

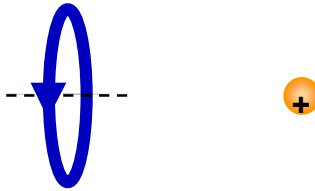
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## MFF 1B: CHARGE AND A CIRCULAR CURRENT LOOP



**MFF1B—CCT1: CHARGE AND A CIRCULAR CURRENT LOOP**

Consider the following statements. (The figure below shows the situation they are talking about.)



Student A: *“A positively charged particle placed at rest near a circular current carrying loop of wire will experience a repulsive force from the magnetic field of the current.”*

Student B: *“A positively charged particle placed at rest near a circular current carrying loop of wire will experience an attractive force from the magnetic field of the current.”*

Student C: *“A positively charged particle placed at rest near a circular current carrying loop of wire will experience no force from the magnetic field of the current.”*

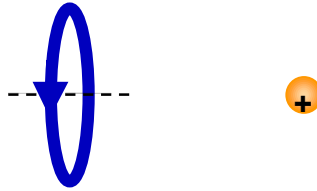
**With which, if any, student do you agree?**

Student A \_\_\_\_\_ Student B \_\_\_\_\_ Student C \_\_\_\_\_ None of them \_\_\_\_\_

**Carefully explain your reasoning.**

**MFF1B—WWT1: CHARGE AND A CIRCULAR CURRENT LOOP**

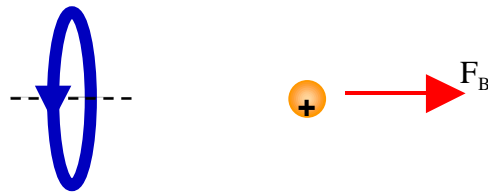
**What, if anything, is wrong with the statement presented below. If something is wrong, identify it and explain how to correct it. If nothing is wrong, explain why the statement is correct.**



A positively charged particle placed at rest along the axis of a circular loop of current-carrying wire (see figure above) will start moving away from the loop because it will be repelled by the magnetic field produced by the constant current in the loop.

### MFF1B—TT1: CHARGE AND A CIRCULAR CURRENT LOOP

Something is wrong with the situation described below. Identify what is wrong and explain how to correct it.

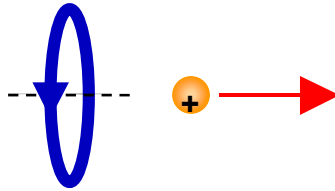


A positively charged particle placed at rest along the center line of a circular loop of wire (see figure above) that is carrying a constant current of 4 A will move away from the loop due to the magnetic force acting on the particle.

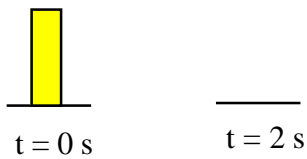
**MFF1B—BCT1: CHARGE AND A CIRCULAR CURRENT LOOP**

The figure below shows a positively charged particle at a certain position relative to a circular loop of wire carrying a current of 4 A, and a bar chart (a histogram) showing the particle's speed at that point. The particle is released at  $t = 0$  s moving with a velocity of 3 m/s and allowed to move freely.

**Complete the bar chart below showing the particle's speed 2 seconds after being released.**



Speed Bar Chart



**Explain your answer fully.**

### **MFF1B—PET1: CHARGE AND A CIRCULAR CURRENT LOOP**

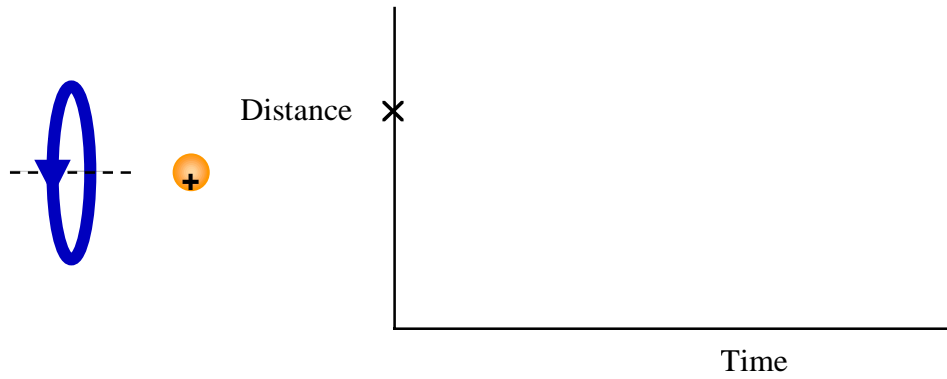
A positively charged Styrofoam packing “peanut” is suspended from a thread and hangs freely. A circular loop of wire carrying a constant current of 4 A is brought up near the peanut. The peanut swings toward the wire loop indicating that it is attracted to the wire loop.

Suppose that the loop is brought up near the peanut with the opposite side of the loop near the peanut, **what will the peanut do and why?**

**MFF1B—CRT1: CHARGE AND A CIRCULAR CURRENT LOOP**

A positively charged particle is released from rest near a circular wire loop that is carrying a constant current of 4 A. The particle is placed on the line running through the center of the loop.

**On the axes below, plot the distance of the particle from the wire loop versus time. (The particle's initial distance from the loop is marked with an X on the vertical axis.)**



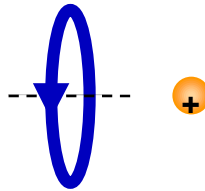
**Explain fully why the graph looks as you have drawn it.**

### MFF1B—LMCT1: CHARGE AND A CIRCULAR CURRENT LOOP

A positively charged particle is placed at rest 3 cm from a circular loop of wire carrying 4 A. The particle is on the line running through the center of the loop as shown below. Several modifications to this initial situation are going to be described below. For each, **identify how the magnetic force, if any, exerted on the particle will change, if it does.**

The same possible answers are available for all changes. They are:

- (a) this modifications will increase the force.
- (b) this modifications will decrease the force.
- (c) this modifications will reverse the direction of the force.
- (d) this modifications will reverse the direction of the force and alter the strength.
- (e) there was no force and this change will not alter that.

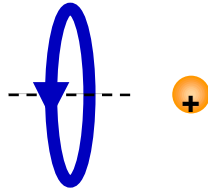


All the modifications are of the original situation.

- (1) The current in the wire loop is doubled \_\_\_\_\_
- (2) The particle placed 7 cm from the wire loop. \_\_\_\_\_
- (3) The current in the loop is reversed. \_\_\_\_\_
- (4) The diameter of the loop is increased. \_\_\_\_\_
- (5) The charge polarity is reversed to negative. \_\_\_\_\_
- (6) The loop is moved toward the charge keeping the charge on the centerline. \_\_\_\_\_
- (7) The diameter of the loop is decreased. \_\_\_\_\_

### MFF1B—QRT1: CHARGE AND A CIRCULAR CURRENT LOOP

The figure below shows a positively charged particle placed along the axis at rest at a certain position relative to a circular loop of wire that is carrying a constant current of 4 A. A number of modifications are going to be made to this situation. **In each case, explain how the modification will affect, if it does, the magnetic force exerted on the particle.**



- (a) The charge on the particle is tripled.
- (b) The current in the loop is decreased.
- (c) The charge is placed closer to the loop.
- (d) The loop is reversed so the particle is sitting near the other side.
- (e) The particle's charge is reversed.
- (f) The diameter of the loop is doubled.