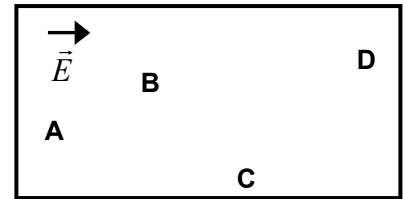


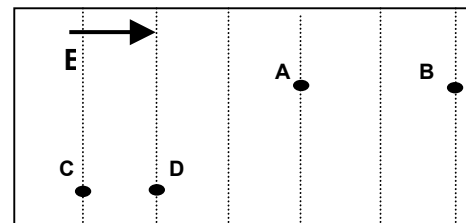
1. A region with a uniform electric field is shown. Where should you place a proton so that it would experience the largest magnitude of electric potential?

- A. Point A
- B. Point B
- C. Point C
- D. Point D
- E. The electric potential is the same at all four points.



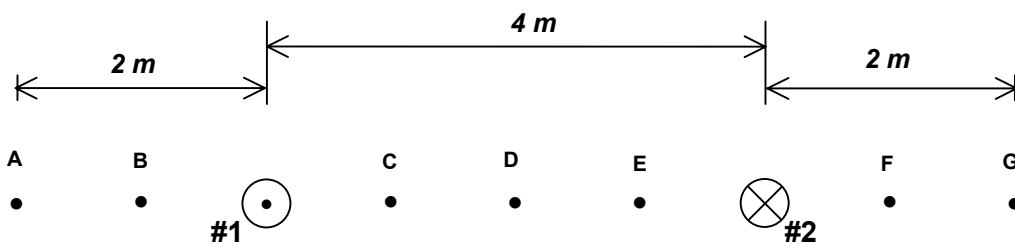
2. A 4-C charge is released from rest at point A, in a region where there is a uniform electric field. When it passes through point B, its speed is 20 m/s. If instead a 2-C charge with the same mass is released from rest at point C, what will be its speed when it passes through point D:

- A. greater than 20 m/s
- B. equal to 20 m/s
- C. less than 20 m/s
- D. not enough information to decide



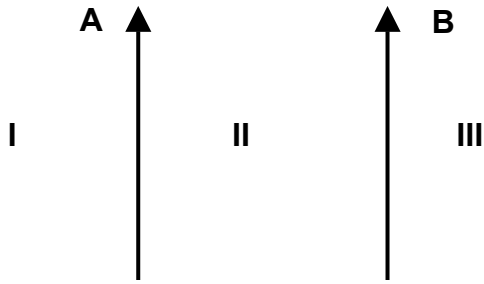
(The gridlines in the figure are equally spaced.)

3. Two parallel straight wires are carrying current in directions indicated on the diagram. (View is “head-on,” current heading toward or away from you.) Current in wire #1 (on the left) is I , current in wire #2 (on the right) is $3I$. (That is, current in wire #2 is three times as much as in wire #1.)



- i. At which point will the magnitude of the net magnetic field be the largest?
- ii. At which point will the magnitude of the net magnetic field be the smallest?

4. Two long straight wires, parallel to each other, are separated by 12 m. They carry currents in the same direction; the current in wire A is **double** the current in wire B. Consider Region II (between the wires), and regions I and III (*not* between the wires). Then:



A. Will the net magnetic field be zero at a point

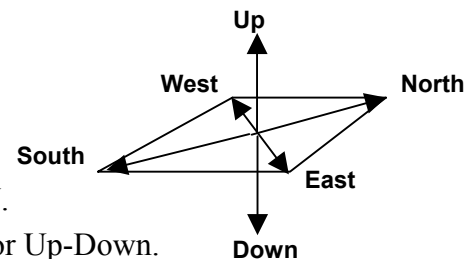
- i) in Region I only;
- ii) in Region II only;
- iii) in Region III only;
- iv) in Regions I and III only;
- v) in all three regions

B. *Briefly* explain your answer to A.

C. A point where the net magnetic field is zero is *what distance* from wire A? (If there is more than one point, you only have to give the distance for one of them.)

