

STE study magnetism, global warming; flashback see *flashback assignment* on web site

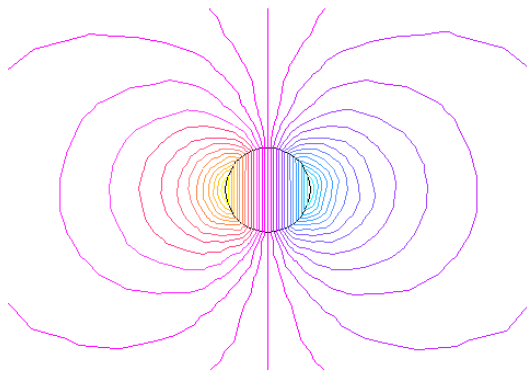
ST: study magnetism, carbon cycle, N-Cycle (but counts for STE); flashback: acid-bases, pH and energy-efficiency and conservation

**ST/STE Pretest 3.2 v 2015** (note that even though nitrogen cycle is officially part of ST, it involves material closely related to STE, so it will count for STE on the test. For magnetism, STE includes all material related to strength of electromagnets and the two left hand rules)

1. Which of the following materials form domains?
  - a) plastic
  - b) silver(Ag)
  - c) copper(Cu)
  - d) cobalt(Co)
  - e) neodymium(Nd)
2. What property of “cooperating” valence electrons is mostly responsible for creating domains in special elements? CHOOSE ONE ANSWER ONLY

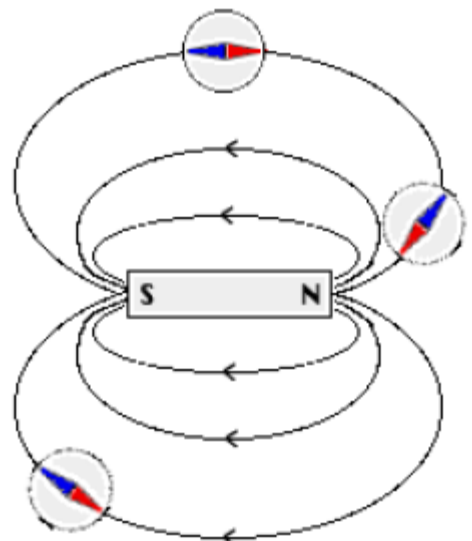
- (A) Their charge
- (B) The fact that they’re part of metals
- (C) Their looseness
- (D) Their charge and spin

3. What will happen to a ferromagnetic material like nickel if it comes into contact with a temporary magnet?
4. Draw the domains within a permanent spherical magnet.



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5.
  - a) In the diagram of a magnetic field around a bar magnet, are the field lines drawn properly?
  - b) Label the North end of each compass needle.
  - c) Modify the diagram so that it represents a stronger magnet.

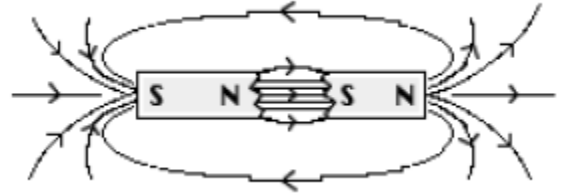


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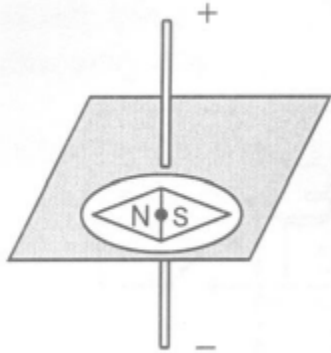
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6. a) In the diagram below, can you predict whether the 2 magnets are attracting?

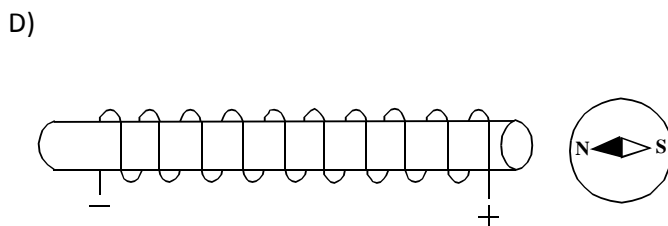
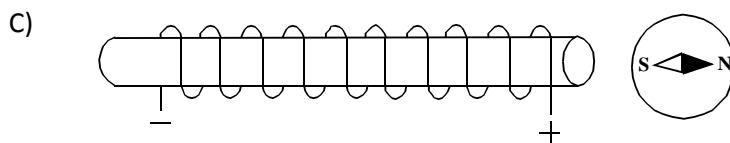
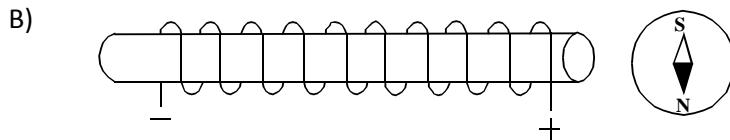
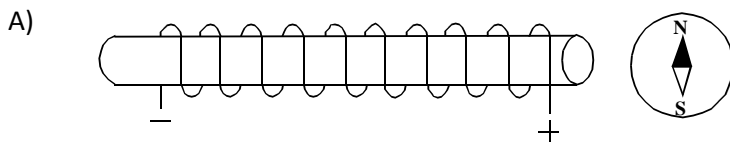
b) Are the magnetic field lines correctly represented in between the two opposite poles?



