EXAM REVIEW

SCH3U_2010 - 2011

1. When a chlorine atom becomes a chloride ion the:

   a. Ion has the same diameter as the atom
   b. Ion has a smaller diameter than the atom
   c. Ion has a larger diameter than the atom
   d. Nucleus becomes larger
   e. Nucleus becomes smaller

2. 20 mL of a gaseous hydrocarbon require 90 mL of oxygen gas for complete combustion, both volumes being measured under the same conditions of temperature and pressure. Which one of the following is the hydrocarbon?

   a. CH_4 b. C_2H_2 c. C_2H_4 d. C_3H_6 e. C_3H_8

3. The new element Canadium has two isotopes, ^{300}Cn and ^{310}Cn with relative abundances of 25 % and 75 % respectively. The relative atomic mass of Canadium is:

   a. 302.5 b. 305.0 c. 307.5 d. 309.0

4. What would be the mass of 0.200 mol of sulfuric acid?

   a. 19.60 g b. 9.70 g c. 9.80 g d. 8.10 g e. 8.20 g

5. A sample of a compound contains only 9.0 g of hydrogen and 36 g of carbon. The simplest formula for the compound is:

   a. C_4H b.$C_{36}H_6$ c.CH_2 d. CH_3 e. C_2H_4

6. The molar mass of a hypothetical element X is 25 g/mol. It is found that 50.0 g of X combine with 32.0 g of oxygen. What is the simplest formula for the oxide of X?

   a. X_2O b.XO_2 c.X_2O_3 d. XO e. XO_4

7. Sulfur (S_8) reacts with oxygen (O_2) and produces sulfur trioxide (SO_3) according to the following balanced equation:

   $$S_8(s) + 12\ O_2(g) \longrightarrow 8\ SO_3(g)$$

   How many moles of oxygen molecules must react to produce 160 g of sulfur trioxide?

   a. 3.00 b. 6.00 c. 9.0 d. 12.0

8. Consider the following equation for the next question:

   $$Fe_3O_4 + 4\ H_2 \longrightarrow 3\ Fe + 4\ H_2O$$

   The number of moles of hydrogen required to completely react with 2.0 mol of (Fe_3O_4) is:

   a. 4 b. 6 c. 8 d. 12

9. Which element has the highest ionization energy?

   a. Na b. F c. Ne d. Cl e. Mg

The **next two questions** deal with the identification and characterization of three elements which we shall call X, Y, and Z.

The elements have successive atomic numbers each increasing by one in the order given. Atoms of element Z form stable ions with the formula Z^+.

10. Which of the following statements is **FALSE** concerning elements X, Y, and Z?

    a. A neutral atom of element Y would have one more electron than a neutral atom of element X, but one less electron than a neutral atom of element Z.
    b. Element X could be a halogen.
    c. Elements X, Y, and Z would all be in the same chemical family of the periodic table.
    d. Elements X, Y, and Z could be those elements with atomic numbers 9, 10, and 11 respectively.

11. Which of the following statements is **FALSE** concerning the elements X, Y, Z and their ions?

    a. The ions X^- and Z^+ would have the same number of electrons as neutral atoms of element Y.
    b. Atoms of element Y would react with either those of elements X or Z.
    c. Element X would form a compound with hydrogen with the formula HX.
    d. Element Z would form a compound with chlorine with the formula ZCl.
    e. Elements X and Z would react to form a compound with the formula ZX.

12. 1 L of gas in a container at - 73 ^{0}C is allowed to expand to 1.5 L. What must the temperature be increased to so that the pressure remains constant?

    a - 36 ^{0}C b. 0 ^{0}C c. 27 ^{0}C d. 73 ^{0}C

13. During a chemical reaction which of the following statements is true?

    a. When one of the products of reaction is a gas the mass of the reactants will be greater than the mass of the products.
    b. When of the products is a precipitate the mass of the products will be greater than the mass of the reactants.
    c. The mass of the products is not dependant on the mass of the reactants.
    d. The mass of the products equals the mass of the reactants.

