CH. 18 ELECTROMAGNETISM

1

7th Physical Science

WORD BANK (CH. 18 PUZZLE)

- domain
- electric motor
- electromagnet
- Faraday
- ferromagnet
- galvanometer
- generator
- induction
- maglev
- magnet
- magnetic field
- magnetic force
- Oersted
- poles
- solenoid
- transformer

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ON THE BACK OF YOUR PACKET…

- Ch. 18 Principles
  - Ampere's Law: Current → Magnetic Field
    - Cause of magnetism: electron currents, domains
  - Lorentz Force: Moving charge in magnetic field feels a force
    - $q\mathbf{v}\times\mathbf{B} = \mathbf{F}_B$
    - Galvanometers
  - Faraday's Law: Changing Magnetic Field → Electric Field
    - Power generators
    - Light!!

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TOPICS OF THE DAY…

- What are the magnetic poles?
- What's a magnetic force?
- Are there monopoles?
- What's a magnetic field?
- How is Earth like a big magnet?
- What's a compass?
- Where does magnetism come from? Ampere's Law
- Why are some materials magnetic? Domains

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18.1

18.1

① Magnet Properties

a) What attracts? ✓ or ✗

foil	metal clip
plastic	metal cup
coin	staples
glass	light bulb
paper clips	
wood	
metal pen	

Magnet = anything that attracts _____
(steel too)

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18.1 MAGNETS

- Magnetic Poles?

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18.1 MAGNETS

- What's a compass?

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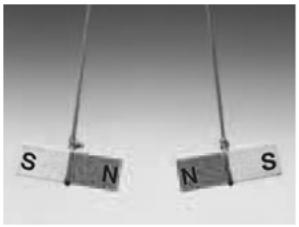
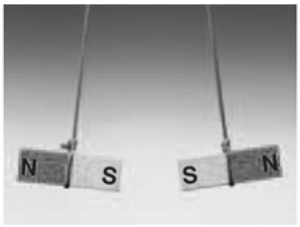
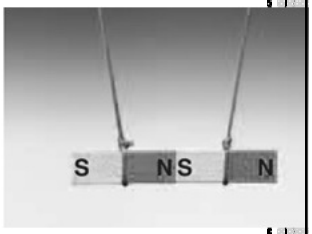
18.1 MAGNETS

- Magnetic force?







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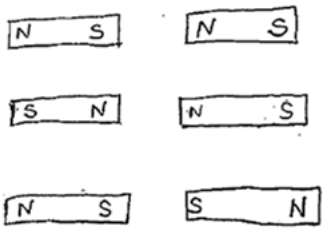
18.1 MAGNETS

- Magnetic Force?

b) Magnetic forces. Draw the force vectors.



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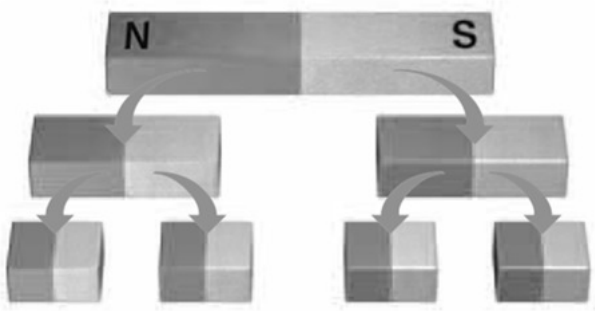
18.1 MAGNETS

- Are there magnetic monopoles?



c) If you cut a magnet in half, is there still a North and South? _____

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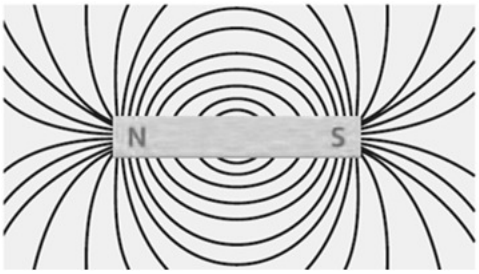
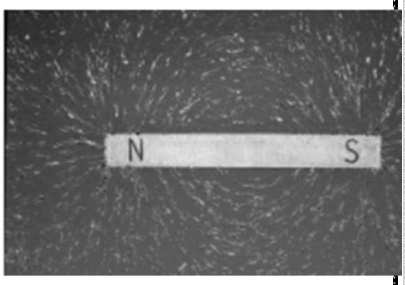
18.1 MAGNETS

