Chapter 18

Moving Charges

18.1 2.5 T

18.2 (a) The isotopes curve because they carry a charge and moving charges experience a magnetic force that is perpendicular to their velocity (when moving through a magnetic field that is perpendicular to their velocity), leading to a circular pattern, (b) big circles because the strength of the force on each is the same but the mass of each is different and so they experience different accelerations and thus different size circles, (c) 90°, (d) no, the direction of motion remains perpendicular to the direction of the field.

18.3 (a) toward the north, (b) toward the south

18.4 2.6×10^{-11} N toward the west

18.5 (a) 200 N/C, (b) 3.2 $\times 10^{-17}$ N, (c) 0.5 T, (d) at right angles to each other and at right angles to the direction the electron is moving, (e) No (it only takes 1.7×10^{-8} s before it hits one of the plates and in that time it only moves 6.8×10^{-6} m through the gap)

18.6 (a) 1.04×10^{-4} N, (b) 3.6×10^{-5} N, (c) 1.10×10^{-5} N

18.7 (a) toward the north, (b) upward, (c) 19° upward from north

18.8 (a) Yes, they attract, (b) 1×10^{-5} N/m, (c) The gravitational force per length is 8.6×10^{-5} N/m, which is almost ten times greater than the magnetic force per length (to get the force per length, you need to rewrite gm in terms of length. The way to do this is to replace m by $\rho A\ell$ (i.e., density times cross-sectional area times the length). Then, you can rewrite the equation to give F_g/ℓ. Since the wire is made of copper, you'll need the density of copper, which you can look up.)

18.9 No

18.10 (a) 5.6×10^{-19} N, (b) because all of the protons are forced upward (and all electrons forced downward) leading to no circulation of the charges around the loop.

18.11 (a) Counter-clockwise (induced magnetic field is directed out of the page), (b) Yes, to the left (against the motion), (b) Yes, to the left (against the motion), because now the induced current is clockwise (induced magnetic field is directed into the page)