

Key

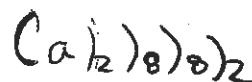
Science and Technology 404  
Review Package  
2014

The Material World

Organization

Groups and periods

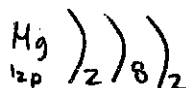
1. The following shows the Rutherford-Bohr model of an atom.



a) What is the name of the group this element belongs to?  
(family, column)  
Alkaline earth metals.

b) To what period does this element belong?  
period 4.

2. Write the symbol for the alkaline Earth metal in period 3, and represent this element using the Rutherford-Bohr model.



3. Listed below are the characteristics of an element on the periodic table.

- It is a nonmetal
- Its outermost energy level has seven electrons.
- It is used to purify and disinfect water.

(chlorine)

What is the name of the group this element belongs to?  
halogens

4. Which of the following are ions? Explain your answer.

- a) Na  $\text{Cl}^-$  and  $\text{Mg}^{2+}$  because they both lost or gained electrons
- b)  $\text{Cl}^-$  or protons.
- c)  $\text{Mg}^{2+}$
- d) K



## Lewis notation

5. Refer to your periodic table.

- Determine the number of valence electrons each of the elements has.
- Draw the Lewis diagram.
- Name the chemical group (family) to which the element belongs (example: alkali metals, alkaline-earth metals, halogens or inert gases)

Element	Number of valence electrons	Lewis Diagram	Name of chemical group
Cl	7	$\cdot \ddot{\text{Cl}} \cdot$	chlorine group
K	1	$\cdot \text{K}$	potassium group.
Ar	8	$\cdot \cdot \ddot{\text{Ar}} \cdot \cdot$	argon group.
N	5	$\cdot \ddot{\text{N}} \cdot$	Nitrogen group
Al	3	$\cdot \ddot{\text{Al}} \cdot$	Boron group
O	6	$\cdot \ddot{\text{O}} \cdot$	Oxygen group
C	4	$\cdot \ddot{\text{C}} \cdot$	Carbon group
Ca	2	$\cdot \ddot{\text{Ca}} \cdot$	calcium group.

## Chemical changes

### Combustion

6. What are three necessary conditions for combustion to take place?

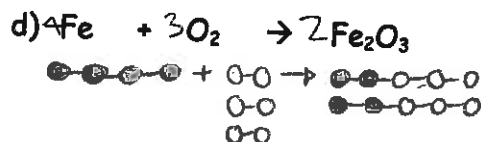
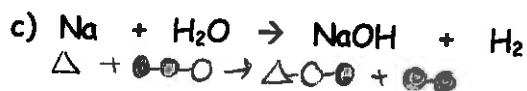
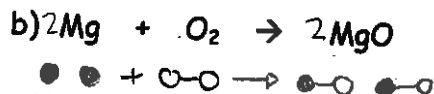
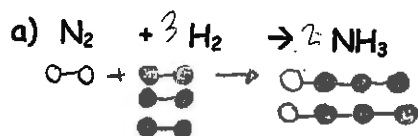
- 1) ignition temperature
- 2) fuel
- 3) oxidizing agent

7. Which part of the fire triangle is involved in each of the following situations? Explain your answers.

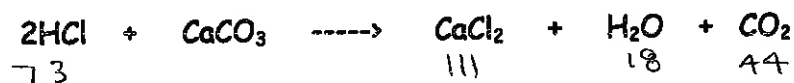
- a) The carbon dioxide ( $\text{CO}_2$ ) gas that comes out of an extinguisher is a powerful spray that puts out small paper fires by scattering the pieces of material involved.  
oxidizing agent because it involves  $\text{CO}_2$ .
- b)  $\text{CO}_2$  from an extinguisher has a cooling effect as it comes out of the extinguisher at a temperature of  $-78^\circ\text{C}$ .  
ignition temperature because it cools the fire.
- c) During a forest fire, firefighters begin clear-cutting a threatened area. They cut a 50-m-wide stretch of forest a few kilometres ahead of the fire.  
fuel because it is in the threatened area.
- d) A fire blanket can smother a fire.  
oxidizing agent because the blanket is taking the oxygen away from the blanket by suffocating it.

### Law of Conservation of mass

8. Balance the following equations and then draw diagrams of the molecules in the chemical reactions.



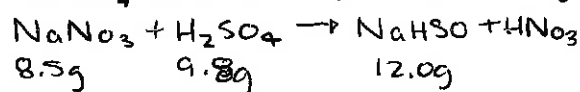
9. In a small lake affected by acid rain on Grand Island, 73 Kg of hydrochloric acid (HCl) reacted with calcium carbonate ( $\text{CaCO}_3$ ) to produce 111 kg of calcium chloride ( $\text{CaCl}_2$ ), 18 kg of water ( $\text{H}_2\text{O}$ ) and 44 kg of carbon dioxide ( $\text{CO}_2$ ). The balanced equation for a particular chemical reaction is:



What mass of calcium carbonate was needed to neutralize the small lake?

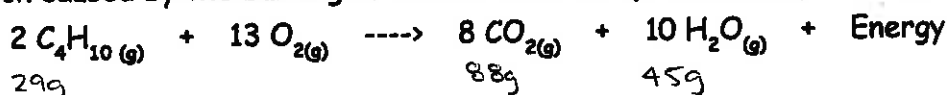
100Kg.

10. In the lab, you react 8.5 g of  $\text{NaNO}_3$  with 9.8 g of  $\text{H}_2\text{SO}_4$ . You obtain 12.0 g of  $\text{NaHSO}_4$  and a certain quantity of  $\text{HNO}_3$ . What is this quantity of  $\text{HNO}_3$ ?



$\text{HNO}_3 = 6.3\text{g}$

11. The reaction caused by the burning of butane in air is represented by the following equation:



During a laboratory experiment, you reacted 29 g of butane ( $\text{C}_4\text{H}_{10}$ ) in the presence of oxygen ( $\text{O}_2$ ). You observed that 88 g of carbon dioxide ( $\text{CO}_2$ ) and 45 g of water vapour ( $\text{H}_2\text{O}$ ) form.

What mass of oxygen gas ( $\text{O}_2$ ) did you use in this experiment?

$\text{O}_2 = 104\text{g}$ .

## Electricity and electromagnetism

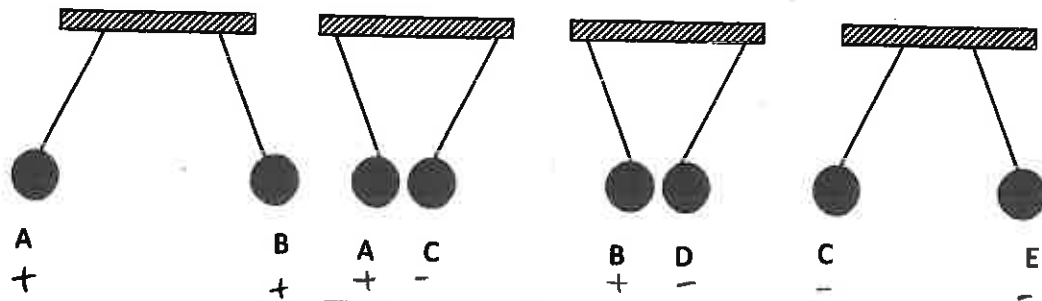
### Electric charge

12. Will the following atoms be positively or negatively charged? Explain your answers.

- a) an atom containing 12 protons and 10 electrons positively because there are more protons than electrons.
- b) an atom containing 8 protons and 10 electrons negatively charged because there are more electrons than protons.