14. A substance that changes the speed of a chemical reaction without being permanently altered is:

    a. A catalytic agent b. A dehydrating agent
    c. An oxidizing agent d. A reducing agent

15. Which of the following principles of conservation apply in all chemical reactions having a balanced equation?

    1. conservation of volume
    2. conservation of the number of molecules
    3. conservation of the number of atoms
    4. conservation of mass

a. 1 – 2 – 3 b. 2 – 3 – 4 c. 3 – 4 only d. 1 – 2 only

16. The pressure on 600 cm^3 of gas is increased from 100 kPa to 300 kPa at constant temperature. What will the new volume of gas be?

    a. 200 cm^3 b. 300 cm^3 c. 1200 cm^3 d. 1800 cm^3

17. Which of the following equations is not balanced?

a. $P_4 + 5\,O_2 \rightarrow 2\,P_2O_5$
b. $2\,NCl_3 \rightarrow N_2 + Cl_3$
c. $2\,H_2O + 2\,K_2O_2 \rightarrow O_2 + 4\,KOH$
d. $PbS + 4\,H_2O_2 \rightarrow PbSO_4 + 4\,H_2O$

18. Which one of the following reactions is not possible?

a. $Na \rightarrow Na^+ + e^-$
b. $F \rightarrow F^+ + e^-$
c. $H_2 \rightarrow 2\,H^+ + 2e^-$
d. $Cl \rightarrow Cl^- + e^-$
e. $Ba \rightarrow Ba^{2+} + 2e^-$

19. How many electrons are there in a sulphide ion, S^{2-} ?

a. 14 b. 15 c. 16 d. 17 e. 18

20. A bromide ion will have a charge of:

a. +1 b. +2 c. +3 d. –1 e. –2

21. An atom of iron $^{56}_{26}Fe$ has:

a. 26 protons, 26 electrons, 30 neutrons
b. 30 protons, 30 electrons, 26 neutrons
c. 30 protons, 26 electrons, 26 neutrons
d. 26 protons, 26 electrons, 56 neutrons
e. 26 protons, 30 electrons, 30 neutrons

22. How many electrons are in the outer (highest) energy level of a $^{39}_{19}K$ ion?

a. 3 b. 5 c. 6 d. 7 e. 8

23. 8.00 g of NaOH is dissolved in sufficient water to make 200.0 mL of solution. The concentration of the solution is (in mol/L):

a. 1.00 b. 0.200 c. 0.250 d. 0.500 e. 0.040

24. The atom with an atomic number of 13 will tend to:

a. gain 5 electrons b. gain 3 electrons
c. lose 5 electrons d. lose 3 electrons e. lose 1 electron

25. When sodium reacts with water the products are:

a. H_2 and Na_2O b. H_2 and NaOH c. H_2 and NaH
d. O_2 and NaOH e. O_2 and NaH

26. Which of the following is a **quantitative chemical** property of magnesium?

a. The boiling point of magnesium is 1107°C
b. The density of magnesium is 1.74 g/cm^3
c. Magnesium reacts with chlorine to form magnesium chloride
d. Magnesium is a silvery solid.
e. Magnesium will ignite at 648°C

27. Which of the following elements has the **lowest second ionization energy**?

a. Na b. K c. Mg d. Ca e. Al

28. Zinc + hydrochloric acid produces:

a. hydrogen and zinc hydroxide
b. hydrogen and zinc chloride
c. hydrogen and zinc nitrate
d. chlorine and zinc hydride
e. chlorine and zinc hydroxide

29. If the **molecular mass** for a compound having the ratio of carbon to hydrogen atoms, 1 to 1, is 52 g/mol, what would its molecular formula be?

a. CH b. C_2H_2 c. C_4H_4 d. C_5H_5 e. C_6H_6

30. What is the molar concentration of OH^- ions in pure water?

a) 1.0×10^{-1} mol L^{-1} b) 1.0×10^{-7} mol L^{-1}
c) 1.0×10^{-10} mol L^{-1} d) 1.0×10^{-14} mol L^{-1}

31. Experimentally, a strong acid differs from a weak acid in :

a) concentration b) solubility
c) electrical conductivity d) its reaction with litmus paper

32. Consider the following equation :

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

What mass of NaOH would be required to produce 117 g of NaCl?