7. Why does the compass point to the left in the diagram below?



8. A compass is placed at one end of a solenoid. (2 marks)  
In which illustration is the compass needle pointing in the proper direction?

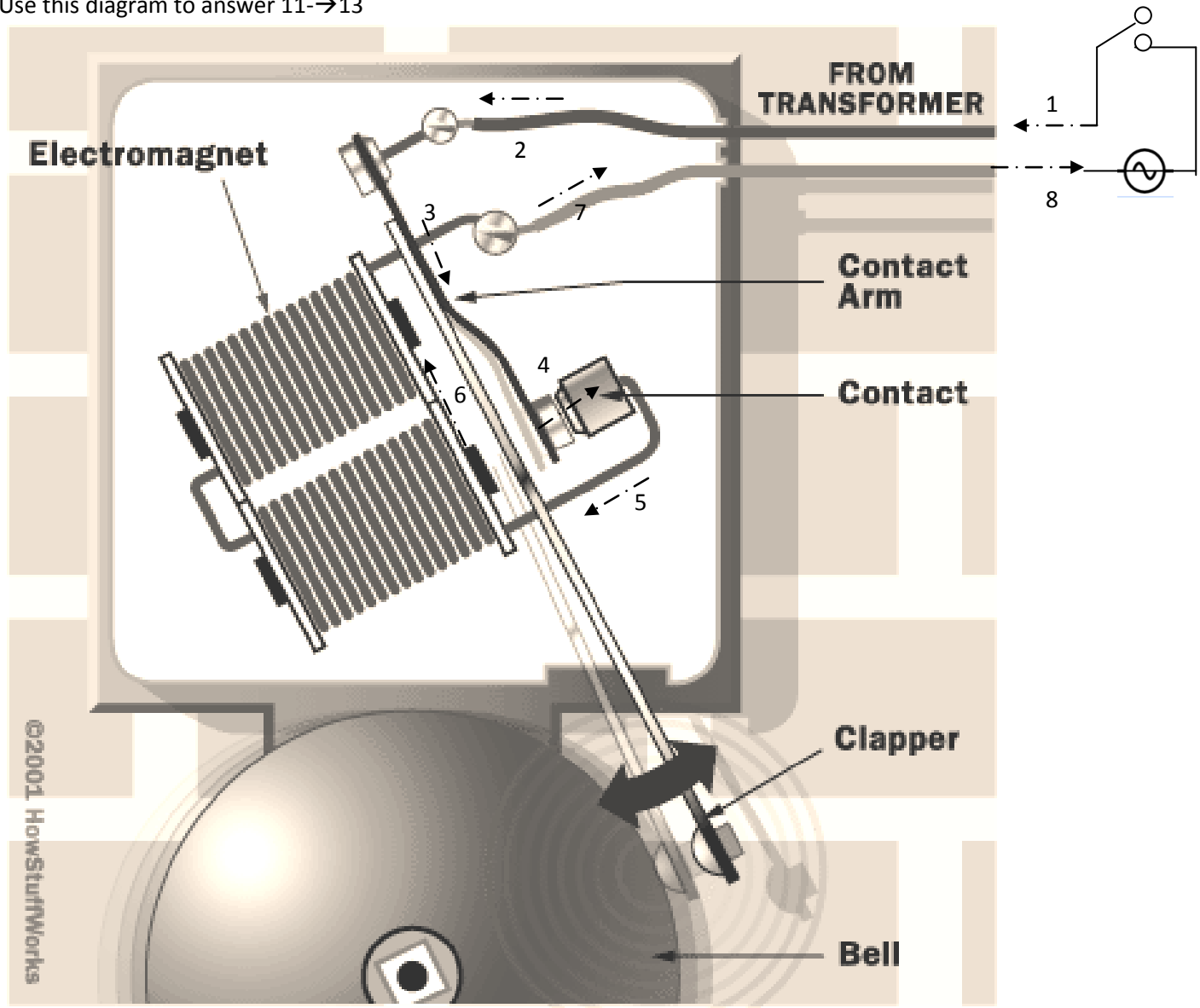


9. How can the electromagnets in no. 8 be strengthened? List all three ways and explain why they work.

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10. Redraw a solenoid, showing two different ways by which the magnetic field direction can be reversed.

