

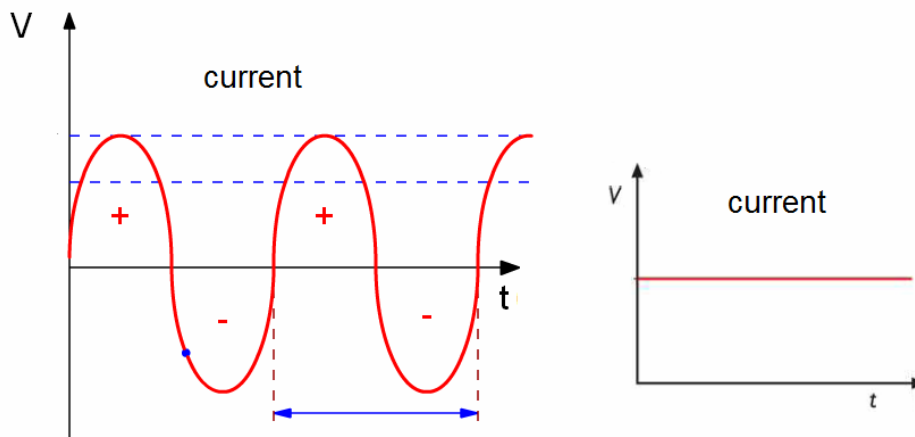
(U1) ELECTROMECHANICS CLASS ACTIVITIES

1 NAME AND SURNAMES:				Group:	
2 NAME AND SURNAMES:					
Day/Date	Signatures		Day/Date	Signatures	
09/	Name1:	Name2:	10/	Name1:	Name2:

Electric Machines

Alternating Current & Direct Current

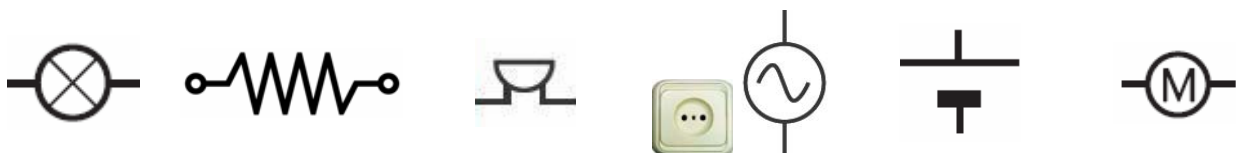
1. **Alternating Current (AC) versus Direct Current (DC).** Identify the most important instantaneous values in the picture below:



Effective Value (Vef): the effective value of an alternating current is that current which will produce the same heating effect as an equivalent direct current. For example, the domestic mains supply in Spain is 230 V (it used to be 220 V) and is assumed to mean 240 V rms (root mean square). The practical value is calculated this way $V_{ef} = V_{max} / \sqrt{2}$

2. **Electrical appliances: Electricity, energy and electrical symbols.**

- Identify the electrical symbols below and with the form of energy they produce. Label two of them with direct current (DC) or alternating current (AC).



--	--	--	--	--	--

- Label the electrical appliances below with their **name** (speaker, drill, street lamp, iron, fan, hairdryer, radio alarm clock, laptop, radiator, doorbell, headlight, washing machine, induction cooker), **type of current** (DC or AC) and **form(s) of energy** they produce:



radiator (AC)

Produce (1): heat



Produce (2):



Produce (1):



Produce (1):



Produce (2):



Produce (2):



Produce (2):



Produce (3):



Produce (1):



Produce (1):



