

10. A cell of emf  $\mathcal{E}$  delivers a charge  $Q$  to an external circuit. Which statement is correct?
- The energy dissipation in the external circuit is  $\mathcal{E}Q$
  - The energy dissipation within the cell is  $\mathcal{E}Q$
  - The total energy delivered by the cell is  $\mathcal{E}Q$
  - The external resistance is  $\mathcal{E}Q$
11. A particle executing simple harmonic motion of amplitude 5 cm has a maximum speed of  $20\pi^2$  cm/s. The frequency of its oscillation is
- $3\pi$  Hz
  - $4\pi$  Hz
  - $\pi$  Hz
  - $2\pi$  Hz
12. An electron enters a magnetic field. Which of the following diagrams show a magnetic force directed to the top of the page? (Dot and cross represent magnetic field directed out of and into the page respectively)
- A.

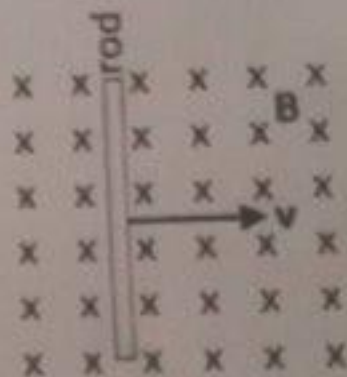
C.

E.
- B.

D.
13. The temperature in the Fahrenheit scale corresponding to 253 K is
- $4^\circ\text{F}$
  - $12^\circ\text{F}$
  - $-4^\circ\text{F}$
  - $-36^\circ\text{F}$
14. How can you quadruple the electric force between two charged particles?
- Double the distance between them and double the product of the charges
  - Halve the distance between them or quadruple the product of the charges
  - Double each charge while keeping the distance between them the same
  - Double each charge and double the distance between the charges
15. In a certain process, 400 J of heat energy is added to a system and the system simultaneously does 100 J of work. The change in the internal energy of the system is:
- 300J
  - 500J
  - 300J
  - 500J
- To produce current with a coil and bar magnet you can:
- put the coil close to the magnet.
  - move both the coil and the magnet together
  - move either the coil or the magnet.
  - A and B
  - B and C
16. The energy required to bring a charge  $q = -8.8$  nC from infinity to 5.5 cm from a point charge  $Q$  is 13 mJ. What is the potential at the final position of  $q$ ?
- 1.12 MV
  - +1.5 MV
  - 0.66 MV
  - 1.5 MV

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33. A 25 cm rod moves at 5.0 m/s in a plane perpendicular to a magnetic field of strength 0.25 T and directed into the page. The rod, velocity vector, and magnetic field vector are mutually perpendicular. Calculate
- the magnetic force on an electron in the rod,
  - the electric field in the rod, and
  - the potential difference between the ends of the rod.
  - What is the speed of the rod if the potential difference is 1.0 V?



### PART III: WORK-OUT PROBLEMS

**Instruction:** Solve the following problems by showing all the necessary steps. (10 pts)

31. A 4 kg object attached to spring oscillates with angular frequency of  $0.5 \text{ rad/s}$  and amplitude of  $1.0 \text{ m}$ .
- What is the total energy of the mass-spring system?
  - What is the maximum speed of the object?
  - At what position is the speed equal to one quarter its maximum value?

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28. In Figure 1 below, what is the directions of the current in the loop if  $B$  is decreasing and pointing into the page? (clockwise, anticlockwise) \_\_\_\_\_



Figure 1



Figure 2

30. In Figure 2 above, the magnetic flux through the horizontal circular coil is \_\_\_\_\_.

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### PART III: WORK-OUT PROBLEMS

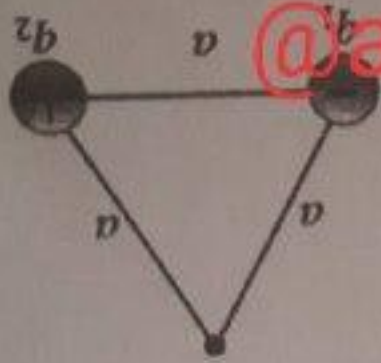
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32.

Two point charges  $q_1 = -6 \mu\text{C}$  and  $q_2 = +6 \mu\text{C}$  are placed at two vertices of an equilateral triangle, as shown. If  $a = 10 \text{ cm}$ , find the magnitude and direction of the net electric field at the third corner.



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Constants

3. Which equation below for electric power is INCORRECT?  
 A.  $P = I^2 R$     B.  $P = V^2 / R$     C.  $P = IV$     D.  $P = V^2 R$
4. Three objects are brought close to each other, two at a time. When objects A and B are brought together, they repel. When objects B and C are brought together, they also repel. Which of the following are true?  
 A. Objects A and B possess charges of the opposite sign.  
 B. Objects A and C possess charges of opposite sign.  
 C. Objects A, B, and C possess charges of the same sign.  
 D. Objects B and C possess charges of opposite sign.
5. A 9.0 V battery is connected across resistor  $R_1$  and the current is measured. With the same voltage across resistor  $R_2$ , twice the current is measured. What is the ratio  $R_1 / R_2$ ?  
 A. 2    B. 1/2    C. 4    D. 1/4
6. A cylindrical rod has resistance  $R$ , length  $L$ , and diameter  $D$ . If both the length and the diameter are doubled, then the new resistance  $R_{\text{new}}$  will be:  
 A.  $R_{\text{new}} = 4R$     B.  $R_{\text{new}} = 2R$     C.  $R_{\text{new}} = R$     D.  $R_{\text{new}} = \frac{1}{2} R$
7. A battery with an internal resistance of  $1.5 \Omega$  and an emf of 20 V is connected in series to an external resistance of  $10 \Omega$ . The potential difference across the external resistor is:  
 A. 17.4 V    B. 20 V    C. 13.3 V    D. 11.5 V
8. If you applied a voltage across two points E and G in a uniform electric field, how would you calculate the electric field between those points?  
 A. Divide the distance between the points by the voltage.  
 B. Divide the voltage by the square of distance between the points.  
 C. Multiply the distance between the points by the voltage.  
 D. Divide the voltage by the distance between the points.
9. A positive charge is located at  $x = -5 \text{ cm}$ . When a negative charge is placed at  $x = +5 \text{ cm}$ , what happens to the electric field at  $x = 0$ ?  
 A. It decreases    B. It increases    C. It will be zero    D. It won't change

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## PART 1: MULTIPLE CHOICE

Instruction: Encircle the letter of your choice. (17)pts

1. An electron is at rest in a magnetic field  $B$  and a proton is moving with speed  $v$  parallel to the field. What are the magnetic forces on these particles?
  - A. The force on the proton is  $evB$ , the force on the electron is zero
  - B. The force on the proton is zero, the force on the electron is zero
  - C. The force on the proton is maximum, the force on the electron is zero
  - D. The force on the proton is zero, the force on the electron is  $evB$
2. Which one of the following statements is true for the speed  $v$  and the acceleration  $a$  of a particle executing simple harmonic motion?
  - A. When  $v$  is zero,  $a$  is zero.
  - B. When  $v$  is maximum,  $a$  is maximum.
  - C. When  $v$  is maximum,  $a$  is zero.
  - D. The value of  $a$  is zero, whatever may be the value of  $v$ .
3. Which equation below for electric power is INCORRECT?
  - A.  $P = I^2 R$
  - B.  $P = V^2 / R$
  - C.  $P = IV$
  - D.  $P = V^2 R$
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  - A. Object A and C possess charges of the opposite sign.
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General Inst

- This ex
- quest
- Read
- You
- You
- You
- Any

Constants