Magnetism Exercises

Solenoids

1. A 25.0cm solenoid has 1800 loops and a diameter of 3.00cm. Calculate the magnetic field in the air core of the solenoid when a current of 1.25A is flowing through it.
2. An air core solenoid is 25cm long and carries a current of 0.72A. If the magnetic field in the core is 2.1×10^{-3}T, how many turns does this solenoid have?
3. An air core solenoid is 30.0cm long and has 775 turns. If the magnetic field in the core is 0.100T, what is the current flowing through this solenoid?
4. What is the magnetic field near the centre of a 0.30m long solenoid that has 800 turns of wire and carries an electric current of 2.0A?

Magnetic Forces

1. A proton travelling vertically at a speed of 2.10×10^5 m/s through a horizontal magnetic field experiences a magnetic force of 9.50×10^{-14}N. What is the magnitude of the magnetic field?
2. A copper wire (l = 0.222m) carries conventional current of 0.960A north through a magnetic field (B = 7.50×10^{-4}T) that is directed vertically upward. What is the magnitude and direction of the magnetic force acting on the wire?
3. Calculate the magnitude and the direction of the magnetic force on an electron travelling north at a speed of 3.52×10^5 m/s through a vertically upward magnetic field of 2.80×10^{-1}T.
4. Calculate the magnitude and the direction of the magnetic force on an alpha particle travelling south at a speed of 7.40×10^4 m/s through a vertically upward magnetic field of 5.50T.
5. Calculate the magnitude and the direction of the magnetic field that produced a magnetic force of 1.70×10^{-14}N east on a proton that is travelling 1.90×10^4 m/s north through the magnetic field.
6. An electron experiences an upward force of 7.1×10^{-14}N when it is travelling 2.7×10^5 m/s south through a magnetic field. What is the magnitude and direction of the magnetic field?
7. Calculate the magnitude and the direction of the magnetic force on an alpha particle travelling upward at a speed of 2.11×10^5 m/s through a magnetic field that is directed down.
8. A wire in the armature of an electric motor is 2.50×10^{-1} m long and is perpendicular to a magnetic field of 5.00×10^{-1}T. Calculate the magnitude of the magnetic force on the wire when it carries a current of 3.60A.
9. An electron is accelerated from rest by a potential difference of 1.70×10^3V, and then enters a magnetic field of 2.50×10^{-1}T, moving perpendicular to it. What is the magnitude of the magnetic force acting on the electron?
10. ~~An electron is accelerated by a potential difference and then travels perpendicular through a magnetic field of 7.20×10^{-1}T where it experiences a magnetic force of 4.1×10^{-13}N. If it is assumed that this electron starts from rest, through what potential difference is the electron accelerated?~~
11. Calculate the downward acceleration of an electron that is travelling horizontally at a speed of 6.20×10^5 m/s perpendicular to a horizontal magnetic field of 2.30×10^{-1}T.

Motion of Charged Particles in Magnetic Fields

1. An alpha particle travels through a magnetic field of $4.22\text{x } 10^{-1}$T perpendicular to the field. If the radius of the arc of the deflected particles is $1.50 \text{ x}10^{-3}$m, what is the speed of the particles?

2. A proton travels through a magnetic field at a speed of 5.40×10^5 m/s perpendicular to the field. If the radius of the arc of the deflected proton is 7.20×10^{-3} m, what is the magnetic field strength?
3. Calculate the charge-to-mass ratio of a particle that is travelling 3.60×10^5 m/s and is deflected in an arc with a radius of 7.40×10^{-2} m as it travels through a perpendicular magnetic field of 6.10×10^{-1} T.
4. ~~Alpha particles travel undeflected through magnetic and electric fields that are perpendicular to each other. The speed of the alpha particles is 7.80×10^5 m/s and the strength of the magnetic field is 2.20×10^{-1} T. If it is assumed that the alpha particles are travelling perpendicular to these fields, what is the strength of the electric field?~~
5. ~~Positive charged particles travel undeflected through magnetic and electric fields that are perpendicular to each other. The magnetic field strength is 6.50×10^{-1} T and the strength of the electric field is 2.10×10^5 N/C. If it is assumed the charged particles are travelling perpendicular to these fields, what is the speed of the charged particles?~~
6. Alpha particles travel through a magnetic field of 3.60×10^{-1} T and are deflected in an arc with a radius of 8.20×10^{-2} m. If it assumed that the alpha particles are travelling perpendicular to the field, what is the energy of each alpha particle?
7. ~~In a CRT (cathode ray tube), electrons are accelerated from rest by a potential difference of 2.50×10^3 V. What is the maximum speed of the electrons?~~
8. ~~In a CRT, an electron reaches a maximum speed of 4.75×10^7 m/s. If this electron is accelerated from rest, what is the potential difference across the tube?~~
9. ~~In a CRT, electrons are accelerated from rest by a potential difference of 1.40×10^3 V. These electrons enter a magnetic field with a strength of 2.20×10^{-2} T. If it is assumed that the electrons are travelling perpendicular to the field, what is the radius of the arc of the deflected electrons?~~
10. ~~Electrons are accelerated from rest in a CRT. These electrons now pass through a magnetic field of 1.40×10^{-2} T and through an electric field of 4.20×10^5 N/C. The fields are perpendicular to each other, and the electrons are not deflected. If it is assumed the electrons are travelling perpendicular to these fields, what is the potential difference across the CRT?~~
11. A negatively charged particle with a mass of 8.4×10^{-27} kg is travelling at a velocity of 5.6×10^5 m/s perpendicularly through a magnetic field of 0.28 T. If the radius of the path of the particle is 3.5cm, how many excess electrons does this particle carry?
12. Alpha particles travel at a speed of 3.00×10^6 m/s through a magnetic field. If the magnetic field strength is 4.2×10^{-2} T, what is the radius of the path followed by the alpha particles when the magnetic field is parallel to the direction the alpha particles travel?
13. A proton moves through a 0.75T magnetic field in a circle with a radius of 0.30m. What is the rotational speed of this proton?
14. ~~Electrons are accelerated from rest through a potential difference. These electrons are then deflected along an arc of radius 0.77 m when they travel through a 2.2×10^{-4} T magnetic field. What is the accelerating voltage?~~
15. An ion with a charge to mass ratio of 1.10×10^4 C/kg travels perpendicular to a magnetic field (B = 0.91T) in a circular path (r = 0.240m). How long does it take the ion to complete one revolution?

Solenoids 1. 1.3×10^{-2} T, 2. 580, 3. 31A, 4. 6.7×10^{-3} T

Magnetic Forces 1. 2.83T, 2. 1.60×10^{-4} N East, 3. 1.58×10^{-14} N West, 4. 1.30×10^{-13} N West, 5. 5.59T up, 6. 1.6T West, 7. 0, 8. 0.45, 9. 9.77×10^{-13} N, 10. 36V, 11. 2.50×10^{16} m/s^2

Motion of Charged Particles in Magnetic Fields 1. 3.05×10^4 m/s, 2. 0.783T, 3. 7.98×10^6 C/kg, 4. 1.72×10^5 N/C, 5. 3.23×10^5 m/s, 6. 6.71×10^{-15} J, 7. 2.96×10^7 m/s, 8. 6.42×10^3 V, 9. 5.74×10^{-3} m, 10. 2.56×10^3 V, 11. 3, 12. No deflection, 13. 2.16×10^7 m/s, 14. 2.5×10^3 V, 15. 6.28×10^{-4} s