Use this diagram to answer 11-→13



The above model of a doorbell uses an electromagnet and a contact arm. The electron flow is revealed by the 8 numbered broken-lined arrows in the diagram.

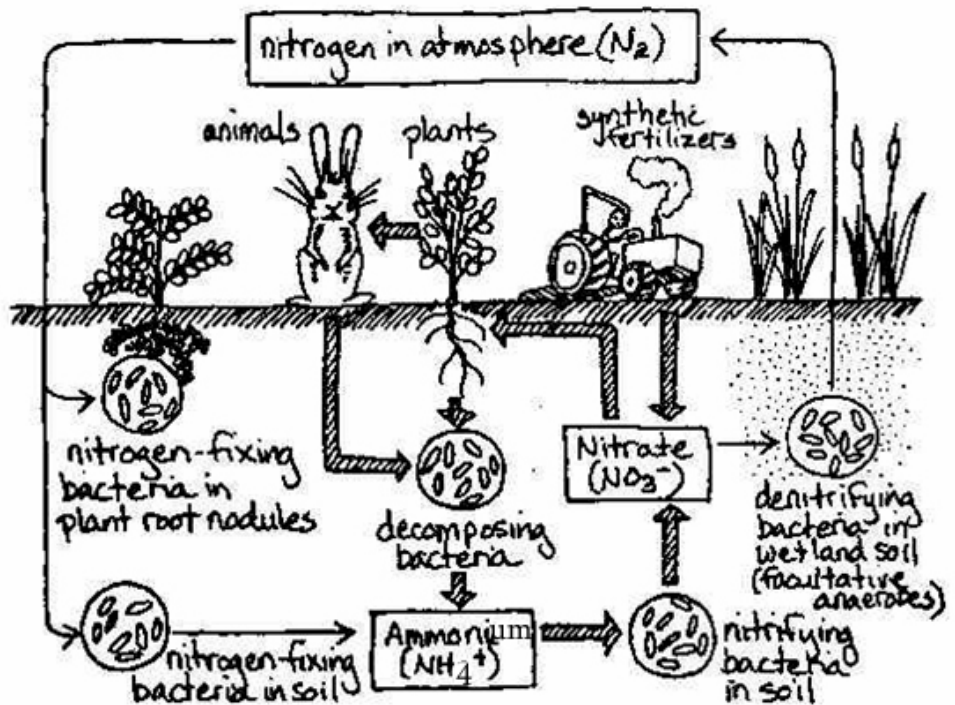
11. What must you do to make the clapper hit the bell?
12. Why does your action make the clapper move?
13. Aside from the obvious one, there is another “switch” that makes sure that the clapper does not get stuck to the bell when the electromagnet attracts the clapper arm. Where is it, and explain how it works?

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14. Show the difference in the type of bonding formed by oxygen when
- (A) It reacts with any alkaline earth metal and
  - (B) When it reacts with carbon to make  $\text{CO}_2$ .
15. Why does 28.0 grams of nitrogen gas contain 1 mole of molecules but two moles of atoms?  
Show work?
16. a) What biological process removes some  $\text{CO}_2$  from the atmosphere?
- b) What weather phenomenon (not shown in diagram) removes some  $\text{CO}_2$  from the atmosphere?
- c) List two ways that humans add  $\text{CO}_2$  to the carbon cycle?
- d) Which type of rock captures some carbon from ocean sediments?
- e) How do igneous rocks and magma from **volcanoes** play a role in the carbon cycle?

## The Nitrogen Cycle



17. a) What kind of plants have nitrogen-fixing nodules in their roots?
- b) Why can't plants use the nitrogen directly from the air?
- c) What is the role of denitrifying bacteria?
- d) How is the rabbit contributing to the N-

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cycle?

e) Explain runoff.

18. List two ways in which gases like  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{H}_2\text{O}$  and  $\text{N}_2\text{O}$  act like glass in a green house.

19. a) It is the most powerful of the greenhouse gases, but there's so much of it in the atmosphere that our contribution does not mess up things. That gas is \_\_\_\_\_.

b) This greenhouse gas is the 2<sup>nd</sup> most abundant one in the atmosphere, and human activities change the percentage significantly \_\_\_\_\_

20. Predict what will form when the following acids and bases react:

a)  $\text{NaOH} + \text{HF} \rightarrow$

b)  $\text{KOH} + \text{HCl} \rightarrow$

21. Even though dark coffee has some bitter tasting substances, it contains more acid than base giving a pH of 4.8. How much more acidic is it when compared to a soil whose pH = 5.8?

