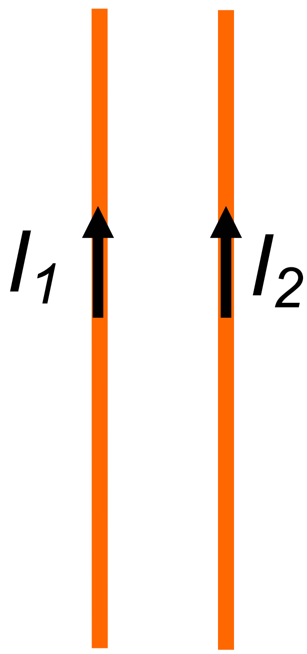
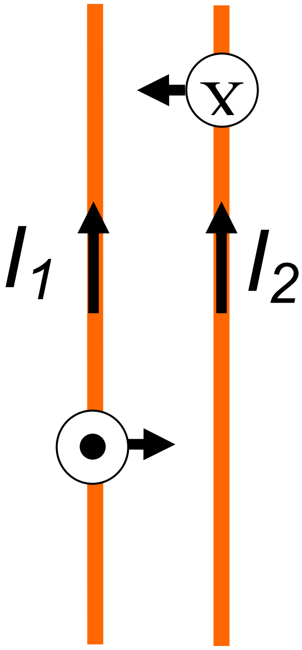
Parallel Wires



Consider two parallel current carrying wires. With the currents running in the same direction, the wires are

1. attracted (likes attract?)
2. repelled (likes repel?)
3. pushed in another direction
4. not pushed – no net force

Parallel Wires

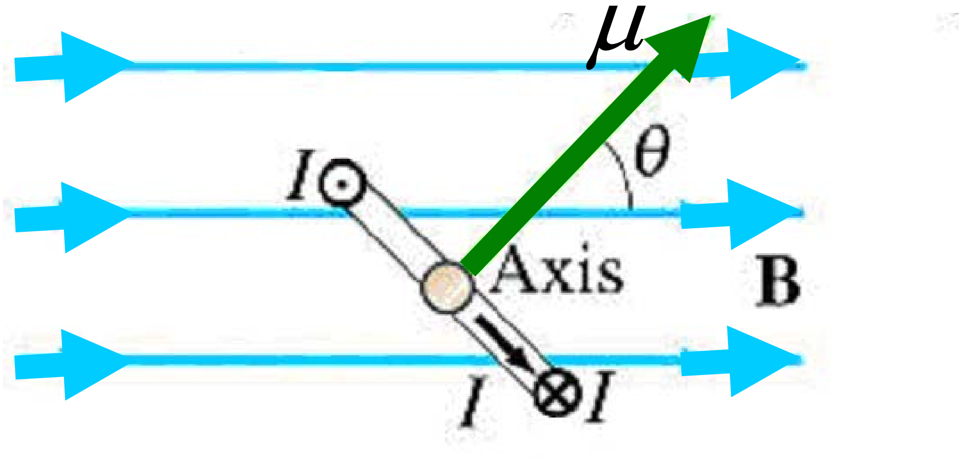


(1) Wires attracted

I_1 creates a field into the page at I_2. That makes a force to the left.

I_2 creates a field out of the page at I_1. That makes a force to the right.

