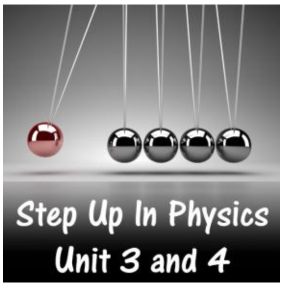
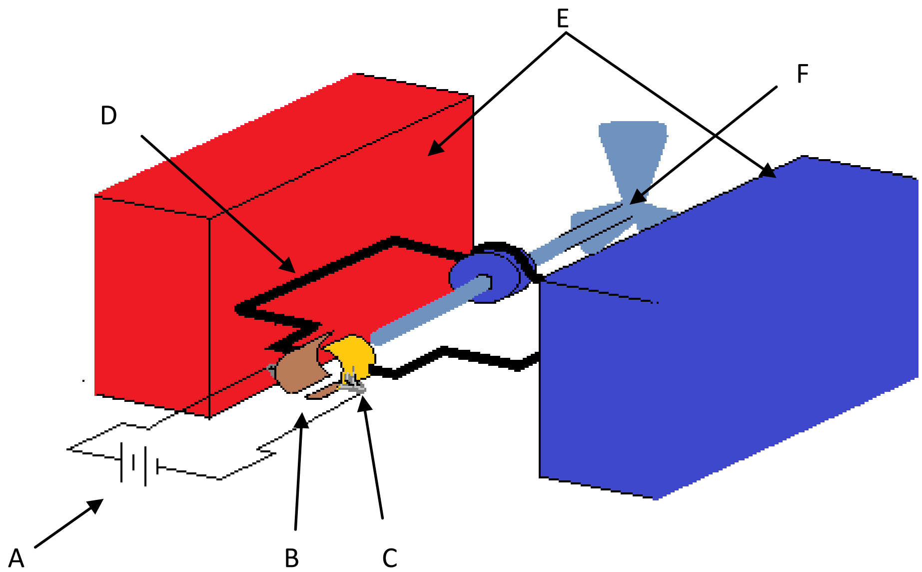
Electric Motors

Problems Worksheet

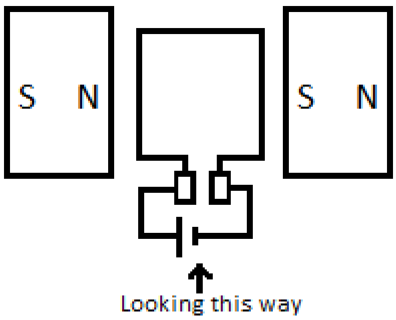


1. Identify the name of the parts labelled A-F in the diagram of the simple electric motor shown below. Briefly state each part's function.



Part Label	Part Name	Part Function
A		
B		
C		
D		
E		
F		

2. The top down view of the electric motor given below shows the position of the coil while it is parallel with the magnetic field.



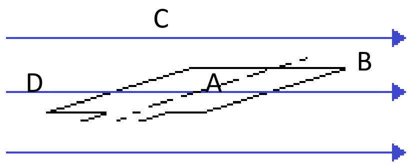
a. Looking from the position shown in the diagram, would the coil be rotating clockwise or anticlockwise?

b. Circle the sections of the coil that are experiencing a force which causes a rotation while the motor is in operation.

c. Explain why not all sides of the coil are responsible for the rotation of the coil.

d. Will the coil be experiencing a maximum or minimum torque in the position shown in the diagram? Justify your response.

3. A child's remote controlled car uses a small electric motor powered by a 600 mA power source. The motor has a 40 turn square coil with 4.20 cm long sides and is surrounded by a 1.20 T magnetic field.



a. Calculate the magnitude of the force acting on side AB when the coil is in the position shown in the diagram.

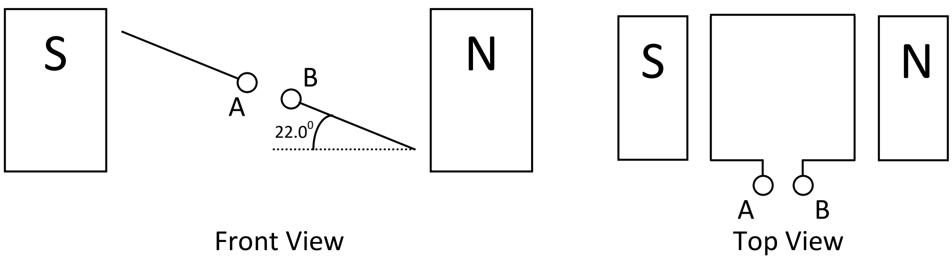
b. Describe the alignment of the coil and magnetic field when that same side of the coil would experience a minimum force.

4. On a hot day it's nice to have a small battery powered fan to keep cool. The sides of the 80 turn coil rotating within the fan's motor follow a 4.15 cm radius circular path. The other length of the rectangular coil is 6.20 cm. The permanent magnets form a 1.80 T field and the current in the coil is 1.30 A.

   a. What evidence suggests this is a DC motor and not an AC motor?

   b. Calculate the maximum torque this motor is capable of producing.

