SCH3U0 – Practice Final Examination (1.5 hours)

YOUR NAME: _____

YOUR STUDENT #: _____

Teacher:

PLEASE NOTE:

There should be 7 exam question pages plus 3 pages of reference tables and this cover sheet in this exam paper - check now that they are all there

All questions are to be answered on the exam paper

Show ALL your work for the short answer section

Non-programmable calculators are allowed.

A periodic table and reference tables are provided at the end of the exam paper. Detach for quick reference.

	SECTION	MARKS	TIME
PART A	MULTIPLE CHOICE	22	
PART B	SHORT ANSWER	52	
TOTAL		**74**	**90 MINUTES**

/74

PART A: MULTIPLE CHOICE- (22 MARKS)

1. Which Lewis structure shows element 117, represented by the letter X?
   A) X B) X
   C) X D) X

2. How many electrons, protons, and neutrons are in [$^{120}_{50}Sn$] $^{4+}$
   A) 54 e, 50 p^+, 70 n^0 B) 50 e, 54 p^+, 70 n^0
   C) 46 e, 50 p^+, 70 n^0 D) 50 e, 50 p^+, 120 n^0

3. The name corresponding to the compound with the formula $Cu(NO_2)_2 \bullet 7\ H_2O$ is,
   A) copper nitrate heptahydrate B) copper nitrogen dioxide heptahydrate
   C) copper nitrite septahydrate D) copper(II) nitrite heptahydrate

4. An element has a low first ionization energy and a low electron affinity. What is it most likely to be?
   A) a halogen B) an alkali metal
   C) a noble gas D) a Group 16 (VIA) element

5. How many ions are represented in the formula $(NH_4)_2HPO_4$?
   A) 0 D) 4
   B) 2 E) 16
   C) 3

6. Consider the reaction shown below:
   $N_2O_4 \rightarrow 2NO_2$
   This reaction is an example of:
   A) synthesis reaction B) it is not a chemical reaction
   C) combustion reaction D) decomposition reaction

7. Which of the following equations is correctly balanced?
   A) $2H_2O \rightarrow H_2 + O_2$ D) $2Mg + Cl_2 \rightarrow MgCl_2$
   B) $HgO \rightarrow Hg + O_2$ E) None of these
   C) $C + O_2 \rightarrow CO_2$

8. How many molecules of sulfur dioxide are present in 1.60 mol of sulfur dioxide?
   A) 9.63×10^{23} B) 1.54×10^{2}
   C) 3.76×10^{23} D) 2.65×10^{-24}

9. 98 g of hydrogen are reacted with 800 g of oxygen in a synthesis reaction. Which reagent is limiting?
   A) The two reactants are consumed simultaneously
   B) The hydrogen is limiting by about 700 g
   C) The oxygen is limiting
   D) The hydrogen is limiting by less than 2 mol

10. How many moles are in 2.55 g of sodium?
   A) 58.6 mol
   B) 0.111 mol
   C) 0.0554 mol
   D) 9.02 mol

11. The molecular formula of a compound is represented by $X_2Y_3Z_4$. What is the empirical formula?
   A) XYZ B) XY_3Z_2
   C) $X_2Y_3Z_4$ D) $X_6Y_4Z_3$

12. What is the percentage composition of aluminum in aluminum sulfide?
   A) 36% B) 32%
   C) 11% D) 25%

13. Which property is *not* characteristic of an acid?
   A) turns phenolphthalein pink C) conducts electricity
   B) turns litmus paper red D) reacts with an active metal to produce hydrogen gas

14. 67.2 g of copper(II) chloride is dissolved in enough water to make 250 mL of solution. What is the molar concentration of the solution?
   A) 2.5 mol/L C) 1.0 mol/L
   B) 2.0 mol/L D) 0.50 mol/L

15. Identify the conjugate acid for the following reaction:

   $CO_3^{2-}(aq) + HNO_3(aq) \rightarrow HCO_3^-(aq) + NO_3^-(aq)$

   A) CO_3^{2-} B) HNO_3
   C) HCO_3^- D) NO_3^-

16. What's the $[H^+]$ of a solution with a pOH of 5.1?
A) 1.2×10^{-9} mol/L B) 7.9×10^{-6} mol/L
C) 4.5×10^{-2} mol/L D) 3.1×10^{-3} mol/L

17. A solution with a pH of 10.8 is used in a ten-fold dilution. What is the pH of the new solution?
A) 11.8 C) 10.7
B) 10.9 D) 9.8

18. For the equation below, the volume of NH_3 gas produced at STP from one mole of N_2 (g) would be, $N_{2\,(g)} + 3\,H_{2\,(g)} \rightarrow 2\,NH_{3\,(g)}$
A) 44.8 L B) 22.4 L
C) 3.0 L D) 0.66 L

19. According to Boyle's law, the volume of a given mass of gas is inversely proportional to the pressure at a constant temperature. How will an increase in the pressure exerted on a gas affect its density?