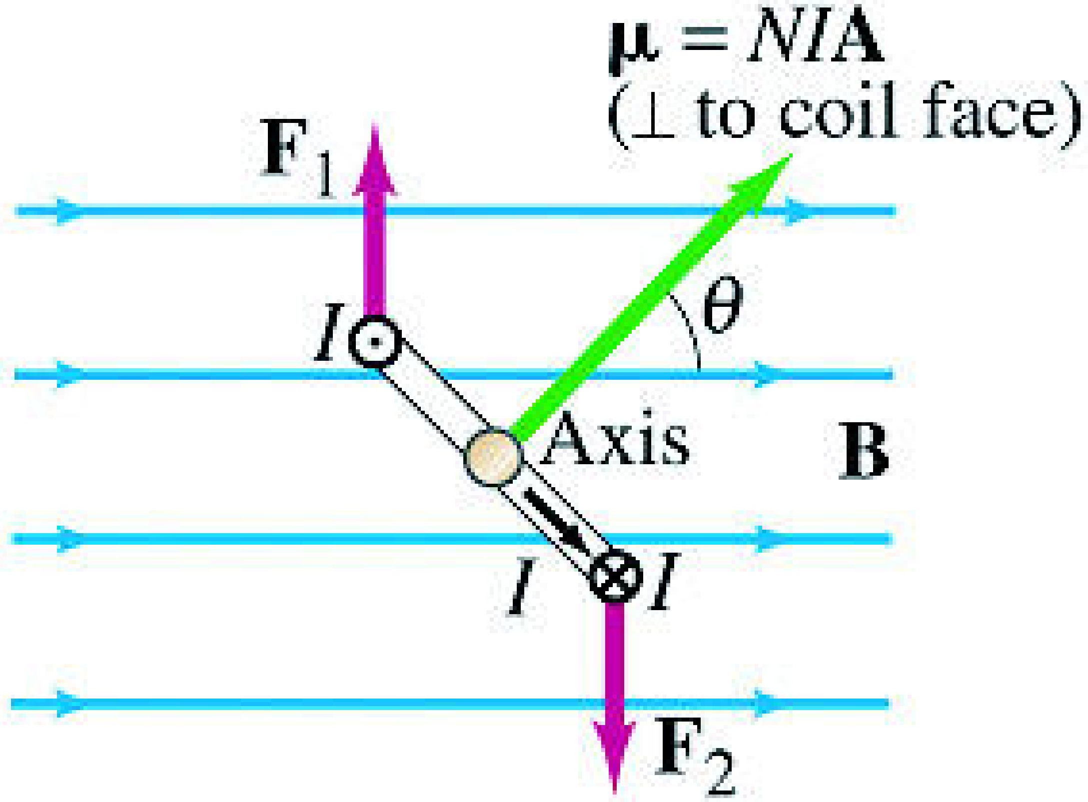
Dipole in Field



The coil above will:

1. rotate clockwise, not move
2. rotate countercw, not move
3. move to the right, no rotation
4. move to the left, no rotation
5. move in another direction, without rotation
6. move and rotate
7. no net force so no rotation or motion