## Static electricity

13. Five spheres (A to E) carry an electric charge. If A carries a positive charge, what is the charge of the other spheres?



Sphere	Charge on the sphere
B	+
C	-
D	-
E	-

14. An ebonite rubbed on a piece of fur becomes negatively-charged. Draw a diagram to show the transfer of charges when the ebonite rod is in contact with the fur.

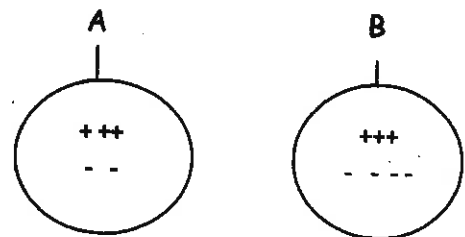
Before Rubbing	During Rubbing	After Rubbing
 ebonite      fur	 ebonite      fur	 e bonite      fur
<b>Explanation:</b> they are both neutral	<b>Explanation:</b> atoms attract electrons.	<b>Explanation:</b> they go back to neutral because this is temporary

15. The charged spheres, A and B, are suspended from a wire.

- a) What is the polarity (charge) of each sphere?

Sphere A : positive

Sphere B: negative



- b) Would the spheres attract or repel?

attract.



## Electrical Engineering

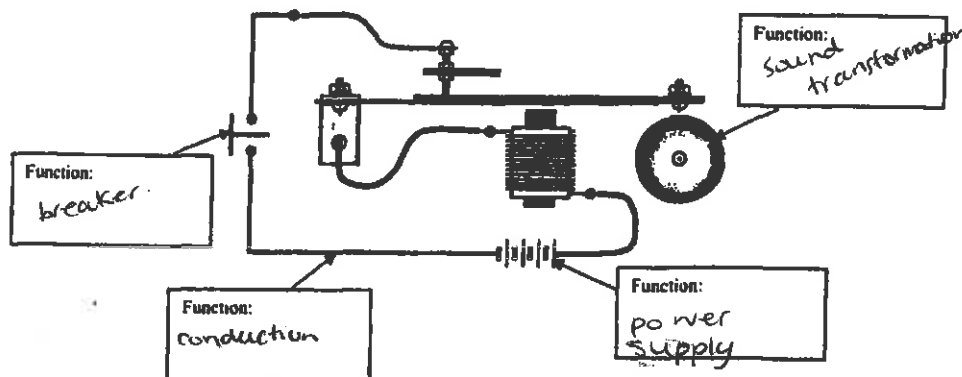
Power Supply, Conduction, insulation, protection, control and transformation of energy

16. What is the electrical function of the following components of an electrical circuit?

Choice of answers: Conduction, Insulation, protection, power supply, control, transformation of energy.

- a) a wire conduction
- b) a bulb transformation of energy
- c) a battery power supply
- d) a generator power supply
- e) a heating element protection
- f) a door bell transformation of energy
- g) the plastic on a wire insulation
- h) the circuit breaker protection
- i) a push-button switch control

17. Refer to the diagram of a doorbell and indicate the four electrical functions in the boxes supplied.



18. Give two examples of protective devices.

fuse, breaker

19. What four factors affect the electrical conductivity of a wire? Explain.

When a wire is short: loses less energy  
fat: loses less energy  
cold: conducts better  
copper: better conduction.

20. What is the function of a switch?

To control the electricity in a circuit.

## Ohm's Law

$$V=RI$$

R - resistance (measured in ohms -  $\Omega$ )

V - voltage or potential difference (measured in volts - V)

I - current intensity (measured in amps - A)



21. A flashlight has a power source of 3.0 V and operates with a current of 0.20A. What is the resistance in the circuit?

$$R = V/I$$

$$R = 3/0.20$$

$$R = 15 \Omega$$

22. A circuit has a resistance of  $27 \Omega$  and draws a current of 4.4 A. What is the voltage in the circuit?

$$V = IR$$

$$V = 27 \times 4.4$$

$$V = 118.8 \text{ V}$$

23. An MP3 player uses a current of 2.0 A and has an internal resistance of  $3.0 \Omega$ . How many 1.5V batteries are required?

$$V = IR$$

$$V = 2.0 \times 3.0$$

$$V = 6/1.5$$

$$= 4 \text{ batteries}$$

24. Your younger brother's computer game console does not work anymore. You decide to open it up to fix it and notice that the resistor must be replaced. You know that when the console operates with a 9-V battery, the current intensity is 1.2 A. What is the value of the resistor to be replaced?

$$R = V/I$$

$$R = 9/1.2$$

$$R = 7.5 \Omega$$

25. Apples are best stored at  $0^\circ\text{C}$  with 90% relative humidity and some air circulation. Warmer temperatures will cause apples to age faster and low humidity can cause excessive shriveling. Some apple orchards have refrigerated sheds to store apples that will be distributed at a later date. The refrigeration unit runs on a 240 V generator and requires a current of 15 A. Determine the resistance of the refrigeration unit.

$$R = V/I$$

$$R = 240/15$$

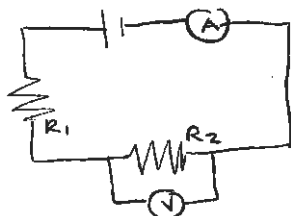
$$R = 16 \Omega$$

✓

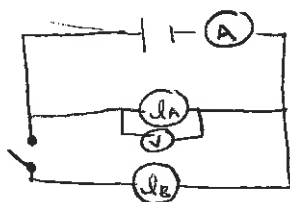
## Electrical Circuits

26. Draw a circuit diagram to represent each of the situations described.

- a) a power supply, two resistors (A and B) in series, an ammeter to measure the current in the circuit and a voltmeter to measure the voltage across resistor B.



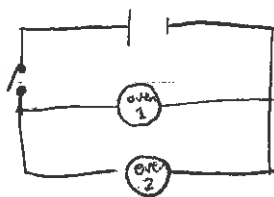
- b) a power supply, two light bulbs (A and B) in parallel, a switch that will turn off light bulb B, an ammeter to measure the current in the entire circuit and a voltmeter to measure potential difference across light bulb A.



27. A bakery would like to install two ovens that will be powered by a single generator. The criteria for the electrical circuit for the ovens are listed below:

- The ovens must be on the same circuit
- The ovens must be able to work independently from one another
- For safety reasons, the circuit must have a safety switch that stops the operation of both ovens when open.

Draw a circuit diagram to show the two ovens connected to the generator with the safety switch open.



