SILICON AND ITS COMPOUNDS

27.1 Compare:
A. silicon with carbon; B. silicon with phosphorus; with respect to the place in the Periodic Table and atomic structure.

27.2 Complete the reactions that characterize the chemical properties of the silicon and name of the products.
A. $Si + F_2 \rightarrow ?$
B. $Si + O_2 + (temp.) \rightarrow ?$
C. $Si + C + (temp.) \rightarrow ?$
D. $Si + Mg + (temp.) \rightarrow ?$
E. $Si + Cl_2 + (temp.) \rightarrow ?$
G. $Si + NaOH + H_2O \rightarrow Na_2SiO_3 + ?$
H. $Si + Ca + (temp.) \rightarrow ?$

Determine the role of silicon as reductant or oxidant in the reactions and draw a conclusion about the activity of silicon as a nonmetal.

27.3 Finish the reaction equations and give the name of reaction products.

I

A. $SiO_2 + CaO + (temp.) \rightarrow$
B. $SiO_2 + NaOH + (temp.) \rightarrow$
C. $SiO_2 + CaCO_3 + (temp.) \rightarrow$
D. $SiO_2 + K_2CO_3 + (temp.) \rightarrow$
E. $Na_2SiO_3 + HCl + \rightarrow$
F. $Na_2SiO_3 + H_2O + CO_2 \rightarrow$

II

A. $SiO_2 + MgO + (temp.) \rightarrow$
B. $SiO_2 + KOH + (temp.) \rightarrow$
C. $SiO_2 + Na_2CO_3 + (temp.) \rightarrow$
D. $H_2SiO_3 + (temp.) \rightarrow$
E. $K_2SiO_3 + HCl + (temp.) \rightarrow$
F. $SiO_2 + HF \rightarrow SiF_4 + ?$

27.4 Compare the chemical and physical properties of:
A. CO_2 and SiO_2;
B. H_2CO_3 and H_2SiO_3.

27.5 The silicate mineral formulas below form oxide:
A. Orthoclase, $K_2Al_2Si_6O_{16}$;
B. Mica, $K_2H_4Al_6Si_6O_{24}$;
C. Nepheline, $Na_2Al_2Si_2O_8$
D. Albite, $Na_2Al_2Si_6O_{16}$;
E. Kaolinite, $H_4Al_2Si_2O_9$;
F. Talc, $Mg_3H_2Si_4O_{12}$

27.6 Explain how do:
A. nonmetallic and metallic properties;
B. oxidizing and reducing properties;
C. superior oxide character;
D. acidic strength (for C and Si)
varies in this row:
$C \rightarrow Si \rightarrow Ge \rightarrow Sn \rightarrow Pb$?

27.7 Silicon does not react with hydrogen directly. Compound of silicon with hydrogen, Silane, SiH_4, can be obtained by indirect method, for example, silane is obtained by decomposition of magnesium silicide on acid spontaneously in air by releasing a lot of heat. Write down the reactions below;
1. magnesium silicide with;
A. hydrochloric acid;
B. sulfuric acid;
2. burning of silane, SiH_4.

27.8 Perform the following transformations;
A. $Mg_2Si \rightarrow SiH_4$ $CaSiO_3$

$Si \rightarrow SiO_2 \rightarrow K_2SiO_3 \rightarrow H_2SiO_3 \rightarrow SiO_2 \rightarrow$ glass

SiF_4

B. $Mg_2Si \rightarrow SiH_4 \rightarrow SiO_2$

$Si \rightarrow Na_2CO_3 \rightarrow H_2SiO_3 \rightarrow SiO_2$

27.9 Complete the following reactions possible;
A. $SiO_2 + NaOH \rightarrow$
B. $Si + O_2 \rightarrow$
C. $H_2SiO_3 + HCl \rightarrow$
D. $SiO_2 + CO_2 \rightarrow$
E. $Na_2SiO_3 + HNO_3 \rightarrow$
F. $SiO_2 + H_2O \rightarrow$
G. $SiO_2 + HNO_3 \rightarrow$
H. $H_2SiO_3 + NaOH \rightarrow$
I. $SiO_2 + CaCO_3 \rightarrow$
K. $Si + KOH + H_2O \rightarrow$

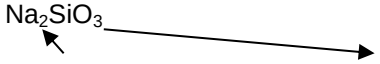
27.10 Write down the molecular equations of the following ionic equations;
A. $SiO_2^{2-} + 2H^+ \leftrightarrow H_2SiO_3\downarrow$
B. $SiO_2 + 2OH^- \leftrightarrow SiO_3^{2-} + H_2O$
C. $H_2SiO_3 + 2OH^- \leftrightarrow SiO_3^{2-} + 2H_2O$

27.11 Balance the following redox reactions by using oxidation number method.
A. $Si + NaOH + H_2O \rightarrow Na_2SiO_3 + H_2\uparrow$
B. $Si + Ba(OH)_2 + H_2O \rightarrow BaSiO_3 + H_2\uparrow$
C. $SiO_2 + Mg \rightarrow Si + MgO$
D. $SiH_4 + O_2 \rightarrow SiO_2 + H_2O$

27.12 Show the reaction equations that help us to obtain soluble substances in water from sand.

27.13 Write the reaction equations to obtain ……by different methods.
A. sodium silicate;
B. calcium silicate.
Indicate the conditions that are necessary for the reaction.

27.14 Perform the following transformations;



A. $Si \rightarrow SiO_2 \rightarrow K_2SiO_3 \rightarrow H_2SiO_3 \rightarrow SiO_2 \rightarrow MgSiO_3$
B. $Si \rightarrow K_2SiO_3 \rightarrow CaSiO_3$
C. $Si \rightarrow Mg_2Si \rightarrow SiH_4 \rightarrow SiO_2 \rightarrow CaSiO_3$

27.15 The silicon carbide is obtained at 2000°C from quartz and coke mixture by the following reaction;
$SiO_2 + C + (temp.) \rightarrow SiC + CO\uparrow$
Find the mass of quartz which is necessary to obtain 60 g of silicon carbide.

27.16 Find the mass of silicon that contains 10% impurities, if 2.24 L of hydrogen were obtained by the reaction of sodium hydroxide with silicon:
$Si + NaOH \rightarrow Na_2SiO_3 + H_2\uparrow$

27.17 29 kg of calcium silicate were obtained from melting of 18 kg of sand with chalk. Find the mass of silicon oxide percentage in the sand.

27.18 24.4 kg of sodium silicate were obtained from melting of 26.5 kg mixture of sand and sodium carbonate. Find the percent yield of the reaction.

27.19 600 kg of quartz were melted with 800 kg of calcium hydroxide. 957 kg calcium silicate was obtained.
Find the percent of yield the reaction.

27.20 Find the mass of caustic soda, that contains 95% NaOH, and the mass of sand that contains 90% SiO_2, necessary to obtain 1 t of sodium silicate.

27.21 Calculate the volume of carbon dioxide that is obtained from the calcinations of 720 kg sand, that contains 95% SiO_2 and 1000 kg chalk that contains 90% $CaCO_3$. Find the mass of calcium silicate, if the percent yield of the reaction is 80%.

27.22 Calculate the mass of potash (80% K_2CO_3 by mass), chalk (90% $CaCO_3$ by mass), and sand (95% SiO_2 by mass) are necessary to obtain 100 kg glass with the formula of $K_2O.CaO.6SiO_2$.

27.23 A 13 g mixture of carbon and silicon was treated with an alkaline base and 11.2 L hydrogen gas was released. Calculate the mass percentage of each component in the mixture.