- Magnetic Field





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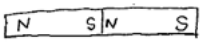
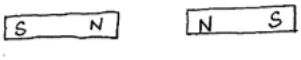
18.1 MAGNETS

- Magnetic Field

③ Use a compass to draw the magnetic field lines.

a)





b) Try to see the field lines using iron fillings.

c) Draw the Earth's field lines in #2c)

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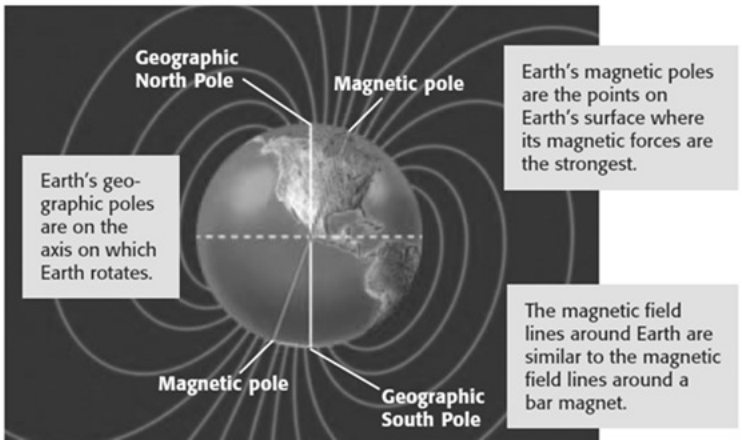
18.1 MAGNETS

- Earth's Magnetic Field

Figure 9 Earth's Geographic and Magnetic Poles



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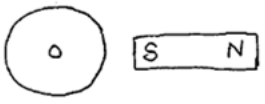
18.1 MAGNETS

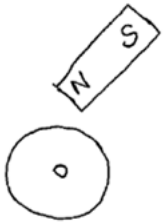
- Earth's Magnetic Field

(a) Compass

a) Where is the north pole?

b) Bring a magnet near





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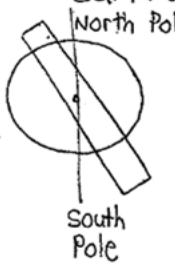
18.1 MAGNETS

- Earth's Magnetic Field

c) Label Earth's Magnetic Poles



d) Make your own compass. Draw it pointing north.

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18.1 MAGNETS – HOW?

- Magnets?
- Nonmagnets?
- Temporary magnets?
- Electromagnets?

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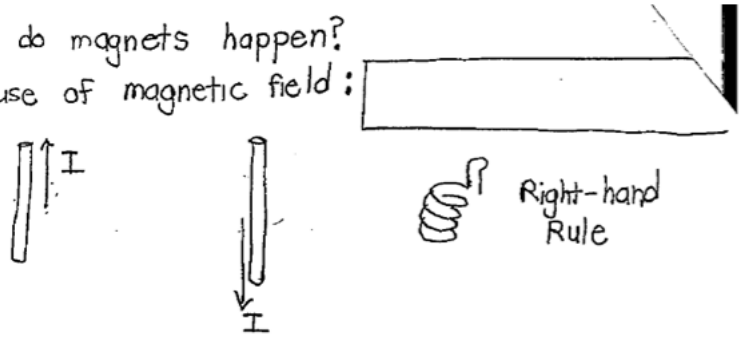
18.1 MAGNETS – HOW?

④ Why do magnets happen?

a) Cause of magnetic field:



b) Atoms have some current: _____
so atoms have _____

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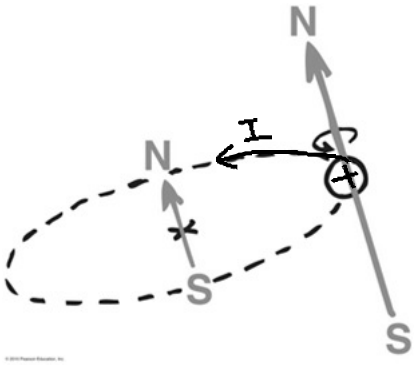
II. WHAT MAKES A MAGNET?