22. A certain amount of gasoline with a total energy content of 2000kJ is burnt, but only 260 kJ of it goes towards moving the car's wheels.

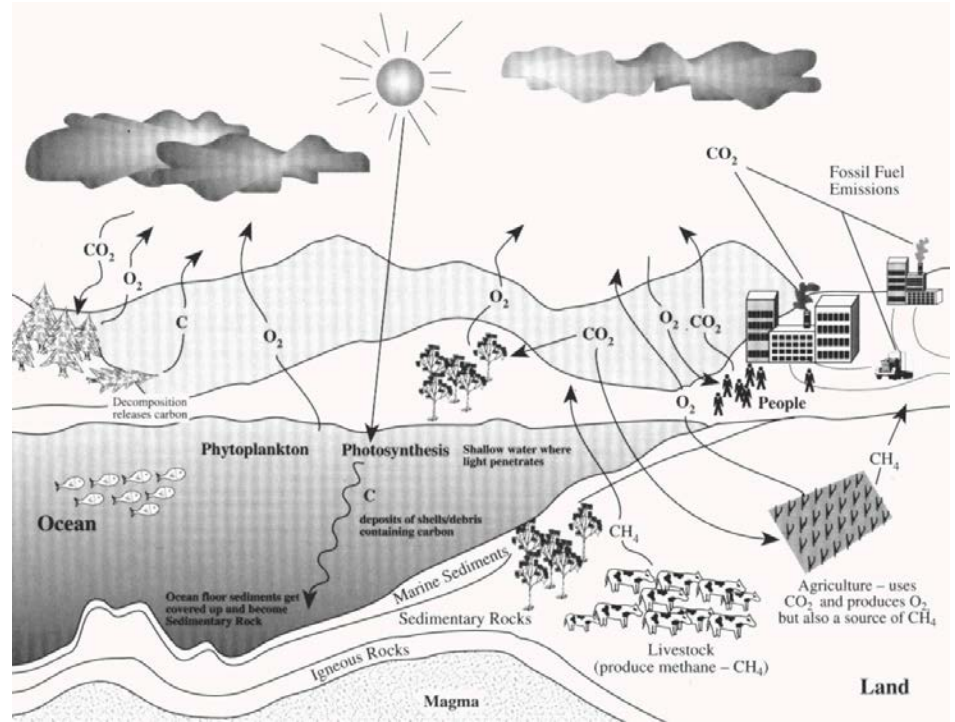
a) What is the % efficiency of an automobile burning gasoline?

c) If the engine was redesigned so as to become 20% efficient, how much energy would go towards moving the car?

c) Why would this be desirable?

