

# ST4 JUNE 2012 FINAL EXAM

**Date:** Tuesday, June 19, 2012  
**Time:** 9:00 am – 12:00 pm  
**Room:** Group 01 (David's Group) Rm 215  
 Group 03 (Sabrina's Group) Rm 308

**NOTE:** Please return your **textbook** and the **June 2011 exam**, so that you can get a ticket from me before you head to your exam. You will need the ticket to enter the exam room.

## Compulsory Concepts Evaluated

The Living World	The Material World	Earth and Space
<p><b>ECOLOGY</b></p> <ul style="list-style-type: none"> <li>– Study of populations (density, biological cycles)</li> <li>– Dynamics of communities</li> <li>• Biodiversity</li> <li>• Disturbances</li> <li>– Dynamics of ecosystems</li> <li>• Trophic relationships</li> <li>• Primary productivity</li> <li>• Material and energy flow</li> <li>• Chemical recycling</li> </ul>	<p><b>PHYSICAL PROPERTIES OF SOLUTIONS</b></p> <ul style="list-style-type: none"> <li>– Concentration (ppm)</li> <li>– Electrolytes</li> <li>– pH scale</li> <li>– Electrolytic dissociation</li> <li>– Ions</li> <li>– Electrical conductivity</li> </ul> <p><b>CHEMICAL CHANGES</b></p> <ul style="list-style-type: none"> <li>– Combustion</li> <li>– Photosynthesis and respiration</li> <li>– Acid-base neutralization reaction</li> <li>– Balancing chemical equations</li> <li>– Law of conservation of mass</li> </ul> <p><b>ORGANIZATION OF MATTER</b></p> <ul style="list-style-type: none"> <li>– Rutherford-Bohr atomic model</li> <li>– Lewis notation</li> </ul> <p><b>ELECTRICITY AND ELECTROMAGNETISM</b></p> <p><b>ELECTRICITY</b></p> <ul style="list-style-type: none"> <li>– Electrical charge</li> <li>– Static electricity</li> <li>– Ohm's law</li> <li>– Electrical circuits</li> <li>– Relationship between power and electrical energy</li> </ul> <p><b>ELECTROMAGNETISM</b></p> <ul style="list-style-type: none"> <li>– Forces of attraction and repulsion</li> <li>– Magnetic field of a live wire</li> </ul> <p><b>TRANSFORMATION OF ENERGY</b></p> <ul style="list-style-type: none"> <li>– Law of conservation of energy</li> <li>– Energy efficiency</li> <li>– Distinction between</li> </ul>	<p><b>BIOGEOCHEMICAL CYCLES</b></p> <ul style="list-style-type: none"> <li>– Carbon cycle</li> <li>– Nitrogen cycle</li> </ul> <p><b>CLIMATE ZONES</b></p> <ul style="list-style-type: none"> <li>– Factors that influence the distribution of biomes</li> <li>– Marine biomes</li> <li>– Terrestrial biomes</li> </ul> <p><b>LITHOSPHERE</b></p> <ul style="list-style-type: none"> <li>– Minerals</li> <li>– Soil profile (horizons)</li> <li>– Permafrost</li> <li>– Energy resources</li> </ul> <p><b>HYDROSPHERE</b></p> <ul style="list-style-type: none"> <li>– Catchment area</li> <li>– Oceanic circulation</li> <li>– Glacier and ice floe</li> <li>– Salinity</li> <li>– Energy resources</li> </ul> <p><b>ATMOSPHERE</b></p> <ul style="list-style-type: none"> <li>– Greenhouse effect</li> <li>– Atmospheric circulation</li> <li>– Air mass</li> <li>– Cyclone and anticyclone</li> <li>– Energy resources</li> </ul> <p><b>SPACE</b></p> <ul style="list-style-type: none"> <li>– Solar energy flow</li> <li>– Earth-Moon system (gravitational effect)</li> </ul>
The Technological World		
<p><b>MECHANICAL ENGINEERING</b></p> <ul style="list-style-type: none"> <li>– Characteristics of linking of mechanical parts</li> <li>– Guiding controls</li> <li>– Construction and characteristics of motion transmission systems (friction gears, pulleys and belt, gear assembly, sprocket wheels and chain, wheel and worm gear)</li> <li>– Speed changes</li> <li>– Construction and characteristics of motion transformation systems (screw gear system, cams, connecting rods, cranks, slides, rotating slider crank mechanisms, rack-and-pinion drive)</li> </ul>	<p><b>ELECTRICAL ENGINEERING</b></p> <ul style="list-style-type: none"> <li>– Power supply</li> <li>– Conduction, insulation and protection</li> <li>– Control</li> <li>– Transformation of energy (electricity and light, heat, vibration, magnetism)</li> </ul>	<p><b>MATERIALS</b></p> <ul style="list-style-type: none"> <li>– Constraints (deflection, shearing)</li> <li>– Characteristics of mechanical properties</li> <li>– Types and properties</li> <li>• Plastics (thermoplastics, thermosetting plastics)</li> <li>• Ceramics</li> <li>• Composites</li> <li>– Modification of properties</li> </ul>

