

## OXYGEN, GENERAL PROPERTIES

5.1. Select the properties of oxygen element.

- A. there are 6 electrons in the last energy level.
- B. It is found in air.
- C. Chemical symbol is O.
- D. It is in 2<sup>nd</sup> period and 6A group in the periodic table.
- E. Relative molecular mass is 32 g.
- F. Atomic number is 8.
- G. Relative atomic mass is 16.
- H. Chemical formula is O<sub>2</sub>.

5.2. Choose the properties of oxygen gas;

- A. It makes non polar covalent bond
- B. Molar mass is 32 g/mol.
- C. Nuclear charge is +8.
- D. Number of bonds is 2.
- E. Colorless gas.
- F. Chemical formula is O<sub>2</sub>.
- G. Chemical symbol is O.

5.3. Fill the blanks with elemental oxygen or compound of oxygen

- A. the most abundant element in Earth`s crust is .....oxygen
- B. ....is found in most of the compounds in life like proteins, fats and carbohydrates.
- C. ....oxygen constitutes of 49.3% in Earth crust, 85.8% in sea water and 90% in cucumber.
- D. ....oxygen constitutes of 1/5 of air.
- E. ....oxygen has the properties of colorless, tasteless, odorless and less soluble in water.

5.4. Determine the statements related whether elemental oxygen or compound of oxygen.

- A. Oxygen is found in many natural substances such as clay and sand.
- B. Oxygen is heavier than air.
- C. Mass percent of oxygen in water is 89%.

5.5. Choose the physical properties of oxygen;

- A. Oxygen is lighter than air.
- B. Solid
- C. Liquid
- D. Gas
- E. Colorless
- F. Yellow
- G. Less soluble in water
- H. Well soluble in water
- I. Heavier than water.
- J. Pungent smell
- K. Sweet taste

5.6. There are two balloons: In one there is oxygen and in the other there is air. Can you determine oxygen by appearance? Which physical properties can be used to determine oxygen?

5.7. Explain by which methods oxygen is obtained in pure form;

- A. from water
- B. from air

5.8. Choose the physical properties of oxygen;

- A. Conducts electricity
- B. Sour taste
- C. Tasteless
- D. Bitter
- E. Nonconductor of electricity
- F. Blue
- G. Boiling point is -183°C.
- H. Melting point is -196°C.
- I. Odorless

5.9. Choose the correct statement about oxygen;

- A. Gaseous in standard conditions.
- B. Having odor
- C. Found in nature in free and compound forms.
- D. Solid and liquid forms are colored.

## PREPARATION OF OXYGEN

6.1. Choose the method to prepare oxygen in industry;

- A. Decomposition of KMnO<sub>4</sub>
- B. Decomposition of HgO
- C. Photosynthesis
- D. From liquefied air
- E. From electrolysis of water.

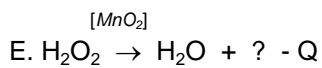
6.2. Choose the method to prepare oxygen in laboratory;

- A. Decomposition of KClO<sub>3</sub>
- B. Decomposition of water
- C. Decomposition of H<sub>2</sub>O<sub>2</sub>
- D. Photosynthesis

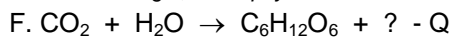
6.3. Complete the following reactions of oxygen, balance the reactions;

Indicate the types of reactions according to heat change.

- A.  $\text{KMnO}_4 \rightarrow \text{K}_2\text{MnO}_4 + \text{MnO}_2 + ? - \text{Q}$
- B.  $\text{KClO}_3 \rightarrow \text{KCl} + ? - \text{Q}$
- C.  $\text{H}_2\text{O} \rightarrow ? + ? - \text{Q}$
- D.  $\text{HgO} \rightarrow ? + ? - \text{Q}$



*Light, chlorophyll*



6.4. Write down the reactions to obtain oxygen by;

- A. Decomposition of water
- B. Decomposition of HgO
- C. Decomposition of H<sub>2</sub>O<sub>2</sub>

6.5. Explain the preparation of oxygen from H<sub>2</sub>SO<sub>4</sub>, KMnO<sub>4</sub>, KClO<sub>3</sub>, HgO. Discuss preparations by the reaction equations.

6.6. Calculate the amount of oxygen obtained from the decomposition of 6 moles of water. Calculate the mass of oxygen and water.

6.7. Calculate the amount of KMnO<sub>4</sub> which produces 2 moles of oxygen. Calculate the mass of K<sub>2</sub>MnO<sub>4</sub>.

