

CHEM 2
Problem Set Ch.21

[Key begins on page 3.](#)

1. Write equations for each of the following.

a) $\text{TiCl}_{4(l)}$ is reduced by $\text{Na}_{(l)}$ to yield $\text{Ti}_{(s)}$.

b) Carbon dioxide is added to a solution saturated with ammonia and sodium chloride.

c) ZnS is roasted in air.

2. Write equations for the preparation of:

a) sodium from sodium chloride.

b) potassium hydroxide from potassium chloride.

c) lime from seashells.

3. Give a brief explanation for each of the following.

a) The barium ion is toxic, yet a suspension of barium sulfate is administered orally by physicians to obtain diagnostic x-ray photographs of the stomach with no harm to the patient.

b) Sand, not a CO_2 fire extinguisher, must be used to put out magnesium fires.

4. Tin forms two chlorides, SnCl_2 and SnCl_4 . One chloride is a crystalline substance with a melting point of 246°C . The other is a liquid at room temperature and boils at 114°C . Match the properties to the formulas and explain your answer.

5. Explain why the standard reduction potential for lithium and beryllium are so far out of line with respect to their group trends.

6. How many kilograms of manganese can be obtained from 1.00 kg of aluminum when you reduce manganese(IV)oxide?

7. Potassium hydroxide and barium hydroxide are both strong bases. What simple chemical test could you use to distinguish between solutions of these two bases?

8. Sodium phosphate, Na_3PO_4 , is produced by an acid-base neutralization reaction. The phosphoric acid, H_3PO_4 , is obtained by burning phosphorus to P_4O_{10} , then reacting the oxide with water to give the acid. Write balanced equations (in four steps) for the preparation of Na_3PO_4 from P_4 , H_2O , air and NaCl .

9. How many grams of lithium carbonate are required to produce 10.00 grams of lithium hydroxide?

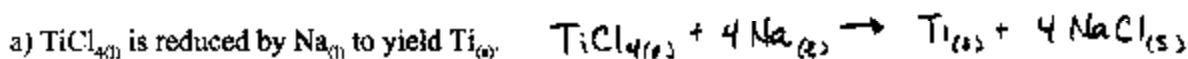
10. Estimate the temperature at which barium carbonate decomposes to barium oxide and CO_2 at 1 atm. (Use the thermodynamic data in appendix C of your text)



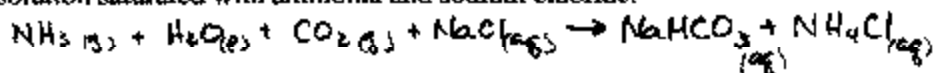
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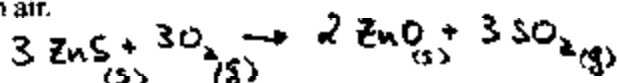
1. Write equations for each of the following.



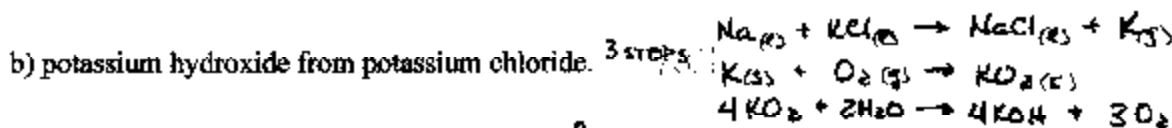
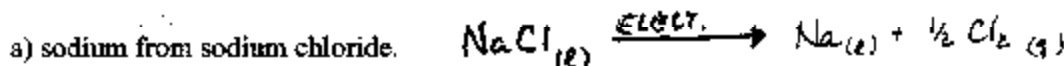
b) Carbon dioxide is added to a solution saturated with ammonia and sodium chloride.



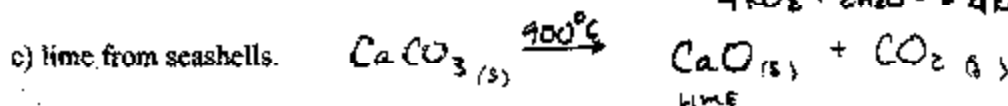
c) ZnS is roasted in air.



2. Write equations for the preparation of:



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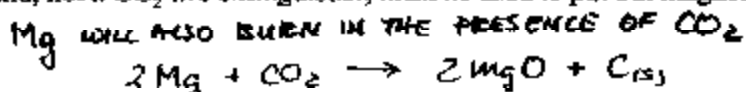


3. Give a brief explanation for each of the following.

a) The barium ion is toxic, yet a suspension of barium sulfate is administered orally by physicians to obtain diagnostic x-ray photographs of the stomach with no harm to the patient.

