Q1.
Two transmitters, S_1 and S_2 shown in the figure, emit identical sound waves of wavelength λ . The transmitters are separated by a distance $\lambda/2$. Consider a big circle of radius R with its center halfway between these transmitters. How many interference maxima are there on this big circle?

Fig#

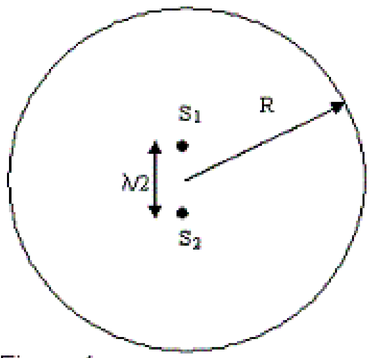

Figure 1

A) 2
B) 5
C) 1
D) 6
E) 8

Sec# Wave Motion - Superposition and Interference of Waves

Q2.
A pipe is closed at one end and open at the other end. The length of the pipe is 1.50 m. The air column in the pipe can resonate with a sound source of frequency: [speed of sound in air = 348 m/s]

A) 174 Hz
B) 116 Hz
C) 320 Hz
D) 200 Hz
E) 25 Hz

Sec# Sound Waves - Standing waves in Air Columns

Q3.
A steel rod is exactly 15.24 m long at 35 ^oC; its length at -10 ^oC is 15.232 m. What is the coefficient of linear expansion of steel?

A) 1.17×10^{-5} K^{-1}
B) -1.21×10^{2} K^{-1}
C) -1.17×10^{-5} K^{-1}
D) 1.21×10^{-8} K^{-1}
E) 2.17×10^{-5} K^{-1}

Sec# Temerature - Termometers and Temperature Scale

Q4.
Four moles of oxygen are confined to a 10-liter vessel at a pressure of 5.0 atm. What is the average transnational kinetic energy of an oxygen molecule (O_2) if its mass is 5.34×10^{-26} kg?

A) 3.15×10^{-21} J
B) 1.04×10^{-21} J
C) 2.23×10^{-21} J
D) 6.37×10^{-21} J
E) 4.36×10^{-21} J

Sec# The kinetic Theory of Gases - The Equipartition of Energy

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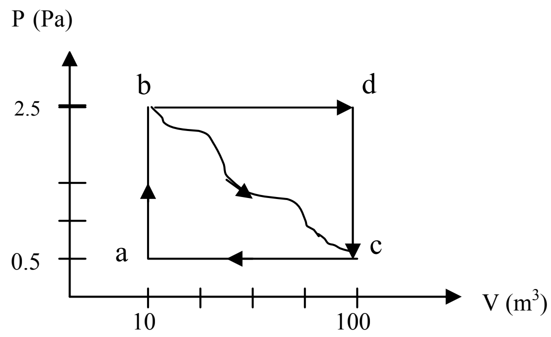
Q5.
For the monatomic gas in the following figure, calculate the change in the internal energy of the process b -> c.

Fig#



A) 37.5 J
B) 100 J
C) 12.2 J
D) 0.23 J
E) 49.0 J

Sec# The kinetic Theory of Gases - Specific Heat of an Ideal Gas

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Q6.
A Carnot refrigerator extracts 35 kJ of heat during each cycle and operates between reservoirs at temperatures of 260 K and 300 K. What is work done per cycle?

A) 5.4 kJ
B) 230 kJ
C) 4.7 kJ
D) 263 kJ
E) 40 kJ

Sec# Heat engines, entropy and the 2nd law - The Carnot Engine

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Q7.
A 2.5 0 kg cube of aluminum is heated to 92.0 ^{o}C and then dropped into 8.0 kg of water at 5.00 ^{o}C. Assuming that the cube-water system is thermally isolated, what is the system's equilibrium temperature? [Specific heat of the aluminum = 900 J/kg.K]

A) 10.5 ^{o}C
B) 99.5 ^{o}C
C) 1.2 ^{o}C
D) 22.4 ^{o}C
E) 11.7 ^{o}C

Sec# Temerature - Temperatur and the First Law of Thermodynamics

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Q8.
If the electric field is 12 V/m in the positive *x*-direction, what is the potential difference between the origin, (0, 0), and the point (3m, 4m)?

A) 36 V with the origin at the higher potential
B) 48 V with the origin at the higher potential
C) 48 V with the origin at the lower potential
D) 36 V with the origin at the lower potential
E) 100 V with the origin at the lower potential

Sec# Electric Potential - Obtaining E from the Electric Potential

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Q9.
Two hollow metal spheres of radii R_1 and R_2 carry an equal electric charge Q. The spheres have potentials V_1 and V_2 at their centers, respectively. If the ratio V_1/V_2 is equal to 3, what is the value of the ratio R_1/R_2?