6.8. Calculate the maximum amount of oxygen from decomposition of 1 mole of substances;

- A.  $H_2O_2 \rightarrow H_2O + O_2 \uparrow$
- B.  $KClO_3 \rightarrow KCl + O_2 \uparrow$

6.9. Calculate the mass of KMnO<sub>4</sub> to obtain 6.4 g of O<sub>2</sub>.

6.10. In the world all plants annually absorb 200 billion tons of CO<sub>2</sub>. Calculate the mass of oxygen produced by photosynthesis.

### CHEMICAL PROPERTIES OF OXYGEN

7.1. Write the formula of the oxides according to given oxidation states.

- |        |        |        |        |        |       |
|--------|--------|--------|--------|--------|-------|
| IV     | II     | IV     | V      | III    | II    |
| A. SO; | B. CO; | C. CO; | D. PO; | E. PO; | F. NO |

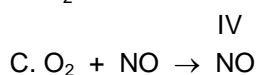
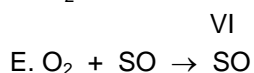
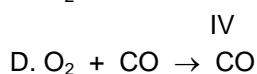
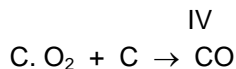
7.2. Write the formula of the oxides according to given oxidation states.

- |         |         |         |         |         |        |
|---------|---------|---------|---------|---------|--------|
| +3      | +2      | +2      | +2      | +1      | +3     |
| A. AlO; | B. ZnO; | C. CuO; | D. CaO; | E. CuO; | F. CrO |

7.3. Complete the formulas of substances in given chemical equations and balance them.

Write type of the reactions and name the products

- A.  $O_2 + S \rightarrow SO$
- B.  $O_2 + P \rightarrow PO$



7.4. Complete the reactions of metals with oxygen. Name the products. Indicate the type of reactions according to heat change.

- A.  $Ca + O_2 \rightarrow ?$
- B.  $Al + O_2 \rightarrow ?$
- C.  $Fe + O_2 \rightarrow ?$
- D.  $Li + O_2 \rightarrow ?$
- E.  $Cu + O_2 \rightarrow ?$
- F.  $Zn + O_2 \rightarrow ?$

7.5. Write burning reactions of given elements in oxygen

- |                   |               |               |
|-------------------|---------------|---------------|
| A. Phosphorous(V) | B. Barium     | C. Aluminum   |
| D. Lithium        | E. Carbon(IV) | F. Sulfur(IV) |

7.6. Choose substance which give reaction with oxygen. Write the possible reactions.

- |            |            |         |             |
|------------|------------|---------|-------------|
| A. Lithium | B. Calcium | C. Iron | D. Aluminum |
|------------|------------|---------|-------------|

7.7. Complete the following reactions of oxygen, and balance the reactions;

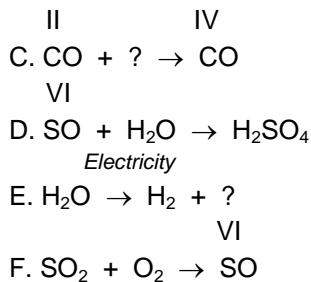
- A.  $CH_4 + O_2 \rightarrow CO + H_2O$
- B.  $C_2H_2 + O_2 \rightarrow CO + H_2O$
- C.  $H_2S + O_2 \rightarrow SO + H_2O$
- D.  $C_3H_8 + ? \rightarrow CO + H_2O$
- E.  $C_4H_{10} + ? \rightarrow CO + H_2O$
- F.  $FeS + ? \rightarrow FeO + SO \uparrow$

7.8. Choose the process where oxygen is consumed.

- |                  |            |                   |
|------------------|------------|-------------------|
| A. Respiration   | B. Burning | C. Photosynthesis |
| D. putrefication |            |                   |

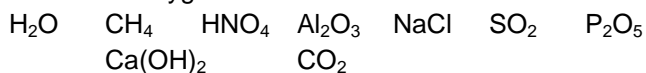
7.9. Complete the reactions and choose the oxidation reactions.

- A.  $CaO + CO_2 \rightarrow CaCO_3$
- B.  $Ca + O_2 \rightarrow ?$

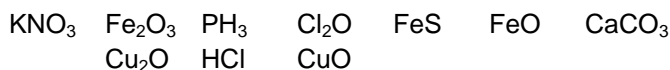


7.10. Choose formulas of the oxides from the compounds given below and name them.

Write the preparation reaction of oxides by burning of element in oxygen.



7.11. Choose formulas of the oxides and name them.



7.12. Calculate the mole number and mass of oxygen which is needed react with 4 moles of magnesium.

7.13. Calculate the mole number of water which is produced from 5 mole of hydrogen. How many mole of oxygen is used in this reaction?

7.14. Calculate the mole number of oxygen needed to burn 5 mole of methane ( $\text{CH}_4$ ). How many mole of carbon dioxide produced?