28. Certain substances (conductors) allow electricity to travel through them, while others (insulators) do not allow electricity to travel through them. For each substance listed below, identify it as a conductor (C) or an insulator (I).

- |            |          |           |          |
|------------|----------|-----------|----------|
| 1. Copper  | <u>C</u> | 4. Wood   | <u>I</u> |
| 2. Plastic | <u>I</u> | 5. Silver | <u>C</u> |
| 3. Ceramic | <u>I</u> | 6. Rubber | <u>I</u> |





29. How is alternating current (AC) different from direct current (DC)?  
 dc: electric current in which electrons are continuously moving the same direction.

ac: an electric current in which the electrons move back and forth in a regular pattern.

Relationship between power and electrical energy

$$E = P\Delta t$$

$$P = VI$$



30. A toaster has an electrical power of 970 W. if it used for two and a half minutes, what amount of energy does that represent? Give your answer in joules and kWh.

$$E = P \cdot t$$

$$E = 970 \text{ W} \cdot 150$$

$$E = 145,500 \text{ J}$$

$$970 \text{ W} / 1000 = 0.97 \text{ kW}$$

$$150 / 60 / 60 = 0.041\bar{6}$$

$$E = P \cdot t$$

$$E = 0.97 \cdot 0.041\bar{6}$$

$$E = 0.0404 \text{ kWh}$$

31. The energy consumption for four 40" LCD big screen televisions is listed in the table below as well as the time the televisions were in operation. Based on the information below, determine which model of television consumes the least power.

Model	Electrical energy consumed (kWh)	Time in operation (hours)
1	3.6	4
2	3.2	5
3	3.0	6
4	2.4	3

$$P = E / T$$

$$P = 0.9 \text{ kWh}$$

$$0.64 \text{ kWh}$$

$$0.5 \text{ kWh}$$

$$0.8 \text{ kW}$$

Model 3.

✓

32. The local bakery uses fresh blueberries to make pies. Two ovens were used to bake the pies;  
**Oven A:** The oven is connected to a 220 V wall outlet that draws a current of 14 A. It took 1 hour to bake the pies in Oven A

**Oven B:** It took 2 hours to bake the pies in a 2400 W oven. The bakery would like to become more environmentally friendly by consuming less energy.

Which oven should the bakery use in order to be more environmentally friendly? Justify your answer.

Oven A  
 $P = VI$   
 $P = 220 \cdot 14$   
 $P = 3080 \text{ W}$   
 $E = P \cdot t$   
 $E = 3080 \cdot 3600$   
 $E = 11,088,000 \text{ J}$

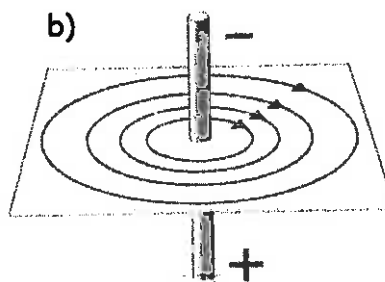
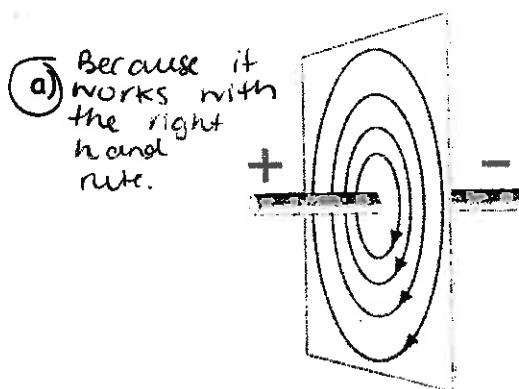
Oven B  
 $E = P \cdot t$   
 $E = 2400 \cdot 7200$   
 $E = 17,280,000$

Oven A is a better choice because it uses less energy.

### Electromagnetism

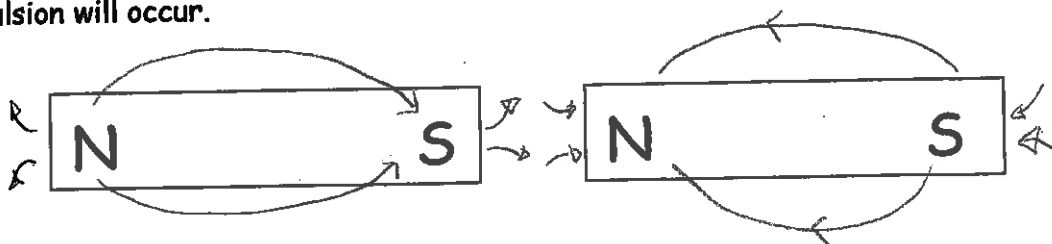
#### Magnetic field of a live wire

33. Which of the illustrations below, is an accurate representation of the magnetic field of a live wire. Explain your answer.



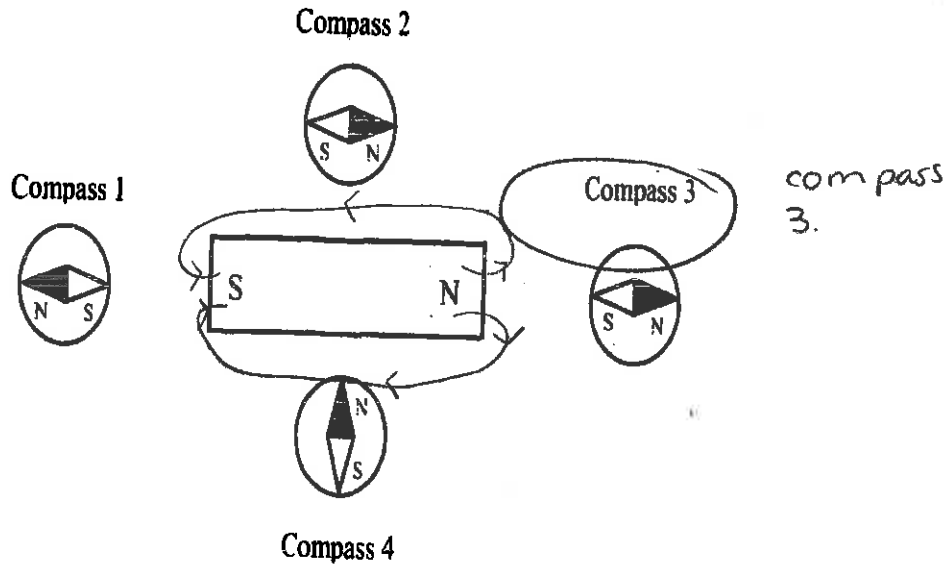
#### Forces of attraction and repulsion

34. Draw the direction of the magnetic field around the magnets and determine if an attraction or repulsion will occur.



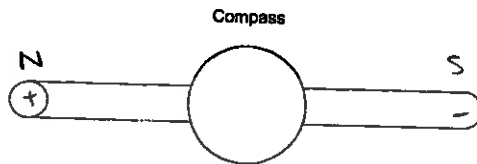
attraction.