5. A single square coil with 28.0 cm sides is positioned between two permanent magnets that produce a uniform 5.60 T horiontal field. The coil is angled at 22^0 from a horizontal position. A current source is then attached which causes a 2.00 A current to flow from A to B within the coil.



   a. From the front view perspective, will the coil rotate clockwise or anticlockwise?

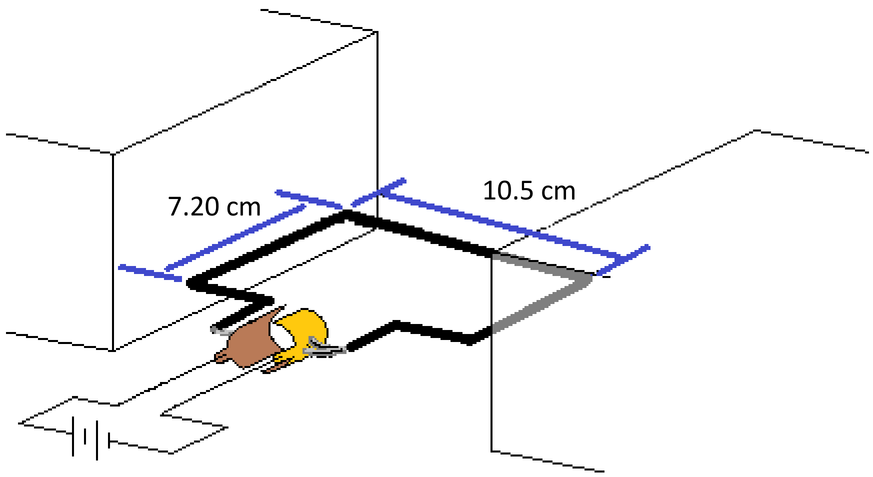
   b. Calculate the force acting on the left side of the coil as viewed from the top.

   c. Calculate the net force acting on the coil as the current flows from A to B.

d. Calculate the torque acting on the coil in the position shown in the diagram.

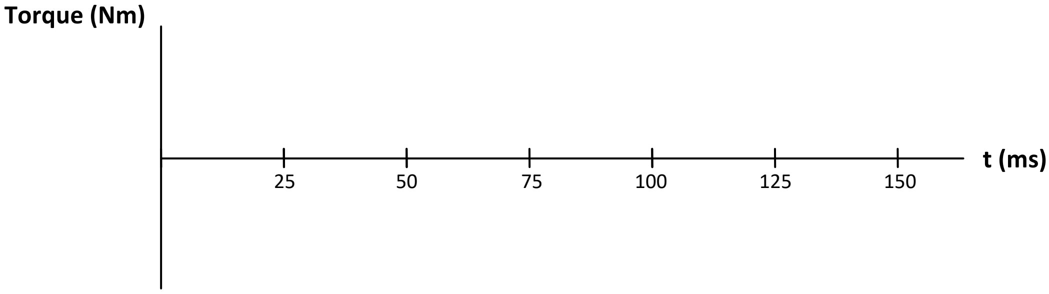
e. There is no commutator between the current source and the coil. Explain how the coil would behave when the current source is turned on. Draw a diagram of the coil from the front view with suitable forces shown to help with your explanation.

6. A hand held vacuum creates the suction using a pump powered by a small electric motor. The armature is made of 120 coils and is in the position shown in the diagram below. The permanent magnets produce a uniform 1.80 T field. The EMF source provides a 3.60 A current. At full load the motor operates at 1200 rpm.



a. Calculate the maximum torque produced by this motor.

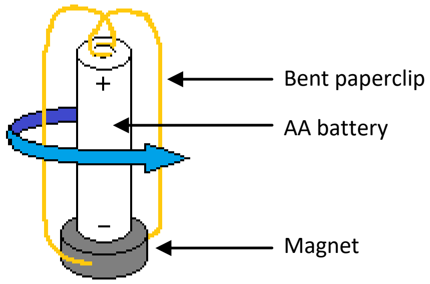
b. From the starting position of the coils shown in the diagram, make a sketch of the torque produced by the motor while under full load over a 150 ms time interval.



c. State five changes that you could make to the design of this motor that would increase the maximum torque produced by the motor.

7. The diagrams below show two designs of DC motors. What advantage does the right design have over the left design?

8. The diagram below shows a simple apparatus made from an AA battery, a small but powerful rare earth metal magnet and a paperclip balancing on and connected to both.



a. When all the equipment is setup, as shown in the diagram, the paperclip rotates around the battery. Explain, using physical principles, why this rotation occurs.

b. State two separate changes you could make to the equipment which would result in either change causing the paperclip to rotate in the reverse direction.

9. Two students are building a DC motor for a Physics project. They used wire of total length P to form a square coil to use in the motor. Each side of the coil had a length W. The students were not impressed with the measured torque output of the motor. They removed the coil and reshaped the wire (still total length P) into a rectangle with a width that was half of the square coil's width ($\frac{1}{2}W$). How would the torque of the rectangular coil compare to the torque of the square coil?