5. A uniform magnetic field points in the North direction; a straight wire carrying a current is sitting in this field. Rank in order the *magnitude of the force* exerted on this wire for the following five orientations of this wire [Note: use “=” sign if necessary]:

- A. along the N-S direction.
- B. along the E-W direction.
- C. along the Up-Down direction.
- D. in the N-S-E-W plane, but not exactly along either N-S *or* E-W.
- E. in the E-W-Up-Down plane, but not exactly along either E-W or Up-Down.



6. Bulb A has higher resistance than bulb B.

- i) If both bulbs are connected to a battery in series, which bulb will use the most energy each second: Bulb A, Bulb B, or both bulbs the same? Answer: _____
- ii) If both bulbs are connected to a battery in parallel, which bulb will use the most energy each second: Bulb A, Bulb B, or both bulbs the same? Answer: _____

7. Which of these statements regarding a charged particle in a magnetic field is true?
- A charged particle will experience a magnetic force if it moves in the direction of the magnetic field.
 - A charged particle will experience a magnetic force if it is at rest.
 - A charged particle will experience a magnetic force if it moves perpendicular to the magnetic field.
 - A charged particle will never experience a magnetic force in the presence of a magnetic field.
 - A charged particle will always experience a magnetic force in the presence of a magnetic field.

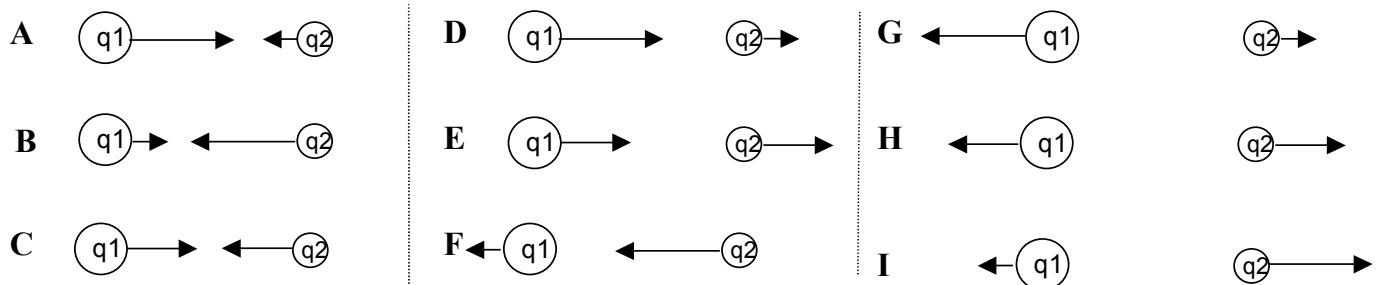
Grade out of 3? Write "3" here: _____

8. Suppose that you are sent into an apparently empty room, but you are told that there is a uniform magnetic field of 6 T in the room produced by source currents outside the room. You are supplied with a 3-m length of straight wire that has a resistance of 5 ohms, a 25-volt battery, and a spring scale to measure the force on the wire. You connect the wire to the battery and measure the force. The force on the wire seems to depend on how you orient the wire, but after trying all orientations you find one that gives a maximum value for the force. What is the magnitude of the maximum force you observe on the wire? *No partial credit; answer must be within 10% of correct answer. -1 point for incorrect or missing units.*

Answer: _____

9. Particle *A* has a charge that is ten times the magnitude of the charge on particle *B*. How does the magnitude of the electrical force exerted by charge *A* on the smaller charge *B* compare with the magnitude of the electrical force exerted by charge *B* on charge *A*? The force exerted by charge *A* on the smaller charge *B* is:
- 100 times larger
 - 10 times larger
 - exactly the same
 - 10 times smaller
 - 100 times smaller

10. In the figure below, particle *q1* has a charge of +10 C, and particle *q2* has a charge of -2 C.



(A) [3 points] Which of these diagrams most closely represents the electrical forces that the two charges exert *on each other*?

(B) [2 points] Explain your answer to part (A).