## STRUCTURE OF EXAM:

Exam	Type of Question	Number of Questions	Marks per Question	Percentage of the Exam
Part A	Multiple Choice	15	4	60%
Part B	Constructed Response	6	4	24%
Part C	Technological Analysis	4	4	16%

## WEIGHTING TABLE:

	The Living World	Earth and Space	The Material World	The Technological World
Weight	12% ( 3 questions)	20% (5 questions)	48% (12 questions)	20% (5 questions)



12. Which of the following statements correctly describes Rutherford's model of the atom?

- A) made up of indivisible particles  
 B) a sphere containing evenly distributed positive and negative charges  
 C) a sphere in which the positive charges are concentrated in the nucleus with the negative charges outside the nucleus.  
 D) A sphere containing evenly distributed positive and negative particles in the nucleus.

13. An atom consists of 23 protons, 23 electrons and 28 neutrons. What is its atomic number?

- A) 23                                      B) 28                                      C) 46                                      D) 51

14. The number of valence electrons contained in an atom of lithium is:

- A) 1    B) 2    C) 3    D) 4

15. To which family of the periodic table does potassium, belong?

- A) The inert gases                      B) The halogens                      C) The alkali metals                      D) The alkaline-earth metals

16. The atomic number of magnesium is 12. How many protons and valence electrons respectively does magnesium have?

- A) 12 and 12                              B) 12 and 0                              C) 12 and 2                              D) 2 and 12

17. What is the maximum number of electrons which can fit on the second energy level (or shell)?

- A) 2    B) 8    C) 18    D) 32

18. The "Plum Pudding" model of the atom was first proposed by:

- A) John Dalton                              B) Niels Bohr                              C) Ernest Rutherford                      D) J.J. Thomson

19. In 1803, John Dalton, in an attempt to explain the findings of his work on the solubility of gases as well as the laws of Lavoisier and Proust, wrote the first atomic theory based on experimental fact.

Which of the following statements **does not** correspond with Dalton's theory?

- A) Matter is composed of spherical, indivisible, sometimes neutral, sometimes positively or negatively charged particles.  
 B) All atoms in an element are identical.  
 C) The atoms of each distinct element are different.  
 D) When a chemical reaction occurs, the products obtained result from a rearrangement of the atoms of the reagents.

20. Rutherford modified the atomic model after doing experiments where alpha particles were dispersed by a sheet of gold foil.

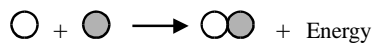

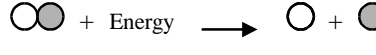
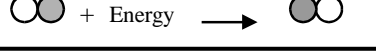
Consider the following:

- 1- The number of protons equals the number of electrons.
- 2- Protons are concentrated in a small positive space at the center of the atom.
- 3- Atoms consist mostly of empty space.
- 4- Electrons are contained in a positive sphere made up of protons.
- 5- Electrons move about in specific energy levels (or shells).

Which of these statements are based on Rutherford's experiments?

