Exam 2a
Chem 1141
Fall 2008

Name: KEY

MULTIPLE CHOICE. [2 pts ea.]

Q1. The atomic mass unit (amu) is defined as exactly equal to:
(a) 1/12 mass of an atom of C-12 b) the mass of one atom of H-1
c) 1/16 the mass of an atom of O-16 d) one gram per mole
e) the mass of one proton

Q2. The (average) atomic mass of chlorine is:
a) 12.01 b) 17 c) 18 d) 35 (e) 35.45

Q3. The molar mass of H_2O (in g/mol) is:
a) 1.00 b) 16.00 c) 17.01 (d) 18.02 e) 21.03

Q4. The number of moles of H_2 in a 3.40 g sample is:
a) 1.00 (b) 1.69 c) 3.40 d) 3.43 e) 6.85

Q5. A device used to *weigh* individual atom/molecules by measuring the deflection of a charged ion in a magnetic field:
a) pipet (b) mass spectrometer c) titration d) isotope
e) analytical balance

Q6. When the equation:

$$\_\_C_2H_4(g) + \underline{6}\,N_2O(g) \rightarrow \underline{2}\,CO_2(g) + \underline{6}\,N_2(g) + \underline{2}\,H_2O(l)$$

is balanced using the lowest set of whole number coefficients, the number written in front of N_2O is:
a) 1 b) 2 c) 4 d) 5 (e) 6

Q7. When the equation:

$$\_\_C_2H_4(g) + \_\_N_2O(g) \rightarrow \_\_CO_2(g) + \_\_N_2(g) + \_\_H_2O(l)$$

is balanced using the lowest set of whole number coefficients, the number written in front of CO_2 is:
a) 1 (b) 2 c) 4 d) 5 e) 6

Q8. A substance that dissolves in water to form a solution than conducts electricity is called a(n):
(a) electrolyte b) non-electrolyte c) precipitate d) molecule
e) conductor

Q9. The compound $Mg(NO_3)_2$ is soluble in water:
(a) TRUE b) FALSE

Q10. The compound Fe_2S_3 is soluble in water:
a) TRUE (b) FALSE

Q11. An acid is a substance that:

a) Forms OH^- ions when dissolved in water
b) Turns litmus blue
c) Forms H^+ ions when dissolved in water
d) Forms NO_3^- ions when dissolved in water
e) Tastes bitter

Q12. The oxidation number of the ~~oxygen~~ sulfur atom in the ion: SO_3^{2-} is:

a) +1 b) +2 c) +3 d) +4 e) +5 f) +6

Q13. A substance that is oxidized:

a) Reacts with hydrogen
b) dissolves well in water
c) burns in air
d) gains electrons
e) loses electrons

Q14. 100.0 mL of a solution that is 1.50 M HCl contains how many moles of HCl?

a) 150 b) 15.0 c) 1.50 d) 0.150 e) 0.0150

Q15. What volume of 2.0 M NaCl contains 0.10 mol NaCl?

a) 20.0 L b) 2.0 L c) 0.20 L d) 0.020L e) 0.050 L

Q16. The molar concentration of a sample of NaOH that has 0.25 mol of NaOH in 125 mL of solution is:

a) 0.00200 M b) 0.25 M c) 2.0 M d) 31 M e) 500 M

Q17. Water is added to a 10. mL sample of 15.0 M HNO_3 until the final volume is 100. mL. What is the molar concentration of the HNO_3?

a) 0.015 M b) 0.15 M c) 1.5 M d) 15 M e) 150 M

Q18. What type of equation is represented below:

$Mg^{2+}(aq) + 2NO_3^-(aq) + 2Na^+(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s) + 2Na^+(aq) + 2NO_3^-(aq)$

a) Net ionic b) Full ionic c) Molecular d) Spectator e) Redox

Short Response.

Show ALL work to receive credit. Use the conversion factor method for all problems to receive full credit.

Q19. [9 pts.] Bornite is an important copper mineral with the chemical formula Cu_5FeS_4. Its nickname is *peacock copper* due to its purple/bronze iridescent color. Calculate the percent composition by mass of each element in Bornite.

Cu_5FeS_4

$5 \times Cu = 5 \times 63.55 = 317.8$

$1 \times Fe = 1 \times 55.85 = 55.85$

$4 \times S = 4 \times 32.07 = 128.3$

501.95

$= 502.0$

$\%\ Cu = \frac{317.8}{502.0} \times 100\% = 63.31\%$

$\%\ Fe = \frac{55.85}{502.0} \times 100\% = 11.13\%$

$\%\ S = \frac{128.3}{502.0} \times 100\% = 25.56$

Q20. [15 pts.] Write the **balanced** molecular, full-ionic, and net-ionic chemical equations for the reaction between aqueous hydrochloric acid, HCl(aq) and aqueous sodium carbonate, $Na_2CO_3(aq)$. Be sure to include **all state symbols and charges**.