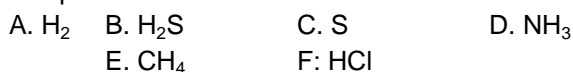
7.15. 1 mole of methane is needed to boil 1 L of water. How many mole of oxygen is necessary to burn 1 mole of methane? Calculate the mole number of carbon dioxide and water produced from the reaction.

### OXIDATION-REDUCTION REACTIONS

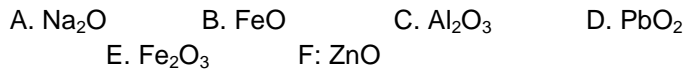
8.1. Determine the oxidation states of elements in given compounds below.



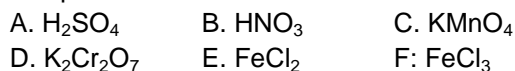
8.2. Determine the oxidation states of elements in given compounds below.



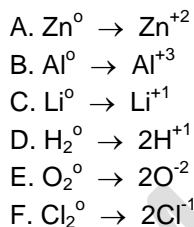
8.3. Determine the oxidation states of elements in given compounds below.



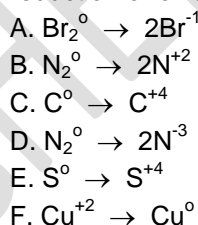
8.4. Determine the oxidation states of elements in given compounds below.



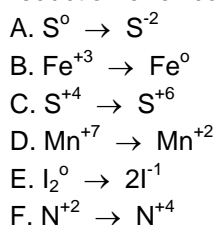
8.5. Complete the equations by putting electrons to proper side of the equations. Indicate oxidizing and reducing agents. Determine processes that whether they are reduction or oxidation.



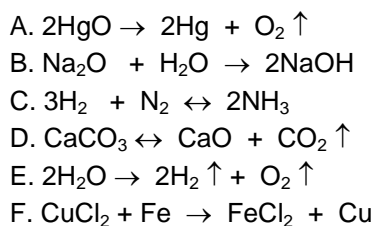
8.6. Complete the equations by putting electrons to proper side of the equations. Indicate oxidizing and reducing agents. Determine processes that whether they are reduction or oxidation.



8.7. Complete the equations by putting electrons to proper side of the equations. Indicate oxidizing and reducing agents. Determine processes that whether they are reduction or oxidation.



8.8. Select the redox reactions.



8.9. Select the redox reactions.

- A.  $4\text{Al} + 3\text{O}_2 \rightarrow \text{Al}_2\text{O}_3 \uparrow$   
 B.  $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$   
 C.  $\text{Cu}(\text{OH})_2 \rightarrow \text{CuO} + \text{H}_2\text{O}$   
 D.  $2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2 \uparrow$   
 E.  $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$   
 F.  $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$

8.10. Balance the redox reactions by electron balance method. Show oxidizing and reducing agents.

- A.  $\text{Li} + \text{O}_2 \rightarrow \text{Li}_2\text{O} \uparrow$   
 B.  $\text{Ca} + \text{O}_2 \rightarrow \text{CaO}$   
 C.  $3\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$   
 D.  $\text{KClO}_3 \rightarrow \text{KCl} + \text{O}_2 \uparrow$   
 E.  $\text{CO} + \text{O}_2 \rightarrow \text{CO}_2$   
 F.  $\text{SO}_2 + \text{O}_2 \rightarrow \text{SO}_3$

8.11. Balance the redox reactions by electron balance method.

- A.  $\text{Al} + \text{S} \rightarrow \text{Al}_2\text{S}_3$   
 B.  $\text{Al} + \text{I}_2 \rightarrow \text{Al}_2\text{I}_3$   
 C.  $\text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3$   
 D.  $\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2 \uparrow$   
 E.  $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$   
 F.  $\text{NH}_3 + \text{O}_2 \rightarrow \text{N}_2 + \text{H}_2\text{O}$

8.12. Select the redox reactions and balance them by electron balance method.

- A.  $\text{Al}(\text{OH})_3 \rightarrow \text{Al}_2\text{O}_3 + \text{H}_2\text{O}$   
 B.  $\text{Ag}_2\text{O} \rightarrow \text{Ag} + \text{O}_2 \uparrow$   
 C.  $\text{SO}_3 + \text{Na}_2\text{O} \rightarrow \text{Na}_2\text{SO}_4$   
 D.  $\text{Al} + \text{HCl} \rightarrow \text{AlCl}_3 + \text{H}_2 \uparrow$   
 E.  $\text{CuO} + \text{HCl} \rightarrow \text{CuCl}_2 + \text{H}_2\text{O}$   
 F.  $\text{N}_2 + \text{O}_2 \rightarrow \text{NO}$

8.13. Calculate the mole and mass of oxygen necessary to oxidize sulfur dioxide to obtain 4 mole of sulfur trioxide.

8.14. Calculate the mole and mass of hydrogen peroxide if it produces 6 mole of oxygen when decomposed. How many mole of water produced?