- A) 1 and 2                                      B) 1 and 4                                      C) 2 and 3                                      D) 3 and 5

21. Which of the following illustrates the formation of a compound from its elements?

- A)  + Energy  
 B)  + Energy  
 C)  + Energy  
 D)  + Energy

22. The "Plum Pudding" model of the atom was first proposed by:

- A) John Dalton                              B) Niels Bohr                              C) Ernest Rutherford                      D) J.J. Thomson

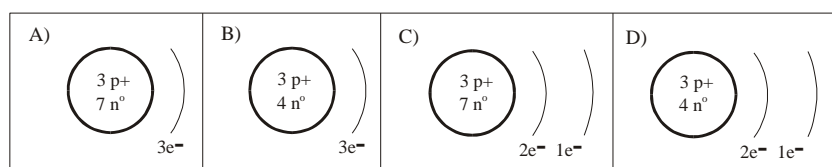
23. Which of the following names and symbols is **correctly** matched?

- A) Helium - H                              B) Nitrogen - Ni                              C) Magnesium - Mg                              D) Aluminum - Am

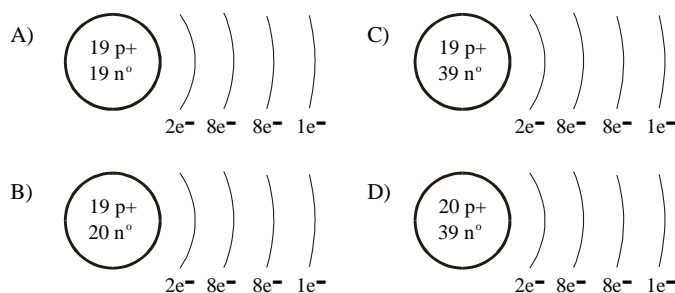
24. Which of the following substances is **nonmagnetic**?

- A) Ceramic                                      B) Cobalt                                      C) Nickel                                      D) Iron

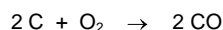
25. Knowing that the mass number of the Lithium atom is 7 and its atomic number is 3, which of the following diagrams represents a simplified model of a Lithium atom?



26. The atomic number of potassium, K, is 19 and its mass number is 39. Which of the following diagrams correctly represents the simplified atomic model (Rutherford-Bohr) of the potassium atom?

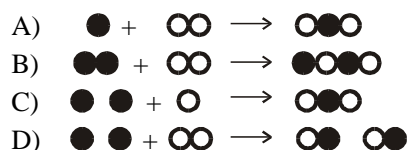


27. The incomplete combustion of carbon, C, in an environment containing little oxygen gas, O<sub>2</sub>, produces a toxic gas called carbon monoxide, CO. This reaction is represented by the following equation:



Which of the following models correctly represents this reaction.

● = Carbon      ○ = Oxygen



28. There are five unshaded boxes in the mini periodic table illustrated below.

IA 1							VIIIA 18
	IIA 2		IIIA 13	IVA 14	VA 15	VIA 16	VIIA 17
				?			?
			?		?		
		?					

Four of the five elements appear in these blank boxes as described below.

First element: Its third energy level contains 5 valence electrons.

Second element: It is a gas that does not react with metals or nonmetals.

Third element: It is an alkaline earth metal and one of the components of bones and teeth.

Fourth element: It is a light metal that has 3 more electrons than an inert gas.

What is the fifth element?

- A) Calcium (Ca)      B) Carbon (C)      C) Aluminum (Al)      D) Phosphorus (P)

29. The following items concern the structure of the Periodic Table of the Elements. Correctly match the terms in Column-I with the descriptions in Column-II.

**Column-I**

- Atomic number
- Group or Family of Elements
- Period of Elements
- Inert (noble) Elements
- F, Cl, Br, I, and At

**Column-II**

- indicates number of electron shells
- are the Halogens
- are relatively inactive
- indicates the number of protons
- indicates the number of outermost electrons

- A) 1a, 2b, 3c, 4d, 5e      B) 1d, 2e, 3a, 4c, 5b      C) 1e, 2a, 3e, 4b, 5c      D) 1a, 2d, 3e, 4c, 5b

30. Karen observed and recorded the properties of a solid substance.

PROPERTY	OBSERVATION
Mass	8.90 g
Volume	1.13 cm <sup>3</sup>
Magnetic	Yes
Conducts electricity	Yes

Given the observations in the table above and the information in the table below, identify the substance Karen observed.