35. The following diagram shows a bar magnet and four compasses. Which compass shows the needle pointing in the correct direction?

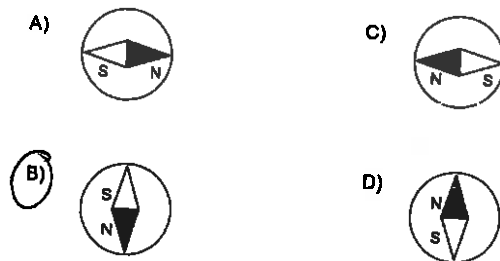


36.

The following diagram shows a compass placed over a conducting wire. Electricity is flowing through this wire.



Which of the following compasses shows the needle pointing in the correct direction for this situation?



## Transformation of Energy

### Energy Efficiency

$$\text{Energy Efficiency} = \frac{\text{Amount of useful energy}}{\text{Amount of energy consumed}} \times 100$$

37. A refrigeration unit consumes 16 500 000 J of energy when in use. It uses 9 275 000 J to cool the air in the storage shed. What is the energy efficiency of the refrigeration unit?

$$\frac{9\,275\,000}{16\,500\,000} (100) = 56.2\%$$

✓

38. A machine has an energy efficiency of 35 percent. What amount of energy must this machine consume to provide 68 kWh of useful energy?

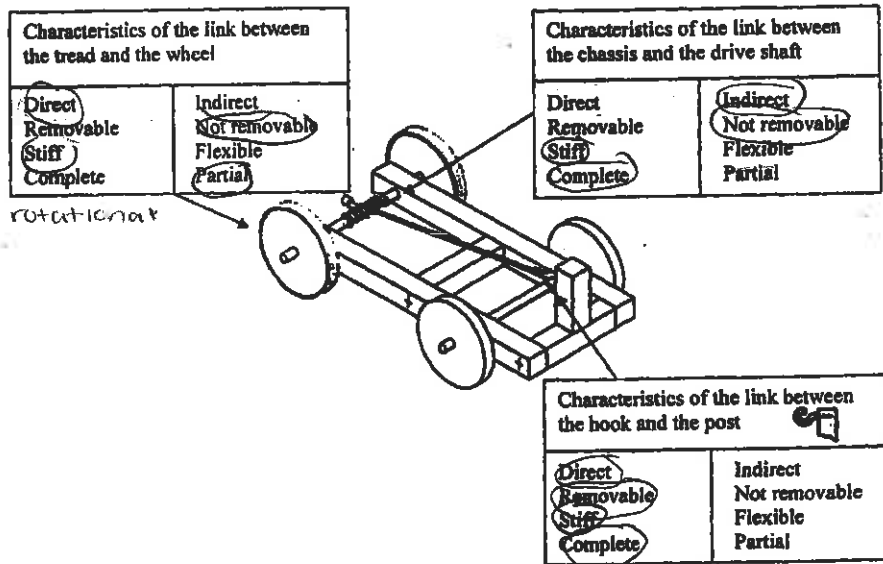
$$\frac{68}{194.28} = \frac{35}{100} \quad 194.28 \text{ kWh.}$$

## The Technological World

### Mechanical Engineering

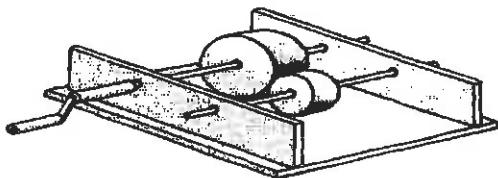
#### Characteristics of mechanical links and guiding controls

39. The drawing below indicates three links. Circle the appropriate characteristics of each link. Name the type of guiding between the chassis and the drive shaft.

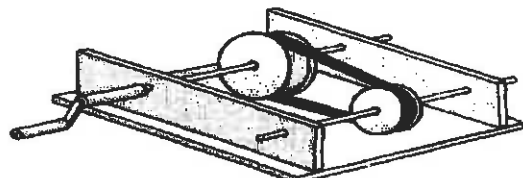


40. The following are diagrams of different mechanisms.

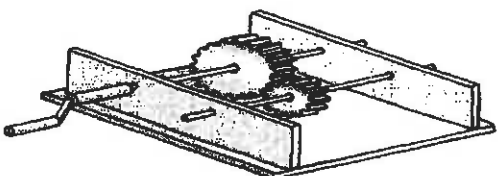
Which of these mechanisms makes the driven component rotate in the same direction as the driver component?



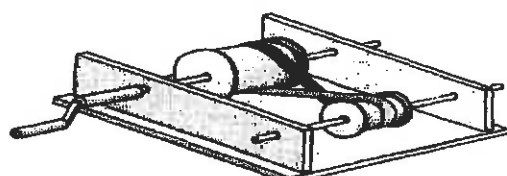
Mechanism 1



Mechanism 2



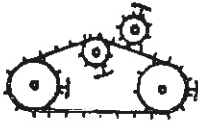
Mechanism 3



Mechanism 4

41. Identify the motion transmission systems and state whether or not they are reversible.

a) chain and sprocket, yes



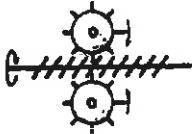
c) friction gear, yes



e) gear trains, yes



b) worm and worm gear, no



d) belt and pulley, yes



42. Identify the following motion transformation systems and state whether or not they are reversible.

a) screw gear, no



c) screw gear, no



e) Rack and pinion, yes



cam and follower, no

b)

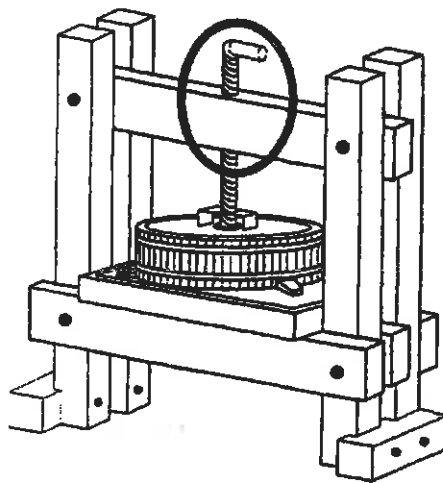


slider-crank, yes

d)



43. A diagram of a cider press is shown below.



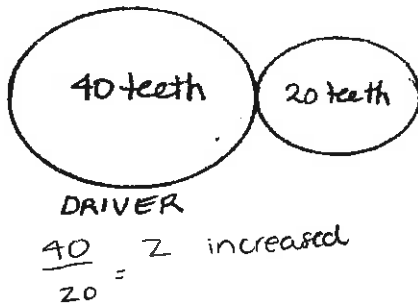
a) Identify the type of guiding control circled in the illustration above. Explain your answer.  
helical because it is translational and rotational.

b) Identify and justify the type of motion system in the cider press.  
screw gear

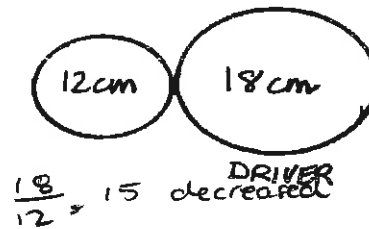
## Speed Changes

44. Determine the speed ratio for each of the following motion transmission systems and state whether the speed is increased, decreased or not changed.