a) 117 g b) 58.5 g c) 40 g d) 80 g e) 20 g

33. The concentration of **OH^-** ions in a solution with a pH of 3 is:

a) 1.0×10^{-3} mol L^{-1} b) 1.0×10^{3} mol L^{-1}
c) 1.0×10^{-1} mol L^{-1} d) 1.0×10^{-11} mol L^{-1}

34. The pH at which the colour of an indicator changes is called the :

a) endpoint b) turning point c) equivalence point
d) neutralization point e) titration point

35. Which of the following 1.0 mol L^{-1} solutions will be the poorest conductor of electricity ?

a) hydrochloric acid b) acetic acid
c) sodium hydroxide d) sodium chloride

36. If 4.0 g of sodium hydroxide is dissolved in enough water to make 400 mL of solution, what is the **molar concentration of sodium ions** in the solution?

a) 10.0 mol L^{-1} b) 0.40 mol L^{-1} c) 0.25 mol L^{-1}
d) 0.040 mol L^{-1} e) 0.010 mol L^{-1}

37. AB_2 is the salt of a strong acid and a weak base. A 0.02 mol L^{-1} solution of this salt is a saturated solution at 25 ^{0}C. What is the concentration of B^- ions in solution?
a) 1.0×10^{-7} mol L^{-1} b) 4.0×10^{-4} mol L^{-1} c) 1.0×10^{-3} mol L^{-1}
d) 2.0×10^{-2} mol L^{-1} e) 4.0×10^{-2} mol L^{-1}

38. The pH of tomato juice is 4.5. The $[H^+]$ in tomato juice is:

a) 3.2×10^{-10} mol L^{-1} b) 3.2×10^{-5} mol L^{-1} c) 5.0×10^{-4} mol L^{-1}
d) 4.5 mol L^{-1} e) 3.2×10^{10} mol L^{-1}

39. The boiling point of oxygen is - 183 ^{0}C, and its freezing point is - 219 ^{0}C. Within 50 K of absolute zero, oxygen is a :

a) gas b) liquid c) solid d) solution

40. Which one of the following statements is true?

a) a decrease in pressure on a gas causes a decrease in volume
b) absolute zero is - 273 K
c) an increase in the pressure of a gas could be due to a decrease in the number of molecules
d) in a mixture of gases, the one with the most molecules exerts the most pressure.

41. Which one of the following is a basic assumption of the kinetic molecular theory?

a) particles are in constant random motion
b) particles lose energy with an increase in velocity
c) particles travel faster as the temperature decreases
d) particles lose energy when the temperature increases.

42. A vessel contains 2.50 mol of oxygen gas, 0.50 mol of nitrogen gas and 1.00 mol of carbon dioxide gas. The total pressure is 200 kPa. The partial pressure exerted by the oxygen gas in the mixture is:

a) 125 kPa b) 150 kPa c) 200 kPa d) 250 kPa

43. The density of an unknown gas is 1.34 g L^{-1} at STP. The gas could be:

a) F_2 b) Cl_2 c) CH_4 d) CH_2O

44. A gas occupies 40.0 mL at - 123 ^{0}C. What volume does it occupy at 27 ^{0}C, assuming pressure is constant?

a) 182 mL b) 8.80 mL c) 80.0 mL d) 20.0 mL

45. A gas occupies a volume of 0.2 L at 25 kPa. What volume will the gas occupy at 2.5 kPa assuming the temperature is kept constant.

a) 0.02 L b) 2 L c) 20 L d) 4 L

46. The following equation represents the electrolysis of water:

$$2\ H_2O_{(l)} \longrightarrow 2\ H_{2(g)} + O_{2(g)}$$

What volume of oxygen gas will be evolved if 360 g of water are electrolyzed at 273 K and 101.3 kPa ?

a) 224 L b) 245 L c) 448 L d) 490 L

47. What volume of ammonia, NH_3, will be produced when 200 L of nitrogen gas reacts with a sufficient quantity of hydrogen gas at O ^{0}C and 100 kPa according to the following equation?