Substance	Density	Conducts electricity	Magnetic
Cobalt, Co	8.90 g/cm <sup>3</sup>	Yes	Yes
Copper, Cu	8.95 g/cm <sup>3</sup>	Yes	No
Iron, Fe	7.87 g/cm <sup>3</sup>	Yes	Yes
Sulfur, S	2.07 g/cm <sup>3</sup>	No	No

- A) Cobalt      B) Iron      C) Copper      D) Sulfur



41. Which of the following substances are conductors?

- 1-Rubber 2-Plastic 3-Aluminum 4-Copper 5-Steel

- A) 1 and 2                      B) 1 and 3                      C) 2, 4 and 5                      D) 3, 4 and 5

42. There are three simple ways to charge an object electrically: by rubbing, by direct contact and by induction. Which of the following statements are true?

1. It is very easy to charge a conductor by contact.
2. By rubbing, glass picks up electrons from silk and becomes positively charged.
3. An object charged by induction remains electrically neutral overall.
4. In a clothes drier, the clothes can become charged by contact.

43. Which of the following is **TRUE** concerning a **series** circuit?

- I- The current through each element (resistor) is the same.  
 II- The voltage drop across each element (resistor) is the same  
 III- The sum of the voltage drops equals the power source voltage.

- A) I                      B) II                      C) III                      D) I and II                      E) I and III

44. Which of the following is **TRUE** concerning a **parallel** circuit?

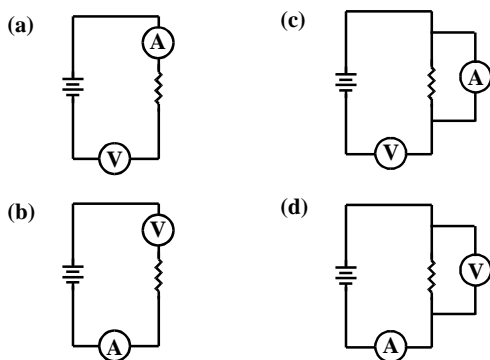
- I- The total resistance is less than the resistance of the lowest value resistor.  
 II- Adding a resistor in parallel decreases the total resistance.  
 III- Adding a resistor in parallel increases the total resistance.  
 IV- The feed line current increases as more resistors are added in parallel.

- A) I and II                      B) I and IV                      C) II and IV                      D) I, II and IV                      E) I, III and IV

45. What must be the value of a resistor so that when connected in **parallel** with a  $12\ \Omega$  resistor it produces a total resistance of  $3\ \Omega$  ?

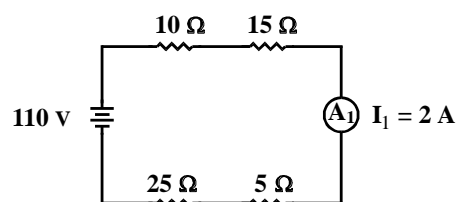
- A)  $1\ \Omega$                       B)  $2\ \Omega$                       C)  $3\ \Omega$                       D)  $4\ \Omega$                       E)  $6\ \Omega$

46. Which of the following diagrams is **correct**?



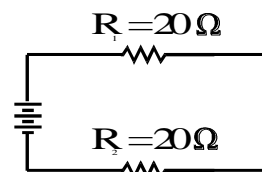
47. For the circuit below, what are the potential difference across the  $15\ \Omega$  and  $25\ \Omega$  resistors respectively?

- A) 20 v and 30 v                      B) 10 v and 50 v  
 C) 30 v and 50 v                      D) 20 v and 50  
 E) 30 v and 10

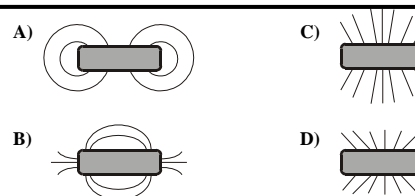


48. The following electric circuit consists of two resistors ( $R_1$  and  $R_2$ ) and a power source. What is the equivalent (or total) resistance of the circuit?

- A)  $0.1\ \Omega$                       C)  $20\ \Omega$   
 B)  $10\ \Omega$                       D)  $40\ \Omega$

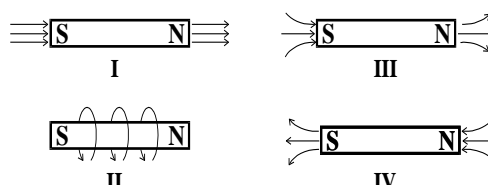


49. Marc wants to draw a sketch representing the magnetic field he observed around a current-carrying solenoid he used in the laboratory. Which sketch is **correct**?