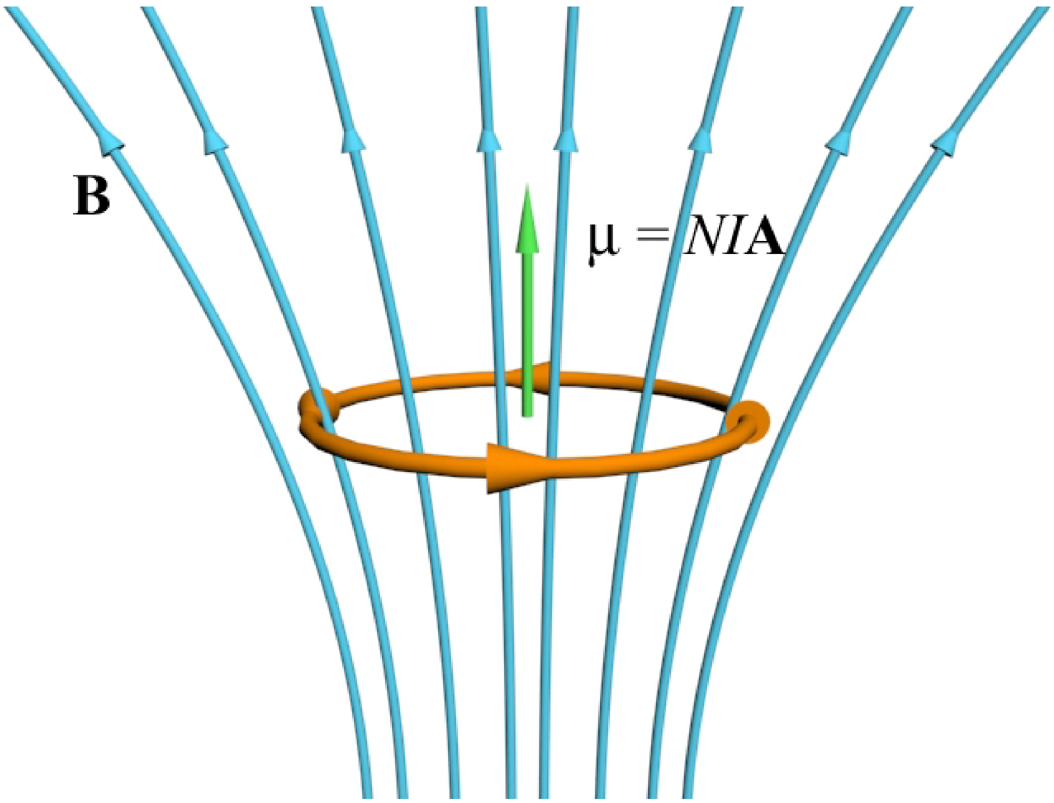
Dipole in Field



(1) Coil will rotate clockwise

No net force so no center of mass motion. BUT Magnetic dipoles rotate to align with external field!

