Student #: ________________________ Student Name: ________________________

Grade 12 Physics Class 10: Electricity & Magnetism

_____ 1. A charge moves in a circular orbit of radius R due to a uniform magnetic field. If the velocity of the charge is doubled, the orbital radius will become

(a) $2R$
(b) R
(c) $R/2$
(d) $4R$
(e) $R/4$

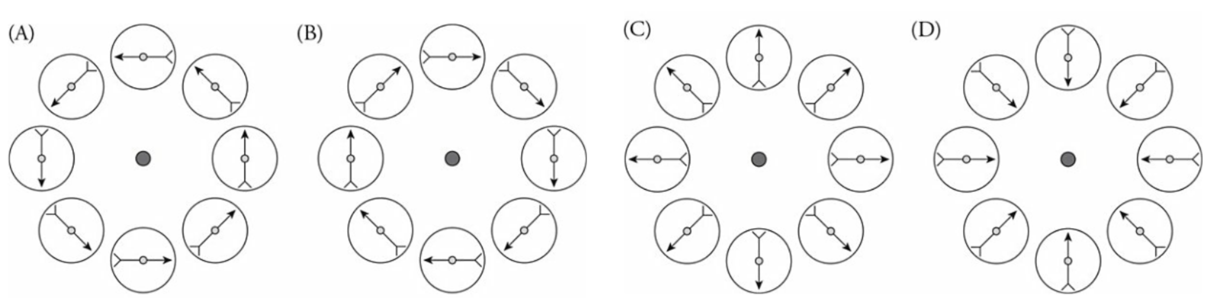
_____ 2. Inside a solenoid, the magnetic field:

(a) is zero
(b) decreases along the axis
(c) increases along the axis
(d) is uniform
(e) cannot be determined

_____ 3. A proton is moving towards the top of the page when it encounters a magnetic field that changes its direction of motion. After encountering the magnetic field, the proton's velocity vector is pointing out of the page. What is the direction of the magnetic field? Assume gravitational force is negligible.

(a) Towards the bottom of the page
(b) To the right
(c) To the left
(d) Into the page
(e) Out of the page

_____ 4. Compasses are arranged in a tight circle around a long wire that is perpendicular to the plane of the compasses. The wire is represented in the figures by a dot. The wire carries a large current directly into the page. Which of the following best depicts the orientation of the compass needles?



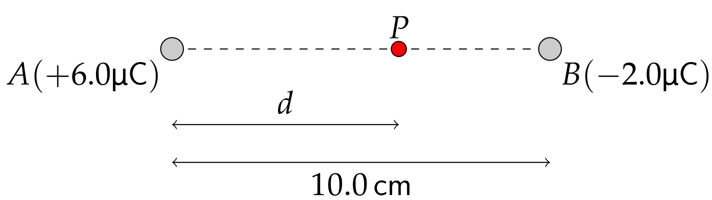
5. A positively charged particle is fixed in place, unable to move. Another charged particle is brought near and released.
   (a) In which direction does the second charged particle move?
   (b) What happens to the force, acceleration, and velocity on the moving particle as it moves?
   (c) What happens to the charge's electric potential energy as it moves?

   Consider that the second charged particle can either be positive or negative.

6. There are two situations in which it is possible for a charged particle to be in a magnetic field but not experiencing a magnetic force. What are they?

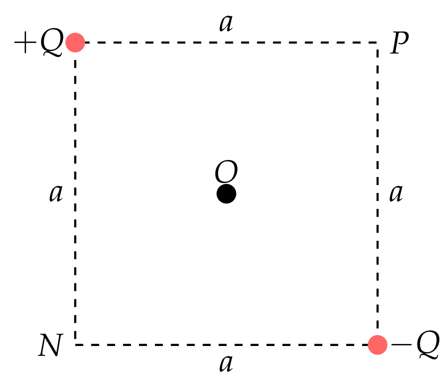
7. Does a magnetic field cause an increase in kinetic energy of a charged particle? Why or why not?

8. Charge $A(+6.0\mu\text{C})$ is separated $10.0\,\text{cm}$ from charge $B(-2.0\mu\text{C})$. At what location along the line that passes through the two charges will the total electric potential be zero?



9. The potential gradient between two parallel plates $2.0\,\text{cm}$ apart is $2.0 \times 10^3\,\text{V/m}$.
   (a) What is the potential difference between the plates?
   (b) What is the electric field intensity between the plates?

