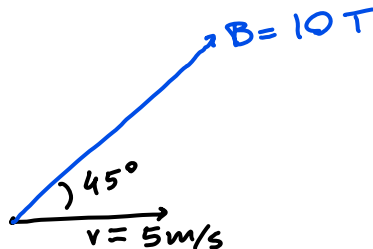


Homework 1

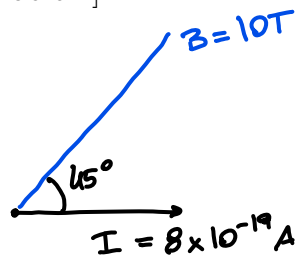
Name: _____

1. In the following questions you are asked to calculate the force on a moving charge/current moving/flowing in a uniform magnetic field. Remember that a force has magnitude and direction so you should state the magnitude (by writing the numerical value) and the direction by drawing an arrow on the diagrams below:

- (a) An electron ($q = 1.6 \times 10^{-19} C$) is moving to the right with velocity $v = 5 m/s$ under the influence of a constant magnetic field of strength $B = 10 T$. The magnetic field makes an angle of 45° with the electron's trajectory. What is the force (magnitude and direction) on this electron? $\sin 45 = \frac{\sqrt{2}}{2}$.

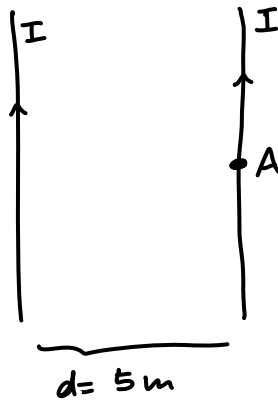


- (b) A current $I = 8 \times 10^{-19} A$ is flowing to the right under the influence of a constant magnetic field of strength $B = 10 T$. The magnetic field makes an angle of 45° with the current's trajectory. What is the force per unit length (magnitude and direction) on this electron? [Hint: force per unit length is $\frac{F}{L}$ so if you divide Lorentz force by L on both sides you should get an expression which you can use for this problem].



- (c) Now (for this part only), assume the wire carrying the current from b) has length $1 m$, so that you can find a force for b). What does your result for a) and b) tell you about the electron and the current? Remember that current is charge per unit time

2. Two wires separated by a distance $d = 5\text{m}$ carry a current $I = 2\text{A}$ upwards. The field due to a wire is given by $B = 2 \times 10^{-7} \frac{I}{d}$.



- (a) What is the direction and magnitude of the magnetic field generated by wire 1 (on the left) at the location of wire 2 shown in point A on the drawing. To write the direction, you can either write the direction explicitly (where does the vector point) or draw the arrow in the picture above).
- (b) What is the direction and magnitude of the force per unit length on wire 2 at this point. Remember that $F = IBL \sin \theta$, where θ is the angle between the current and the magnetic field. Again, you can either draw it above or state the direction, please be clear about which vector is the force and which one is the magnetic field.