SCH3U

January 2014

Here are some tips for getting ready for the final exam:

1. Review each unit one at a time by reading through your notes then trying the unit test again without looking at the correct answers until you have finished it. If you did not make corrections to your test when you first got it back now would be a good time.
2. Make a list of topics you need to work on and questions you need to get some help on.
3. Try the multiple choice questions from the tests again.
4. Complete the review below.

Review for Final Exam

You will be given a periodic table that includes molar masses and electronegativities, solubility rules and the activity series

Atomic Theory and the Period Table

You will need to:

- ✓ Know the trends on the periodic table- ionization energy, atomic radius, electron affinity
- ✓ Describe models of the atom: Rutherford, Bohr, Quantum Mechanical model
- ✓ Write standard atomic notation, electron configurations

1. The atomic radius of the elements decreases as you go left to right across the periodic table.
2. The electron affinity of the elements decreases as you go down a family.
3. The most reactive metals are found on the left hand side of on the periodic table.
4. The least reactive non-metals are found far right hand column on the periodic table.
5. Metals have low ionization energy while non-metals have high electron affinity.
6. Write the standard atomic notation for argon. Ar^{40}_{18}
7. Write the electron configuration for chromium.

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^4$

Bonding and Nomenclature

You will need to:

- ✓ Draw Lewis diagrams for ionic, polyatomic ions and covalent substances
- ✓ Draw structural diagrams and shapes for covalent substances and determine the polarity of the molecules
- ✓ Name and write formulas for ionic and covalent substances

8. Draw Lewis diagrams for the following:
   a) aluminum sulfide
   b) PH_3
   c) CCl_4,
   d) C_2H_2
   e) $SrCl_2$
   f) H_2Se
   g) OH^-
   h) C_2H_2

9. Draw structural diagrams for the following:
   a) CH_3Cl
   b) Cl_2O
   b) CO_3^{2-}
   d) CO_2
   e) HCN
   f) O_2

10. Now draw and name the 3-D shape for #9.

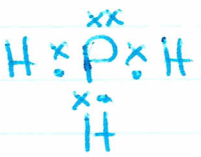
11. Which of the above molecules is polar?

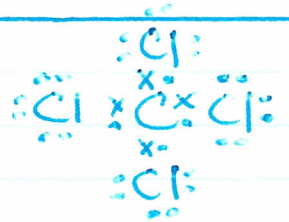
12. Name the following compounds:

   a) $LiHCO_3$ lithium hydrogencarbonate
   b) $Sn(OH)_2$ tin(II) hydroxide
   c) ICl_3 iodine trichloride
   d) $H_3PO_{4(aq)}$ phosphoric acid
   d) $HNO_{2(aq)}$ nitrous acid
   f) $NaClO_3$ sodium chlorate
   f) $CaSO_3$ calcium sulfite
   h) KCN potassium cyanide

13. Write formulas for the following:
   a) ammonium sulfate $(NH_4)_2SO_4$
   b) magnesium hydride MgH_2
   b) diphosphorus pentasulphide P_2S_5
   d) hydrofluoric acid $HF_{(aq)}$
   e) iron (III) sulfide Fe_2S_3
   f) hydrosulfuric acid $H_2S_{(aq)}$

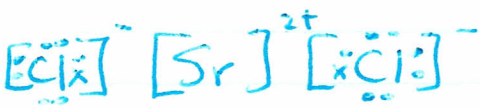
8 a) 

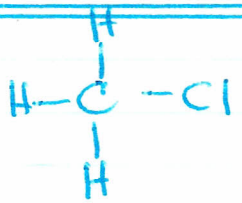
b) 

c) 

d) 

e) 

g) 

9. a) 

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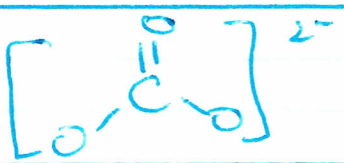
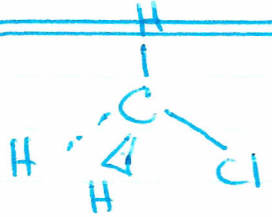
c) 

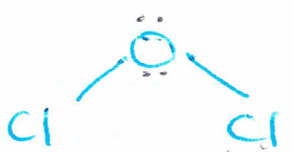
d) 

e) 

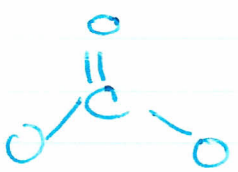
f) 