$$N_{2(g)} + 3\ H_{2(g)} \longrightarrow 2\ NH_{3(g)}$$

a) 200 L b) 300 L c) 400 L d) 500 L

48. 5.02 g of an unknown gas is sealed in a 1.0 L flask at 37 ^{0}C and 3.75 atm. Which one of the following is most likely to be the unknown gas? (R = 0.0821 atm L K^{-1} mol^{-1})

a) H_2O b) HBr c) HCN d) H_2S

49. For a substance that remains a gas under the conditions listed, **deviation** from the ideal gas law would be most pronounced at :

a) 100 ^{0}C and 2.0 atm
b) 0 ^{0}C and 2.0 atm
c) - 100 ^{0}C and 2.0 atm
d) - 100 ^{0}C and 4.0 atm

50. Given the following equation:

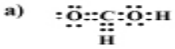
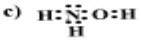
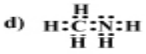
$$CaCO_{3(s)} + 2\ HCl_{(g)} \longrightarrow CaCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$$

How many moles of $CaCl_2$ would one obtain by making 112 L of CO_2 at O ^{0}C and 101.3 kPa ?

a) 0.200 mol b) 4.68 mol c) 5.00 mol d) 112 mol

51. What is the correct name of $SnSO_3$?
a) tin (II) sulphite b) tin (IV) sulphite c) stannic sulphite
d) stannic sulphate e) tin (II) sulphate

52. Which of the following is an example of correct Lewis structure?

a) 
b)
c) 
d) 

53. What is the correct name of $Pb(OH)_2 \cdot 6H_2O$?

a. Lead (II) hydroxide heptahydrate
b. Lead (II) hydroxide hexahydtare
c. Plumbous hydroxide hydrate
d. Lead (IV) hydroxide hydrate

54. 50.0 mL of 0.125 M sulphuric acid solution ($H_2SO_{4(aq)}$) is diluted with water to 1.00 L. The molar concentration of hydrogen ion, $H^+_{(aq)}$ in the diluted solution is:

a) 0.00625 M b) 0.0125 M c) 0.125 M d) 0.250 M e) 6.25 M

55. The first four ionization energies of an element X are :

740 kJ mol^{-1}, 1450 kJ mol^{-1} , 7730 kJ mol^{-1}, 10 470 kJ mol^{-1}

The formula for the stable ion of X is most likely to be:

a) X^+ b) X^{2+} c) X^{3+} d) X^{4+}

56. Atoms of the different isotopes of the same element are identical in the:

a) number of electrons
b) sum of number of protons and neutrons
c) sum of the number of protons and neutrons
d) mass number

57. The elements X and Y have 6 and7 electrons respectively, in the highest energy levels of their atoms. What is the formula and type of bonding used in a compound formed by these elements?

a) XY_2 , ionic b) X_2Y, ionic c) X_2Y, covalent d) XY_2 , covalent

58. In the periodic table, the elements are arranged in order of increasing:

a) Number of neutrons
b) Number of protons
c) Ionization energy
d) Electronegativity

59. Which of the following molecules has a pyramidal shape ?

(a) NF_3 (b) H_2S (c) CCl_4 (d) CO_2

60. Which one of the following covalent bonds is the most polar?

A. H– O B. H– N C. H– Cl D. H– F

61. Which change in conditions would **increase the volume** of a fixed mass of gas?

	Pressure /kPa	Temperature /K
A.	Doubled	Doubled
B.	Halved	Halved
C.	Doubled	Halved
D.	Halved	Doubled

62. Which is a **conjugate acid-base pair** in the following reaction?

$$HNO_3 + H_2SO_4 \rightleftharpoons H_2NO_3^+ + HSO_4^-$$

A. HNO_3 and H_2SO_4 B. HNO_3 and $H_2NO_3^+$

C. HNO_3 and HSO_4^- D. $H_2NO_3^+$ and HSO_4^-

63. Which methods can distinguish between solutions of a strong monoprotic acid and a weak monoprotic acid of the same concentration?

I. Add magnesium to each solution and measure the rate of the formation of gas bubbles.

II. Add pH paper and measure the pH change

III. Use each solution in a circuit with a battery and lamp and see how bright the lamp glows.

A. I and II only B. I and III only C. II and III only D. I, II and III

64. According to the Bronsted-Lowry theory, the conceptual definition of an acid is any substance that _____.

(A) Conducts electricity. (B) Reacts with Zn to liberate H2(g).