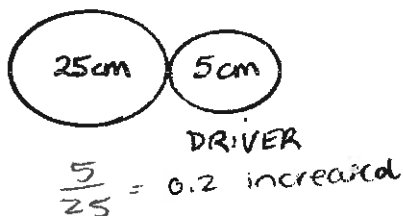
a)



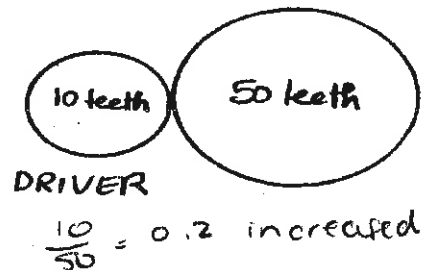
c)



b)



d)



45. Bushel baskets used to carry apples are available in wood, plastic or aluminum. Each of these materials has certain advantages and disadvantages. Which of these materials do you think will be best for the production of bushels? Explain the advantages and disadvantages of the chosen material based on the scientific aspects of the material, considering both the mechanical constraints and the material's properties.

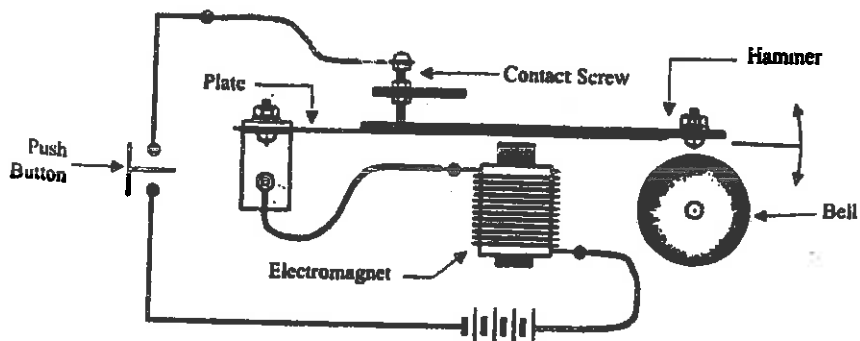
Choice of material: Wood

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>- light</li> <li>- low cost</li> <li>- tough</li> <li>- easily shaped and assembled</li> <li>- hard, resistant to scratching</li> </ul>	<ul style="list-style-type: none"> <li>- decomposes, particularly if wet.</li> <li>- light, could be blown by the wind.</li> </ul>
<p>properties: hardness constraints: compression.</p>	

46. You have considered replacing the broken plate in your doorbell. Some mechanical constraints and properties are listed below. Refer to the diagram of the doorbell and the chart below.

<b>Mechanical Constraints</b>
Shearing
Compression
Deflection
Torsion
Tension

<b>Mechanical Properties</b>
Ductility
Hardness
Elasticity
Malleability
Resilience



- To what mechanical constraint is the plate subjected when someone rings the doorbell?  
compression.
- Name a mechanical property that the plate must have. Describe the property.  
hardness, the material is stiff.

47. What can one do to prevent the corrosion of metals?  
Rust-proof protectant to delay the reaction

## Properties of Solutions

Concentration (g/L, %, and ppm)	Formula	$C = m/V$
---------------------------------	---------	-----------

48. A pitcher containing 2000 ml of iced tea contains 30 g of sugar. What is the sugar concentration of this solution in grams per liter?

$$\frac{30g}{2000ml} = \frac{\quad}{1000000}$$

$\approx 15,000 \text{ ppm}$

49. A variety of orange juice contains 25 g of carbohydrates per 250-mL serving. What is the concentration of carbohydrates in % m/V?

$$\frac{25}{250} = \frac{\quad}{100}$$

$$= 10 \times \frac{m}{v}$$

50. Which of the following is the most concentrated solution?

Solution	Concentration
1	4% m/V
2	2 g/100 ml
3	5 g/L
4	10000mg/1500 ml

solution 1 is more concentrated

$$\text{L} \div 1000 = 10\text{g}$$

$$1 = \frac{4}{100} = \frac{\quad}{1000000} \\ = 40,000 \text{ ppm}$$

$$3 = \frac{5}{1000} = \frac{\quad}{1000000} \\ = 5000 \text{ ppm}$$

$$2 = \frac{2}{100} = \frac{\quad}{1000000} \\ = 20000 \text{ ppm}$$

$$4 = \frac{10}{1500} = \frac{\quad}{1000000} \\ = 666.6 \text{ ppm}$$

51. Synthetic fertilizers are used in the garden. We dissolve 0.1 g of fertilizer in 100 ml of water to make a solution. Calculate, in ppm, the concentration of this solution.

$$\frac{0.1\text{g}}{100\text{ml}} = \frac{\quad}{1000000}$$

$$x = 1000 \text{ ppm}$$

52. City regulations state that swimming pools must be closed when the concentration of free available residual chlorine in water is less than 0.3 ppm or greater than 5 ppm.

The table below lists the concentrations of free available residual chlorine in water samples taken from four swimming pools. Which two of these pools has water that complies with these regulations?

Swimming Pool	Concentration of free available residual chlorine	
1	0.00002% (m/V)	X
2	0.0004% (m/V)	✓
3	0.0004 g/L	✓
4	0.0058 g/L	X

$$\frac{0.00002}{100} = \frac{0.2 \text{ ppm}}{1000000}$$

$$\frac{0.0004}{100} = \frac{4 \text{ ppm}}{1000000}$$

$$\frac{0.0004}{1000} = \frac{0.4 \text{ ppm}}{1000000}$$

$$\frac{0.0058}{1000} = \frac{5.8}{1000000}$$



53. Which of the following solution(s) contain electrolytes? Explain your choice.

Solution	Electrical conductivity test
1	Dim light
2	Strong light
3	No light
4	Strong light

solutions 1, 2 and 4 because they are conducting electricity.

54. Two compounds found in fertilizer are potassium oxide,  $K_2O$  and phosphorous pentoxide,  $P_2O_5$ .

Which of these two compounds forms an electrolytic solution in water? Justify your answer.

$K_2O$  because it is a non-metal and a metal which form a salt. Salt dissociated in water conducts electricity.

### pH Scale

55. Identify the substances listed as acidic, basic or neutral.

Substance	pH	Acidic, Basic or Neutral
Egg white	7.6	basic
Lime water	12.0	basic
Maple syrup	6.7	acid
Vinegar	2.2	acid
Dissolved baking soda	8.3	basic
Distilled water	7.0	neutral
Peas	5.8	acidic

a) Which substance is the strongest base?

lime water

b) Which substance is the strongest acid?

vinegar

56. Classify the following substances by type of electrolyte (acid, base or salt).

- a)  $MgCl_2$  salt
- b)  $H_2SO_4$  acid
- c)  $Mg(OH)_2$  base
- d)  $HNO_3$  acid
- e)  $KF$  salt

### Acid-base neutralization reactions

✓

57. Write a word equation, using the words below, to represent a neutralization reaction.

Words to use: Salt Base Acid Water

acid + base  $\rightarrow$  salt + water

58. One way to neutralize soil is to cover it with lime,  $(\text{Ca}(\text{OH})_2)$ . The following table lists the pH values of three different soils.