A) Its density will decrease B) Its density will increase
C) Its density will remain the same D) The density of only some gases will increase

20. A particular gas occupies 15 L at 0°C. What volume will the gas occupy at -35°C, assuming that the pressure remains constant?
A) 13 L B) 17 L
C) 2 L D) 10 L

21. What is the mass of 5.6 L of gaseous ammonia, NH_3, at STP?
A) 0.25 g
B) 4.3 g
C) 8.5 g
D) 22.4 g

22. Nitrogen gas, N_2, and hydrogen gas, H_2, react to produce ammonia, NH_3, according to the following equation:
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
How many litres of hydrogen gas, measured at 101.3 kPa and 273 K, are needed to react with 11.2 L of nitrogen gas, measured at STP?
A) 11.2 L
B) 22.4 L
C) 33.6 L
D) 67.2 L

PART B: SHORT ANSWER / PROBLEM SOLVING [52 MARKS]

Answer all questions in the space provided. FULL SOLUTIONS REQUIRED.
Be sure to include the **correct number of significant digits and units** where applicable.

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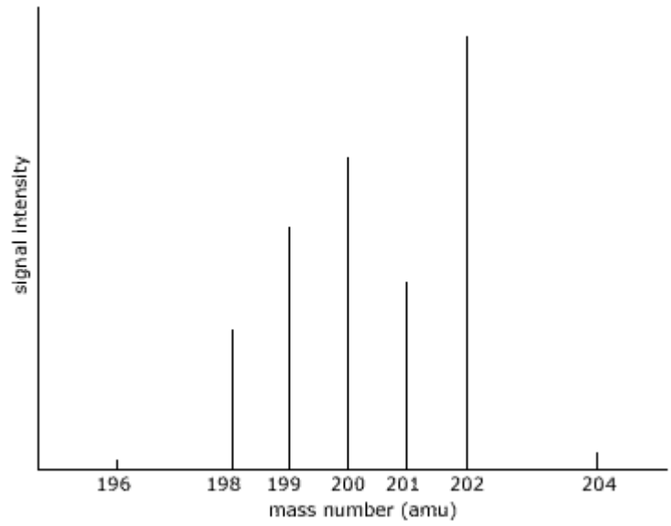
1. a) Write the following in standard atomic notation and determine the number of subatomic particles: **Cesium ion** (2 marks)

b) State and explain the trends in atomic radius and ionization energy for the alkali metals (2 marks)

c) Use the given mass spectrometry data to determine the average atomic mass and thus the identity of the element (3 marks):



2. a) **Name** the following compounds (1 mark each, 5 marks total)

Chemical Formula	**IUPAC Name**
N_2S_3	
$Sn(SO_4)_2$	
$H_3AsO_{3(aq)}$	
$MgO_2 \bullet 6H_2O$	
$H_2S_{aq)}$	

b) Draw the most appropriate Lewis structure for each of the following (2 marks each, 6 marks total)

i) SO_2	ii) NH_4CN
iii) HOCN	

3. Complete the following chemical equations by writing in the correct products (including state) and balancing where necessary. Classify each reaction by stating the type (2 marks each, 10 marks total).

a) $LiOH \rightarrow$

b) $C_5H_9O + O_2 \rightarrow$

c) $Fe_2O_3 + Mg \rightarrow$

d) $CO_2 + H_2O \rightarrow$

e) $AlI_3 + HgCl_2 \rightarrow$

4. Calculate the average mass, in grams, of one atom of mercury (2 marks)

ANS:_____

5. A 5.015 g sample of a compound that contained hydrogen, carbon, and oxygen was combusted in a carbon-hydrogen analyzer. The combustion produced 7.35 g of carbon dioxide and 2.99 g of water. The molar mass of the compound is 60.05 g/mol. What is the molecular formula of the compound? (4 marks)

ANS:_____

6. The following reaction has a 71.7% yield: $2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$

   Calculate the actual mass of water that will form if 51.24 g of each reactant is used in the reaction. (4 marks)

ANS:_____

7. Refer to the given Solubility Curve (Figure 1), and answer the following:

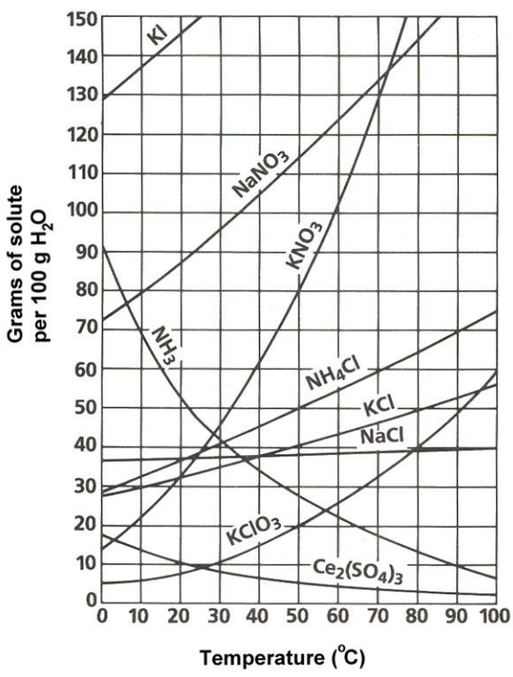


Figure 1: Solubility Curve

a) What mass of NH_4Cl will dissolve in 100 mL of water at 50 °C? (1 mark)

b) What minimum temperature is required to dissolve 24 g of KNO_3 in 40 g of water? (1 mark)

c) Determine the molarity of a saturated solution of NaCl at 25 °C (1 mark)

d) What term best describes a solution that contains 60 g of dissolved KCl per 100 mL H_2O at 80 °C?
(1 mark)

e) Briefly explain why the curve for NH_3 shows a different trend from the other curves. (2 marks)

