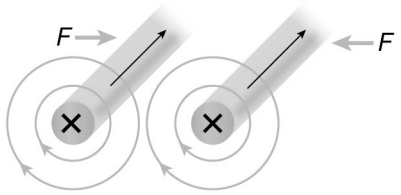
Section 12.4: Solenoids

Section 12.4 Questions, page 562

1. (a) The diagram should have a large X in the centre of the right conductor and a large dot in the centre of the left conductor.
(b) The diagram should be similar to the solution for part (a). The field lines should point up.
(c) The diagram should have an arrow labelled "direction of conventional current" pointing to the positive end of the wire. The top of the solenoid should be labelled "north" and the bottom labelled "south." Magnetic field lines should flow from the north end of the solenoid to the south end.
(d) The diagram should have an arrow labelled "direction of conventional current" pointing parallel to the wire on the battery and downward to the right. The top of the solenoid should be labelled "north," the bottom should be labelled "south." Magnetic field lines should flow from the north end of the battery to the south end.
2. (a) The diagram should have both compass needles pointing directly east (right).
(b) The diagram should have both compass needles pointing directly east (right).
3. If the current is sent down both wires in the same direction, the magnetic field lines will go in opposite directions in between the two wires, as shown in the diagram. This means that the wires will attract one another.



4. (a) Electromagnet B is stronger. Increasing the number of loops and the electric current increases the strength of an electromagnet. Electromagnet B has more loops and a greater electric current than electromagnet A.
(b) Yes. Electromagnet B is only slightly stronger than electromagnet A. Adding a soft-iron core to electromagnet A would increase its strength by a significant amount, so it would be stronger than electromagnet B.
5. (a) When the switch in the circuit containing the solenoids is closed, the conventional current flows from the positive terminal of the source and into the lower solenoid. The current then flows through the solenoids, exits at the top and returns to the negative terminal of the source. Using the right-hand rule for a solenoid, the upper solenoid will have its north pole on its left side, and the lower solenoid will have its south pole on its left side. The soft-iron armature will experience an attractive force by the lower solenoid and the spring will bend, allowing the armature to come in contact with the contact point and completing the second circuit. When the switch is then opened, the solenoids will no longer exert a force on the armature, and the spring will pull it away from the contact point, which will disrupt the second circuit.
(b) An electromagnetic relay allows two circuits to be created that are triggered by the same switch. Two circuits may be necessary if one circuit requires a larger current to power its loads. Devices that are sensitive to high currents cannot be placed in this circuit, so they can instead be placed in their own circuit, which has a smaller current. Then this circuit can be connected to the other with an electromagnetic relay.
6. You could remove the bell and striking tool and add a light bulb somewhere along the circuit to create a flashing light.
7. Table 1

Factor	An electromagnet can be made stronger by	An electromagnet can be made weaker by
loops	increasing the number of loops	decreasing the number of loops
electric current	increasing the amount of electric current	decreasing the amount of electric current
core material	including a core material like soft iron	not including a core material