(C) Gives up protons. (D) Turns litmus red.

Problems

1. Explain how the number of electrons in an atom affects atomic radius

2. Using the periodic table, explain the following:

a. Why potassium is more reactive than sodium

b. Why noble gases are assigned a value of zero for electronegativity.

c. Why silicon has a higher ionization energy than sodium.

d. Explain how first ionization energy is related to atomic radius.

e. Why aluminium has a higher ionization energy than gallium.

f. Why sodium ion is smaller than the sodium atom.

g. Why P^{-3} ion is larger than P atom.

3. For each of the following molecules:

CF_4, PH_3, PH_2^{-1}, PH_4^{+1}, H_2Te, BF_3, $BeCl_2$, SO_2

a. Draw the Lewis structure.
b. State the name of the 3– D shape

4. For each of the following:

. give the reaction type
- give a balanced equation
- give phases for each substance
- state the precipitate
- write a total dissociated equation
- write a net-ionic equation

a. Magnesium sulfate reacts with ammonium hydroxide

b. Lead (II) nitrate solution reacts with sodium iodide solution

c. Acetic acid reacts with sodium hydroxide.

d. Strontium chloride reacts with potassium phosphate.

e. Potassium hydroxide reacts with sulphuric acid.

5. An organic compound was found by analysts to contain 40.45% C; 7.86% H and 15.73% N. The remainder was an element commonly found in nature and all organic acids … like acetic acid. (Think !!!)
A separate experiment determined the molecular mass of the compound to be 89.0g mol^{-1}.

(a) Determine the empirical formula of the compound.

(b) What is the molecular formula of the compound?

6. Tin (II) iodide, SnI_2, can be prepared by adding a solution of potassium iodide, $KI_{(aq)}$ to a solution of tin (II) chloride, $SnCl_{2\,(aq)}$, and precipitating the insoluble iodide.

2.280 g of $SnCl_2$ were dissolved in 25.0 cm^3 of water and mixed with 10.0 cm^3 of 1.40 mol L^{-1} $KI_{(aq)}$ to precipitate the tin (II) iodide.

(i) Write a balanced equation for the reaction of $SnCl_{2(aq)}$ with $KI_{(aq)}$.

(ii)Determine the number of mols of each reactant.

(iii) Determine which of the reagents is present in excess nad which reagent is the limiting reagent.

(iv) Calculate the maximum mass of tin (II) iodide that could be formed

(v) In an experiment carried out as described above, 1.89 g of tin (II) iodide was obtained. Determine the percentage yield.

7. A 0.496 g of an unknown hydrocarbon, (a compound containing just carbon and hydrogen) was completely burned in oxygen. The sample produced 1.5 6 g of carbon dioxide and 0.638 g of water.

(a) (i) How many moles of carbon dioxide were formed?

(ii) How many moles of water were formed?

(iii) What is the empirical formula of the hydrocarbon?

(b) A 1.12 g sample of the hydrocarbon occupied 448 cm^3 at 0 ºC and 101.3 kPa pressure. What is the molecular mass of the compound? (1.00 mol of any gas occupies 22.4 L at 0ºC and 101.3 kPa, a.k.a.: STP)

(c) What is the molecular formula of the compound?

8. Lead (II) nitrate, $Pb(NO_3)_2$, reacts with sodium iodide, NaI. One of the products is a yellow precipitate. How much precipitate would be produced if 6.00 g of sodium iodide was used with sufficient NaI?

9. If hydrogen gas occupies 44. 8 L at STP, at what pressure will the sample occupy 112 L when the temperature is fixed at 30 ^{0}C ?

10. What is the volume occupied by 4.4 g carbon dioxide gas at a temperature of 30.0 ^{O}C and a pressure of 99.6 kPa?

11. What is the density of sulphur dioxide gas, SO_2, if 6.40 g exerts a pressure of 98.8 kPa at a temperature of 23.5 ^{O}C ?

12. Calcium oxide, CaO, reacts with carbon dioxide to produce calcium carbonate, $CaCO_3$. If 10.0 L of carbon dioxide at 5.00 ^{0}C and 121.2 kPa reacts with the calcium oxide, what mass of calcium carbonate will be produced?