10 a) 

tetrahedron

b) 

bent

c) 

trigonal planar

d) 

linear

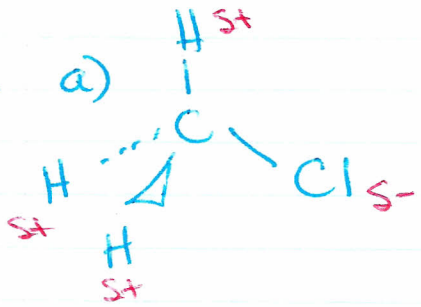
10 e) $H-C\equiv N$

linear

f) $O=O$

linear

11. a)



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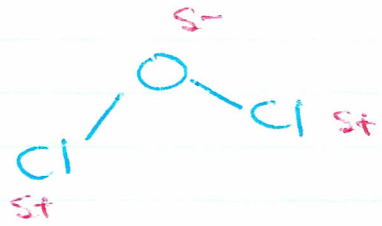

e) $^{St}H-C\equiv N^{S-}$

Types of Reactions

You will need to

- ✓ **Identify types of chemical reactions, balance chemical equations, write ionic and net ionic equations, identify precipitates formed using the solubility chart, know how to use the activity series**

14. Write a balanced chemical equation for each of the following types of reactions:
    a) Synthesis
    b) decomposition
    c) single displacement with metals
    d) single displacement with non-metals
    f) double displacement with a precipitate formation
    g) Neutralization
    h) combustion

15. Write the ionic and net ionic equation for the reaction: $Mg_{(s)} + H_2SO_{4(aq)} \rightarrow MgSO_{4(aq)} + H_{2(g)}$

16. What are spectator ions? ions that don't participate in a chemical reaction

17. Will a precipitate form between

    a) sodium chloride and barium sulfate? NO
    b) barium chloride and sodium sulfate? yes $BaSO_4$
    c) calcium nitrate and sodium hydroxide? yes - $Ca(OH)_2$

The Mole

You will need to:

- ✓ **Make the following calculations: n↔m, N↔n, N↔m**
- ✓ **Determine percent composition of a compound**
- ✓ **Determine empirical and molecular formulas**
- ✓ **Give answers to the correct number of significant digits**

18. Calculate the number of moles and the number of molecules in 150 g of water.
    $n = 150/18.02 = 8.32\ mol$ $N_{H_2O} = 8.32 \times N_A = 5.01 \times 10^{24}$ molecules
19. Calculate the mass of 2.43 moles of C_2H_2.
    $m = (2.43)(26.04) = 63.3\ g$
20. Calculate the number of atoms of each element present in 0.84 moles of CH_4.
    $n_C = 0.84\ mol \Rightarrow N_C = (0.84)N_A = 5.1 \times 10^{23}$ $N_H = 4(5.1 \times 10^{23}) = 2.0 \times 10^{24}$
21. Which contains the greatest number of molecules: 252 g of sulfuric acid OR 300 g of carbonic acid?
    $n_{H_2SO_4} = \frac{252}{98.08} = 2.57\ mol$
    $n_{H_2CO_3} = \frac{300}{62.03} = 4.84\ mol$

14. The following are some examples of what you might write.

a) Synthesis $4\,Al_{(s)} + 3\,O_{2(g)} \rightarrow 2\,Al_2O_{3(s)}$

b) decomposition $2\,H_2O_{(l)} \rightarrow 2\,H_{2(g)} + O_{2(g)}$

c) Single displacement with metals

$2\,Na_{(s)} + CaCl_{2(aq)} \rightarrow 2\,NaCl_{(aq)} + Ca_{(s)}$

d) Single displacement with non-metals

$F_2 + 2\,NaCl_{(aq)} \rightarrow 2\,NaF_{(aq)} + Cl_2$

e) double displacement with precipitate formin

$NaCl_{(aq)} + AgNO_{3(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$

f) neutralization

$2\,NaOH_{(aq)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + 2\,H_2O$

g) Combustion

15. $Mg_{(s)} + H_2SO_{4(aq)} \rightarrow MgSO_{4(aq)} + H_{2(g)}$

ionic $Mg_{(s)} + 2H^+_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow Mg^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} + H_{2(g)}$

net ionic $Mg_{(s)} + 2H^+_{(aq)} \rightarrow Mg^{2+}_{(aq)} + H_{2(g)}$

22. Which represents the greatest amount of silver: 25 g OR 0.25 mol OR 2.0×10^{23} atoms?

$n = \frac{25}{107.9} = 0.23\ mol$ $\quad n = \frac{2.0 \times 10^{23}}{N_A} = 0.33\ mol$