BARIUM SULFATE IS AN INSOLUBLE COMPD, CONSEQUENTLY THERE ARE VIRTUALLY NO FREE Ba^{+2} IONS.

b) Sand, not a CO_2 fire extinguisher, must be used to put out magnesium fires.



CONSEQUENTLY A MAGNESIUM FIRE MUST BE SMOTHERED.

4. Tin forms two chlorides, SnCl_2 and SnCl_4 . One chloride is a crystalline substance with a melting point of 246°C . The other is a liquid at room temperature and boils at 114°C . Match the properties to the formulas and explain your answer.

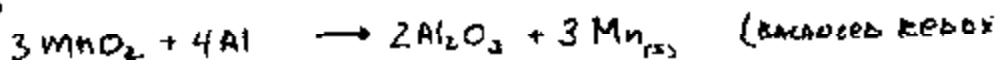
SnCl_2 m.p. = 246°C ← THIS COMPD IS IONIC CONSEQUENTLY HAS HIGH M.P.

SnCl_4 B.P. = 114°C ← THIS COMPD IS MOLECULAR OR COVALENT CONSEQUENTLY HAS LOWER M.P. (B.P)

SEE P. 924 IN TEXT

5. Explain why the standard reduction potential for lithium and beryllium are so far out of line with respect to their group trends. **2nd PERIOD ELEMENTS ARE OFTEN DIFFERENT THAN THEIR FAMILY MEMBERS BECAUSE THE 2nd MAIN SHELL OF e⁻ LIES SO CLOSE TO THE NUCLEUS. CONSEQUENTLY THEIR ELECTRONEGATIVITIES, IONIZATION ENERGIES AND ELECTRODE POTENTIALS ARE HIGHER THAN THEIR FAMILY MEMBERS.**

6. How many kilograms of manganese can be obtained from 1.00 kg of aluminum when you reduce manganese(IV)oxide?

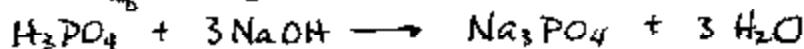
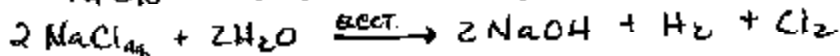


$$1000 \text{g Al} \left(\frac{1 \text{ mol Al}}{27.0 \text{ g}} \right) \left(\frac{3 \text{ mol Mn}}{4 \text{ mol Al}} \right) \left(\frac{54.9 \text{ g Mn}}{1 \text{ mol Mn}} \right) \left(\frac{1 \text{ kg}}{1000 \text{ g}} \right) = 1.53 \text{ kg}$$

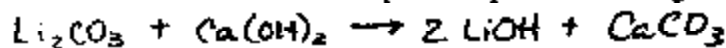
7. Potassium hydroxide and barium hydroxide are both strong bases. What simple chemical test could you use to distinguish between solutions of these two bases?

ADDING H₂SO₄ TO BOTH SOLUTIONS. K₂SO₄ IS SOLUBLE IN H₂O BUT BaSO₄ IS NOT. ITS SOLUTION WOULD PRECIPITATE

8. Sodium phosphate, Na₃PO₄, is produced by an acid-base neutralization reaction. The phosphoric acid, H₃PO₄, is obtained by burning phosphorus to P₄O₁₀, then reacting the oxide with water to give the acid. Write balanced equations (in four steps) for the preparation of Na₃PO₄ from P₄, H₂O, air and NaCl.

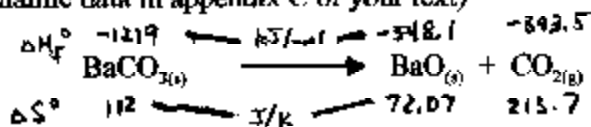


9. How many grams of lithium carbonate are required to produce 10.00 grams of lithium hydroxide?



$$10.00 \text{g LiOH} \left(\frac{1 \text{ mol LiOH}}{23.95 \text{ g LiOH}} \right) \left(\frac{1 \text{ Li}_2\text{CO}_3}{2 \text{ LiOH}} \right) \left(\frac{73.89 \text{ g Li}_2\text{CO}_3}{1 \text{ mol Li}_2\text{CO}_3} \right) = 15.4 \text{ g}$$

10. Estimate the temperature at which barium carbonate decomposes to barium oxide and CO₂ at 1 atm. @ 25°C (Use the thermodynamic data in appendix C. of your text)



$$\Delta H^\circ = 277.4 \text{ kJ}$$

$$\Delta S^\circ = 0.174 \text{ kJ/K}$$

$$T = \frac{\Delta H}{\Delta S} = \frac{277.4 \text{ kJ}}{0.174 \text{ kJ/K}} = 1594 \text{ K}$$

OR
1321°C

NOTE CHANGE TO kJ