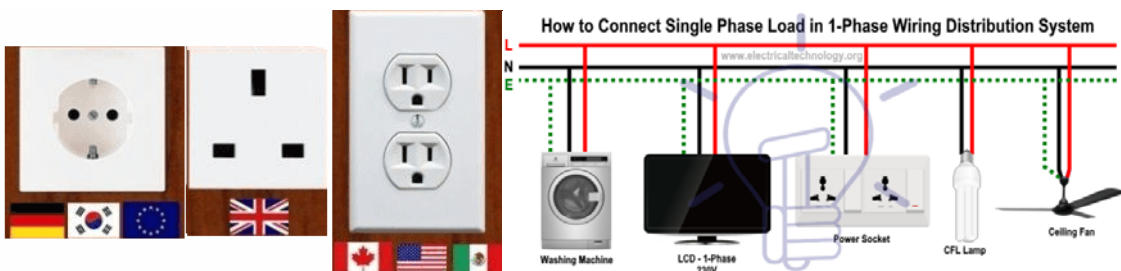
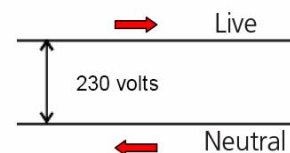
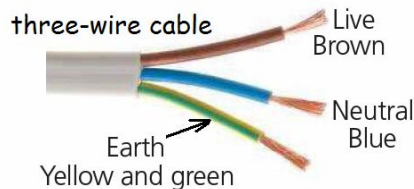
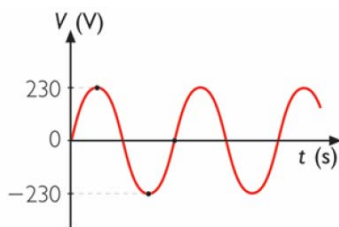
Produce (2):



Produce (2):

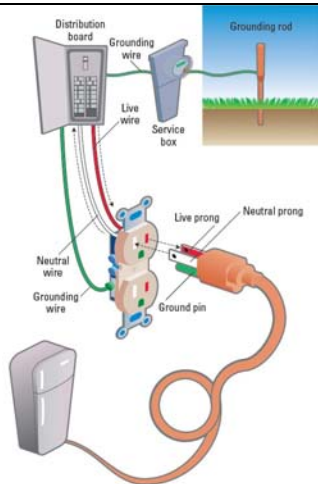
3. Types of alternating current: **single-phase** current and **three-phase** current.

Single-phase power is used for _____. In Spain we usually use single-phase power at home. That means the electricity has a voltage of ___ and a _____ of 50 Hz. A single-phase circuit allows current to flow through one wire (____) with one return path (____) to complete the circuit.



A three-phase circuit has three _____ (R, B and Y) with one neutral (N) wire. In some houses three-phase low voltage (____) is needed due to the use of more _____ household equipment such as elevators... This system is used in _____.

Power Ratings for Appliances	
Appliance	Power (Watts)
Stove	6,000
Hair dryer	1,200
Microwave	1,000
Refrigerator	500
Computer	150
TV	150
Clock radio	12



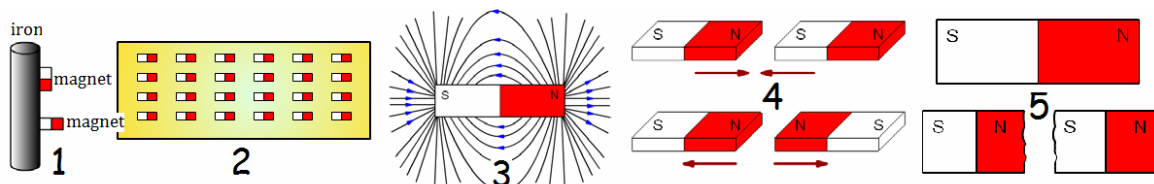
In order to prevent short circuits, three-wire cables include a _____. This wire provides an alternative pathway for electrical current to flow when a _____ in the system of live and neutral wires (that normally carry the current). This way the grounding cable channels (conducts) the stray current back to the ground before it can cause a fire or a _____ (electrocution)

Electric Machines Electromagnetism

4. Magnetisms and Electromagnetism.

- **Magnetism** refers to a group of natural phenomena in which certain metals display a propensity (inclination) for attraction. This propensity can be created also through electricity. **Electromagnetism** refers to creating a magnetic force using an electric current.

a) Match the pictures below with its magnetic property:



✎ Magnetic field lines enter a magnet at the south pole and exit at the north pole:

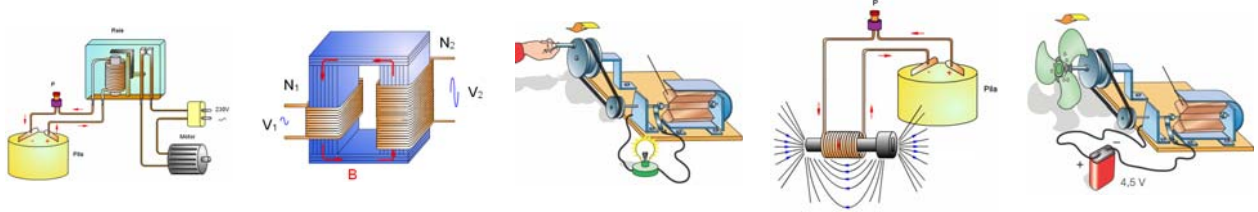
✎ Magnets align their molecules in the same direction:

✎ They attract iron or objects made of iron:

✎ If you place the north poles of two magnets together, they will repel (push away). North pole and south pole of two magnets near each other, they will attract, or come together:

✎ You cannot split a magnet into separate poles:

b) Uses of **electromagnetism**. Identify the following applications of electric magnets:

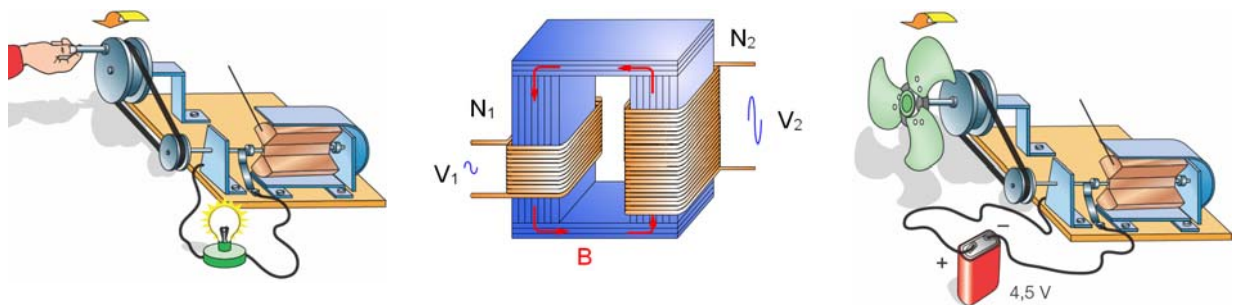


--	--	--	--	--

5. Electric or Electrical Machines.

• An **electric machine** is a device, which can change electric energy to mechanical energy or conversely. But is also a device used to change only parameters of electrical energy.

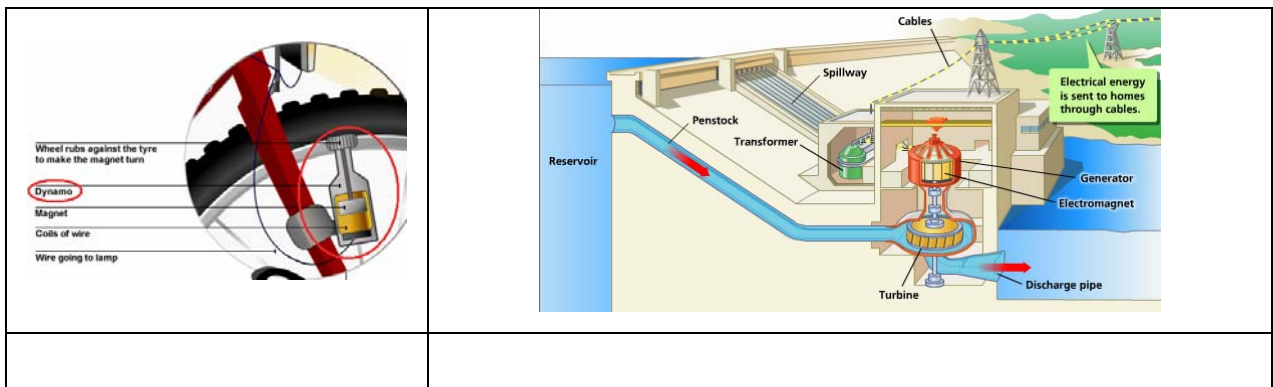
Identify the electric machines below:







--	--	--

• Electric machines are of three main types: generators, motors and transformers.

