

Q1. Under a tension τ , it takes 2 s for a pulse to travel the length of a stretched string. What tension is required for the pulse to take 6 s?

- A) $\tau/9$
- B) $\tau/2$
- C) $\tau/3$
- D) 3τ
- E) 4τ

Q2. A car moving at 34.0 m/s approaches a stationary source that emits sound with a frequency of 220 Hz. What is the frequency of sound as heard by the driver of the car? The speed of sound is 343 m/s.

- A) 242 Hz
- B) 220 Hz
- C) 198 Hz
- D) 200 Hz
- E) 255 Hz

Q3. How much water remains unfrozen after 50.2 kJ is transferred as heat from 260 g of liquid water initially at 0 °C?

- A) 109 g
- B) 151 g
- C) 260 g
- D) 130 g
- E) zero

Q4. One mole of an ideal monatomic gas at 400.0 K is reversibly taken to half of its original volume by an isobaric process. How much work is done in the process?

- A) 1662 J on the gas.
- B) 1662 J by the gas
- C) 3324 J on the gas
- D) 3324 J by the gas
- E) 8300 J by the gas

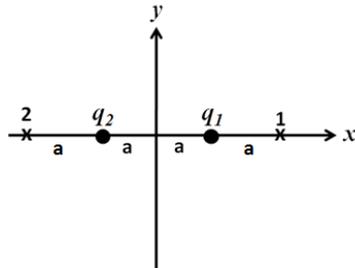
Q5. A 4.0-kg piece of iron at 800 K is dropped into a lake whose temperature is 280 K, and comes to equilibrium with the lake. Assume that the lake is so large that its temperature rise is negligible. Find the change in the entropy of the lake. [specific heat of iron = 460 J/kg.K].

- A) + 3.4 kJ/K
- B) - 3.4 kJ/K
- C) + 0.84 kJ/K
- D) - 0.84 kJ/K
- E) zero

Q6. Two point charges, $q_1 = +4 \mu\text{C}$ and $q_2 = -2 \mu\text{C}$, are fixed on the x axis, as shown in **Figure 1**. Which of the following statements regarding the electric field produced by the two charges on the x axis is CORRECT?

Fig#

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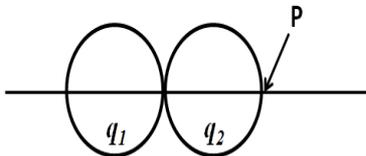


- A) The electric field points to the right at point 1.
- B) The electric field points to the right between the two charges.
- C) The electric field points to the left at point 1.
- D) The electric field points to the left at point 2.
- E) The electric field is zero at the origin.

Q7. **Figure 2** shows two solid spheres, each of radius R , with uniformly distributed charge throughout their volumes. If the net electric field at point P is zero, what is the ratio q_2/q_1 ?

Fig#

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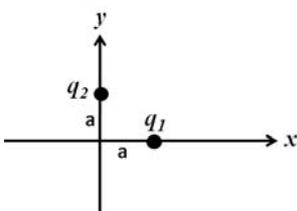


- A) $-1/9$
- B) $1/9$
- C) $1/4$
- D) $-1/4$
- E) $-1/3$

Q8. Two charged particles are fixed in the xy plane as shown in **Figure 15**. Take $q_1 = 10 \text{ nC}$, $q_2 = -30 \text{ nC}$, and $a = 1.0 \text{ m}$. What is the electric potential due to these two particles at the origin?

Fig#

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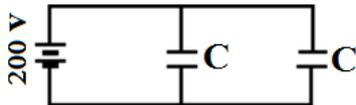
- A) -180 V

- B) + 180 V
- C) - 360 V
- D) + 360 V
- E) - 285 V

Q9. In order to store a total of 0.040 J of energy in the two identical capacitors shown in **Figure 3**, each should have a capacitance of:

Fig#

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- A) 1.0 μF
- B) 0.50 μF
- C) 0.10 μF
- D) 1.5 μF
- E) 2.0 μF

Q10. A parallel-plate capacitor is charged by a battery and then the battery is removed and a dielectric of dielectric constant κ is used to completely fill the gap between the plates. Inserting the dielectric changes the energy stored in the capacitor by a factor of:

- A) $1/\kappa$
- B) κ
- C) $\kappa + 1$
- D) $\kappa - 1$
- E) No change

Q11. A $10\text{-}\Omega$ resistor has a constant current passing through it. If 1200 C of charge flow through it in 4.0 minutes, what is the potential difference across the resistor?

