4. Determine the initial direction of the deflection of charged particles as they enter the magnetic fields as shown in the diagrams below. [The right-hand rule may be helpful.]

(a) \( \vec{B}_{in} \) upward;  
(b) \( \vec{B}_{up} \) out of page (negative charge)  
(c) no deflection (\( B \) is parallel to \( v \))  
(d) into page

6. The magnetic field of Earth at a certain location is directed vertically downward and has a magnitude of 50.0 \( \mu T \). A proton is moving horizontally toward the west in this field with a speed of \( 6.20 \times 10^6 \) m/s. What are the direction and magnitude of the magnetic force that the field exerts on the proton?

The direction of the force is South (right-hand rule)

\[
B = 50. \times 10^{-6}; \ v = 6.20 \times 10^6; \ q = 1.60 \times 10^{-19}; \ Print["Magnetic force = ", q \times v \times B, " Newton"]
\]

Magnetic force = \( 4.96 \times 10^{-17} \) Newton

9. An electron moving in a direction perpendicular to a uniform magnetic field at a speed of \( 1.5 \times 10^7 \) m/s undergoes an acceleration of \( 4.0 \times 10^{16} \) m/s\(^2\) to the right (positive x-direction) when its velocity is upward (positive y-direction). Determine the magnitude and direction of the magnetic field.

\[
F = m \ a = q \ v \ B
\]

\[
a = 4.0 \times 10^{16}; \ v = 1.5 \times 10^7; \ q = 1.60 \times 10^{-19}; \ mass = 9.1 \times 10^{-31};
\]

\[
B = \frac{mass \ a}{q \ v}; \ Print["Magnetic field = ", B, " Tesla"]
\]

Magnetic field = 0.0151667 Tesla
13. A current I = 15 A is directed along the positive x-axis and perpendicular to a magnetic field. A magnetic force per unit length of 0.12 N/m acts on the conductor in the negative y-direction. Calculate the magnitude and direction of the magnetic field in the region through which the current passes.

\[
\text{F} / \text{length} = B I \Rightarrow B = (\text{F} / \text{Length}) / I. 
\]
The direction of the magnetic field is out of the page (right-hand rule).

```
In[21]:= \text{ForcePerLength} = 0.12; \text{current} = 15.; B = \text{ForcePerLength} / \text{current};
Print["Magnetic field = ", B, " Telsa"]
```

Magnetic field = 0.008 Telsa

22. A wire 2.80 m in length carries a current of 5.00 A in a region where a uniform magnetic field has a magnitude of 0.390 T. Calculate the magnitude of the magnetic force on the wire, assuming the angle between the magnetic field and the current is (a) 60.0°, (b) 90.0°, and (c) 120°.

```
In[22]= B = 0.390; \text{length} = 2.80; \text{current} = 5.00; \phi = 60.\text{Degree};
Print["Magnetic force = ", \text{length} * \text{current} * B * \text{Sin[\phi]}, " Newton"]
```

Magnetic force = 4.7285 Newton

```
In[23]= \phi = 90. \text{Degree}; Print["Magnetic force = ", \text{length} * \text{current} * B * \text{Sin[\phi]}, " Newton"]
```

Magnetic force = 5.46 Newton

```
In[24]= \phi = 120. \text{Degree}; Print["Magnetic force = ", \text{length} * \text{current} * B * \text{Sin[\phi]}, " Newton"]
```

Magnetic force = 4.7285 Newton

33. An electron moves in a circular path perpendicular to a uniform magnetic field with a magnitude of 2.0 mT. If the speed of the electron is \(1.5 \times 10^7\) m/s, determine (a) the radius of the circular path and (b) the time it takes to make one revolution.

\[
r = \frac{mv}{qB} \quad \text{and} \quad T = \frac{2\pi r}{v} = \frac{2\pi mv}{qB}.
\]

```
In[28]= B = 2.0 \times 10^{-3}; v = 1.5 \times 10^7; q = 1.60 \times 10^{-19}; mass = 9.1 \times 10^{-31};
Print["Radius of orbit = ", \text{mass} * v, " \text{meter}\]
```

Radius of orbit = 0.0426562 meter

```
In[29]= Print["Time per orbit = ", \frac{2\pi \text{mass}}{qB}, " \text{second}\]
```

Time per orbit = 1.78678 \times 10^{-8} second