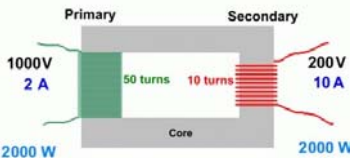
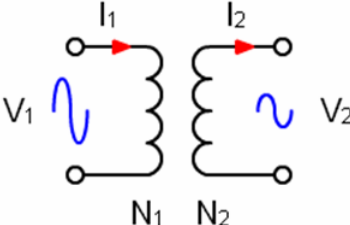
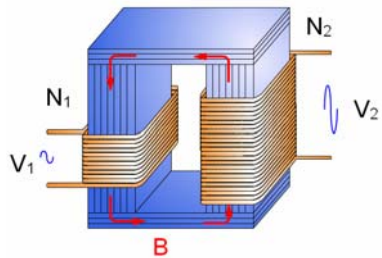
✎ An **electric generator** is a device that changes kinetic energy to electrical energy through electromagnetic induction. Generators may be set up (be configured) to produce either alternating or direct current: DC generators (**dynamos**) and AC generators (**alternators** in power plants). Identify them in the pictures below



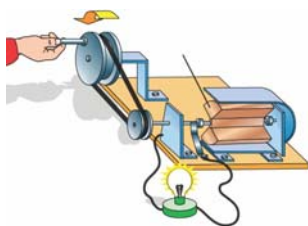
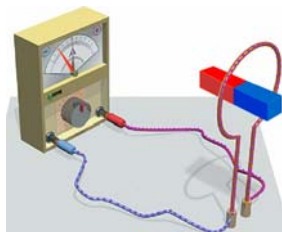
✎ An **electric motor** is a device that changes electrical energy into mechanical energy. Components include an electric circuit with part of the wires inside a magnetic field. Motors are classified into AC motors and DC motors. We will study the direct current permanent magnet electric motor. You can find this motor at home (toys, battery-operated drills, computers fans...), in cars (power windows, windshield wipers...). Identify these applications:

 <p>DC 6V 12V 18V 24V DC 12V: 11600RPM</p> <p>High Speed 550 DC Motor For Drill Screwdriver Electric Tools DIY</p>			
			power window motor

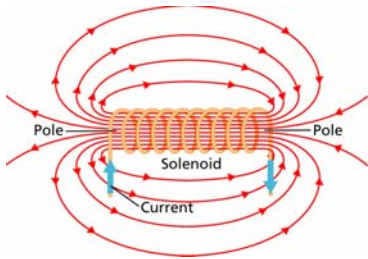
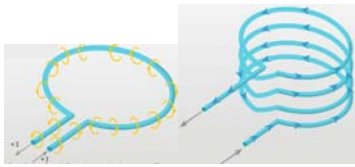
✎ A **transformer** is a device that uses electromagnetic induction to change the voltage of electric current. A transformer may either increase or decrease voltage, but it only works with alternating current. Indicate if the transformers below increase, decrease or maintain the input voltage (input: primary → output: secondary):

<p>Step Down Transformer</p>  <p>Primary: 1000V, 2 A, 50 turns Secondary: 200V, 10 A, 10 turns Core: 2000 W</p>	 <p>I_1 I_2 V_1 V_2 N_1 N_2</p>	 <p>N_1 N_2 V_1 V_2 B</p>

6. Electric machines: Alternators and Dynamos (Generators)



Faraday discovered (1831) that electricity could be made by moving a **magnet** inside a wire coil or by moving an electrical conductor (**wire coil**), such as a wire that contains electric charges, in a magnetic field. This movement creates a **voltage difference** between the two ends of the electrical conductor, which in turn causes the electric charges to flow (electric current). Generating a voltage by rotating a coil in a magnetic field is the basis of both a dynamo and an alternator; the devices differ in how the alternating current (AC) output is managed.