- Atom - There are currents: Electron orbit & spin.



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18.1 MAGNETS – HOW?

c) nonmagnetic material
examples:

Picture

d) magnetic material:
examples:

Picture of nonaligned domains

Picture of paper clip

N S

magnet

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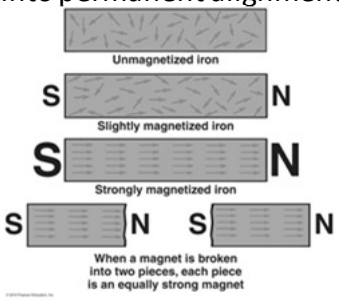
II. WHAT MAKES A MAGNET?

- Wood: Electrons spin in pairs and cancel.
- Magnetic Domains: Atoms' **B** align in clusters
- Iron: The clusters "cancel" each other. Point in different directions.
- Magnetite - Volcanoes. Domains are soft from lava, align with Earth's **B** and harden into permanent alignment.
- Why are there no magnetic dipoles?



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18.1 MAGNETS – HOW?

e) Types of magnets

① Ferromagnet : _____

- How is magnetite made?

(Created naturally)

② Electromagnet

- When ...
- Example:

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18.1 MAGNETS – HOW?

⑤ Make a magnet. Take out 5 staples & an iron nail (or clip)

	How many staples are picked up?
iron nail	
bar magnet	
magnet on nail stroked 50 times	
tapped nail	

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18.1 MAGNETS

- How do you make a magnet?

- How do you de-magnetize?

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TOPICS OF THE DAY…

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- What's a magnetic field?

- How is Earth like a big magnet?
- What's a compass?

- Where does magnetism come from? Ampere's Law
- Why are some materials magnetic? Domains

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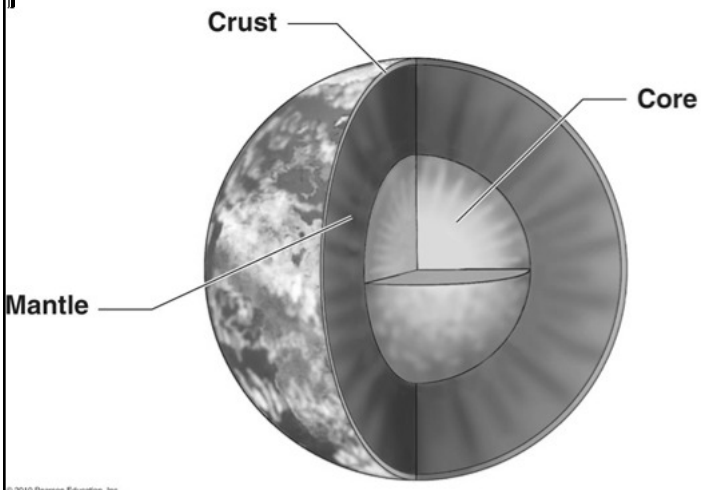
18.1 Earth's Magnetic Field

d) Why does Earth have a magnetic field?



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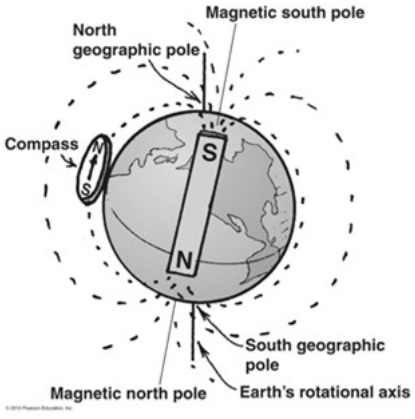
II. What makes a Magnet?

- What makes Earth like a big magnet?
  iron-rich, liquid outer core → current



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18.1 Earth's Magnetic Field

- Why do auroras happen near the poles?