50. Which of the following diagrams represents the magnetic lines produced by a bar magnet?

- A) I                      B) II  
 C) III                      D) IV



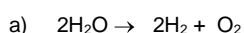
**SHORT/LONG ANSWERS**

51. Using the given symbols for the hydrogen, oxygen and carbon atoms, draw the molecule of each substance below.

○ Hydrogen    ○ Oxygen    ● Carbon

<i>Water</i>	<i>Hydrogen gas</i>	<i>Oxygen gas</i>
<i>Carbon dioxide</i>	<i>Carbon tetrahydride (methane gas)</i>	<i>Carbon monoxide</i>

52. Draw a ball and stick model of the following equation.



53. Why are the columns in the periodic call families? \_\_\_\_\_

54. Identify the family with the following characteristic and state their column number. (3 marks)

- |   |               |
|---|---------------|
| a) Doesn't react with anything. _____         | column # ____ |
| b) Can be used to form acids and salts. _____ | column # ____ |
| c) Is extremely reactive with water. _____    | column # ____ |
| d) Is a powerful disinfectant. _____          | column # ____ |

55. Classify the following changes as **physical** or **chemical**:

- |                         |       |
|-------------------------|-------|
| a) digestion of food    | _____ |
| b) oxidation            | _____ |
| c) growth of a plant    | _____ |
| d) melting of ice       | _____ |
| e) neutralization       | _____ |
| f) healing of a wound   | _____ |
| g) drying of paint      | _____ |
| h) dissolving of sugar  | _____ |
| i) baking of bread      | _____ |
| j) formation of dew     | _____ |
| k) fermentation of wine | _____ |
| l) boiling of water     | _____ |

56. State the number of each different types of atoms in each of the following compounds.

- |  |                              |
|--|------------------------------|
| a) $\text{NH}_4\text{OH}$                | N ____ H ____ O ____         |
| b) $\text{Ca}(\text{HCO}_3)_2$           | Ca ____ H ____ C ____ O ____ |
| c) $\text{CH}_3\text{COOH}$              | C ____ H ____ O ____         |
| d) $(\text{NH}_4)_2\text{C}_2\text{O}_4$ | N ____ H ____ C ____ O ____  |

57. Balance the following chemical equations and name the type of reaction.

Equation	Type of reaction
1. $\text{Fe}_{(s)} + \text{O}_{2(g)} \rightarrow \text{Fe}_2\text{O}_{3(s)}$	_____
2. $\text{H}_2\text{O}_{(l)} \rightarrow \text{H}_{2(g)} + \text{O}_{2(g)}$	_____
3. $\text{KOH}_{(s)} + \text{H}_2\text{SO}_{4(aq)} \rightarrow \text{K}_2\text{SO}_{4(aq)} + \text{H}_2\text{O}_{(l)}$	_____
4. $\text{CuSO}_{4(l)} + \text{NaOH}_{(l)} \rightarrow \text{Cu}(\text{OH})_{2(\text{ppt})} + \text{Na}_2\text{SO}_{4(s)}$	_____

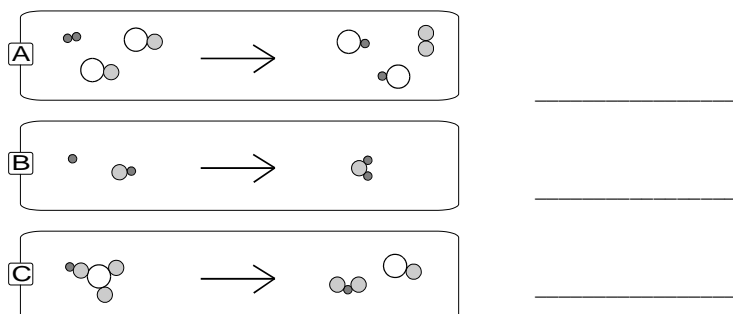
58. a) Write the balance equation for cellular respiration.

- b) What is the ratio of products produced?