13. What mass of sodium phosphate, Na_3PO_4, was used to produce 250 mL of 0.100 mol/L solution?

14. A 145.0 mL sample of sulphuric acid reacts completely with zinc metal to produce 125.0 mL of hydrogen gas at 22.0 ^{O}C and a pressure of 102.3 kPa. What is the molar concentration of the sulphuric acid?

15. Tums, essentially calcium carbonate, $CaCO_3$, on the market are sold as an antacid. A tablet of Tums was crushed and reacted with hydrochloric acid, $HCl_{(aq)}$. 28.50 mL of 0.200 mol L^{-1} hydrochloric acid was required to completely neutralize one of the Tums tablet.

a. Write a balanced equation for the reaction of the Tums tablet, ($CaCO_{3\,(s)}$) with hydrochloric acid, $HCl_{(aq)}$.
b. Write a net-ionic equation.
c. Determine the mols of hydrochloric acid consumed.
d. Determine the mols of Tums consumed.
e. Determine the mass of the $CaCO_{3(s)}$ in each of the Tums tablet.

16. How much 15.4 mol/L nitric acid is needed so that the dilution results in 150 mL of 0.200 mol/L solution of the nitric acid.

17. A chemist makes nitroglycerin, $C_3H_5(NO_3)_3$ from glycerol $C_3H_5(OH)_3$ and HNO_3.
The balanced chemical reaction is listed below:

$$C_3H_5(OH)_{3(l)} + 3\,HNO_{3\,(aq)} \longrightarrow C_3H_5(NO_3)_{3\,(l)} + 3\,H_2O_{\,(l)}$$

If 4.1 g of glycerol and 13.5 g of HNO_3 are used to produce 8.80 g of nitroglycerin:
a. What is the limiting reagent?
b. What is the theoretical yield of nitroglycerin?
c. What is the actual yield of nitroglycerin?
d. What is the percentage yield of nitroglycerin?

18. If 26.55 mL of LiOH are required to neutralize 21.70 mL of 0.500 mol/L $HBr_{(aq)}$ what is the concentration of the base?

19. How many grams of table sugar $C_{12}H_{22}O_{11}$ are contained in 50.0 mL of a 0.400 mol/L solution of sugar in water?

20. What is the molar mass of a vapour, 0.842 g of which occupies 450 mL at a pressure of 100 kPa and a temperature of 100 ^{0}C?

21. How many litres of hydrogen gas at 23.0EC and 103.0 kPa can be obtained by the reaction of 75.0 g of aluminium with excess sulfuric acid?

$$2\,Al(s) + 3\,H_2SO_4(aq) \longrightarrow A1_2(S0_4)_3(aq) + 3\,H_2(g)$$

22. A gas occupies 0.045 L at 240K and 100 kPa. When the pressure is changed, the volume becomes 0.015 L at a temperature of 300K. What is the new pressure?

23. 8.0 L of a gas is kept at constant pressure. The temperature is changed to 580 K, and the gas now occupies 20.0 L. What was the initial temperature?

24. A gas occupies 1.0 L container at 20 ^{O}C and 50.0 kPa, it is transferred into a 250 mL container and is subjected to a pressure of 200.0 kPa, what will be the new temperature of the gas?

25. A white powder is a mixture of X mol of hydrated magnesium sulfate ($MgSO_4 \bullet 7H_2O$, Relative Molecular Mass = 246.5) and Y ml of hydrated zinc sulfate ($ZnSO_4 \bullet 7H_2O$, Relative Molecular Mass = 287.5).
0.3973 g of the powder was dissolved in water and an excess of barium chloride solution was added to precipitate barium sulfate. This precipitate was filtered off, dried and weighted. The mass of barium sulfate isolated was 0.3550 g.

(a) How many mol of barium sulfate were precipitated?
(b) In terms of X and Y, what is the total number of the two compounds in the weighted sample of mixture?
(c) Stated also in terms of X and Y, what is the total number of mol of sulfate in the sample which was tested?
(d) Calculate the numerical value of X.
(e) What is the percentage by weight of hydrated magnesium sulfate in the mixture?