23. Calculate the percent by mass of carbon in lithium carbonate. Li_2CO_3 $mm = 73.89\ g/mol$

$\%\ Li = \frac{2(6.941)}{73.89} \times 100\% = 18.79\%$ $\quad \%\ C = \frac{12.01}{73.89} \times 100\% = 16.25\%$ $\quad \%\ O = 64.96\%$

24. What mass of carbon is in 25 g of lithium carbonate?

$m = 16.25\%$ of $25 = 4.1\ g$

25. A sample of a compound was analyzed and found to contain the following: Carbon: 66.6%; Hydrogen: 11.2%; Oxygen: 22.2%. Determine the empirical formula of the compound. The molar mass of the compound was found to be 144.21 g/mol. Determine the molecular mass of the compound.

on next sheet

Stoichiometry and Solutions

You will need to:

- ✓ **Using balanced equations: carry out calculations involving mole to mole, mass to mass, percent yield, limiting reactant**
- ✓ **Determine concentration in mol/L using the formulas $c=n/v$ and $c_1V_1=c_2V_2$**
- ✓ **Solve stoichiometric problems using solutions**
- ✓ **Know the properties of acids and bases**
- ✓ **Determine pH, pOH, $[H^+]$ and $[OH^-]$**
- ✓ **Do titration problems**

26. Write the balanced chemical equation for the reaction between sodium hydroxide and phosphoric acid.

$3\ NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3\ H_2O$

27. Which is the limiting reactant if

a) 1.5 g of sodium hydroxide is mixed with 15 g of phosphoric acid?

b) 100 mL of 0.10M sodium hydroxide is mixed with 150 mL of 0.10M phosphoric acid?

on next sheet.

28. 21.0 g of sodium hydroxide is added to water for a final volume of 500 mL. What is the concentration of sodium hydroxide? $n = \frac{21.0}{40.00} = 0.525$ $\quad C = \frac{0.525}{0.500} = 1.05M$

29. What mass of NaCl needs to be added to water to make 100 mL of 1.0M NaOH?

$n = (0.100)(1.0) = 0.100\ mol$

$m = (0.100)(58.44) = 5.8\ g$

30. What volume of 18.0M sulfuric acid is needed to prepare 500 mL of 0.750 M sulfuric acid?

$18.0\ V_1 = (500)(0.750)$ $\quad V_1 = 20.8\ mL$

31. 15.0 g of sodium is added to water. The final volume of the solution formed is 350 mL. After writing out the balanced chemical equation, determine the concentration of sodium hydroxide formed.

$2Na + 2H_2O \rightarrow 2NaOH + H_2$

15.0 g

$n = \frac{15.0}{22.99} = 0.6525$ $\quad n = 0.6525$ (1:1) $\quad C = \frac{0.6525}{0.350} = 1.86M$

25. $n_C = \frac{66.6}{12.01} = 5.545\ mol$ $\quad n_H = \frac{11.2}{1.008} = 11.11\ mol$ $\quad n_O = \frac{22.2}{16.00} = 1.388\ mol$

$\div 1.388 \quad 4.00 \quad : \quad 8.00 \quad : \quad 1$

empirical formula $C_4H_8O_1$

$mm_{C_4H_8O} = 72.10\ g/mol \quad \times 2 = 144.21$

∴ molecular formula $C_8H_{16}O_2$

27. $3NaOH + H_3PO_4 \rightarrow$

a) $1.5\ g \qquad 15\ g$

$n = \frac{1.5}{40.00} = 0.0375\ mol \qquad n = \frac{15}{97.99} = 0.153\ mol$

↑

not 3×0.153 ∴ LR.

b) $3NaOH + H_3PO_4$

100 mL 0.10M $\qquad$ 150 mL 0.10M

$n = (0.10)(0.10) = 0.010\ mol \qquad n = (0.10)(0.150) = 0.015\ mol$

LR - again - not $3(0.015)$

$V_{H_2CO_3}$

32. 10.0 mL of H_2CO_3 is titrated with 0.50 M NaOH. C_{NaOH}

a) Write the chemical equation that represents the reaction.

b) Complete the chart:

Trial	Initial reading on burette	Final reading on burette	Volume of NaOH added (mL)
1	0.0	12.4	12.4
2	12.4	24.2	11.8
3	24.2	36.5	12.3
		Average volume NaOH added	12.2 mL

$2NaOH + H_2CO_3 \rightarrow Na_2CO_3 + 2H_2O$

c) How many moles of NaOH were required to neutralize the acid? $n = (0.50)(0.0122) = 0.00610$ mol

d) How many moles of carbonic acid were neutralized? $n = \frac{0.00610}{2} = 0.00305$ mol

e) What is the concentration of the carbonic acid?

f) If phenolphthalein is used as the acid-base indicator, what colour will the endpoint be? Pale pink.

