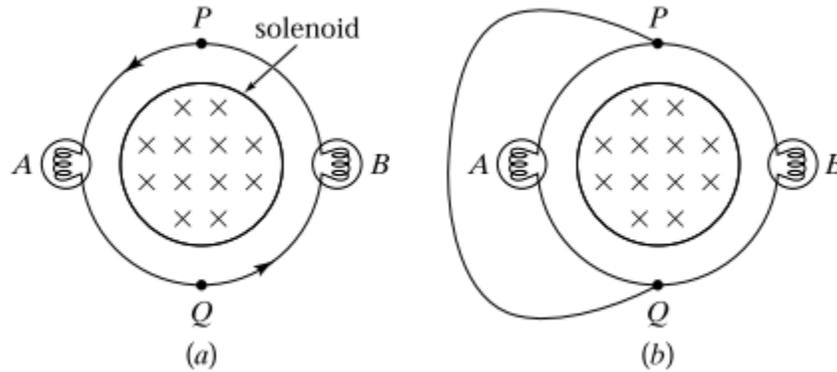


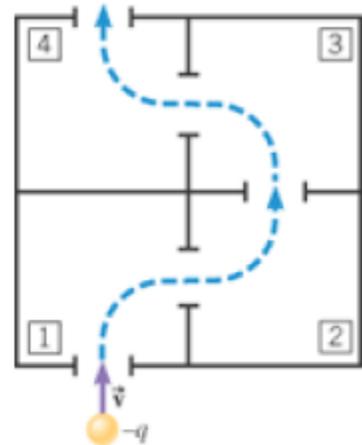
Conceptual Questions

1. In figure (a), a solenoid produces a magnetic field whose strength increases into the plane of the page. An induced current is established in a conducting loop surrounding the solenoid which lights bulbs **A** and **B**. In figure (b), points P and Q are shorted. After the short is inserted,¹



- a) bulb **A** goes out; bulb **B** gets brighter
 b) bulb **B** goes out; bulb **A** gets brighter
 c) bulb **A** goes out; bulb **B** gets dimmer
 d) bulb **B** goes out; bulb **A** gets dimmer
 e) both bulbs go out
 f) none of the above

2. The drawing shows a top view of four interconnected chambers. A negative charge is fired into chamber **1**. By turning on separate magnetic fields in each chamber, the charge can be made to exit from chamber **4**, as shown.
 (a) Describe how the magnetic field in each chamber should be directed. (b) If the speed of the charge is v when it enters chamber **1**, what is the speed of the charge when it exits chamber **4**? Why?²



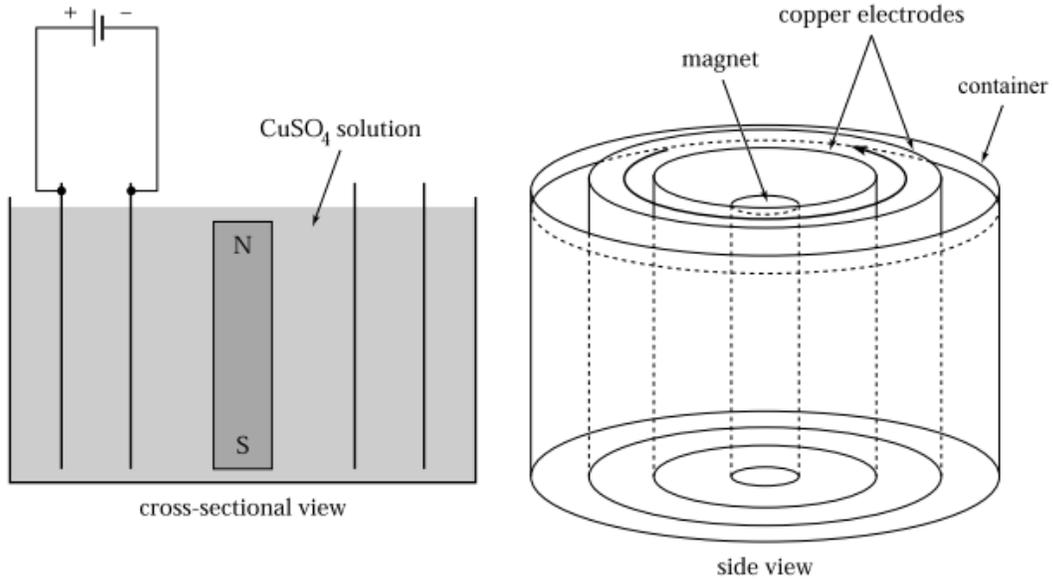
3. A charged particle is moving in a circular path under the influence of a uniform magnetic field. Describe how the path would change in response to each of the following factors, considered separately:³
- The strength of the magnetic field is increased.
 - An electric field is added, in the same direction as the magnetic field.
 - The magnetic field is removed.

