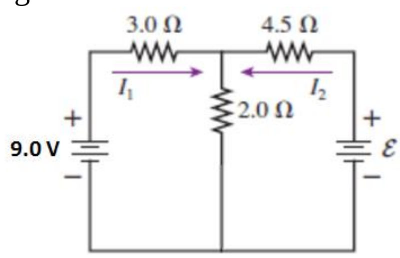
Fig#



A) 0.38 W
B) 0.55 W
C) 0.11 W
D) 0.73 W
E) 0.92 W

Q16.
Figure 6 shows a circuit where the current in 2.0 Ω resistor is 3.0 A. Find the unknown emf ε.

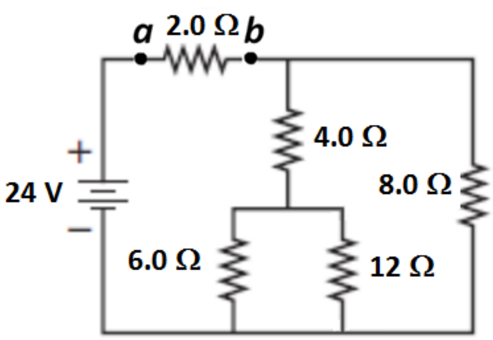
Fig#



A) 15 V
B) 9.5 V
C) 10 V
D) 12 V
E) 8.8 V

Q17.
For the circuit shown in **Figure 7**, find the potential difference $V_a - V_b$ across the 2.0 Ω resistor.

Fig#



A) 8.0 V
B) 5.5 V
C) 9.1 V
D) 14 V
E) 10 V

Q18.
A capacitor is being charged through a 12 Ω resistor using a 10 V battery. What will be the current in the circuit when the capacitor has acquired ¼ of its maximum charge?

A) 0.63 A
B) 0.42 A
C) 0.51 A
D) 0.29 A
E) 0.75 A

Q19.
A proton, enters a region of uniform magnetic field $\vec{\mathbf{B}}$ with a velocity $\vec{\mathbf{v}}$ = 1.50 km/s $\hat{\boldsymbol{i}}$. At that instant it experiences a magnetic force $\vec{\mathbf{F}}_{\mathbf{B}} = 2.25 \times 10^{-16}$ N $\hat{\boldsymbol{j}}$. What is the magnetic field $\vec{\boldsymbol{B}}$? Ignore the gravitational force.

A) $-(0.938\text{ T})\hat{\boldsymbol{k}}$
B) $+(0.938\text{ T})\hat{\boldsymbol{k}}$
C) $-(0.532\text{ T})\hat{\boldsymbol{k}}$
D) $+(0.532\text{ T})\hat{\boldsymbol{k}}$
E) $-(0.232\text{ T})\hat{\boldsymbol{k}}$

Q20.
A proton moving in the positive *x*–direction with a speed $v = 1.35 \times 10^6$ m/s enters the region between the two plates as shown in **figure 8**. The potential of the top plate is 200 V, and the potential of the bottom plate is 0 V. What is magnetic field, $\vec{\boldsymbol{B}}$, that is required between the plates so that the proton continues traveling in a straight line in the positive *x*-direction? Ignore the gravitational force.

Fig#

A) $-(4.23\times10^{-3}\text{T})\hat{\boldsymbol{k}}$
B) $+(4.23\times10^{-3}\text{T})\hat{\boldsymbol{k}}$
C) $-(1.22\times10^{-3}\text{T})\hat{\boldsymbol{k}}$
D) $+(1.22\times10^{-3}\text{T})\hat{\boldsymbol{k}}$

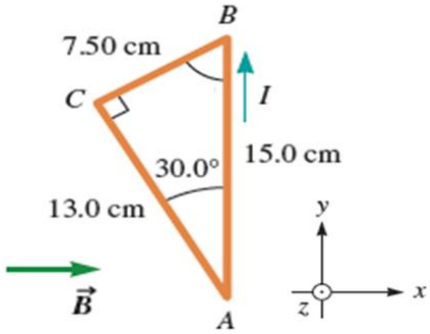
E) $-(6.55\times10^{-3}\text{T})\hat{\boldsymbol{k}}$

Q21.
A charged particle undergoes uniform circular motion of radius 55.0 μm in a uniform magnetic field. The magnetic force on the particle has a magnitude of 2.80×10^{-14} N. What is the kinetic energy of the particle?

