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PHYSICAL SCIENCES - PHYSICS

Chapter 10 – Electric and Magnetic Fields

10.1 Electric Charge and Electric Field

Charging and Electric Field

Electric charge (or charge for short): The basic properties of particles (remember electrons and protons?) in matter.

- Protons are positively (+) charged.
- Electrons are negatively (–) charged.

Like charges repel and unlike charges attract.



Charging: A transfer of electrons between the two objects.

- The object that loses electrons will become positively charged.
- The object that gains electrons will become negatively charged.
- { The total charge of an object = 0 : the number of electrons = the number of protons
- { The total charge of an object = + : the object loses electrons
- { The total charge of an object = – : the object gains electrons

Conduction and induction:

- **Conduction:** Transfer of charge from one object to another by direct *contact*.
- **Induction:** Transfer of charge from one object to another *without* direct *contact*.

Changing / discharging caused by conduction or induction.

Static electricity: An accumulation (build up) of an electric charge on the surface of an object (electric charge at rest rather than moving).

Static discharge: The release of static electric charge.

Law of conservation of electric charge: The electric charge cannot be created or destroyed, but it can be transferred from one form to another (the total electric charge remains constant).

Electric field: The area near a charged object experiences electric forces that fill the area.

Electric field lines: The imaginary lines around a charged object that describe the electric field in an area. They begin as positive charges and end as negative charges. + → -

10.2 Electromagnetism

Magnetism

Magnet: A piece of iron (or steel, alloy, etc...) that has the ability to attract another metal object.

Magnet field: The area near a magnet (an invisible area of magnetism produced by moving electric charge).

Permanent magnet: A magnet that retains its magnetism after it is removed from a magnetic field.

Magnetism: The attraction or repulsion properties of a magnet.

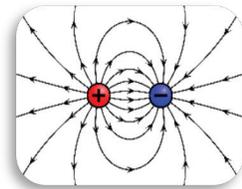
A magnet has two areas of strongest force, called poles.

- Every magnet has a north pole and south pole.
- Like poles repel, unlike poles attract.



Magnetic field lines: The imaginary lines around a magnet that describe the directions of the magnetic field (they can be plotted with iron filings and paper).

- **Outside:** The magnetic field lines travel from the North Pole (N) to the South Pole (S).
- **Inside:** From the South Pole to the North Pole.



Electromagnetic force: A force between charged objects around their electric and magnetic fields.

The Earth is like a giant magnet: The Earth itself contains magnetic materials and is a magnet.

- The north pole of a compass points to the Earth's magnetic North Pole.
- **Compass:** A device for finding direction. It contains a needle that swings to point north.
- The Earth's magnetic field protects the Earth from the Sun's harmful radiation.
- The magnetic poles (N and S poles) and the geographic poles (Earth) are not located in the same place.



Electricity

Electric current (I): A flow of electric charge through an electric circuit.

Electric circuit: A closed loop pathway with electric charges or current flowing through it.

Voltage (V): The amount of energy or work required to move electrons (or current).

Resistor (R): A two-terminal component of a circuit that limits the flow of current.



Resistance: The measure of a material’s opposition to the flow of current.

Direct current (DC): An electric current that flows in one direction only (the direction of current does not change).

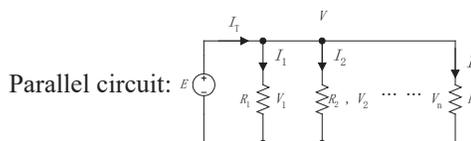
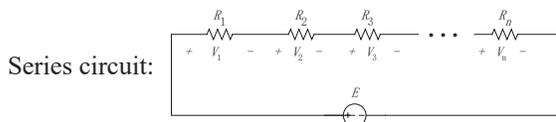
Alternating current (AC): An electric current that changes direction over time (the direction of current periodically changes with time).

Series circuit:

- The components are connected one after the other.
- There is only one current path.
- The current flow through each component is always the same.

Parallel circuit:

- The components are connected end to end.
- There are at least two current paths in the circuit.
- The voltage across each component is the same.



An electric current can produce a magnetic field.

- A moving charge creates a magnetic field.
- When an electric current passes through a wire, a magnetic field is formed around the wire.

Electromagnetism: A magnetic field that is created by an electric current.

An electromagnetism is a relationship between electricity and magnetism.

Electromagnetic induction: Moving a loop of wire through a magnetic field, or moving a magnetic field relative to a coil, will produce an electric current.

Electric motor: A device that converts electric energy into mechanical energy.



A motor uses a magnet to put a force on a wire coil, this force makes the motor rotate (turn).

Electric generator: A device that converts mechanical energy into electrical energy.



The external torque (mechanical force) rotates a loop of wire through a magnetic field producing an induced current.