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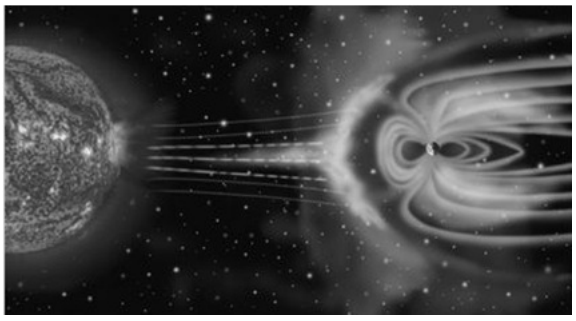
18.1 What's a Geomagnetic Storm?

- Caused a 9-hour power outage in Quebec 1989



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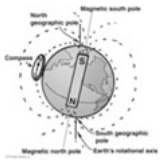
II. What makes a Magnet?

- Earth as a big magnet:



- Biological Compass: Bits of magnetite in pigeon brains align with Earth's **B.**

  Pigeons, bees, bacteria, monarch butterflies, sea turtles…humans?

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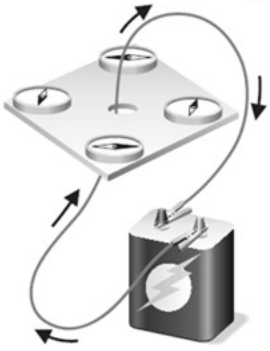
18.2 Current → Magnetic field

- demo

a If no electric current exists in the wire, the compass needles point in the same direction.

b Electric current in one direction in the wire causes the compass needles to deflect in a clockwise direction.



c Electric current in the opposite direction makes the compass needles deflect in a counterclockwise direction.

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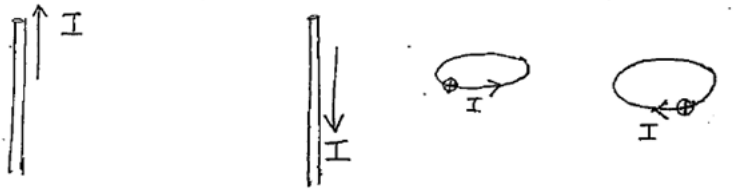
18.2 CURRENT → MAGNETIC FIELD

① A law of physics is that a current sets up a magnetic field.

Draw the magnetic field that's set up.



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18.2 CURRENT → MAGNETIC FIELD

- Solenoid

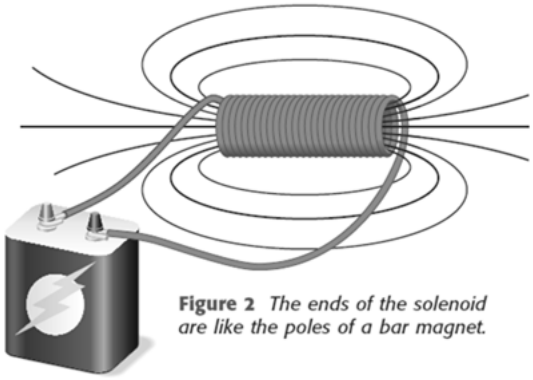

Figure 2 *The ends of the solenoid are like the poles of a bar magnet.*

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18.2 CURRENT → MAGNETIC FIELD

② a) what's a solenoid? _____

b) Draw a solenoid c) solenoid's magnetic field d) like bar magnet

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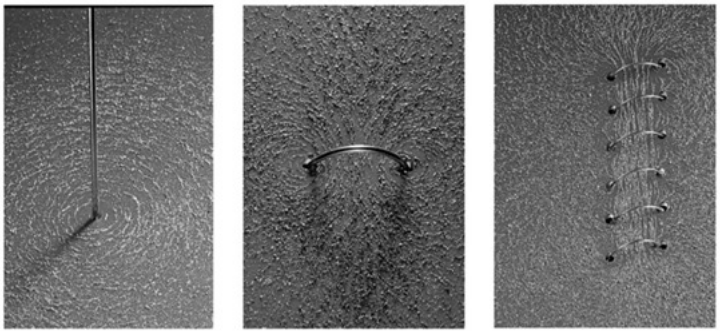
III. MORE ON AMPERE'S LAW



(a) (b) (c)

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18.2 CURRENT → MAGNETIC FIELD

e) How is Earth like a solenoid, bar magnet?

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18.2 CURRENT → MAGNETIC FIELD

- Electromagnet - demo

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18.2 CURRENT → MAGNETIC FIELD

③ what's an electromagnet?