- A) 50 V
- B) 0.50 V
- C) 3.0 V
- D) 15 V
- E) 20 V

Q12. A certain resistor dissipates 0.50 W when connected to a 3.0-V potential difference. When connected to a 1.0-V potential difference, this resistor will dissipate:

- A) 0.056 W
- B) 0.17 W
- C) 1.5 W
- D) 0.50 W
- E) 18 W

Q13. Four $20\text{-}\Omega$ resistors are connected in parallel and the combination is connected to a 20-V emf device. The current in the device is:

- A) 4.0 A
- B) 1.0 A
- C) 0.25 A
- D) 5.0 A
- E) 100 A

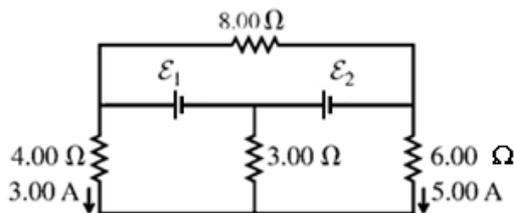
Q14. Resistor 1 has twice the resistance of resistor 2. They are connected in parallel to a battery. If the power dissipated in R_1 is P_1 and the power dissipated in R_2 is P_2 , then P_1/P_2 is:

- A) 0.50
- B) 1.0
- C) 0.25
- D) 4.0
- E) 0.05

Q15. Find the current in $8.00\text{-}\Omega$ resistor in the circuit shown in **Figure 4**?

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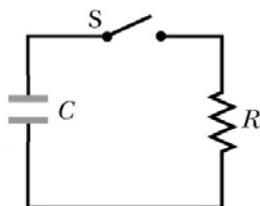


- A) 2.25 A toward the left
- B) 11.3 A toward the left
- C) 2.25 A toward the right
- D) 11.3 A toward the right
- E) 6.75 A toward the left

Q16. The capacitor shown in **Figure 14** is initially charged. Switch S is closed at time $t = 0$. At the end of 10.0 ms , the charge on the capacitor is one third the initial value. The time constant of this circuit is:

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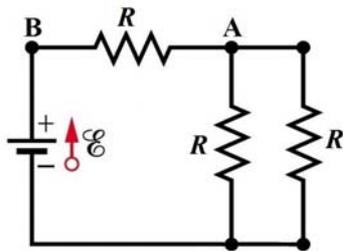
- A) 9.10 ms

- B) 3.33 ms
- C) 30.0 ms
- D) 24.7 ms
- E) 4.05 ms

Q17. In the circuit of **Figure 5**: $\mathcal{E} = 30 \text{ V}$, and the resistance of each resistor is 10Ω . What is the potential difference $V_A - V_B$?

Fig#

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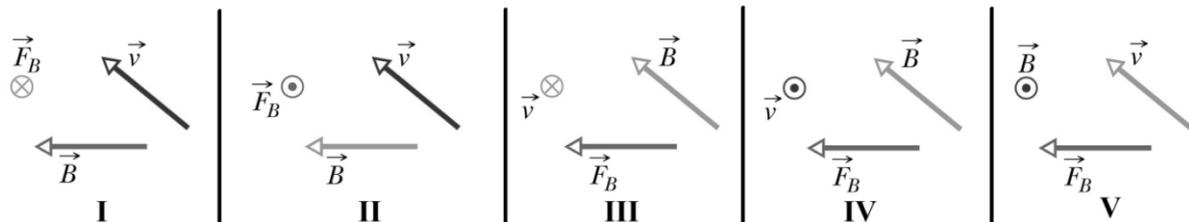


- A) - 20 V
- B) + 20 V
- C) + 10 V
- D) - 10 V
- E) - 45 V

Q18. **Figure 7** shows five situations in which a positively charged particle moves at velocity \vec{v} through a uniform magnetic field \vec{B} and experiences a magnetic force \vec{F}_B . Which of the five situations is possible?