59. Three simple classifications of chemical reactions are:

- |                               |                             |
|-------------------------------|-----------------------------|
| ① Synthesis (or composition)  | $A + B \rightarrow AB$      |
| ② Analysis (or decomposition) | $AB \rightarrow A + B$      |
| ③ Displacement                | $AB + C \rightarrow AC + B$ |

The following illustrations represent the three reactions listed above; classify them:



60. When 191 g of copper, Cu, is combined with 756 g of nitric acid, HNO<sub>3</sub>, the chemical reaction produces 563 g of copper nitrate, Cu(NO<sub>3</sub>)<sub>2</sub>, 108 g of water, H<sub>2</sub>O, and a certain amount of nitrogen dioxide, NO<sub>2</sub>. This reaction is represented by the following balanced chemical equation:



- a) What mass of nitrogen dioxide does this reaction produce?
- b) What is the ratio of the reactants used?
61. Anna Banana needs to neutralize a window-cleaner that contains ammonia. When she tests it with red litmus paper, the paper turns blue.
- a) What type of substance must she use to neutralize the cleaner? \_\_\_\_\_
- b) What will 2 compounds will be produced after she neutralizes it? \_\_\_\_\_
62. In the laboratory, you are to neutralize an acid solution before disposing of it. Explain in detail how you would neutralize this solution. In you explanation, indicate the **material used and the steps involved**.
63. What are electrolytes? \_\_\_\_\_

64. How many electrons do the following ions have:



65. Are the following acids, bases, salts or neither? If they are electrolytes, what is there ionic dissociation?


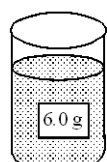
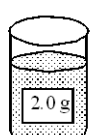
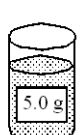
**Ionic Dissociation**

- |                      |       |       |
|----------------------|-------|-------|
| a) HBr               | _____ | _____ |
| b) H <sub>2</sub> O  | _____ | _____ |
| c) HCl               | _____ | _____ |
| d) CaCl <sub>2</sub> | _____ | _____ |
| e) NaOH              | _____ | _____ |

66. Convert the following concentration into ppm.

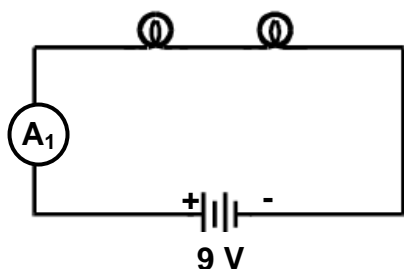
- a) —
- b) —
- c) —
- d) —

67. List the following solutions below from least to most concentrated.

Solution	Solution	Solution	Solution
			
100 mL	3 L	4000 ppm	200 mL

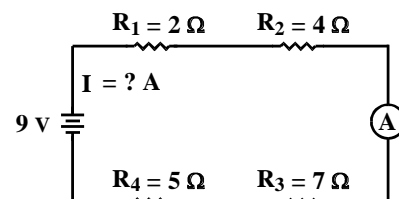


68. Draw the direction of an electron current and a conventional current.



69. What are the 4 factors that influences the conductivity of a material? \_\_\_\_\_

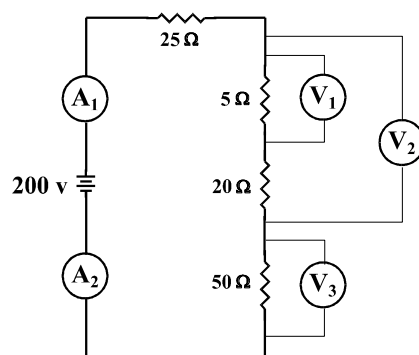
70. The circuit on the right consists of 4 resistors whose values are  $2\ \Omega$ ,  $4\ \Omega$ ,  $7\ \Omega$  and  $5\ \Omega$  respectively. Calculate the reading of the ammeter.



71. A  $6\ \Omega$  resistor, an  $18\ \Omega$  resistor and a  $9\ \Omega$  resistor are connected in parallel and placed across a  $36\ \text{V}$  battery. What is the **total resistance** and **total current** of the circuit?

72. For the circuit below, state the readings of each meter (be sure to include the unit).

- a)  $A_1 =$  \_\_\_\_\_
- b)  $A_2 =$  \_\_\_\_\_
- c)  $V_1 =$  \_\_\_\_\_
- d)  $V_2 =$  \_\_\_\_\_
- e)  $V_3 =$  \_\_\_\_\_



73. The circuit is composed of a  $6.0\text{-V}$  battery connected to a  $10\text{-}\Omega$  resistor. It includes an ammeter and a voltmeter connected to the resistor terminals. How much energy will the resistor release in one minute's work?