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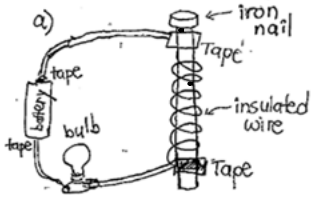
18.2 CURRENT → MAGNETIC FIELD

- Connect your electromagnet
  - In series with
  - The ammeter
  - The light bulb

④ Make an electromagnet.

a)



ⓘ How many staples are picked up?

ⓘⓘ Draw the magnetic field

ⓘⓘⓘ Draw a bar magnet representing the nail.

b) List 2 ways to increase the strength of your electromagnet.

i. _____

ii. _____

c) ⓘ Short out the light bulb. How?

ⓘⓘ How many staples are picked up?

ⓘⓘⓘ What happened to the current? Why?

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18.2 Moving Charge In Magnetic Field

- Lorentz Force –write on the last page of packet
  - A ***moving*** charge in a magnetic field feels a force

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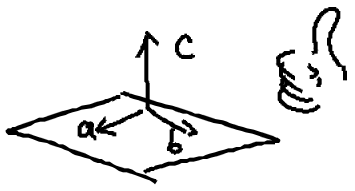
Moving charge in Magnetic Field

- Lorentz Force $\vec{F}_B = q\vec{v} \times \vec{B}$
- Cross-Product

moving charge in magnetic field experience a force

$\vec{a} \times \vec{b} = \vec{c}$



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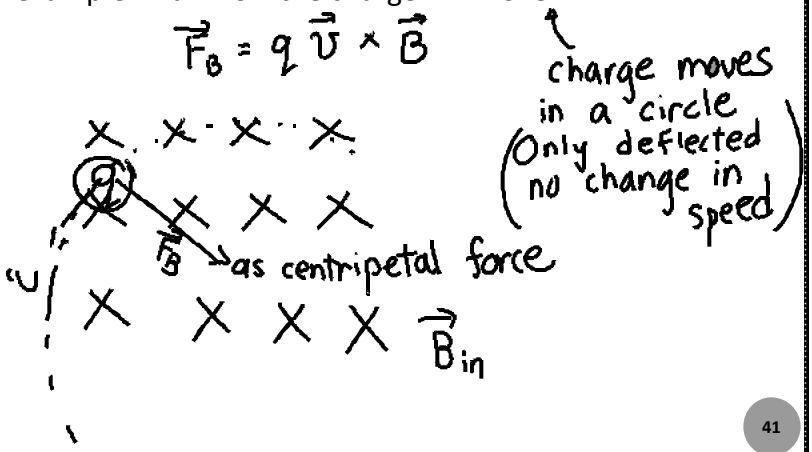
MOVING CHARGE IN MAGNETIC FIELD

- An example. Draw how the charge will move.



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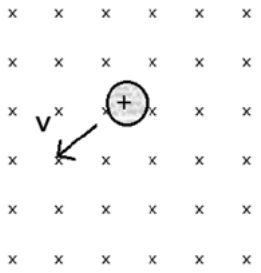
MOVING CHARGE IN MAGNETIC FIELD

- Draw the force vector on the charge
- How will the charge move?



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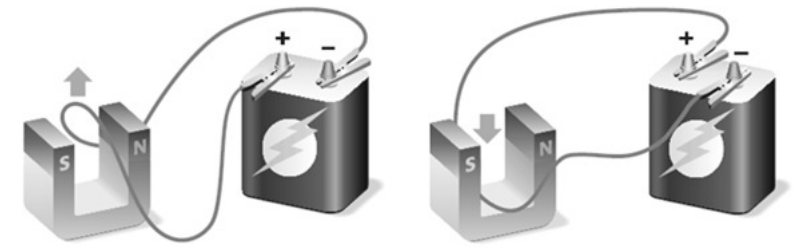
MOVING CHARGE IN MAGNETIC FIELD

- Can you understand these pictures?
- Which way is the current?
- Where is the force arrow?

Figure 5 Magnetic Force on a Current-Carrying Wire



(a) When a current-carrying wire is placed between two poles of a magnet, the wire will jump up.