A) 1/3
B) 3
C) 1/9
D) 9
E) 1

Sec# Electric Potential - Potential of a Charged Conductor

Q10.
A copper wire has a radius of 0.51×10^{-3} m and carries current of 1.67 A. Find the resistance of a 50 m length of this wire. (The conductivity of copper = $6.3\times10^{7}\,\Omega.\text{m}$)

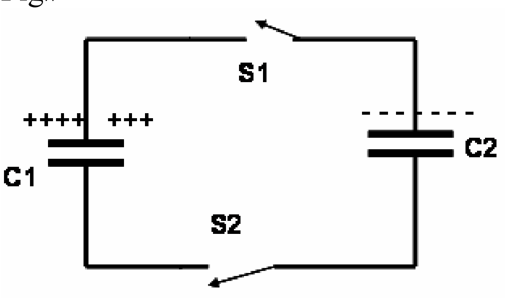
A) 1.0 Ω
B) 0.3 Ω
C) 2.2 Ω
D) 0.4 Ω
E) 0.6 Ω

Sec# Current and Resistance - Resistance and Temperature

Q11.

Two capacitors C_1 = 3.0 μF and C_2= 9.0 μF are charged, separately, to a potential difference of V = 30 V but with opposite polarity as shown in the following figure. Switch S1 and S2 are closed. What is charge on capacitor C_2 after closing the two switches?

Fig#



A) 135 μC
B) 360 μC
C) 90 μC
D) 270 μC
E) 180 μC

Sec# Capacitance and Dielectrics - Energy Stored in a Charged Capacitor

Q12.

Find the potential difference across 30 Ω resistor, when it is connected across a battery of emf 6 V and internal resistance of 0.5 Ω.

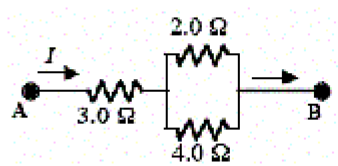
A) 5.9 V
B) 1.3 V
C) 6.5 V
D) 5.0 V
E) 4.8 V

Sec# Current and Resistance - Ohm's Law

Q13.

Three resistors are connected as shown in the following figure. The potential difference between points A and B is 30 V. How much current flows through the 4-Ohm resistor?

Fig#



A) 2.3 A
B) 8.7 A
C) 4.0 A
D) 10 A
E) 6.0 A

Sec# Direct Current Circuits - Resistors in Series and in Parallel

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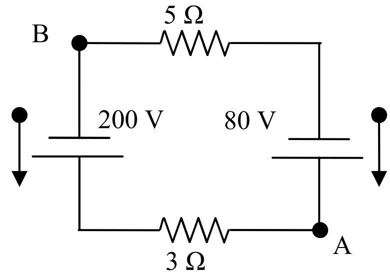
Q14.
Two ideal emf sources along with two resistors are connected as shown in the following figure. If the potential at A is 150 V, what would be the potential at point B?

Fig#

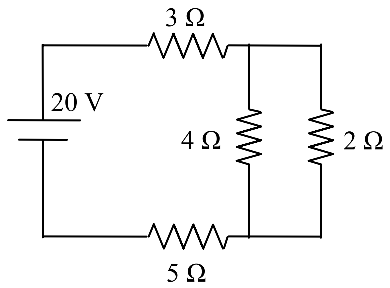


A) - 5 V
B) - 7 V
C) 6 V
D) 8 V
E) 10 V

Sec# Direct Current Circuits - Kirchhoffs Rules

Q15.
What is the total power dissipation in the circuit shown in the following figure.

Fig#



A) 43 W
B) 50 W
C) 55 W
D) 61 W
E) 48 W

Sec# Direct Current Circuits - Resistors in Series and in Parallel

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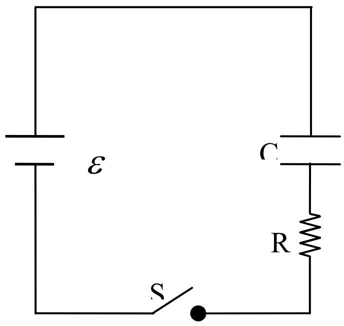
Q16.

Consider a series RC circuit as shown in the following figure, where $R = 1.0\times10^{6}\ \Omega$, C = 5.0 μF and ε = 30 V. If the switch is closed at t =0, what is the current in resistance R at time 10 s after the switch is closed?