74. At the hottest setting, a blow dryer uses  $90\ 000\ \text{J}$  in  $60$  seconds. What is its power rating?

75. A  $1000\ \text{W}$  heater is turned on for  $4$  hours. How much energy is used?

76. What type of energy are the following objects associated with? (

- a) Solar panel \_\_\_\_\_
- b) Eating food \_\_\_\_\_
- c) Atoms \_\_\_\_\_
- d) Hydroelectric Dams \_\_\_\_\_
- e) Batteries \_\_\_\_\_
- f) Windmill \_\_\_\_\_

77. A car consumed  $2000\ \text{kJ}$  of energy.

- a) If its efficiency is only  $15\%$ , how much energy is actually used to move the car? Show all your work.
- b) If the car consumes triples the amount of energy, how much energy is actually used to move the car? Show all your work.

78. When we rub a glass rod with silk, the rod becomes electrically charged. What happens during the rubbing process?

79. A student conducted an experiment involving three electrically charged spheres A, B and C. The steps in the experiment and some of the results are given below.

STEP	RESULT
1. Bring sphere A close to sphere B.	1. They attracted each other.
2. Bring sphere A close to sphere C.	2. They repelled each other.
3. Bring sphere B close to sphere C.	3. ?

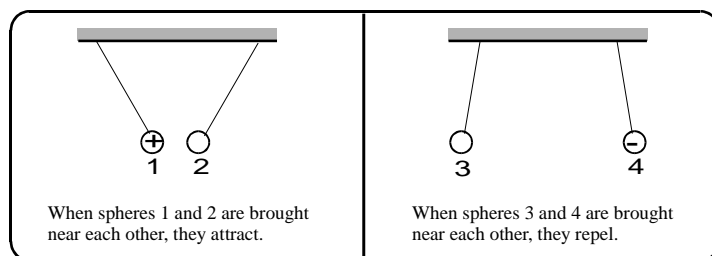
Given the above information, what was the result of Step 3?

80. A balloon rubbed against human hair becomes negatively charged with static electricity.

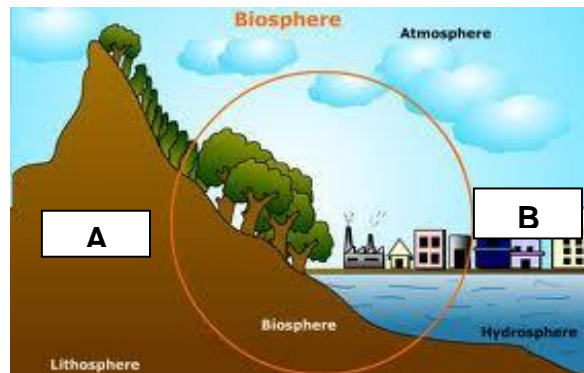
Draw 3 diagrams and use (+) and (-) signs to show the electric charges and arrows to show any transfer of charges. **Explain each of the three steps.**

81. Spheres 1, 2, 3 and 4 are electrically charged. The charge on sphere 1 is positive and the charge on sphere 4 is negative. We do not know the type of charge on spheres 2 and 3.

What type of charge is on sphere 2 and on sphere 3?



82. Which part of the Earth is represented by the following letters in the picture below?

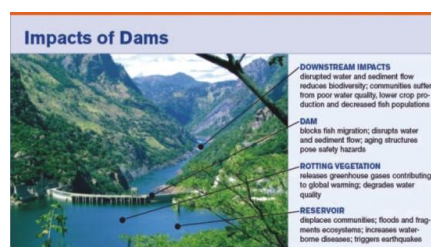


83. What type of energy resource is associated with the following pictures? Explain how you know. Where does the energy resource come from?

A)



B)



84. What are the 3 types of rocks? Give an example of each one and state its use.

85. What are the 3 conditions necessary for soil to support plant life?

86. What type of chemical reaction is the combustion of fossil fuels? Write the chemical equation for it.

87. Water can be carried from the equator to the North Pole. Why?

88. What are the 2 reasons that cause ocean water to move?