Soil	pH
A	8
B	7
C	6

Which soil, A, B or C, needs to be covered with lime to neutralize it? Justify your answer.

C because it is an acid

59. Bodies of water tend to die from acid rain that flows into them. A technique called liming is used to neutralize a body of water over the short term.

a) What is the effect of liming on the pH of the water in this lake? Does it increase or decrease?

Its pH increases up to 7.

b) What would be the final pH value if the water in this lake was completely neutralized?

7

### Energy resources

60. An environmental group has asked a company to consider using electricity from renewable energy resources. These energy resources can be found in the lithosphere, hydrosphere and atmosphere. Give an example of an energy resource used to generate electricity for each of the lithosphere, hydrosphere and atmosphere.

Sphere	Energy Resource
Lithosphere	geothermal
Hydrosphere	hydroelectricity
Atmosphere	wind

61. Fill in the table below.

✓

Source	Layer of the layer where the energy comes from (atmosphere, hydrosphere or lithosphere?)
Hydroelectric energy	hydrosphere
Fossil energy	lithosphere
Wind energy	atmosphere
Tidal energy	hydrosphere
Geothermal energy	lithosphere
Solar energy	atmosphere

## The Earth and Space

### Distinction between heat and temperature

62. How is heat different from temperature?

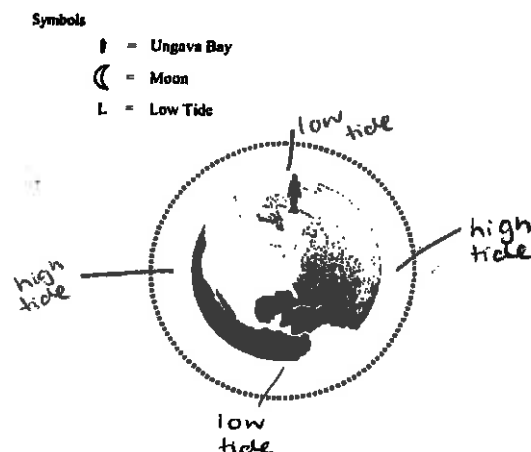
Heat is the transfer of thermal energy between two environments with different temperatures. Heat always passes from the warmer to the cooler environment. Temperature is the measure of the degree of agitation of particles of a substance.

### Space - Earth-Moon System

63. In the diagram below, the dotted circle represents the moon's orbit around the Earth.

- 1) Draw the symbol on the dotted circle to indicate the two (2) points in the orbit where the moon causes the high tides in Ungava Bay. The position of this bay is denoted by the symbol
- 2) Write the letter L on the Earth to indicate the two (2) points where the tides are low at the same time as the tide is high in Ungava Bay.

In the diagram below, the dotted line represents the moon's orbit around the Earth.



64. Indicate whether the following descriptions apply to heat or temperature.

- a) A fire in the fireplace heats every room in the house. heat
- b) Tomorrow, the weather forecast calls for a high of 22 °C. temperature
- c) The weather calls for the arrival of a cold air current. temperature.

## Hydrosphere

### **Catchment area**

- 65. What is a catchment area (watershed)?  
an area where the water drains to
- 66. Name three types of human activity that can cause an impact on the waterways in a catchment area (watershed).  
a dam, urban development and certain agriculture.

### **Salinity**

- 67. What is salinity?  
the measure of the amount of salt dissolved in a liquid.
- 68. Which is denser: distilled water, lake water or ocean water? Explain.  
Ocean water because there is more salt.

### **Oceanic circulation**

- 69. What causes surface ocean currents?  
an area where the water drains to.
- 70. What causes subsurface ocean currents?  
thermohaline circulation.
- 71. Which is denser, cold water or warm water?  
cold water
- 72. How is oceanic circulation important in regulating global climate?  
Ocean currents move the water in a certain direction.  
If they didn't exist, warm current would be too hot and cold currents would be too cold.

## Glaciers and ice floe

73. What is the major difference between an ice floe and a glacier?

a glacier is a mass of ice on land and is formed by compressed snow and and ice floe is ice floating on the oceans near the north and south poles

74. What two effects do the melting of glaciers and ice floes have on Earth?

slow thermohaline circulation.

## Atmosphere

### Greenhouse Effect

75. What is the greenhouse effect?

Natural process that allows the earth to retain some of the heat it receives from the sun.

76. Name four greenhouse gases that are found in the Earth's atmosphere.

- water vapour
- carbon dioxide
- methane
- nitrous oxide.

77. Name two causes of the intensification of the greenhouse effect.

surplus of  $\text{CO}_2$ ,  $\text{N}_2\text{O}$ ,  $\text{CH}_4$  and  $\text{CFC}$

78. Describe a consequence of a higher concentration of greenhouse gases in the atmosphere.

- abnormal climate change
- melts permafrost which debalances vegetation, causes flooding, "extinguishes" certain species, releases too much  $\text{CO}_2$ .
- melts permafrost and pack ice - slows down thermohaline circulation, damaging infrastructure.

### Air mass

79. An air mass that originated from the Caribbean lies over Quebec, while a fast-moving air mass from the far north is heading down towards it. Explain what happens when the air mass from the far north meets the air mass from the Caribbean. In your explanation, discuss the various phenomena involved.

causes cyclones, strong enough to cause floods, landslides, uproot trees, shatter windows and rip roofs off windows.

K

80. The weather forecast for the next week states that a cold Northeast wind has moved off the coast of New Brunswick, originating from the North Pole. Over the next few days, an air mass will be moving in off the coast of Jamaica towards the Monteregie region of Quebec. Explain what will happen when the two air masses meet. Your explanation must include the various phenomena involved.

If the mass is cold, they will meet and produce clouds and heavy rain but if the air mass is warm, there will be clouds and light rain.

### Atmospheric circulation

81. What causes winds to blow?

The movement of the particles

82. Cyclist A leaves Montreal for Quebec while at the same time, Cyclist B of equal ability leaves Quebec from Montreal. If a high pressure system is hanging over Quebec, and a low pressure system is hanging over Montreal, which cyclist A or B will be first to arrive at his destination. Explain your answer.

Cyclist B because the wind will slow cyclist A.

### Cyclone and anticyclone

83. What happens to the density of air as it is warmed up in the atmosphere? Explain.

The particles move closer together and the density becomes higher.

84. What happens to the density of air as it is cooled in the atmosphere? Explain.

The particles are more spread out so the pressure tends to fall.

85. What do you call an area of atmospheric circulation surrounding an area of high pressure?

anticyclone

86. What do you call an area of atmospheric circulation surrounding an area of low pressure?

depression

87. What type of weather do you expect in an area of high pressure. Explain.

windy and cloudy.

