Final Exam Review Problems

Chemistry 101
Fall Semester 2005
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1. How many grams of H₂ are produced from reaction of 25.0 g of B₄H₁₀ according to the following equation?

\[ \text{B}_4\text{H}_{10} + 12 \text{H}_2\text{O} \rightarrow 4 \text{H}_3\text{BO}_3 + 11 \text{H}_2 \]

2. What is the theoretical yield of B₂H₆ when 115 g of NaBH₄ and 260 g of BF₃ react according to the following equation?

\[ 3 \text{NaBH}_4 + 4 \text{BF}_3 \rightarrow 2 \text{B}_2\text{H}_6 + 3 \text{NaBF}_4 \]

3. If 36.21 mL of KMnO₄ titrates 50.0 mL of 0.0428 M H₃AsO₃ according to the following equation, what is the molarity of the KMnO₄ solution?

\[ 2 \text{MnO}_4^- + 6 \text{H}^+ + 5 \text{H}_3\text{AsO}_3 \rightarrow 2 \text{Mn}^{2+} + 5 \text{H}_3\text{AsO}_4 + 3 \text{H}_2\text{O} \]

4. Supply the missing information in the table below. Indicate the atomic number, mass number, and charge on atomic symbols.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>69(^{31}\text{Ga}^{3+})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protons</td>
<td>43</td>
</tr>
<tr>
<td>Neutrons</td>
<td>55</td>
</tr>
<tr>
<td>Electrons</td>
<td>36</td>
</tr>
<tr>
<td>Charge</td>
<td>+3</td>
</tr>
</tbody>
</table>

5. Give the correct name for the following compounds from the molecular formulas:
   a) CuCO₃
   b) IF₇
   c) Ba(ClO₃)₂
   d) Mn₂O₃
   e) K₂O
   f) AsF₅

6. Give the correct molecular formula for each of the following names:
   a) lithium perchlorate
   b) iron (III) sulfate
   c) manganese (II) fluoride
   d) strontium nitrate
   e) silver (I) acetate
   f) sulfur dichloride
7. Balance the following equations:

a) _____ Zn(s) + _____ NiCl₂(aq) → _____ ZnCl₂(aq) + _____ Ni(s)

b) _____ Cl₂(g) + _____ LiBr(aq) → _____ LiCl(aq) + _____ Br₂(l)

c) _____ Al(s) + _____ Br₂(aq) → _____ AlBr₃(aq)

8. Give the oxidation number for the atoms underlined in each of the following molecules or ions:

a) C₂H₅⁺

b) HBrO₄

c) K₃PO₄

9. Draw Lewis structures for the following molecules or ions. Be sure to show all valence electrons and formal charges. Clearly indicate your final answer.

a) SO₃F

b) HNO₃ (H bonded to one O)

c) H₃PO₄

d) SiO₂

e) NH₄⁺

10. A particular sodium ion has 10 electrons and 14 neutrons. What is the mass number of this ion?

a) 21  b) 23  c) 24  d) 25

11. What is the molarity of a solution prepared by dissolving 21.462 g of K₂CrO₄ (molar mass = 194.19 g/mol) in enough water to make 5.00 x 10² mL of solution?

a) 0.0429 M  
b) 0.111 M  
c) 0.221 M  
d) 0.388 M

12. The compound N₂O₄ is named

a) Dinitrogen tetroxide  
b) Nitrogen peroxide  
c) Nitrogen (II) oxygen (IV)  
d) Nitrogen dioxide
13. An aqueous solution of which ion would produce a precipitate upon addition of NaOH(aq)?
   a) NH$_4^+$
   b) Fe$_3^+$
   c) Na$^+$
   d) H$^+$

14. Which species has 23 electrons?
   a) $^{23}$Na$^+$
   b) $^{44}$Sc
   c) $^{51}$V$^{2+}$
   d) $^{56}$Fe$^{3+}$

15. Which electronic configuration corresponds to $^{28}$Si in its ground state?
   a) 1s$^2$2s$^2$2p$^4$2d$^3$3s$^2$
   b) 1s$^2$2s$^2$2p$^6$3s$^2$3p$^2$
   c) 1s$^2$2s$^2$2p$^6$2d$^{10}$3s$^2$3p$^6$
   d) 1s$^2$2s$^2$2p$^5$3d$^2$3s$^2$3p$^6$4s$^2$

16. Why is “iron sulfate” an inadequate name for FeSO$_4$?
   a) The name does not specify the oxidation state of iron.
   b) The name does not specify the oxidation state of sulfur.
   c) The correct formula for sulfate is SO$_3^{2-}$, not SO$_4^{2-}$.
   d) The name does not indicate that the molecule is ionic.

17. In the following reaction, what is the percent yield if 1.50 mol of phosphorus reacts with excess sulfur to produce 1.00 mol of P$_4$S$_3$?

   \[ 8 \text{P}_4(s) + 3 \text{S}_8(s) \rightarrow 8 \text{P}_4\text{S}_3(s) \]

18. How many grams of Mg(OH)$_2$ are required to neutralize 23.6 mL of a 0.135 M solution of HCl?

19. In which case would a precipitate form if aqueous solutions of these substances were mixed?
   a) NaNO$_3$ and NH$_4$Cl
   b) Pb(ClO$_4)_2$ and K$_2$SO$_4$
   c) Cu(NO$_3)_2$ and LiCl
   d) HCl and NaOH

20. When water evaporates, the particles in the gas phase are
   a) hydrogen ions and oxygen ions
   b) hydrogen molecules and oxygen molecules
   c) separate hydrogen atoms and oxygen atoms
   d) water molecules
21. Metals have loosely held electrons. This explains why metals usually
   a) are oxidized, rather than reduced
   b) form anions
   c) have high ionization energies
   d) have low thermal conductivity

22. Write the ground state electron configuration for an atom of strontium.

23. Identify which species is oxidized and which is reduced in each of the following
    reactions. (Hint: Assign the oxidation number to each atom in each reaction.)

   a) \( \text{Ba(s)} + 2 \text{HCl(aq)} \rightarrow \text{BaCl}_2(\text{aq}) + \text{H}_2(\text{g}) \)

   b) \( \text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 3 \text{Sn}^{2+}(\text{aq}) + 14 \text{H}^+(\text{aq}) \rightarrow 2 \text{Cr}^{3+}(\text{aq}) + 3 \text{Sn}^{4+}(\text{aq}) + 7 \text{H}_2\text{O(l)} \)

24. A 1.00 mL sample of a solution of \( \text{H}_2\text{O}_2 \) reacted with 18.2 mL of 0.0193 M \( \text{KMnO}_4 \) solution. What is the molar concentration of \( \text{H}_2\text{O}_2 \) ?

   \[ 2 \text{MnO}_4^- + 6 \text{H}^+ + 5 \text{H}_2\text{O}_2 \rightarrow 2 \text{Mn}^{2+} + 5 \text{O}_2 + 8 \text{H}_2\text{O} \]