(b) Switching the wires at the battery reverses the direction of the current, and the wire is pushed down.

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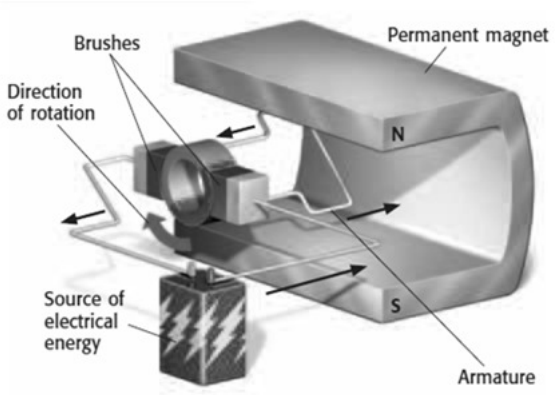
MOVING CHARGE IN MAGNETIC FIELD

- Electric Motor:
  - _____energy → _____ energy



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MOVING CHARGE IN MAGNETIC FIELD

- Galvanometer. How does it work?

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18.3 ELECTRICITY FROM MAGNETISM

- I A cat $\overset{\Rightarrow}{\underset{?}{\Leftarrow}}$ an animal. Is an animal a cat?

Faraday: Current $\overset{\Rightarrow}{\underset{?}{\Leftarrow}}$ Magnetic field. 

True / false: Magnetic field causes a current.

Correction: _____ causes current.
This is called _____.

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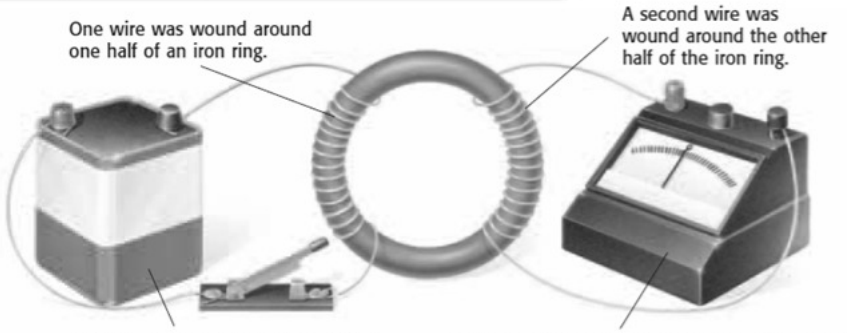
18.3 ELECTRICITY FROM MAGNETISM

- demo

Figure 1 Faraday's Experiment with Magnets and Induction



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a An electric current is induced when you move a magnet through a coil of wire.

b A greater electric current is induced if you move the magnet faster through the coil because the magnetic field is changing faster.

c A greater electric current is induced if you add more loops of wire. This magnet is moving at the same speed as the magnet in b.

d The induced electric current reverses direction if the magnet is pulled out rather than pushed in.

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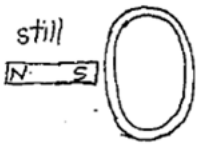
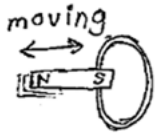
18.3 ELECTRICITY FROM MAGNETISM

Q Is there a current in the wire?

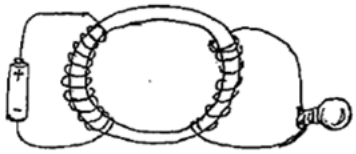
a) _____



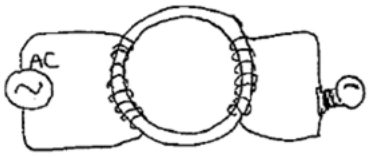
b) _____



c) _____



d) _____



e) _____ The moment the wire is connected to battery.

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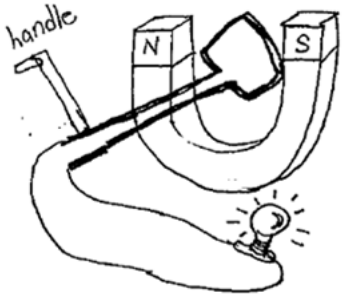
18.3 ELECTRICITY FROM MAGNETISM

II Electric Generators. a) Explain how this works.



b) what's the difference between a generator and a motor.