88. What type of weather do you expect in an area of low pressure? Explain.

clear sky and sunny.

## Lithosphere

### Minerals

89. What is the difference between a mineral and an ore?

an ore is a rock containing a mineral with mining potential and a mineral is a solid inorganic substance with clearly defined composition and properties.

90. Look at the illustration opposite.

Name each of the soil layers.

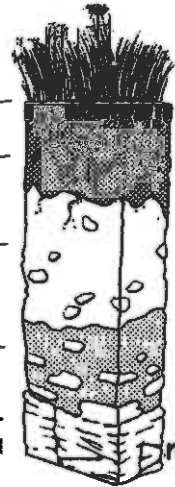
organic matter

topsoil

subsoil

fragmented parent rock

unaltered parent rock.



91. At the student horticulturists' market, they are selling 25-L bags of soil labeled "topsoil." Which soil layer is removed to fill these bags? Explain your answer.

fragmented parent rock and unaltered parent rock

92. What is permafrost?

frozen ice, under 0°C and that has been frozen for over 2 years.

93. What is a consequence of a rise in temperature in the permafrost?

it will melt, which will worsen global warming.

### Carbon cycle

94. Fill in the blanks with the following words: Respiration, photosynthesis, ingestion, decomposition of wastes, the formation of fossil fuels, decomposers, shells, skeletons.

a) Plants capture carbon dioxide and transform it into glucose by the process called photosynthesis.

b) Living organisms return the carbon they have ingested to the atmosphere by breathing out carbon dioxide in a process called Respiration.

c) The rest of the carbon from living organisms is eliminated as waste and broken down by decomposers.

d) Carbon dioxide dissolved in water reacts with water and then with calcium to become calcium carbonate which gradually forms the shells and skeletons of marine organisms.

- e) The carbon in dead animals sometimes changes into fossil fuels such as coal, gas or oil in a process that takes millions of years.
- f) Animals eat plants to get the carbon they need to grow. ingestion.

### Nitrogen cycle

95. Fill in the blanks with the following words: Nitrification, proteins, denitrification, decomposition of wastes, nitrogen absorption, nitrogen fixation, nitrites, consumers, decomposers.

- a) Nitrogen is essential in the formation of proteins and DNA.
- b) Since atmospheric nitrogen cannot be used by living organisms, bacteria first change it into ammonia in a process called nitrogen fixation.
- c) Bacteria also oxidize ammonium to form nitrites in a process called nitrification.
- d) Other bacteria oxidize nitrites into nitrate.
- e) Consumers get the nitrogen they need by eating producers.
- f) decomposers break down the nitrogen-containing substances in plant and animal waste. They produce ammonia which dissolves and forms ammonium.
- g) Certain bacteria convert nitrates into atmospheric nitrogen in a process called denitrification.

### Climate zone

#### Factors that influence the distribution of biomes

96. What are biomes?

Biomes are large regions of the world with distinctive climates, wildlife and vegetation.

#### Terrestrial Biomes

97. Which terrestrial biome has the most biodiversity? Explain.

Tropical forest because the climate and soil is perfect for the animals. Since the biodiversity is rich, more animals will feed off each other.

98. Which terrestrial biome has the least biodiversity? Explain.

deserts because the temperature is not suitable for most animals.

99. Which terrestrial biome is the most at risk from climate change? Explain.

The arctic tundra because it is warming up twice as fast from global warming. ✓



## Marine Biomes

100. How is a freshwater biome different than a marine biome?

Marine biomes are salt water and freshwater biomes do not contain salt.

101. Name three different types of freshwater biomes.

lakes, rivers, wetlands

102. Name three different types of marine biomes.

estuaries, oceans and seas and coral reefs.

## The Living World

### Study of populations

#### Population Size and population density

103. You want to find out the size of a daisy population in a field of 10 000m<sup>2</sup> so you count the average number of daisies in two-square meter (2m<sup>2</sup>) quadrants. You determine that there is an average of five daisies per quadrant. What is the size of the population of daisies?

$$\frac{1}{5} = \frac{2000 \text{ m}^2}{10000}$$

104. In a 500 000 km<sup>2</sup> African wildlife park, there are 20 000 giraffes. What is the density of giraffes per km<sup>2</sup>?

$$\frac{20000}{500000} = 0.04 \text{ giraffes/km}^2$$

105. Last year, 24 deer were captured and marked in an effort to determine the size of the deer population living in the park. This year, in this same rectangular area measuring 12.85 km by 3.5 km, a second group of deer was captured and of the 27 deer captured, 18 were already marked. Calculate the deer population density in this park.

$$\frac{18}{27} = \frac{18}{27} = 18 \text{ animals/rectangle.}$$

#### Population Distribution

106. Individuals that make up a population are distributed in different ways within the space they inhabit. Choose whether the following show clumped distribution, uniform distribution or random distribution.

- a) Many fish move around their habitats in schools. Clumped
- b) Northern gannets give each other minimal territory by spacing their nests at regular intervals. uniform
- c) The balsam poplar that grows in Québec is a tree that can reach a height of 35 m. It can reproduce asexually, with the result that isolated stands of balsam poplars are often found in the forest. random.

## Biological Cycles

107. Associate each of the following with an increase or a decrease in the size of a Québec population. Support your answer by citing factors that affect population size.

a) The black bear population in Québec experiences a 50-birth boom. At the same time 60 bears cross the border into Ontario.

decrease because more bears left than were born.

b) Fish farmers stock a river with salmon fry.

increase the add salmon.

c) Every spring, Canada geese return to Lac Tranquille.

increase because more geese come.

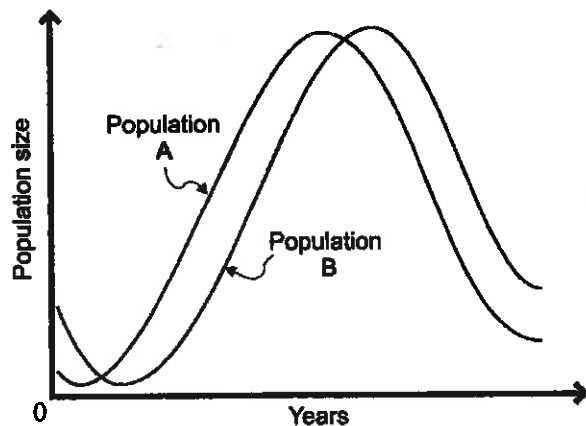
108. The graph opposite represents the biological cycles of two animal populations in a predator-prey relationship.

a) Which population is the prey?

A

b) Which population is the predator?

B



c) Explain how you arrived at your answers to questions a) and b).

As population A drops, population B also drops because the predators have eaten all the preys and decrease because they have no food left.