Fig#

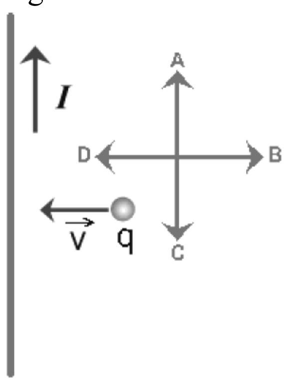


A) 4.1×10^{-6} A
B) 5.0×10^{-6} A
C) 4.6×10^{-8} A
D) 6.0×10^{6} A
E) 4.5×10^{6} A

Sec# Direct Current Circuits - RC Circuits

Q17.
The figure below shows a small positive charge q moving toward a long current-carrying wire. Which of the arrows labeled A to D correctly represents the direction of the magnetic force applied on the charge?

Fig#



A) C
B) A
C) B
D) D
E) The force points in a direction perpendicular to the plane of the figure.

Sec# Magnetic Fields - Magnetic Field and Force

Q18.

A charged particle is moving with speed **v** perpendicular to a uniform magnetic field. A second identical charged particle is moving with speed **2v** perpendicular to the same magnetic field. The frequency of revolution of the first particle is *f*. The frequency of revolution of the second particle is

A) f
B) $4f$
C) $f/2$
D) $2f$
E) $f/4$

Sec# Magnetic Fields - Motion of a Charged Particle in a Magnetic Field

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Q19.
An electron with a velocity $\vec{\mathbf{v}} = 5.0\times10^{7}\,\hat{\mathbf{i}}$ (m/s) enters a region of space where perpendicular electric and magnetic fields are present. The electric field is $\vec{\mathbf{E}} = -10^{4}\,\hat{\mathbf{j}}$ (N/C). What magnetic field (in Tesla) will allow the electron to go through undeflected?

A) $\vec{\mathbf{B}} = +(2.0\times10^{-4})\hat{\mathbf{k}}$
B) $\vec{\mathbf{B}} = +(2.0\times10^{-4})\hat{\mathbf{j}}$
C) $\vec{\mathbf{B}} = -(2.0\times10^{-4})\hat{\mathbf{i}}$
D) $\vec{\mathbf{B}} = -(2.0\times10^{-4})\hat{\mathbf{k}}$
E) $\vec{\mathbf{B}} = +(5.0\times10^{-4})\hat{\mathbf{k}}$

Sec# Magnetic Fields - Motion of a Charged Particle in a Magnetic Field

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Q20.
A moving charge has a velocity $\vec{\mathbf{v}} = v_o\hat{\mathbf{i}}$ ($v_o > 0$) when it enters in a region where there is a uniform magnetic field. The magnetic force acting on the charge is $\vec{\mathbf{F}} = F_o\hat{\mathbf{k}}$ where $F_o > 0$. Which of the following expressions correctly represents the orientation of the magnetic field? (Take $B_o > 0$).

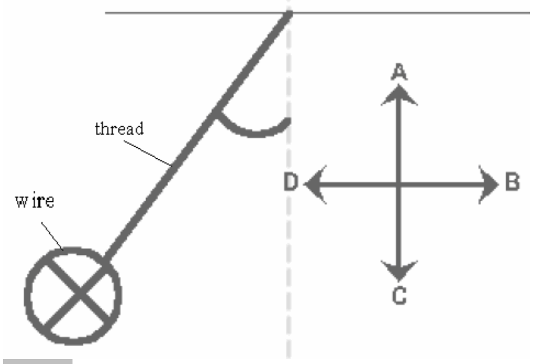
A) $\vec{\mathbf{B}} = B_o\hat{\mathbf{i}} + B_o\hat{\mathbf{j}}$
B) $\vec{\mathbf{B}} = -B_o\hat{\mathbf{i}} + B_o\hat{\mathbf{j}}$
C) $\vec{\mathbf{B}} = -B_o\hat{\mathbf{i}} - B_o\hat{\mathbf{j}}$
D) $\vec{\mathbf{B}} = B_o\hat{\mathbf{i}} - B_o\hat{\mathbf{j}}$
E) $\vec{\mathbf{B}} = -B_o\hat{\mathbf{i}} + B_o\hat{\mathbf{k}}$

Sec# Magnetic Fields - Magnetic Field and Force

Q21.
A horizontal, long current-carrying wire is hanging from a vertical thread. The current is oriented into the plane of the figure shown below. A uniform magnetic field is applied and

the wire is pulled away from the vertical. Which of the arrows labeled **A** to **D** correctly indicates the direction of the magnetic field?

Fig#



A) C
B) A
C) D
D) B
E) The magnetic field is oriented into the plane of the picture.