23. Give an example of conservation of energy involving the energy contained in your breakfast cereal.

24. What is the difference between heat and temperature?

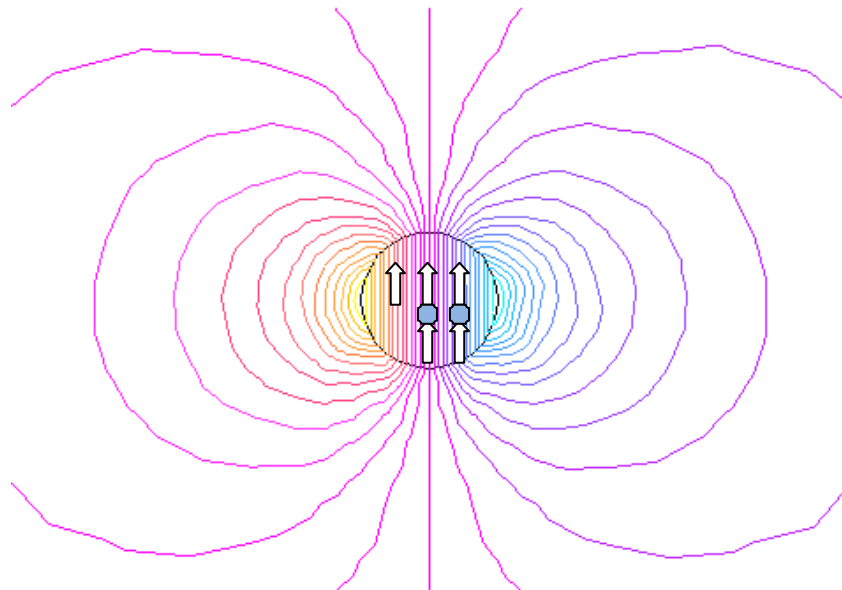


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## ANSWERS

- Which of the following materials form domains? **Domains = ferromagnetic=Co,Ni,Fe,Nd**
  - plastic\_\_no\_\_
  - silver(Ag)\_\_no\_\_
  - copper(Cu)\_\_no\_\_
  - cobalt(Co)\_\_yes
  - neodymium(Nd)\_ yes Fe,Nd,Co,Ni
- What property of “cooperating” valence electrons is mostly responsible for creating domains in special elements? CHOOSE the best ANSWER ONLY
  - Their charge
  - The fact that they’re part of metals
  - Their looseness
  - Their charge and spin**
- What will happen to a ferromagnetic material like nickel if it comes into contact with a temporary magnet?  
**It will stick to it.**
- Draw the domains within a permanent spherical magnet.



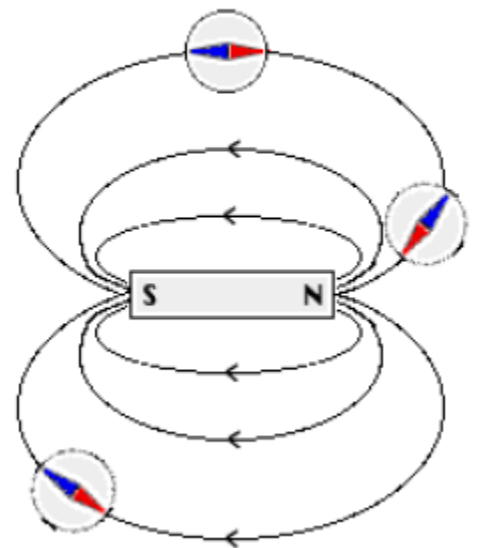
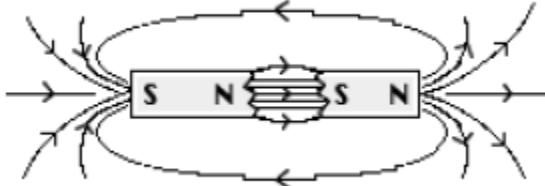
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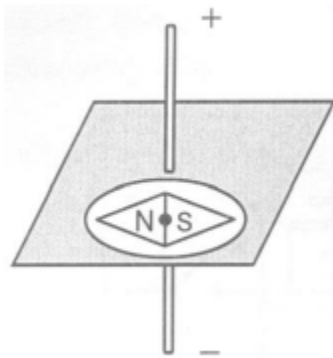
5. a) In the diagram above, are the magnetic field lines drawn correctly? **yes**  
b) Label the North end of each compass needle. **North is blue**  
c) Modify the diagram so that it represents a stronger magnet. **Add more lines**



6. a) In the diagram below, can you predict whether the 2 magnets are attracting? **Yes they are. Look at N and S in the middle.**  
b) Are the magnetic field lines correctly represented in between the two opposite poles? **Yes**



7. Why does the compass point to the left?

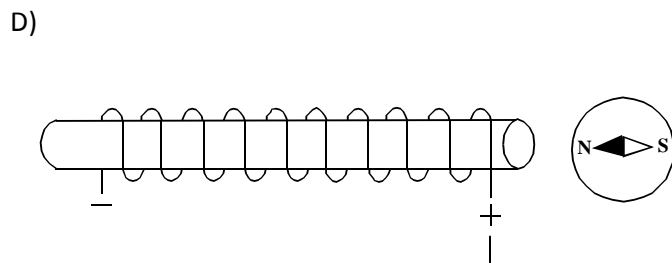
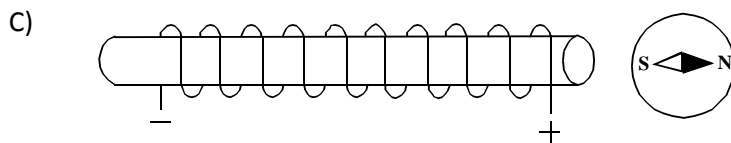
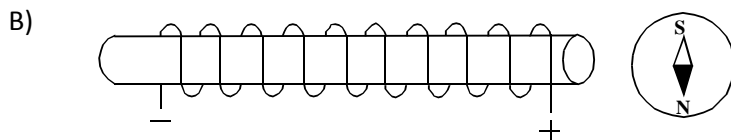
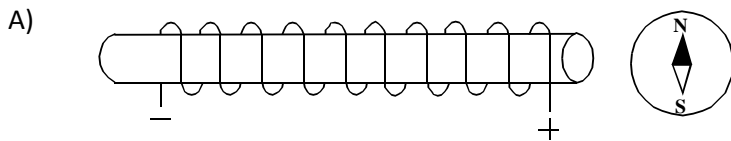


Apply the left hand rule. Have your thumb point up because the electricity is flowing straight (like your thumb) from (-) to (+). Notice that the rest of your fingers point left. This is the direction of the magnetic field in front of the wire. The field is caused by the moving electrons.

