Section 12.5: The Motor Principle

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A. Answers may vary. Sample answer:
My prediction was correct. When the power was turned on, the wire experienced a force to the side, twisting the wire toward becoming horizontal.
B. Answers may vary. Sample answer:
The wire was carrying a current vertically because it was passing through external magnetic field lines that ran vertically from one pole of the horseshoe magnet to the other. The motor principle states that the current-carrying wire should experience a force perpendicular to both the magnetic field and the direction of the current, which in this case was horizontal.
C. If the horseshoe magnet is flipped over so that the north magnetic pole is above its south magnetic pole, the wire will twist in the opposite direction and become taut against the magnet.

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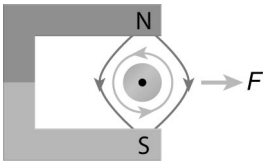
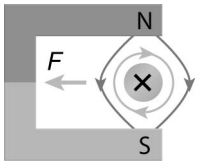
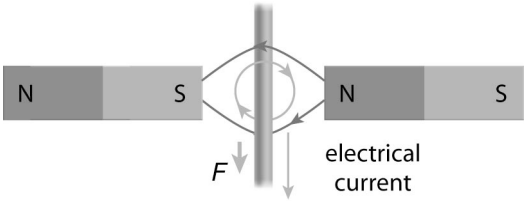
1. (a) The force on the conductor is directed to the right.



(b) The force on the conductor is directed to the left.



(c) The force on the conductor will be directed into the page.



2. To increase the force on a current-carrying conductor, increase the magnitude of the external magnetic field or increase the magnitude of the electric current through the conductor.

3. Increasing the number of loops in the looped conductor of a galvanometer would increase the sensitivity of the galvanometer. With a greater number of loops, the electric current has more paths to flow through so there are more magnetic fields forcing the coil to rotate. Therefore, the galvanometer will show a higher reading for the same amount of current.
4. (a) The direction of the magnetic field is the same whether you use the right-hand rule or the left-hand rule, so the needle on a galvanometer would move in the same direction if the electron flow model is used.
(b) The needle would move in the opposite direction if the leads connected to the galvanometer were reversed, since the direction of the magnetic field lines around the wire loops would be reversed.
5. If an ammeter is connected in parallel instead of in series, the current will have a separate path to follow, so not all of the current will flow through the ammeter. The ammeter will display a value for the current of the circuit that is incorrect and less than the true value.
6. If the resistor in the voltmeter is replaced with one of a much lower resistance than the original, the amount of current going into the voltmeter when the voltmeter is connected to a circuit will greatly increase. This will possibly damage the galvanometer. A voltmeter is designed to have a resistor with a high resistance to allow only a small amount of current to pass through to the galvanometer.