Sec# Magnetic Fields - Magnetic Force on a Current-Carrying Conductor

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Q22.
The radius *R* of a long current-carrying wire is 4.2 cm. If the magnetic field at $r_1 = 3.0$ cm is equal to four times the magnetic field at r_2, $r_2 > R$, calculate the distance r_2.

A) 23.5 cm
B) 12.2 cm
C) 6.2 cm
D) 8.0 cm
E) 43.1 cm

Sec# Sources of the Magnetic Field - Ampere's Law

Q23.
Two long straight wires are parallel and carry current in opposite directions. The currents are 8.0 and 12A and the wires are separated by 0.40 cm. The magnetic field in tesla at a point midway between the wires is:

A) 20×10^{-4}
B) 40×10^{-4}
C) 80×10^{-4}
D) 12×10^{-4}
E) 0

Sec# Sources of the Magnetic Field - Magnetic Force Between Two Parallel Conductors

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Q24.

An infinitely long wire has a charge density λ per unit length. The wire moves along its axis with a velocity V. The ratio of the magnetic field to the eclectic field at a point r from the wire is:

A) independent of r
B) directly proportional to λ
C) proportional to r
D) inversly proportional to r
E) inversly proportional to r^2

Sec# Sources of the Magnetic Field - Ampere's Law

Q25.
A 600-turn solenoid is 40 cm long, has a radius of 0.6 cm and carries a current of 3.0 A. The magnitude of the magnetic field at the center of the solenoid is:

A) 5.65 mT
B) 2.25 mT
C) 56.2 µT
D) 56.2 mT
E) 2.25 µT

Sec# Sources of the Magnetic Field - The Magnetic Field of a Solenoid

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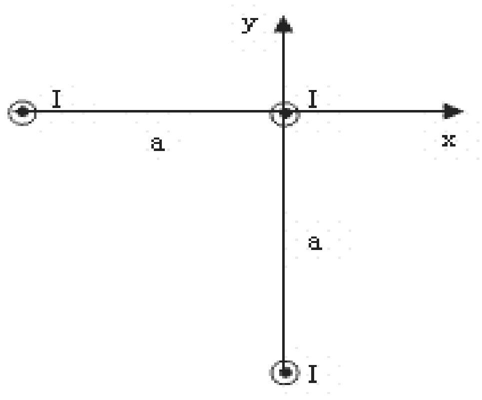
Q26.
Suppose that the identical currents I in the following figure are all out of the page. The magnitude of the force per unit length on the wire at the origin is: [take I = 10.0 A, and a = 10^{-4} m.]

Fig#

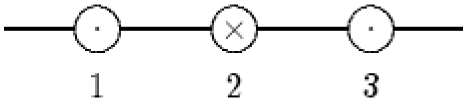


A) 0.28 N/m.
B) 0.18 N/m.
C) 0.55 N/m.
D) 0.13 N/m.
E) 0.30 N/m

Sec# Sources of the Magnetic Field - Ampere's Law

Q27.
The diagram shows three equally spaced wires that are perpendicular to the page. The currents are all equal, two being out of the page and one being into the page. Rank the wires according to the magnitudes of the magnetic forces on them, from least to greatest.

Fig#



A) 2, then 1 and 3 tie
B) 1, 2, 3
C) 2 and 3 tie, then 1
D) 1 and 3 tie, then 2
E) 3, 2, 1

Sec# Sources of the Magnetic Field - Ampere's Law

Q28.
Each turn of a 150-turn coil, encloses an area of 0.8 m^2. What should be the rate of change of a magnetic field parallel to its axis in order to induce a current of 0.1 A in the coil? [The resistance of the coil is 600 Ohm]

A) 0.50 T/s.
B) 0.13 T/s.
C) 0.24 T/s.
D) 7.51 T/s.
E) Zero.

Sec# Faraday's Law - Faraday's Law of Induction

Q29.
A wire of length L carries a current I , is bent in the form of a circle. The magnitude of its magnetic moment is:

A) $\frac{IL^2}{4\pi}$
B) $\frac{2IL^2}{\pi}$
C) $4\pi IL^2$
D) $\frac{IL^2}{\pi}$
E) $\frac{IL^2}{2\pi}$.

Sec# Sources of the Magnetic Field - Gauss's Law in Magnet

Q30.
A constant magnetic flux of 4.0×10^{-5} Wb is maintained through a coil for 0.5 s. What emf is induced in the coil by this flux during that period?

A) Zero.
B) 4.0×10^{-6} V.
C) -4.0×10^{-6} V.
D) 2.0×10^{-4} V.
E) -2.0×10^{-4} V.

Sec# Faraday's Law - Motional emf