10. Two charges, $+Q$ and $-Q$, are placed at the corners of a square whose sides have a length of a. Points P and N are located on the corners of the square. Point O is in the centre of the square.



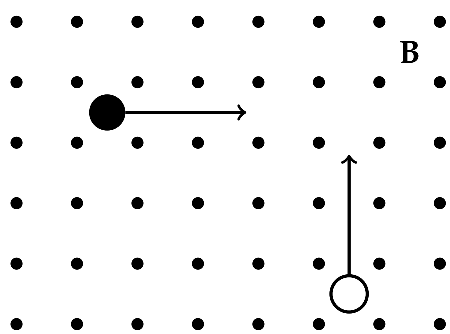
   (a) Sketch the directions of the electric field at points N, O, and P. Make sure the vectors are drawn to the correct proportion.
   (b) What are the electric potentials at points N, O, and P?
   (c) A proton is moved from point P to point O. How much total work is done by the electric field during this move? Explain.
   (d) By moving only one of the charges, explain how the electric field at point O can be made to point directly to the right.

11. A positive ion, having a charge of $3.20 \times 10^{-19}\,\text{C}$, enters at the extreme left of the parallel plate assembly associated with the velocity selector and mass spectrometer shown in class.
   (a) If the potential difference across the simple accelerator is $1.20 \times 10^3\,\text{V}$, what is the kinetic energy of the particle as it leaves through the hole in the right plate?

(b) The parallel plates of the velocity selector are separated by $12.0\,\mathrm{mm}$ and have an electric potential difference across them of $360.0\,\mathrm{V}$. If a magnetic field of strength $0.100\,\mathrm{T}$ is applied at right angles to the electric field, what is the speed of the particles that will be selected to pass on the mass spectrometer?

(c) When these particles then enter the mass spectrometer, which shares a magnetic field with the velocity selector, the radius of the resulting circular path followed by the particles is $6.26\,\mathrm{cm}$. What is the mass of the charged particles?

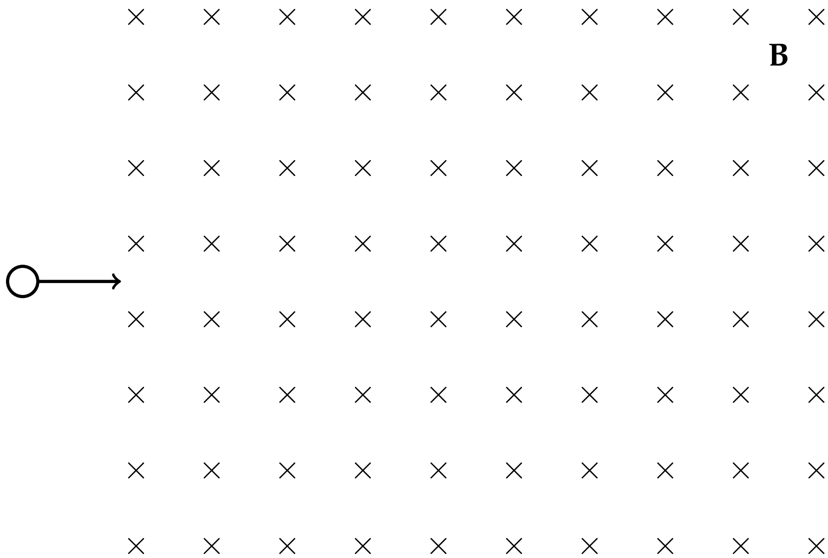
12. Two charged particles moving at $4.0 \times 10^6\,\mathrm{m/s}$ through a magnetic field of $B = 0.50\,\mathrm{T}$ directed out of the page, as shown in the figure.



(a) The black circle is a proton moving to the right. Calculate the magnitude and direction of the force on the proton.

(b) The white circle is an electron moving toward the top of the page. Calculate the magnitude and direction of the force on the electron.

13. A particle is moving towards a magnetic field directed into the page, as shown in the figure. Sketch and label the path taken by each of the following particles. Draw all of the pathways in proportion to the paths taken by all other particles. All particles enter the magnetic field with the same initial velocity and direction.



(a) Neutron
(b) Proton
(c) Electron
(d) Positron (a particle with the same mass as an electron, but with a positive charge)
(e) Alpha particle (the nucleus of a helium atom; 2 protons and 2 neutrons)