¹ Peer Instruction – A User’s Guide, Mazur, Magnetism CT 12

² Physics, 7th Edition, Cutnell & Johnson, Chapter 21 Conceptual Questions, #7

³ Physics 12, Nelson Education, Chapter 8 Review, #4

4. A CuSO_4 solution is placed in a container housing coaxial cylindrical copper electrodes. Electric and magnetic fields are set up as shown. Uncharged pollen grains added to the solution are carried along by the mobile ions in the liquid. Viewed from above, the pollen between the electrodes circulates clockwise. The pollen is carried by ions that are⁴



- a) positive
 b) negative
 c) both positive and negative
 d) need more information

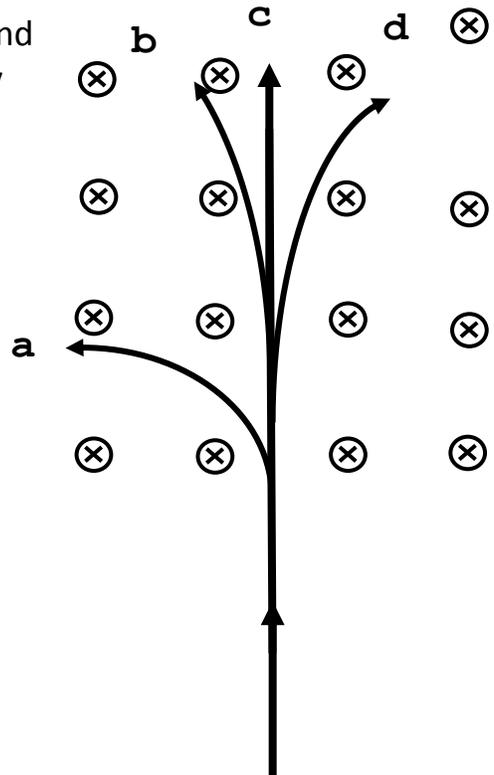
5. A hydrogen atom, a helium nucleus, a Na^+ ion and an F^- ion enter the magnetic field below. Identify the path of each particle.⁵

Hydrogen: _____

Helium: _____

Na^+ : _____

F^- : _____



⁴ Peer Instruction – A User’s Guide, Mazur, Magnetism CT 5

⁵ Almeida, F., Physics Department, Victoria Park C.I.

Problems

6. A conductor 45 cm long, with a mass of 15 g, lies in a horizontal position at a 90° angle to a uniform horizontal magnetic field of magnitude 0.20 T. What must the current in the conductor be if the magnetic force is to support the weight of the conductor?⁶
7. Calculate the magnitude and direction of the force on an electron moving horizontally westward at 3.2×10^6 m/s through a uniform magnetic field of 1.2 T directed horizontally southward.⁷
8. What is the charge-to-mass ratio of a particle accelerated to 6.0×10^6 m/s, moving in a circular path of radius 1.8 cm perpendicular to a uniform magnetic field of magnitude 3.2×10^{-2} T?⁸
9. A proton, of mass 1.67×10^{-27} kg, moves in a circle in the plane perpendicular to a uniform magnetic field of magnitude 1.8 T. The radius of curvature is 3.0 cm. What is the speed of the proton?⁹
10. What is the minimum radius of curvature for an alpha particle, ${}^4_2\text{He}^{2+}$, moving at 2.0×10^6 m/s in a magnetic field of 2.9×10^{-5} T?¹⁰
11. A singly ionized atom ($q = +e$) moves at 1.9×10^4 m/s perpendicular to a uniform magnetic field of magnitude 1.0×10^{-3} T. The radius of curvature is 0.40 m. What is the atom's mass?¹¹
12. An electron moving through an electric field of 475 V/m and a magnetic field of 0.1 T does not accelerate. If the electron's direction and the directions of the electric and magnetic fields are all mutually perpendicular, what is the speed of the electron?¹²

⁶ Physics 12, Nelson Education, Chapter 8 Review, #7

⁷ Physics 12, Nelson Education, Chapter 8 Review, #8

⁸ Physics 12, Nelson Education, Chapter 8 Review, #16

⁹ Physics 12, Nelson Education, Chapter 8 Review, #17

¹⁰ Physics Book Two, Irwin Publishing, Chapter 9 Problems, #34

¹¹ Physics 12, Nelson Education, Chapter 8 Review, #18

¹² Physics Book Two, Irwin Publishing, Chapter 9 Problems, #39

13. A mass spectrometer is being used to monitor air pollutants. It is difficult, however, to separate molecules with nearly identical mass such as carbon monoxide (CO, 28.0106 u, colourless, odourless, tasteless and highly toxic) and nitrogen gas (N₂, 28.0134 u, the major constituent of Earth's atmosphere). How large a radius of curvature must a spectrometer have if these two molecules are to be separated on the film by 0.50 mm?¹³
14. The velocity selector of a mass spectrometer uses parallel plates that are 1.0 cm apart and a perpendicular magnetic field of strength 5.0×10^{-2} T. What potential difference should be applied to the plates to permit singly charged ions of only 5.0×10^6 m/s to pass through the selector?¹⁴
15. A particle of mass 6.0×10^{-8} kg and charge $+7.2 \times 10^{-6}$ C is travelling west. The particle enters a magnetic field of magnitude 3.0 T where it completes one-half of a circle before exiting the field moving east. How much time does this charge spend inside the magnetic field?¹⁵
16. A 3.40-g metallic projectile moves with a speed of 160 m/s perpendicular to the Earth's magnetic field of 5.00×10^{-6} T. If, due to air friction, the projectile acquires a charge of 5.0×10^{-6} C, by what distance will it be deflected from its path due to the Earth's magnetic field after it has travelled 1.00 km?¹⁶

¹³ Physics 6th Edition, Giancoli, Chapter 20 Problems, #63

¹⁴ Physics Book Two, Irwin Publishing, Chapter 9 Problems, #40

¹⁵ Physics Book Two, Irwin Publishing, Chapter 9 Problems, #46

¹⁶ Physics 6th Edition, Giancoli, Chapter 20 Problems, #23