Fig#

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- A) II
- B) III
- C) I
- D) V
- E) IV

Q19. An electron with a velocity of $\vec{v} = 3.0 \times 10^5 \hat{j} \text{ (m/s)}$ enters a region of space where there is a magnetic field given by $\vec{B} = 5.0 \times 10^{-4} \hat{k} \text{ (T)}$. What is the frequency of revolution of the electron?

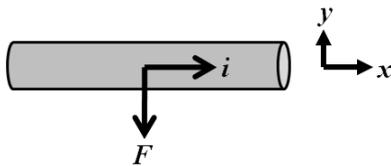
- A) 14 MHz
- B) 88 MHz

- C) 36 MHz
- D) 45 MHz
- E) 75 MHz

Q20. A long straight wire carries a 6.0-A current that is directed in the positive x direction. When a uniform magnetic field is applied perpendicular to a 3.0-m segment of the wire, the magnetic force on the segment is 0.36 N, directed in the negative y direction, as shown in **Figure 6**. What is the magnetic field?

Fig#

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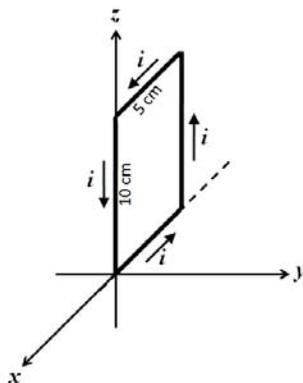


- A) 20 mT out of the page
- B) 20 mT into the page
- C) 60 mT out of the page
- D) 60 mT into the page
- E) 0.65 T out of the page

Q21. **Figure 8** shows a 20- turn rectangular coil of dimensions 10 cm by 5.0 cm. It carries a current of 0.10 A, and is hinged along one long side. There is a uniform magnetic field $\vec{B} = 0.50 \hat{i} \text{ (T)}$ in the region. In unit vector notation what is the torque acting on the coil about the hinge line?

Fig#

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- A) $-5.0 \times 10^{-3} \hat{k} \text{ (N.m)}$
- B) $+5.0 \times 10^{-3} \hat{k} \text{ (N.m)}$
- C) $+3.0 \times 10^{-3} \hat{k} \text{ (N.m)}$
- D) $-3.0 \times 10^{-3} \hat{k} \text{ (N.m)}$
- E) zero

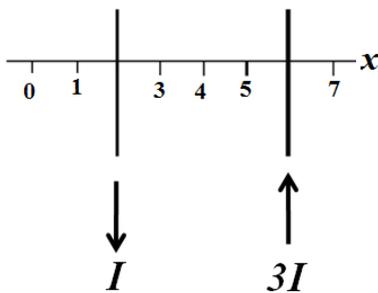
Q22. A charged particle with a charge of $+3.2 \times 10^{-19}$ C is in a region where a uniform electric field of magnitude 5.0×10^4 V/m is perpendicular to a uniform magnetic field of magnitude 0.80 T. If its acceleration is zero, then its speed must be:

- A) 6.3×10^4 m/s
- B) 1.6×10^4 m/s
- C) 4.0×10^4 m/s
- D) zero
- E) 7.9×10^4 m/s

Q23. Two long straight current-carrying parallel wires cross the x axis and carry currents I and $3I$ in the directions shown in **Figure 9**. At what value of x is the net magnetic field zero?

Fig#

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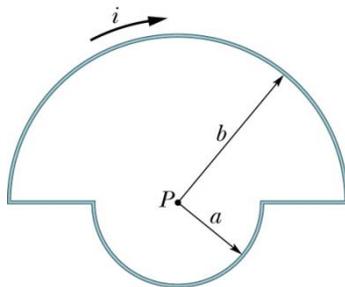


- A) 0
- B) 4
- C) 3
- D) 5
- E) 7

Q24. In the loop shown in **Figure 10**, $a = 5.0$ cm, $b = 10$ cm, and $i = 1.0$ A. What is the magnetic field at point P, which is the center of the two circular arcs?