### USES OF OXYGEN, AIR, COMPOSITION OF AIR

9.1. Explain for what purpose oxygen is used

- A. in medicine  
 B. for cutting and welding metals  
 C. in metallurgy

9.2. Name the gaseous and liquid oxides which are necessary for growth of plants.

9.3. For what purpose, combustion of methane and acetylene are used? Write these reactions.

9.4. Choose the processes in which oxygen is used and produced.

- A. respiration                      B. photosynthesis  
 C. fermentation                  D. petrification    E. corrosion  
 F. combustion

9.5. Select the correct use of oxygen below,

- A. in medicine for respiration,  
 B. in metallurgy to burn fuel in order to get high temperature,  
 C. in meteorology balloon to check weather conditions,  
 D. in acetylene welding tools to reach high temperatures,  
 E. in diver's tubes it is mixed with helium gas,  
 F. in warehouses to store grains and to extend their shelf life.

9.6. Select the correct statement for the use of oxygen gas,

- A. As an oxidizer in rocket fuel,  
 B. As a component of explosive material (in liquid form),  
 C. To enrich air in greenhouses,  
 D. In the composition of air used to speed up the decomposition of garbage material,  
 E. In chemical industry to oxidize metals,  
 F. To get protective atmosphere.

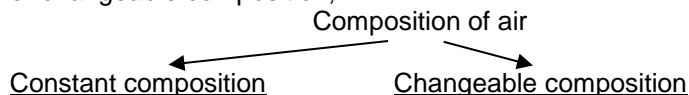
9.7. Select the substances in atmosphere found in constant composition, indicate their compositions in air by volume;

- A. nitrogen  
 B. water vapor  
 C. oxygen  
 D. dust  
 E. noble gases  
 F. carbon oxides

9.8. Select the air pollutant substances produced by human activities;

- A. oxygen  
 B. argon  
 C. sulfur dioxide  
 D. nitrogen oxides  
 E. carbon dioxide

9.9. Make a list of substances found in air either constant or changeable composition;



9.10. Name the oxides in air with constant composition; explain how carbon dioxide is produced in air.

9.11. Select the following processes in which oxygen is used;

- A. Welding of metals,
- B. Photosynthesis,
- C. Cutting of Metals,
- D. Burning of fuel.

9.12. Select the correct responses about the gases found in air in constant compositions;

- A. Oxygen, nitrogen, hydrogen
- B. Oxygen, nitrogen, carbon dioxide
- C. Oxygen, carbon dioxide, sulfur trioxide,
- D. Argon, nitrogen, hydrogen

9.13. Purpose a method to identify the gases in the bottles;

- A. air
- B. nitrogen
- C. oxygen

9.14. Calculate the relative molar masses of the following gases;

- A. carbon dioxide,
- B. sulfur trioxide,
- C. carbon monoxide,
- D. nitrogen dioxide.

9.15. A man uses 720 L of oxygen in 24 hours. Calculate the volume of air which have this amount of oxygen.

9.16. Mass of air in  $1\text{-m}^3$  is 1.28 kg. Calculate;

- A. mass of air in a classroom with  $12 \times 6 \times 2.5$  m dimensions,
- B. volume of oxygen in the same classroom,
- C. volume of oxygen for 25 students

9.17. To boil water in a 1-L kettle 45-L of oxygen is used. What is the volume of air used?

### COMBUSTION IN AIR, AIR AROUND US

10.1. Which of the given substances below burn faster in oxygen or in air?

- A. Sulfur
- B. Phosphorus
- C. Carbon
- D. Hydrogen
- E. Methane

10.2. Does one or two reaction show the combustions of substances in air or in oxygen? Why?

10.3. Explain why wet wood burn slowly.

10.4. Explain why many metals for example aluminum does not burn in large pieces, but they burn with explosions when they are powdered. Write the combustion reactions of Al, Mg, Li and Fe metals.

10.5. Explain, why water does not extinguish the fires of petroleum, gasoline and petroleum products. Write the combustion reactions of;

A.  $\text{C}_3\text{H}_8$  (propane)      B.  $\text{C}_4\text{H}_{10}$  (butane).

10.6. Explain why  $\text{CO}_2$  gas put off fire.

10.7. Explain which method must be used to extinguish a camp fire.

10.8. Write the formula of simple form of oxygen gas.

10.9. Complete the reactions below;



10.10 Write the uses of ozone gas.

10.11. Calculate the amount of ozone gas which is produced from oxygen with;

A. 6 mol      B. 12 mol      C. 18 mol

Calculate the mass of ozone.