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8. A compass is placed at one end of a solenoid. (2 marks)  
In which illustration is the compass needle pointing in the proper direction?



Answer D

9. How can the electromagnets in no. 8 be strengthened? List three ways.

Create more loops or increase current/voltage and use a ferromagnetic core.

- Each loop's field cooperates with and strengthens the overall field.



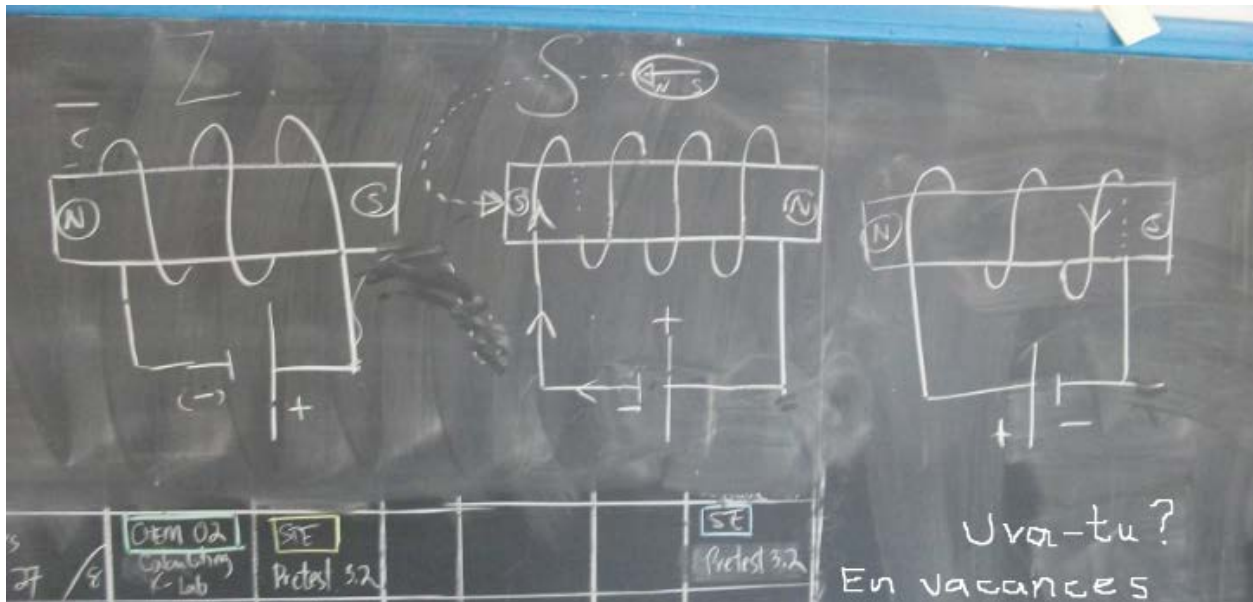
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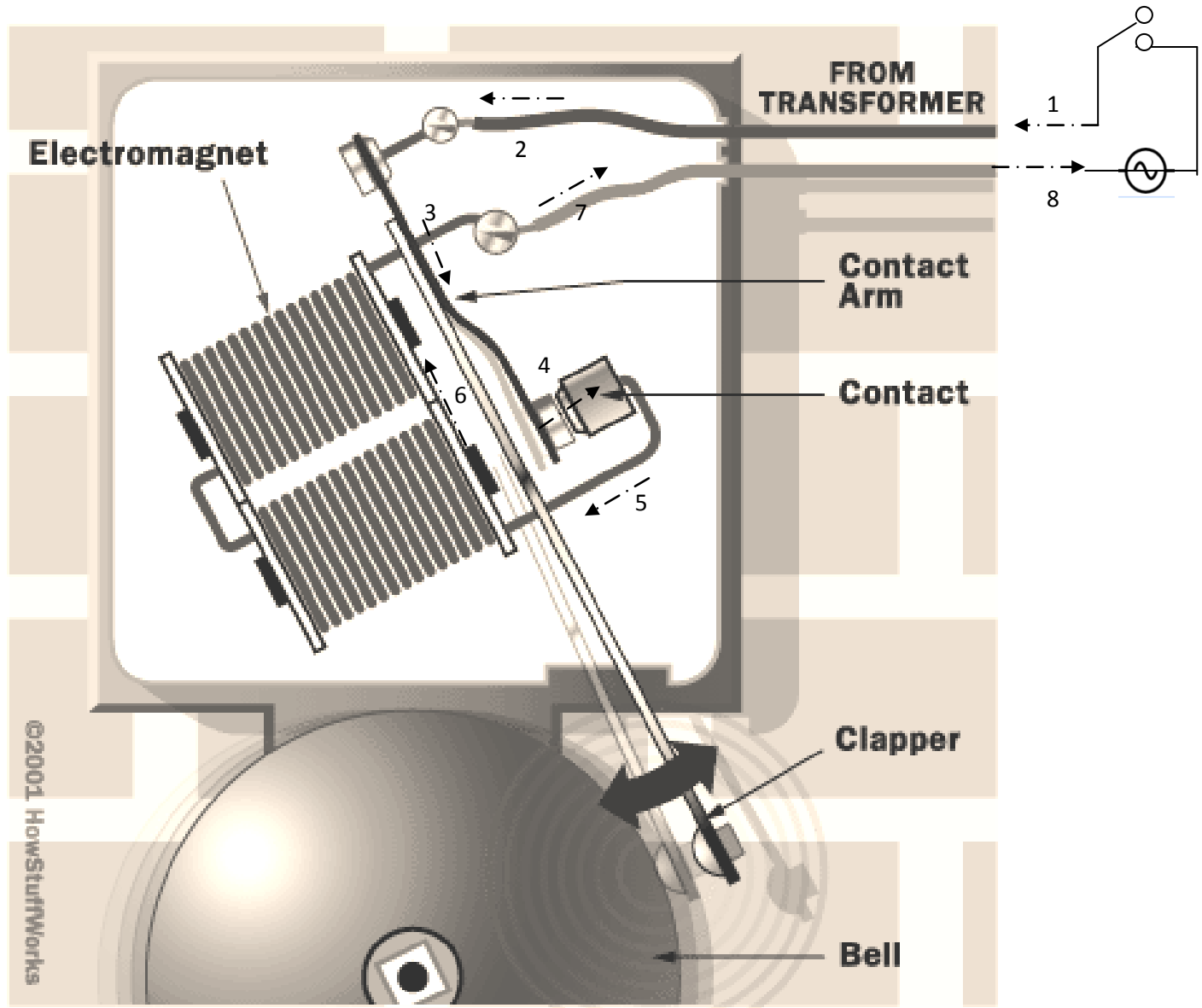
- Magnetic fields are created by moving charges. More current means more moving coulombs of charge, so we will get a stronger magnetic field.
- The ferromagnetic core's domains will cooperate with the of the electrically induced magnetic dipoles(north and south)

