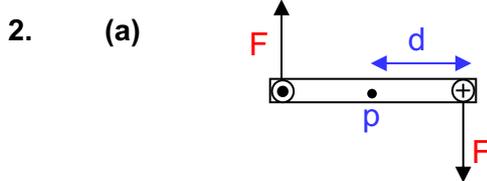




**2022 S4 Assignment 18**  
**Electromagnetism - Answers**

1. (a) When the switch in the first circuit is closed, the current flows through the solenoid and magnetizes the soft iron core so that it attracts the section of the soft iron armature on its left end. The L-shaped armature rotates about the pivot. The top end of the armature is raised and completes the contacts and closes the second circuit.
- (b) The advantage of using a magnetic relay is that a small current in the first circuit can be used to switch on and off a second circuit that requires a large current.



- (b) The two forces produce moments in the clockwise direction, hence the coil rotates in the clockwise direction.
- (c) Draw the coil in the vertical position:
- (d)  $Net\ moment = F \times d \times 2$   
 Ways 1, 2, 3 and 4 increase the force  $F$   
 Way 5 increases the distance  $d$



**Way 1:** Increase the current flow by increasing the e.m.f. of the d.c. voltage source applied to the rectangular coil.

**Reason:** Higher current will increase the magnetic field of the coil, and its interaction with the permanent magnetic field, hence producing a stronger force on the coil. This will increase the net moments produced.

**Way 2:** Increase the number of turns in the coil.

**Reason:** Current in each turn of the coil will induce a magnetic field around the wire, hence the force acting on each side of the coil will increase. This will increase the net moments produced.

**Way 3:** Use a stronger permanent magnet

**Reason:** The stronger magnetic field of the permanent magnet will increase the interaction with the magnetic field of the coil, hence the force acting on each side of the coil will increase. This will increase the net moments produced.

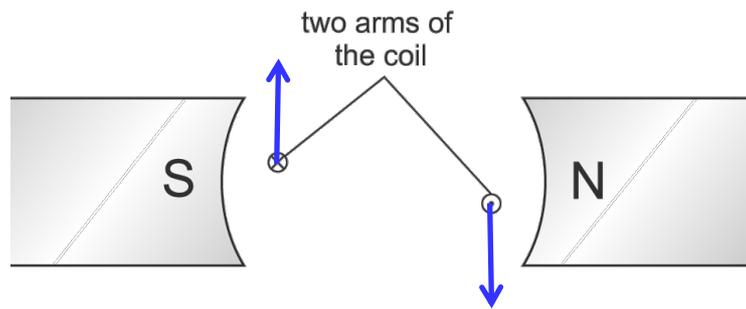
**Way 4:** Insert a soft iron core within the coil

**Reason:** This would concentrate the magnetic field through the coil, and will increase the interaction with the magnetic field of permanent magnet, hence the force acting on each side of the coil will increase. This will increase the net moments produced.

**Way 5:** Increase the width of the coil (or use a coil with larger width)

**Reason:** A wider coil will increase the perpendicular distance of the forces acting on the coil from the axle (pivot). This will increase the net moments produced.

3. (a)



Using Fleming's left-hand rule, the left side of the coil experiences an upward force and the right side of the coil experiences an equal downward force (shown in diagram).

This pair of forces produces a clockwise moment to make the coil rotate clockwise.

- (b) The momentum of the rotating coil will carry it slightly beyond this vertical position, so that the carbon brushes will make contact with the commutator again for the current to flow in the coil again.
- (c) She can replace the magnet with a stronger one or increase the number of turns in the coil.