Chapter 10 – SUMMARY

Electric and Magnetic Fields

Electric Charge

- **Electric charge (or charge for short):**
 - { Protons are positively (+) charged.
 - { Electrons are negatively (–) charged.
 - Like charges repel and unlike charges attract.
- **Charging:** A transfer of electrons between the two objects.
 - { The total charge of an object = 0 : the number of electrons = the number of protons
 - { The total charge of an object = + : the object loses electrons
 - { The total charge of an object = – : the object gains electrons
- **Conduction and induction:**
 - { **Conduction:** Transfer of charge from one object to another by direct **contact**.
 - { **Induction:** Transfer of charge from one object to another **without** direct **contact**.
- **Static electricity:** An accumulation of an electric charge on the surface of an object.
- **Law of conservation of electric charge:** The electric charge cannot be created or destroyed, but it can be transferred from one form to another.

Electromagnetism

- **Electric field:** The area near a charged object experiences electric forces that fill the area.
- **Electric field lines:** The imaginary lines around a charged object that describe the electric field in an area. + \longrightarrow –
- **Magnet:** A piece of iron that has the ability to attract another metal object.
 - Every magnet has a north pole and south pole.
 - Like poles repel, unlike poles attract.
- **Magnet field:** The area near a magnet.
- **Magnetic field lines:** The imaginary lines around a magnet that describe the directions of the magnetic field.
 - { Outside: The magnetic field lines travel from the North Pole (N) to the South Pole (S).
 - { Inside: From the South Pole to the North Pole.
- **Electromagnetic force:** A force between charged objects around their electric and magnetic fields.
- **Electric current (I):** A flow of electric charge through an electric circuit.
- **Electric circuit:** A closed loop pathway with electric charges or current flowing through it.
- **Voltage (V):** The amount of energy or work required to move electrons (or current).
- **Resistance:** The measure of a material’s opposition to the flow of current.
- **Direct current (DC):** An electric current that flows in one direction only.
- **Alternating current (AC):** An electric current that changes direction periodically over time.
- **Electromagnetism:** A magnetic field that is created by an electric current.



PRACTICE

Student Name: _____

Date: _____

CHAPTER 10: 10.1 – 10.2 ELECTRIC AND MAGNETIC FIELDS

True / False

- ___ Electrons are positive charged.
- ___ The object that gains electrons has an excess of negative charge.
- ___ Static electricity is an accumulation of an electric charge on the surface of an object.
- ___ Electric field lines are the real lines around a charged object that describe the electric field in an area.
- ___ The magnetic poles (N and S poles) and the geographic poles (Earth) are located in the same place.
- ___ A resistor is a two-terminal component of a circuit that limits the flow of current.
- ___ electric current cannot produce a magnetic field.

Completion

- Protons are () charged.
- The object that () electrons has an excess of negative charge.
- Conduction is transfer of charge from one object to another by () contact.
- Electric field lines begin as () charges and end as () charges.
- The Earth itself contains () materials and is a magnet.

Multiple Choice

- The attraction or repulsion properties of a () is called magnetism.
 - wood
 - bar
 - magnet
 - copper
- Every () has a north pole and south pole.
 - wood
 - bar
 - force
 - magnet
- Voltage is the amount of energy or work required to move ().
 - force
 - electrons
 - magnet
 - copper
- () is a flow of electric charge through An electric circuit.
 - Resistance
 - Voltage
 - Current
 - Power
- The direction of alternating current periodically changes with ().
 - force
 - time
 - wind
 - power
- Electric () is a device that converts Electric energy into mechanical energy.
 - motor
 - generator
 - instrument
 - device



Chapter 10 – PRACTICE QUIZ

Electric and Magnetic Fields

True / False

1. ___ Electrons are positively (+) charged.
2. ___ The object that loses electrons has an excess of positive charge.
3. ___ Conduction is transfer of charge from one object to another without contact.
4. ___ Electric field is the area near a charged object that experiences electric forces that fill it.
5. ___ Electric field lines are the imaginary lines around a charged object that describe the electric field in an area.
6. ___ The Earth is like a giant magnet.
7. ___ The magnetic poles (N and S poles) and the geographic poles (Earth) are located in the same place.
8. ___ An electric circuit is a closed loop pathway with electric charges or current flowing through it.
9. ___ An electromagnetism is a relationship between electricity and temperature.

Completion

10. () are negatively (–) charged.
11. The object that gains electrons will become () charged.
12. Induction is transfer of charge from one object to another () direct contact.
13. () electricity is an accumulation of an electric charge on the surface of an object.
14. Electric field () begin as positive charges and end as negative charges.
15. Magnetism is attracting or () properties of a magnet.
16. The Earth's magnetic field () the Earth from the sun's harmful radiation.
17. The Earth itself contains magnetic materials and is a ().
18. The direction of () current does not change.
19. An electric generator is a device that converts () energy into electrical energy.

Multiple Choice

20. Magnet field is the area near a ().
 a. wood b. bar c. magnet d. copper
21. Every () has a north pole and south pole.
 a. wood b. bar c. force d. magnet
22. An electric current is a flow of electric () through an electric circuit.
 a. force b. charge c. force d. magnet
23. () is the amount of energy or work required to move electrons (or current).
 a. Resistance b. Voltage c. Current d. Power
24. An electric motor is a device that converts electric energy into () energy.
 a. mechanical b. nuclear c. chemical d. motion