A) 7.70×10^{-19} J
B) 1.22×10^{-19} J
C) 2.56×10^{-19} J
D) 3.66×10^{-19} J
E) 5.34×10^{-19} J

Q22.
A triangular loop of wire carrying a current of 0.125 A is placed in a x-y plane containing a uniform magnetic field $\vec{\mathbf{B}} = 0.250\ \text{T}\hat{\boldsymbol{i}}$, as shown in **Figure 9**. Determine the magnitude of the force on loop sides BC and CA, respectively due to the magnetic field.

Fig#



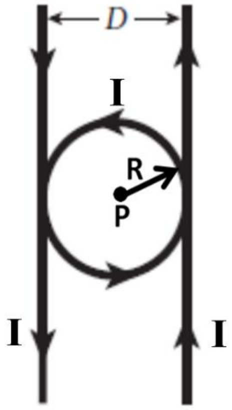
A) 1.17×10^{-3} N; 3.52×10^{-3} N
B) 1.47×10^{-3} N; 2.22×10^{-3} N
C) 2.22×10^{-3} N; 4.55×10^{-3} N
D) 3.52×10^{-3} N; 4.22×10^{-3} N
E) 4.22×10^{-3} N; 5.32×10^{-3} N

Q23.
A circular loop of radius r = 5.13 cm, has 47 turns. The loop is placed in a uniform magnetic field of magnitude 0.911 T. A current of 1.27 A flows through the loop. What is the maximum torque on the loop due to the magnetic field?

A) 0.450 N.m
B) 0.132 N.m
C) 0.225 N.m
D) 0.332 N.m
E) 0.100 N.m

Q24.
Two long parallel wires, separated by a distance D=10.0 cm, each carry a current I=5.00 A, in opposite directions as shown in **Figure 10**. A circular loop, of radius $R = D/2$, has the same current I flowing in the counterclockwise direction. Determine the magnitude and the direction of the net magnetic field at the center of the loop P due to the current in the loop and in the parallel wires.

Fig#



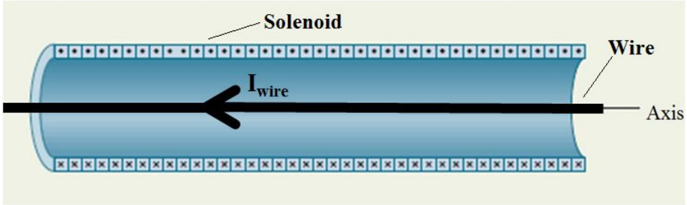
A) 1.03×10^{-4} T out of the page
B) 1.03×10^{-4} T into the page
C) 2.66×10^{-4} T out of the page
D) 2.66×10^{-4} T into the page
E) 3.45×10^{-4} T out of the page

Q25.
Two long parallel wires are separated by a distance of 3.0 mm. The current flowing in one of the wires is I and in the other wire is 2I. If the magnitude of the force on a 1.0 m length of one of the wires is 7.0 μN, what is the magnitude of current I?

A) 0.23 A
B) 0.10 A
C) 0.44 A
D) 0.54 A
E) 0.96 A

Q26.
A long solenoid with 6.00 cm diameter has 1000 turns per meter of thin wire which carries a current of 0.250 A. A long uniform straight wire carrying a current of 10.0 A is inserted along the axis of the solenoid, as shown in **Figure 11**. What is the magnitude of the magnetic field at a point 1.00 cm from the axis of the solenoid?