10. Redraw a solenoid, showing two different ways by which the magnetic field direction can be reversed.

- (1) Reverse the current
- (2) Draw S-shaped loops instead of Z-shaped ones but keep the (-) on the left.



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The above model of a doorbell uses an electromagnet and a contact arm. The electron flow is revealed by the 8 numbered broken-lined arrows in the diagram.

11. What must you do to make the clapper hit the bell? \_\_\_\_\_ Turn on switch by pressing near number 1\_
12. Why does your action make the clapper move? \_\_\_\_\_ The current induces a magnetic field in the electromagnet which makes it pull the clapper towards the bell.
13. Aside from the obvious one, there is another “switch” that makes sure that the clapper does not get stuck to the bell when the electromagnet attracts the clapper arm. Where is it, and explain how it works? It’s at position number 4. As the clapper gets attracted towards the bell, it also breaks the circuit so that the electromagnet loses its magnetism and lets go of the clapper.

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14. Show the difference in the type of bonding formed by oxygen when

(C) It reacts with an alkaline earth metal and

Oxygen gains a pair of electrons from each atom of an alkaline earth metal leading to an ionic bond:

(D) When it reacts with carbon.

Two oxygens will each form two covalent bonds with one carbon.

15. Why does 28.0 grams of nitrogen gas contain 1 mole of molecules but two moles of atoms? Show work?

Nitrogen gas =  $N_2 = 28.0 \text{ g/mole}$ , so that is  $28/28 = 1$  mole of  $N_2$  molecules.

Each mole of  $N_2$  molecules contains two moles of N atoms.

16. a) What biological process removes some  $CO_2$  from the atmosphere?

photosynthesis

f) What weather phenomenon (not shown in diagram) removes some  $CO_2$  from the atmosphere?