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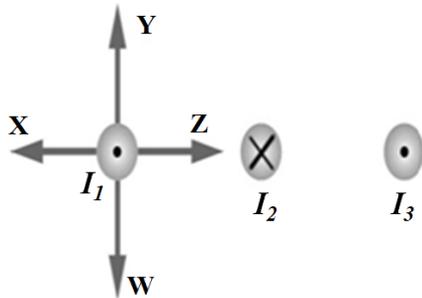


- A) 9.4×10^{-6} T, into the page
- B) 9.4×10^{-6} T, out of the page
- C) 1.9×10^{-5} T, into the page
- D) 1.9×10^{-5} T, out of the page
- E) zero

Q25. **Figure 11** shows three long, parallel current-carrying wires. The magnitudes of the currents are equal and their directions are indicated in the figure. Which of the arrows drawn near the wire carrying current I_1 correctly indicates the direction of the magnetic force acting on that wire?

Fig#

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- A) X
- B) Y
- C) Z
- D) W
- E) The magnetic force is equal to zero.

Q26. A long wire, with radius greater than 4 mm, carries a 10-A current uniformly distributed over its cross section. The magnitude of the magnetic field due to the current at a point at a distance of 4.0 mm from the axis of the wire is 0.28 mT. What is the radius of the wire?

- A) 5.3 mm
- B) 4.1 mm
- C) 6.0 mm
- D) 7.1 mm
- E) 4.8 mm

Q27. A solenoid of length 0.250 m and radius 0.0200 m is comprised of 120 turns of wire. Determine the magnitude of the magnetic field at the center of the solenoid when it carries a current of 15.0 A.

- A) 9.05 mT
- B) 7.50 mT
- C) 2.26 mT
- D) 4.52 mT
- E) zero

Q28. Suppose this page is perpendicular to a uniform magnetic field and the magnetic flux through it is 5.0 Wb. If the page is turned by 30° around an edge the flux through it will be:

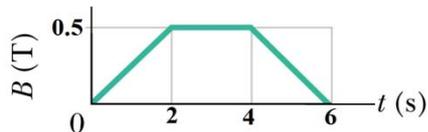
- A) 4.3 Wb
- B) 2.5 Wb
- C) 5.0 Wb
- D) 5.8 Wb

E) 10 Wb

Q29. A circular wire loop of radius 15.0 cm is located in a uniform magnetic field that changes in magnitude as shown in **Figure 12**. The plane of the loop is perpendicular to the magnetic field. What is the magnitude of the emf induced in the loop during the time interval $t = 0$ to $t = 2.00$ s?

Fig#

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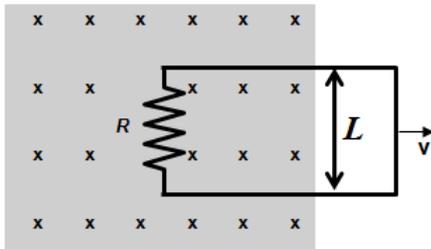


- A) 17.7 mV
- B) 236 mV
- C) 35.4 mV
- D) 118 mV
- E) 245 mV

Q30. A circuit, with side length $L = 1.0$ m, is pulled toward the right at a constant speed $v = 3.0$ m/s. At the instant shown in **Figure 13**, the loop is partially in a magnetic field of magnitude $B = 5.0$ mT that is directed into the page. As the circuit moves, an induced current flows through a resistor $R = 5.0 \Omega$. What are the magnitude and direction of the induced current?

Fig#

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- A) 3.0 mA, clockwise
- B) 3.0 mA, counter-clockwise
- C) 5.0 mA, clockwise
- D) 5.0 mA, counter-clockwise
- E) 1.0 mA counter-clockwise