a) MOLECULAR

$$2HCl_{(aq)} + Na_2CO_{3(aq)} \longrightarrow 2NaCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$$

b) FULL-IONIC

$$2H^+_{(aq)} + 2Cl^-_{(aq)} + 2Na^+_{(aq)} + CO_3^{2-}{}_{(aq)} \longrightarrow 2Na^+_{(aq)} + 2Cl^-_{(aq)} + H_2O_{(l)} + CO_{2(g)}$$

c) NET-IONIC

$$2H^+_{(aq)} + CO_3^{2-}{}_{(aq)} \longrightarrow H_2O_{(l)} + CO_{2(g)}$$

Q21. [4 pts.] Name the following compounds:

i) CuCl copper(I) chloride

ii) N_7F_9 heptanitrogen nonafluoride

iii) $KHCO_3$ potassium bicarbonate

iv) $FeCl_2$ iron(II) chloride

Q22. [4 pts.] Write formulas for the following compounds:

i) sodium phosphate Na_3PO_4

ii) copper(II) nitrate $Cu(NO_3)_2$

iii) trisulfur pentoxide S_3O_5

iv) calcium sulfate pentahydrate $CaSO_4 \cdot 5H_2O$

$Al(OH)_3$

$1 \times Al = 1 \times 26.98$
$3 \times O = 3 \times 16.00$
$3 \times H = 3 \times 1.01$
78.01

Q23. [16 pts.] Given the following unbalanced chemical equation:

$\_Al(NO_3)_3(aq) + \underline{3}KOH(aq) \rightarrow \_Al(OH)_3(s) + \underline{3}KNO_3(aq)$

a) Balance the equation (Write in the coefficients)

b) Calculate the number of moles of $Al(OH)_3$ that can be formed from the complete reaction of 0.40 mol KOH.

$$0.40 \text{ mol KOH} \left| \frac{1 \text{ mol } Al(OH)_3}{3 \text{ mol KOH}} \right. = 0.13 \text{ mol } Al(OH)_3$$

c) Predict the mass of $Al(OH)_3$ that can be made from mixing 20.0 mL of 1.00 M $Al(NO_3)_3(aq)$ and 15.0 mL of 1.60 M KOH(aq).

$$20.0 \text{ mL} \left| \frac{10^{-3} \text{ L}}{\text{mL}} \right| \frac{1.00 \text{ mol } Al(NO_3)_3}{1 \text{ L}} \left| \frac{1 \text{ mol } Al(OH)_3}{1 \text{ mol } Al(NO_3)_3} \right| \frac{78.01 \text{ g } Al(OH)_3}{1 \text{ mol } Al(OH)_3} = 1.56 \text{ g } Al(OH)_3$$

$$15.0 \text{ mL} \left| \frac{10^{-3} \text{ L}}{\text{mL}} \right| \frac{1.60 \text{ mol KOH}}{1 \text{ L}} \left| \frac{1 \text{ mol } Al(OH)_3}{3 \text{ mol KOH}} \right| \frac{78.01 \text{ g } Al(OH)_3}{1 \text{ mol } Al(OH)_3} \left| = 0.624 \text{ g } Al(OH)_3 \right.$$

$\Rightarrow$ 0.624 g $Al(OH)_3$ is formed.

d) If 0.402 g of $Al(OH)_3$ are formed in the reaction described in part (c), then what is the percent yield?

$$\% \text{ yield} = \frac{0.402 \text{ g}}{0.624 \text{ g}} \times 100\% = 64.4\%$$

Q24. [16 pts.] How many moles do the following contain:

CH_2O
1×C = 12.01
2×H = 2.02
1×O = 16.00
30.03

a) 4.50 g of CH_2O

$$4.50\,g\ CH_2O \left| \frac{1\,mol\ CH_2O}{30.03\,g\ CH_2O} \right. = 0.150\,mol\ CH_2O \quad (3sf)$$

NaCl
1×Na = 22.99
1×Cl = 35.45
58.44

b) 12.3 g of NaCl

$$12.3\,g\ NaCl \left| \frac{1\,mol\ NaCl}{58.44\,g\ NaCl} \right. = 0.210\,mol\ NaCl \quad (3sf.)$$

c) 22.0 mL of 0.331 M $MgCl_2$

$$22.0\,mL \left| \frac{10^{-3}\,L}{mL} \right| \frac{0.331\,mol\ MgCl_2}{1\,L} = 0.00728\,mol\ MgCl_2 \quad (3sf.)$$

d) 135 mL of 0.25 M CH_2O

$$135\,mL \left| \frac{10^{-3}\,L}{mL} \right| \frac{0.25\,mol\ CH_2O}{1\,L} = 0.034\,mol\ CH_2O \quad (2s.f.)$$

BONUS: i) How many protons, neutrons, and electrons are there in an atom of sodium-24?

mass # (A)
" $\#p^+ + \#n^0$
" $24 = 11p^+ + 13n^0$

$Z = \#p^+ = \#e^-$ (atoms)

$\Rightarrow 11p^+, 11e^-, 13n^0$

ii) Convert a speed of 3.4 nm/ms to units of pm/ns.

$nm = 10^{-9}m$
$ms = 10^{-3}s$
$pm = 10^{-12}m$
$ns = 10^{-9}s$

$$3.4\,nm \left| \frac{10^{-9}\,m}{nm} \right| \frac{ms}{10^{-3}\,s} \left| \frac{pm}{10^{-12}\,m} \right| \frac{10^{-9}\,s}{ns} = 3.4 \times \frac{10^{-9} \times 10^{-9}}{10^{-15}}\ pm/ns$$

$$= 3.4 \times 10^{-3}\ pm/ns.$$