Rain

g) List two ways that humans add  $CO_2$  to the carbon cycle?

respiration, use of fossil fuels

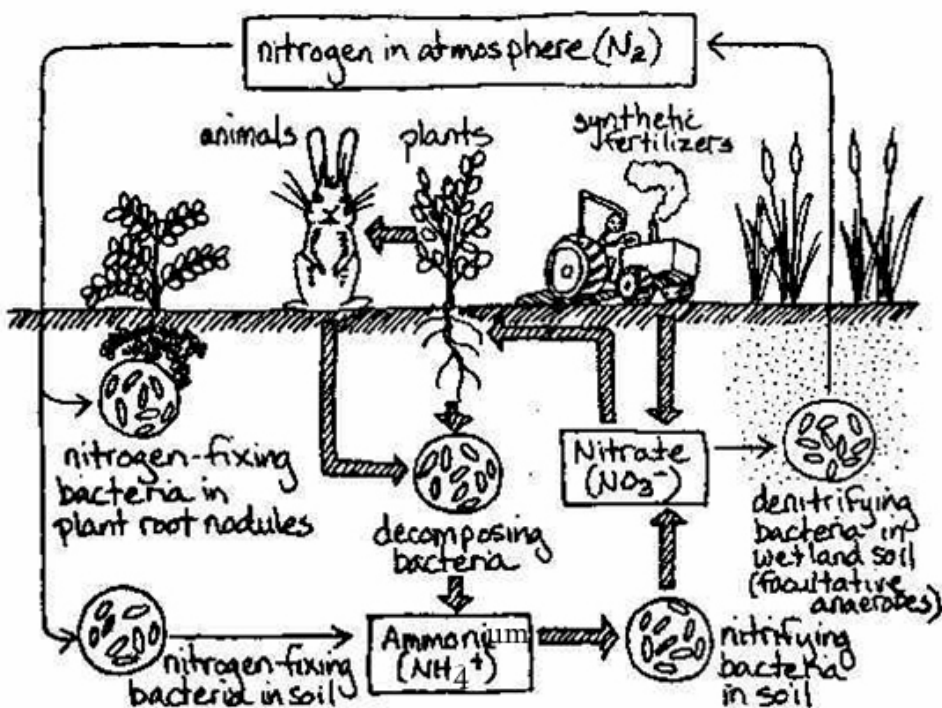
h) Which type of rock captures some carbon from ocean sediments?

Sedimentary or carbonate or  $CaCO_3$

i) How do igneous rocks and magma from volcanoes play a role in the carbon cycle?

They are derived from sedimentary rocks so they eventually release carbon dioxide.

## The Nitrogen Cycle



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17.

f) What kind of plants have nitrogen-fixing nodules in their roots?

legumes

g) Why can't plants use the nitrogen directly from the air?

Not reactive enough

h) What is the role of denitrifying bacteria?

Return nitrogen to the air

i) How is the rabbit contributing to the N-cycle?

its urine has nitrogen-containing wastes

j) Explain runoff.

If there's too much nitrogen in the soil, it gets washed away and it pollutes lakes and rivers

19. List two ways in which gases like CO<sub>2</sub>, CH<sub>4</sub>, H<sub>2</sub>O and N<sub>2</sub>O act like glass in a green house.

(1) Both the glass and greenhouse gases are transparent to visible light from the sun.

(2) After the visible light excites atoms of the soil and other substances on the surface, the surface releases heat. Greenhouse gases and glass both absorb and transfer some of the heat to the air. Greenhouse gases warm up the atmosphere; glass keeps the heat inside the greenhouse.

21. a) It is the most powerful of the greenhouse gases, but there's so much of it in the atmosphere that our contribution does not mess up things. That gas is \_\_\_\_\_.

Water vapour

b) This greenhouse gas is the 2<sup>nd</sup> most abundant one in the atmosphere, and human activities change the percentage significantly \_\_\_\_\_

carbon dioxide

22. Predict what will form when the following acids and bases react:

d) NaOH + HF → NaF + H<sub>2</sub>O

e) KOH + HCl → KCl + H<sub>2</sub>O

21. Even though dark coffee has some bitter tasting substances, it contains more acid than base giving a pH of 4.8. How much more acidic is it when compared to a soil whose pH = 5.8?

5.8 - 4.8 = 1

10<sup>1</sup> = 10 X

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22. A certain amount of gasoline with a total energy content of 2000kJ is burnt, but only 260 kJ of it goes towards moving the car's wheels.

a) What is the % efficiency of an automobile burning gasoline?

$$260/2000 * 100\% = 13\%$$

f) If the engine was redesigned so as to become 20% efficient, how much energy would go towards moving the car?

$$0.20(2000) = 400 \text{ kJ}$$

c) Why would this be desirable?

You would burn less fuel. It would cost and pollute less.

23. Give an example of conservation of energy involving the energy contained in your breakfast cereal.

The energy contained in the cereal = energy used for movement + energy used for thinking + heat + energy for other bodily functions