$C = \frac{0.00305}{0.010} = 0.305\ M$

33. What is the pH of

a) 0.0052M HCl? 2.3

b) 0.15M NaOH? $-\log(0.15) = 0.82$

$pH = 14 - 0.82 = 13.2$

34. What is the $[H^+]$ in a solution with a pH of 2.6? $10^{-2.6} = 0.0025\ M$

35. What is the colour of phenolphthalein in

a) Water: Colourless b) acid: Colourless c) base: pink.

36. A solution tastes sour and is corrosive. Is it an acid or base?

37. A solution turns red litmus paper blue and tastes bitter. Is it an acid or base?

Formulas:

$n = m/mm$ $\quad m = n \times mm$ $\quad n = c \times V$ $\quad c = n/V$ $\quad C_1V_1 = C_2V_2$

$pH = -\log[H^+]$ $\quad pOH = -\log[OH^-]$ $\quad pH + pOH = 14$ $\quad [H^+] = 10^{-pH}$ $\quad [OH^-] = 10^{-pOH}$

% error % yield

Gases.

38 a) $T = 120^\circ C + 273 = 393\ K$

b) $P_1 = 110\ kPa$ $\quad P_2 = 101.3\ kPa$

$T_1 = 25^\circ C + 273 = 298\ K$ $\quad T_2 = 273$

$V_1 = 1.5\ L$ $\quad V_2 = ?$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{(110)(1.5)}{298} = \frac{(101.3)V_2}{273}$$

$$(298)(101.3)V_2 = (110)(1.5)(273)$$

$$V_2 = \frac{(110)(1.5)(273)}{(298)(101.3)} = 1.49\ L$$

39. a) As pressure increases, volume decreases.

b) As temperature decreases, pressure decreases.

c) As "n" increases, pressure increases.

40. $PV = nRT$ $\quad P = 102\ kPa$

$V = ?$

$V = \frac{nRT}{P}$ $\quad n = 1.00/2.016 = 0.4960\ mol$

$R = 8.314$

$= \frac{(0.4960)(8.314)(303)}{102}$ $\quad T = 30^\circ C + 273 = 303\ K$

$= 12.3\ L$

41. $Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$

$Mg_{(s)}$	$2HCl_{(aq)}$	$MgCl_{2(aq)}$	$H_{2(g)}$
10.0 g	500.0 mL of 0.400 M		$n = ?$
$n = \frac{10.0}{24.31}$	$n = CxV$		* use L.R.
$= 0.4114$ mol	$= (0.400)(0.500)$		$n = \frac{0.200}{2}$
	$= 0.200$ mol ↑ L.R. (it is supposed to be 2x Mg but it is less than Mg)		(since 2:1 with HCl) $= 0.100$ mol
			**

** since it is at STP we have 2 ways to solve for volume.

① $V = n \times mV = (0.100)(22.4) = 2.24\,L$

or

② $PV = nRT$ or $V = \frac{nRT}{P}$

$= \frac{(0.100)(8.314)(273)}{101.3}$

$= 2.24\,L$

42. $n_{N_2} = 5.0\ mol$ $n_{He} = 10.0\ mol$ $n_{total} = 15.0\ mol$ of gas

mole fraction for $N_2 = \frac{5.0}{15.0} = \frac{1}{3}$ rd. or 0.333

mole fraction for He: $\frac{10.0}{15.0} = \frac{2}{3}$ or 0.667

$\therefore$ $\frac{1}{3}$ of the total pressure comes from N_2

$\therefore$ $\frac{1}{3}$ of 90 kPa = 30 kPa.

$\frac{2}{3}$ of the total pressure comes from He

$\therefore$ $\frac{2}{3}$ of 90 kPa = 60 kPa.

(ie. $P_{total} = P_{N_2} + P_{He}$)

$90\ kPa = 30\ kPa + 60\ kPa.$