Practice Problems Section 9 Solutions

1. A negative ion ( = -1.6 x 10-19 C, = 5.0 x 10-26 kg) enters a region of uniform magnetic field with magnitude that points directly out of the page. The ion's initial velocity is 2.0 x 106 m/s and points directly downward along the page.
2. What is the magnitude and direction of the initial magnetic force exerted on the ion? **Explain and/or show your work!**

The magnetic force is . The magnitude is with the direction given by the RHR.

According to the RHR for a negative charge, with the velocity pointing down and the magnetic field pointing out of the page, the force will point to the right. Thus,

1. The trajectory of the ion will be a circular path. What is the radius of this path? **You must start with Newton’s 2nd law to derive your answer! Show your work!**

Because the force is always perpendicular to the velocity, the ion will move in a circular path. Newton’s 2nd law states

Thus,

1. A magnetic balance is shown in the picture to the right. The goal of such a balance is to hold the mass in equilibrium, with the magnetic force on the bar counter-acting the force of gravity on the mass.
   1. Which point, or , should be the positive terminal of the battery? **Explain clearly!**

The gravitational force acts down, so we want the magnetic force on the current carrying wire (to act upwards. With the magnetic field pointing into the page, the only way to get a magnetic force to point up is to have the current flowing to the right in the bar. **Thus, point must be the positive terminal of the battery, so the current flows counterclockwise.**

* 1. The magnetic field has a magnitude of 1.50 T. The resistance of the circuit is 5.00 Ω as shown. The bar is 60.0 cm long and the mass is 0.200 kg. Use m/s2. *Assume the bar itself has negligible mass.*

What battery emf is required to maintain the balance? **Show your work!**

We need , where for a current carrying wire. The current is flowing to the right and the magnetic field is into the page, so the angle is 90°.

Thus,

Newton’s 2nd Law: