PART A: MULTIPLE CHOICE (10 MARKS)

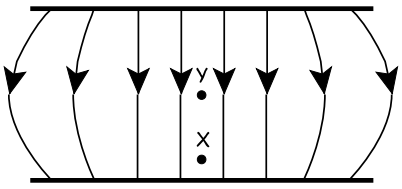
Choose the best response in each case and place your answer in the appropriate space on your answer sheet.

1. As the distance between two charges decreases, the electric potential energy of the two-charge system:
   (a) always increases.
   (b) always decreases.
   (c) increases if the charges have opposite signs and decreases if they have the same sign.
   (d) increases if the charges have the same sign and decreases if they have opposite signs.

2. Through a narrow hole you view an apparatus in which a small charged sphere, attached to a thin thread, hangs at rest at an angle of 10° to the right of the vertical when there is no wind. From your observations, you can infer that:
   (a) the net force on the sphere is zero.
   (b) the electric field is zero.
   (c) the electric field points right.
   (d) the electric field points left.

3. Which of the following statements is true about any type of field line?
   (a) They point in the direction of motion.
   (b) They radiate outwards from the object.
   (c) They never form closed loops.
   (d) They never cross.

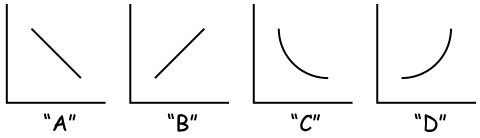
4. The diagram below shows the electric field (fine lines) created by a pair of uniformly charged parallel metal plates (heavy lines).



   Which of the following statements can be deduced correctly from the diagram?
   (a) The top plate is negative and the bottom plate is positive.
   (b) A small positive sphere would experience the same electric force at X or Y.
   (c) A small positive sphere would experience a greater electric force at X than at Y.
   (d) A small positive sphere would experience a smaller electric force at X than at Y.

5. The conclusion from the Millikan oil drop experiment was that:
   (a) there exists a smallest electric charge.
   (b) the speed of the electrons is very great.
   (c) the electron has a negative charge.
   (d) the proton has a positive charge.

6. Which velocity-time graph below best represents the speed of a charged particle in a uniform electric field as a function of time?

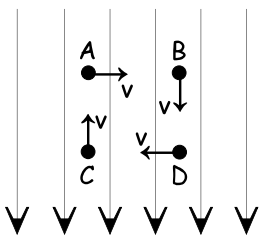


7. A charged particle moves at 90° to a uniform magnetic field of 0.20 T, at a speed of 5.0×10^5 m/s. The magnetic force on the particle:
   (a) is 1.6×10^{-14} N.
   (b) is 1.6×10^{-14} N [perpendicular to velocity].
   (c) is 1.6×10^{-14} N [perpendicular to magnetic field].
   (d) cannot be determined from the information.

8. If a straight length of wire with a current is immersed in a uniform magnetic field, then the wire:
   (a) experiences some magnetic force, no matter what its orientation in the field.
   (b) experiences no force if the current is alternating.
   (c) experiences no force if it is parallel to the field.
   (d) experiences no force if it is perpendicular to the field.

9. An electron passes into a magnetic field at 90°. Its consequent circular path has radius "r". If the speed of the electron were four times as great and the magnetic field were twice as strong, the radius would be:
   (a) r/4 (b) r
   (c) 2r (d) 4r

10. Four particles with the same charge and speed are placed into a uniform magnetic field. Which particle experiences a force directed out of the page?



SPH4U-3 EGM FIELDS: CHARGED PARTICLES & ELECTRIC/MAGNETIC FIELDS QUIZ#3

PART A: MULTIPLE CHOICE (10 MARKS)

1	2	3	4	5	6	7	8	9	10

PART B: MATCH (5 MARKS)

1	2	3	4	5

Match the definition from the 1st column below to the best term in the 2nd column below and place the matching letter in the appropriate space above.

1. A particle accelerator that uses alternating electric fields to accelerate particles in stages.
2. Simple device that consists of a particle source, a pair of parallel plates, and an accelerating potential difference.
3. A cyclic particle accelerator that uses a series of magnets around the circular path and several high-frequency accelerating cavities.
4. Anything that is used to shield a region from an external electric field.
5. Device that can separate particles of different mass and measure that mass.

A) betatron
B) charge density
C) cyclotron
D) Faraday cage
E) linear accelerator
F) mass spectrometer
G) particle accelerator
H) potential gradient
I) synchrocyclotron
J) synchrotron

PART C: PROBLEMS (35 MARKS)

Answer the following questions on a separate sheet of paper. You may use the back of this sheet if you wish.

{5} 1. How many electrons must be removed from a sphere with a negative charge of 4.0×10^{-8} C to give it a positive charge of 8.0×10^{-8} C?

2. In a Millikan type experiment, two horizontal plates are 2.5 cm apart. A latex sphere of mass 1.5×10^{-15} kg remains stationary when the potential difference between the plates is 460 V, with the upper plate positive.

{1} (a) Is the sphere charged negatively or positively?
{3} (b) What is the magnitude of the electric field intensity between the plates?
{3} (c) Calculate the magnitude of the charge on the latex sphere.
{3} (d) How many excess or deficit electrons does the sphere have?

3. Consider a horizontal, straight 2.0 m wire carrying a 22 A current that runs from west to east. If the wire is in Earth's magnetic field, which points north with a magnitude of 4.0×10^{-5} T, calculate

{5} (a) the magnetic force on the wire.
{3} (b) the maximum mass of the wire that would be supported.

4. A small body of unknown charge, travelling 6.1×10^{5} m/s, enters a 0.40 T magnetic field directed perpendicular to its motion.

{4} (a) If the particle experiences a force of 9.0×10^{-4} N, what is the magnitude of the charge?
{3} (b) If the object is sent into the magnetic field so that its velocity makes an angle of 30.0° with the magnetic field, by how much will the magnetic force be reduced?

{5} 5. An electron of mass 9.11×10^{-31} kg travels perpendicularly through a magnetic field of strength 6.8×10^{-5} T at a speed of 3.4×10^{5} m/s. What is the radius of the path of the electron?