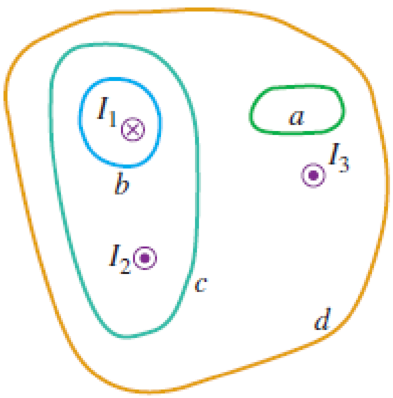
Fig#



A) 3.72×10^{-4} T
B) 1.00×10^{-4} T
C) 1.52×10^{-4} T
D) 2.11×10^{-4} T
E) 2.44×10^{-4} T

Q27.
Figure 12 shows cross-sectional view of three wires that carry currents perpendicular to the plane the figure. The currents have magnitudes $I_1 = 3.0$ A, $I_2 = 4.0$ A and $I_3 = 4.0$ A in the directions shown. Four closed paths, labeled *a, b, c and d* are shown. Rank the magnitude of the line integral $\oint \vec{B}.d\vec{l}$ for each path while going around the path in the counterclockwise direction, the **greatest first**.

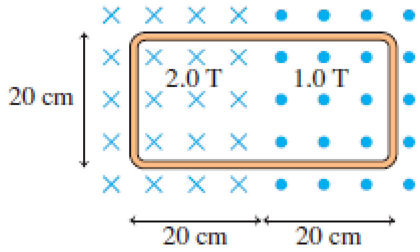
Fig#



A) *d, b, c, a*
B) *a, b, c, d*
C) *b, c, d, a*
D) *c, d, a, b*
E) *b, d, a, c*

Q28.
What is the net magnetic flux through the loop shown in **Figure 13**? Assume the area vector $\vec{A}$ of the loop points into the page.

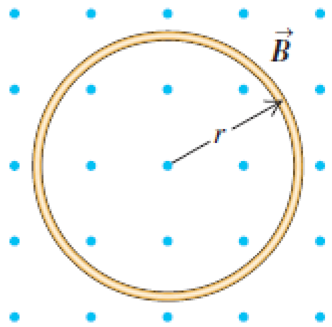
Fig#



A) 4.0×10^{-2} Wb
B) 1.0×10^{-2} Wb
C) 1.5×10^{-2} Wb
D) 2.1×10^{-2} Wb
E) 2.7×10^{-2} Wb

Q29.
A circular wire loop has 4.8 cm radius and an electrical resistance of 0.16 Ω. As shown in **Figure 14,** the loop is placed in a region where magnetic field $\vec{B}$ is perpendicular to the loop. The magnetic field has an initial value of 8.0 T and is decreasing at a rate of 0.68 T/s. Determine the magnitude and direction of the induced current in the loop?

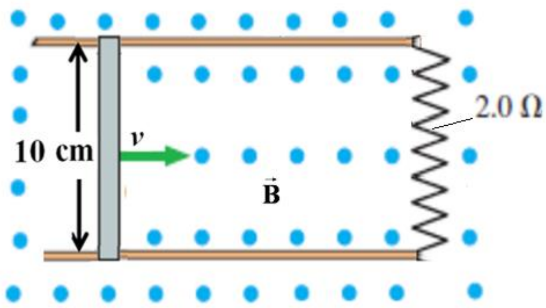
Fig#



A) 3.1×10^{-2} A, counterclockwise
B) 3.1×10^{-2} A, clockwise
C) 1.9×10^{-2} A, counterclockwise
D) 1.9×10^{-2} A, clockwise
E) 1.0×10^{-2} A, clockwise

Q30.
A 10 cm long conducting rod moves at a constant speed v = 0.50 m/s on a zero-resistance horizontal wires towards 2.0 Ω resistor in a uniform magnetic field B = 0.50 T, as shown in **Figure 15**. Find the magnitude of the force acting on the rod?

Fig#



A) 6.3×10^{-4} N
B) 2.3×10^{-4} N
C) 1.3×10^{-4} N
D) 3.5×10^{-4} N
E) 4.4×10^{-4} N