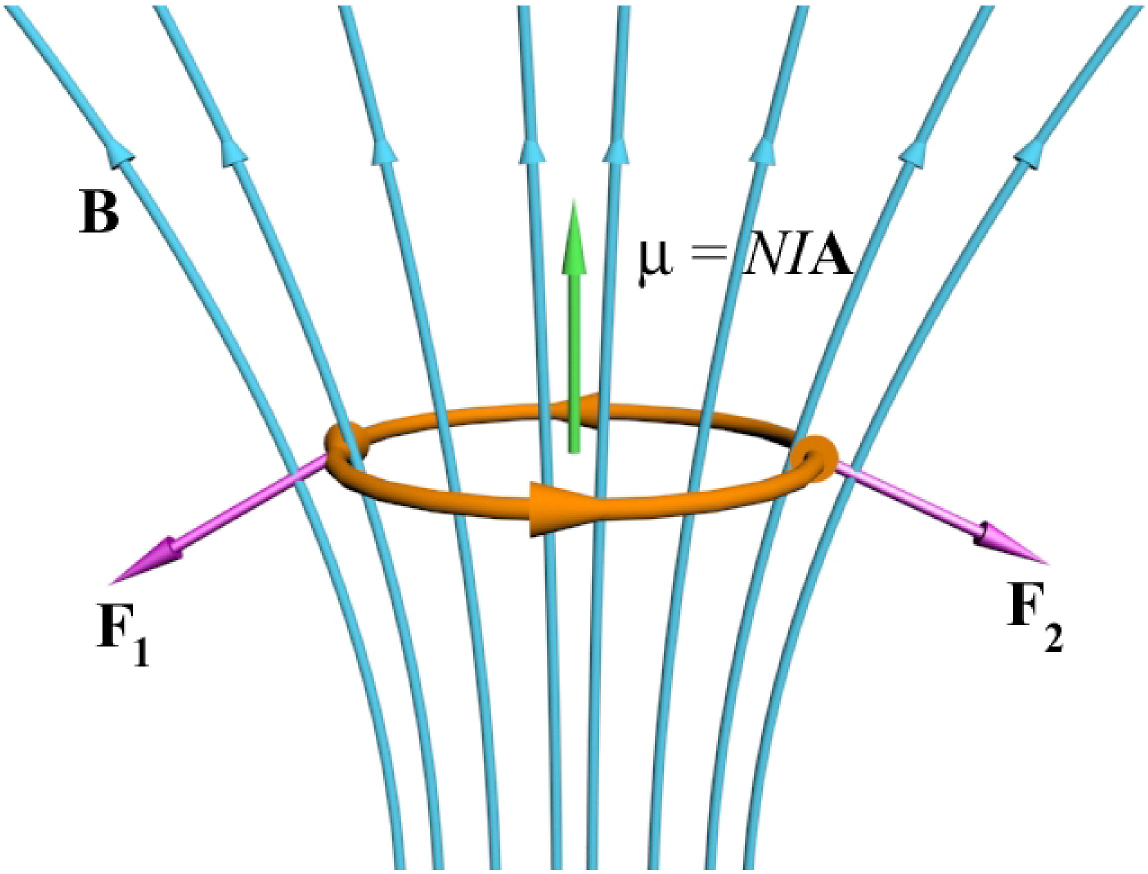
Dipole in Field



The current carrying coil above will move

1. upwards
2. downwards
3. stay where it is because the total force is zero

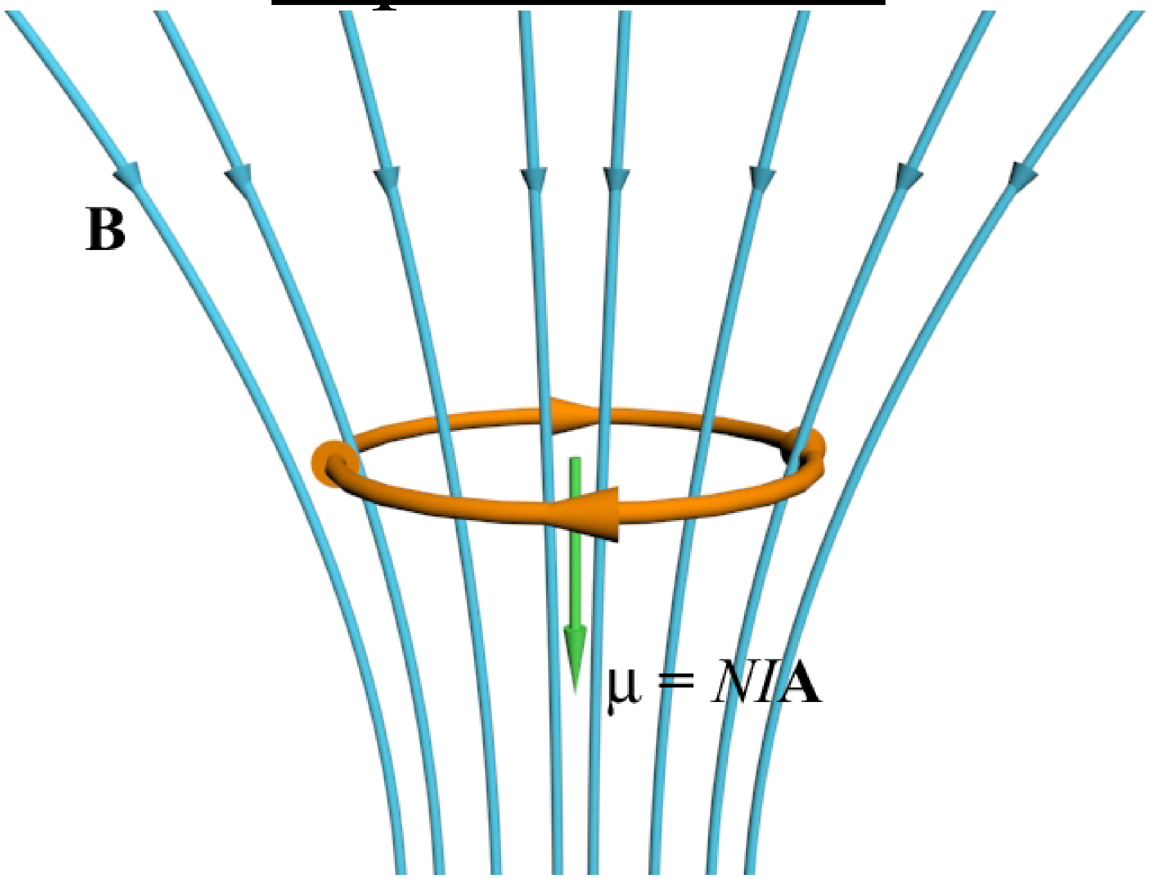
Dipole in Field



(2) Coil will move down

The ***I ds x B*** forces shown produce a net downward force

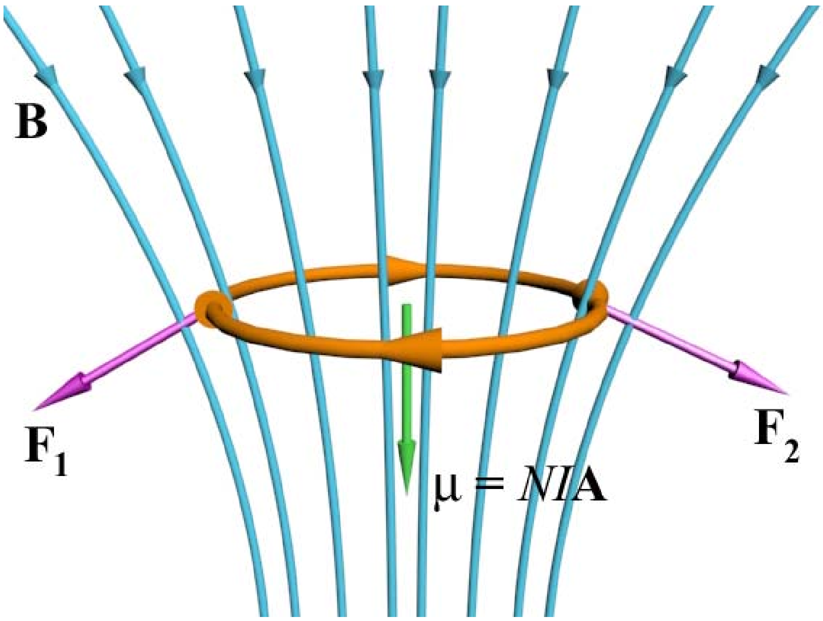
Dipole in Field

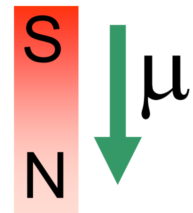


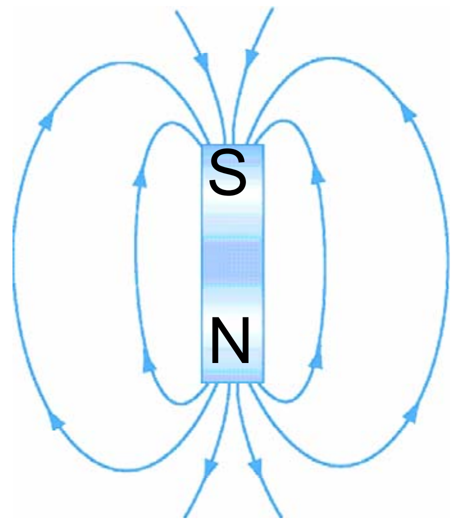
The current-carrying coil above will move

1. upwards
2. downwards
3. stay where it is because the total force is zero

Dipole in Field



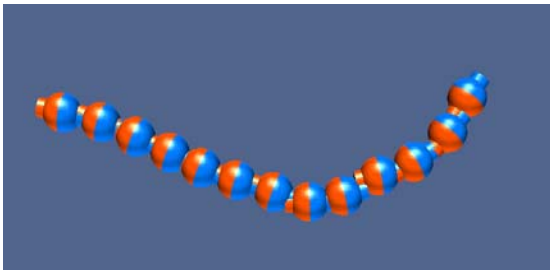




(2) Coil will move down

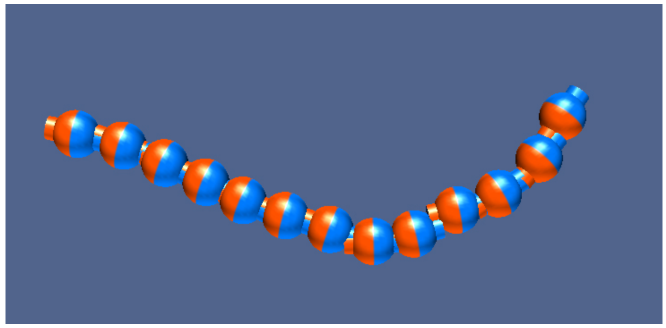
EITHER: The ***I ds x B*** forces shown produce a net downward force

OR: Think about magnets…



Free dipoles attract because:

1. The force between dipoles is always attractive independent of orientation.
2. A dipole will always move towards stronger field, independent of orientation.
3. The torque on the dipole aligns it with the local field and the dipole will then move toward stronger field strength.



(3) Free dipoles attract because the torque on a dipole aligns the dipole with the local field and the dipole then moves toward stronger field strength—that is closer to another dipole. If the dipole were anti-aligned with the local field then it would move toward regions of *weaker* field strength.