## Availability of Resources

109. This year, the deer population has fallen considerably. First, the saplings that deer eat were ravaged by disease. Weakened by lack of food, the deer became easy prey for wolves. To make matters worse, heavy snowfall at the end of the year made finding food on the ground more difficult. Name one abiotic factor and two biotic factors that led to a decline in the deer population.

abiotic: snow

biotic: wolves eating deer and disease of saplings

## Dynamics of communities

### Biodiversity

110. The Addo Elephant National Park serves as a refuge for elephants, buffalos, antelopes and birds. If the Addo park sheltered 30 percent elephants, 30 percent buffalo, 20 percent antelopes and 20 percent birds and the neighboring park sheltered 60 percent giraffes, 30 percent elephants and 10 percent birds, which of the two parks would have the greatest biodiversity with respect to these species? Explain your answer.
- The addo park because the relative abundance is more equal.

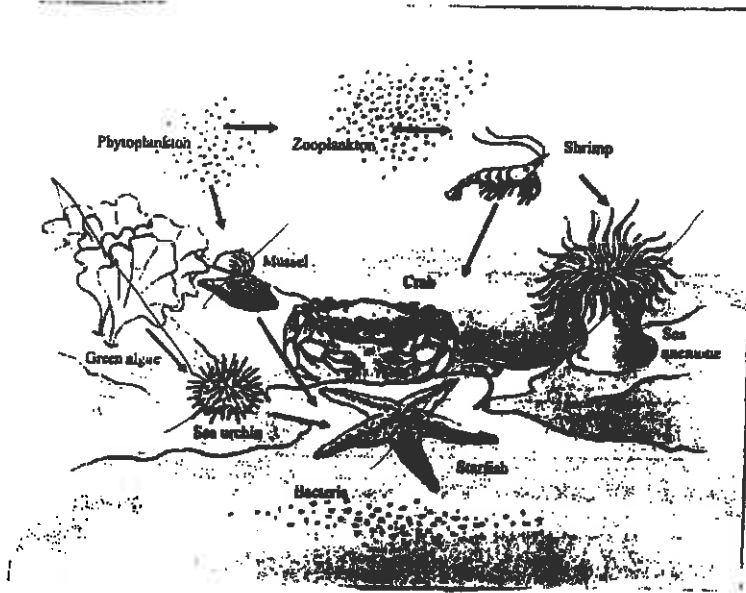
### Disturbances

111. Choose whether the following describes a natural or a human disturbance to an ecosystem
- a) The freezing of a lake in the winter natural
  - b) A volcanic eruption natural
  - c) An oil spill at sea human
  - d) A tree struck by lightning natural
  - e) Mining for copper human
  - f) A heat wave in the summer human

## Dynamics of Ecosystems

### Trophic Relationships

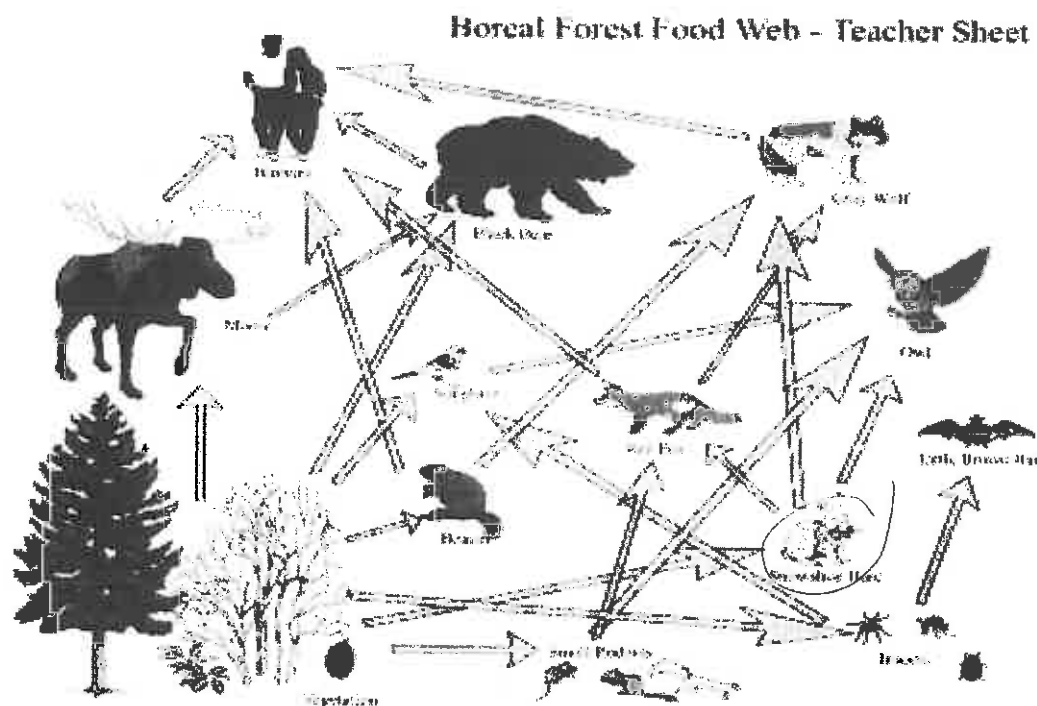
112. Refer to the following food web and answer the questions associated with it.



Indicate the organisms from the food web that belong to the trophic levels indicated.

Producers	First-level Consumers	Second-level Consumers	Third-level Consumers	Decomposers
green algae sea anemone	sea urchin	mussel	shrimp zooplankton phytoplankton	bacteria

113. Refer to the following food web and answer the questions associated with it.



- a) Which populations, the songbird or the snowshoe hare, would be the most affected by deforestation. Explain.

the snowshoe hare because all they eat are trees.

- b) Which of the following populations would have a greater effect on primary productivity in the ecosystem, the extinction of the red fox or the extinction of the brown bat? Explain.

Brown bat because there would be more bugs that would eat the trees.

### Primary Productivity

114. The Earth contains many biomes, including the arctic tundra, the tropical forest, the desert, the boreal forest and grasslands.

- a) Which of these biomes has the greatest primary productivity? Explain.

tropical forest because they have the most important factors of primary productivity in the biomes.

- b) Name four factors that affect primary productivity that make this biome the most productive.

- amount of light ✱ - access to essential nutrients  
- amount of water & - the temperature.

115. An ecosystem is composed of water, trees, beavers, ducks, aquatic plants and soil. Which of these elements are not calculated as part of the biomass? Explain your answer.

Water because primary productivity is the amount of new biomass generated by its producers.

### Material and Energy Flow

116. A researcher has determined that the temperate forest receives 2000 J of energy from solar radiation within a specific period of time. The forest is home to a large variety of plants and animals, forming a complex trophic network. Use this information to answer the following questions.

a) How do the living organisms at the various trophic levels obtain the energy they need?

By eating their prey.

b) What happens to the 2000 J of solar energy as it is passed along the food chain? Explain your answer.

It will decrease and lose more and more energy as it goes higher up because energy is lost.

### Chemical Recycling

117. What is the role of decomposers in the process of chemical recycling?

Breaking down organic matter

118. What is the role of producers in the process of chemical recycling?

Producing inorganic to organic matter