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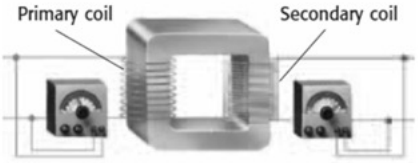
18.3 ELECTRICITY FROM MAGNETISM

Figure 7 How Transformers Change Voltage

The primary coil of a step-up transformer has fewer loops than the secondary coil. So, the voltage of the electric current in the secondary coil is higher than the voltage of the electric current in the primary coil. Therefore, voltage is increased.



The primary coil of a step-down transformer has more loops than the secondary coil. So, the voltage of the electric current in the secondary coil is lower than the voltage of the electric current in the primary coil. Therefore, voltage is decreased.

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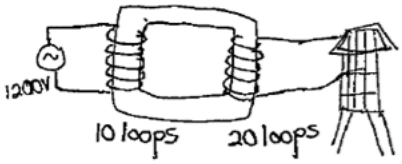
18.3 ELECTRICITY FROM MAGNETISM

What's a Transformer?

-
-
- Only works for _____

Math Practice



What's the voltage in the secondary coil?

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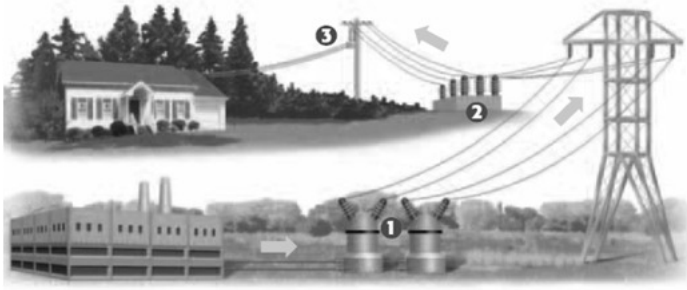
18.3 Electricity from Magnetism

Figure 8 Getting Energy to Your Home



1. The voltage is stepped up thousands of times at the power plant.
2. The voltage is stepped down at a local power distribution center.
3. The voltage is stepped down again at a transformer near your house.

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Induction Applications

IV Applications

a) How does a water boiler work?

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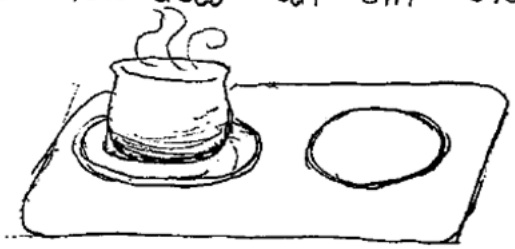
INDUCTION APPLICATIONS

b) How does an em stove work?



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CH. 18 ACTIVITY

1. Electromagnet (P. 8 #8. Add this on the page)
   - Why is the magnet strong if you connect the battery correctly but weak if you connect the battery incorrectly?
   - Test Faraday's experiment. Describe how and why it works. (P. 8 #6)
2. Demonstrate an electric motor. Describe how it works. (P. 4)
   Demonstrate an electric generator. Describe how it works.
3. Demonstrate the Lorentz Force. Draw a diagram and describe how it works. (P. 8 #5)
4. Finish your own electromagnet. (P. 3)

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CH. 18 LAB

- Build your own motor

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CH. 19 ELECTRONIC TECHNOLOGY

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7th Physical Science

PROJECT

- Pick a topic
- Create a poster explaining how it works
- Present your poster to the class
- Presentation:
- 2% of your grade

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PROJECT TOPICS

1. 1989 Geomagnetic Storm (Quebec power outage)
2. Biological compass (bacteria, pigeons,…)
3. Why magnets damage some devices
4. Echolocation: dolphins, bats
5. History of quantum mechanics
6. Semiconductor doping
7. Diode
8. Transistor
9. Integrated circuit and wafers
10. Analog vs. digital signals
11. How a CD player works
12. How a radio works
13. How a bulky TV display works vs. how a plasma display works
14. History of the computer
15. Parts of a computer and what they do
16. How CD-R and CD-RW works
17. Computer networks

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