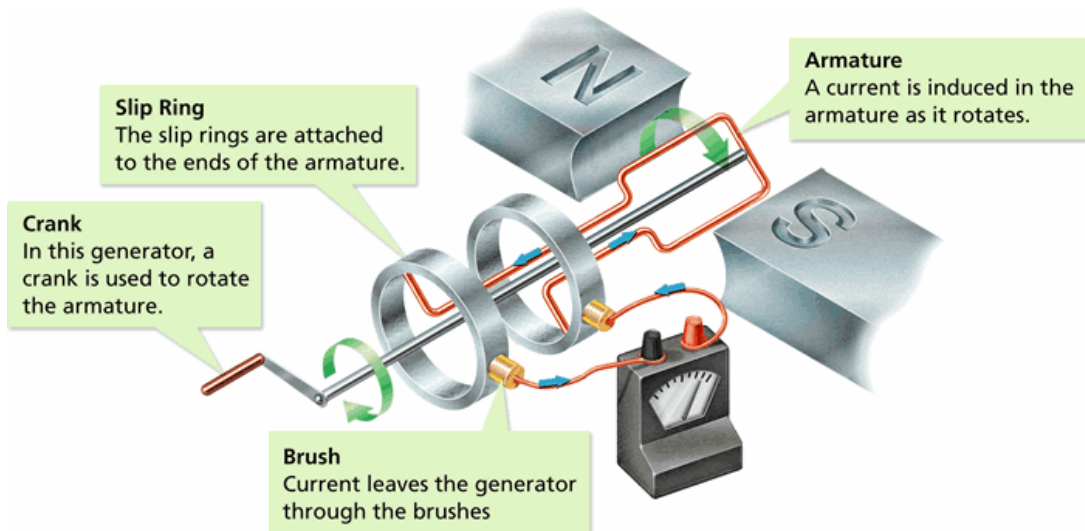


A **solenoid** is a number of turns of insulated conductor wire closely wound in the same direction to form a **coil**. If the coil of wire carries an electric current it produces a magnetic field. The more loops, the stronger the magnetic field. Wrapping a solenoid around an **iron core** makes an **electromagnet**, which combines the magnetic field of the solenoid with the magnetic field of the magnetized iron core. Adding loops to the solenoid or increasing the electric current strengthens the electromagnet. Electromagnets are useful for lifting and moving large metal objects containing iron, galvanometers (a meter that measures the strength and direction of an electric current in a wire), door bells, speakers...

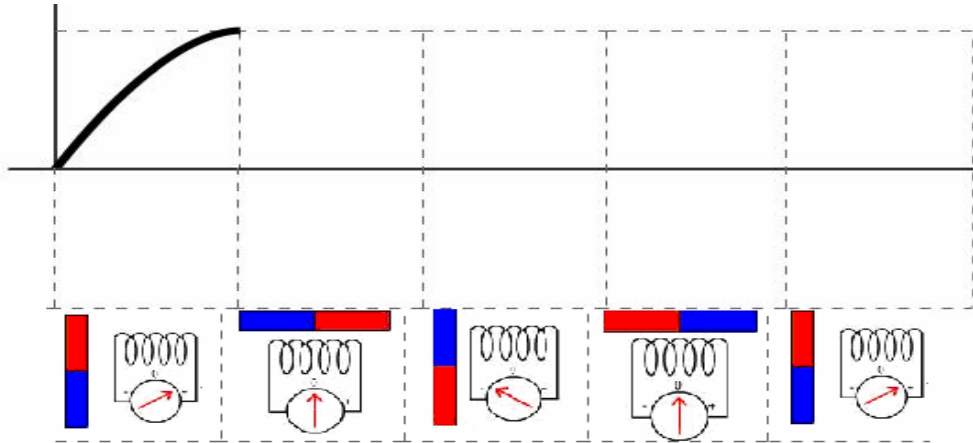
- Identify the following uses of electromagnetism:

				Lifting and moving...	
Day/Date	Signatures		Day/Date	Signatures	
11/	Name1:	Name2:	12/	Name1:	Name2:

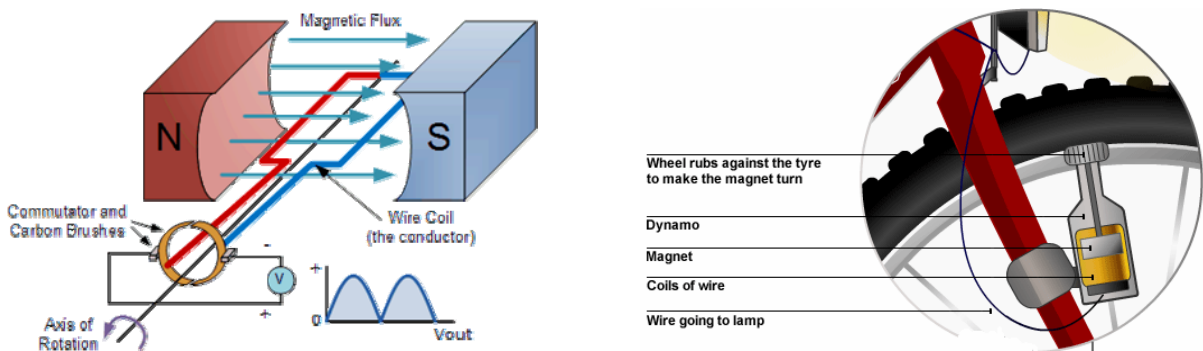
- **Alternators.** In a simple generator a wire loop (armature) at the end of a rod (crank) moves through the magnetic field of a magnet. In the first half of the turn, one side of the loop moves downward. In the second half of the turn, the part of the loop that was moving downward now moves upward, reversing the current. This creates alternating current.



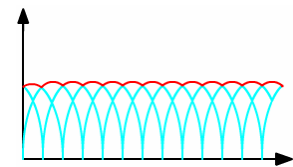
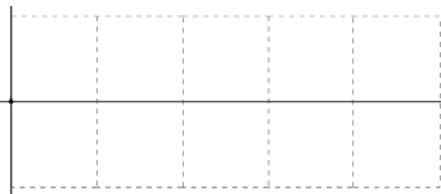
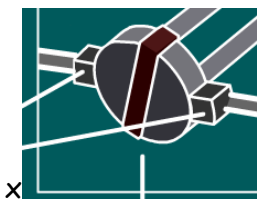
- Draw the alternating current (AC) the alternator produces:



- **Dynamos.** Dynamo is the term we use to describe a generator that makes direct current power (electrons in only one direction). The output voltage in a dynamo is taken from spring mounted carbon brushes that are stationary and rub against the rotating commutator. The wiring of the armature and the segments of the commutator are so arranged that the circuitry is switched as rotation takes place. This switching is a mechanical form of rectification and means that a DC output is obtained.

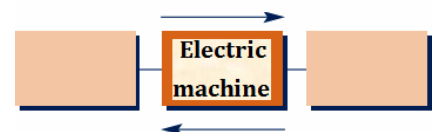
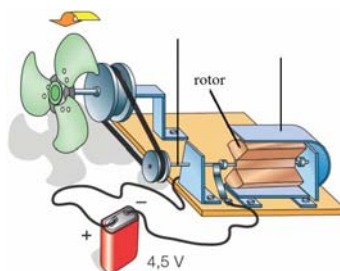
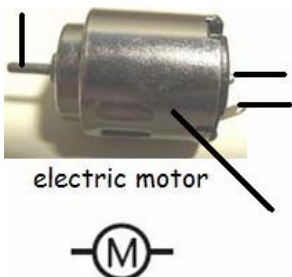


- Identify the component below and draw the current a single coil dynamo produces:



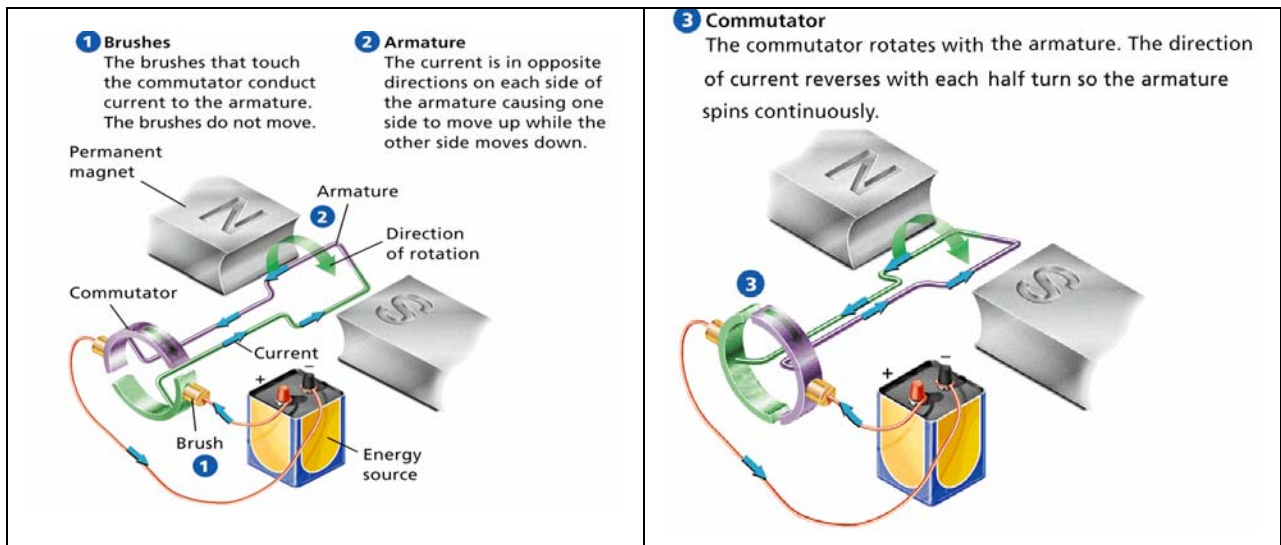
Direct Current (DC)

7. Electric machines: **Motors.** Identify the components of an electric motor and complete the diagram of the reversibility of an electric machine:



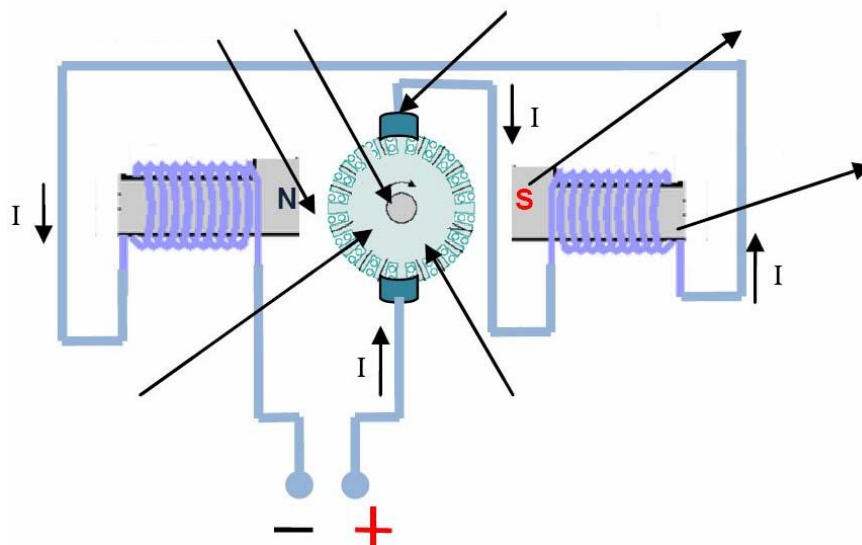
- How a motor works:

Torque is the twisting force that tends to cause rotation.



Current enters the armature through the carbon brushes attached to the commutator. The commutator is joined to the armature so it rotates with the armature. The armature becomes an electromagnet when current passes through it. The current is in opposite direction on each side of the armature causing one side to move up while the other side moves down. These two forces are called **torque** and make the armature rotate until its north pole is opposite the magnet's south pole. Then, the commutator reverses the direction of the current in the armature, causing the armature to complete its turn.

8. Electric machines: **Motor Parts**. Identify the parts of a DC motor:



9. Electric machines: **transformers** (we will study it in Unit 2).