8. Suppose a beaker contains 35.0 mL of 0.175 M sulfuric acid. How many milliliters of 0.250 M sodium hydroxide must be added to react completely with the sulfuric acid? (4 marks)

ANS:_____

9. A bubble of methane gas, CH_4, is released from a deep bog. The temperature at the bottom of the bog is 12ºC with a pressure of 375 kPa. If the bubble has a volume of 475 mL at the bottom, what will the new volume be, just underneath the surface of the bog water level, if the outside temperature is 35ºC and the pressure is 99.5 kPa? (2 marks)

ANS:_____

10. Calculate the volume of water vapour that is produced from the combustion of 15.0 g of ethylene at 25°C and 100 kPa. (2 marks)

$$C_2H_{4(g)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 2H_2O_{(g)}$$

ANS:_____

Inorganic Nomenclature Reference Sheet

Table 1.1: Common Polyatomic Ions

Ion	Name	Ion	Name
CN^-	cyanide	$H_2PO_3^-$	dihydrogen phosphite
CH_3COO^-	acetate	$H_2PO_4^-$	dihydrogen phosphate
ClO^-	hypochlorite	MnO_4^-	permanganate
ClO_2^-	chlorite	NO_2^-	nitrite
ClO_3^-	chlorate	NO_3^-	nitrate
ClO_4^-	perchlorate	OCN^-	cyanate
HCO_3^-	hydrogen carbonate	HS^-	hydrogen sulfide
HSO_3^-	hydrogen sulfite	OH^-	hydroxide
HSO_4^-	hydrogen sulfate	SCN^-	thiocyanate

Ion	Name	Ion	Name
CO_3^{2-}	carbonate	O_2^{2-}	peroxide
$C_2O_4^{2-}$	oxalate	SiO_3^{2-}	silicate
CrO_4^{2-}	chromate	SO_3^{2-}	sulfite
$Cr_2O_7^{2-}$	dichromate	SO_4^{2-}	sulfate
HPO_3^{2-}	hydrogen phosphite	$S_2O_3^{2-}$	thiosulfate
HPO_4^{2-}	hydrogen phosphate		

Ion	Name	Ion	Name
AsO_3^{3-}	arsenite	PO_3^{3-}	phosphite
AsO_4^{3-}	arsenate	PO_4^{3-}	phosphate

Ion	Name
NH_4^+	ammonium

Table 1.2: Naming oxyions (polyatomic ions containing oxygen)

Prefix and suffix	Number of oxygen atoms
hypo…….ite	x-2 oxygen atoms
…….ite	x-1 oxygen atoms
…….ate	x oxygen atoms
per …….ate	x+1 oxygen atoms

Table 1.3: Numerical Prefixes for Covalent compounds

Number	Prefix	Number	Prefix
1	mono	6	hexa
2	di	7	hepta
3	tri	8	octa
4	tetra	9	nona
5	penta	10	deca

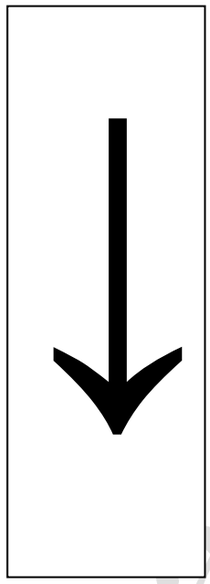
Activity Series

Metals
Lithium*
Potassium*
Barium*
Calcium*
Sodium*
Magnesium
Aluminum
Zinc
Chromium
Iron
Cadmium
Cobalt
Nickel
Tin
Lead
Hydrogen
Copper
Mercury
Silver
Platinum
Gold

*displace hydrogen from cold water

Halogen Series

Halogens
Fluorine
Chlorine
Bromine
Iodine



Solubility Rules

The rules are meant as a guide only. There are exceptions to these rules- when an exception is encountered, do the OPPOSITE of the given rule.

1. Salts of the alkali metals are soluble. (Note: The alkali metals are in group 1.)
e.g. If M = Li, Na or K, then MX, M_2X, M_3X, etc. are soluble regardless of what X is.

2. Ammonium (NH_4^+) salts are soluble.
e.g. NH_4 X, $(NH_4)_2X$, $(NH_4)_3X$, etc. are soluble regardless of what X is.

3. Nitrates (NO_3^-) are soluble.
e.g. MNO_3, $M(NO_3)_2$, $M(NO_3)_3$, etc. are soluble regardless of what M is.

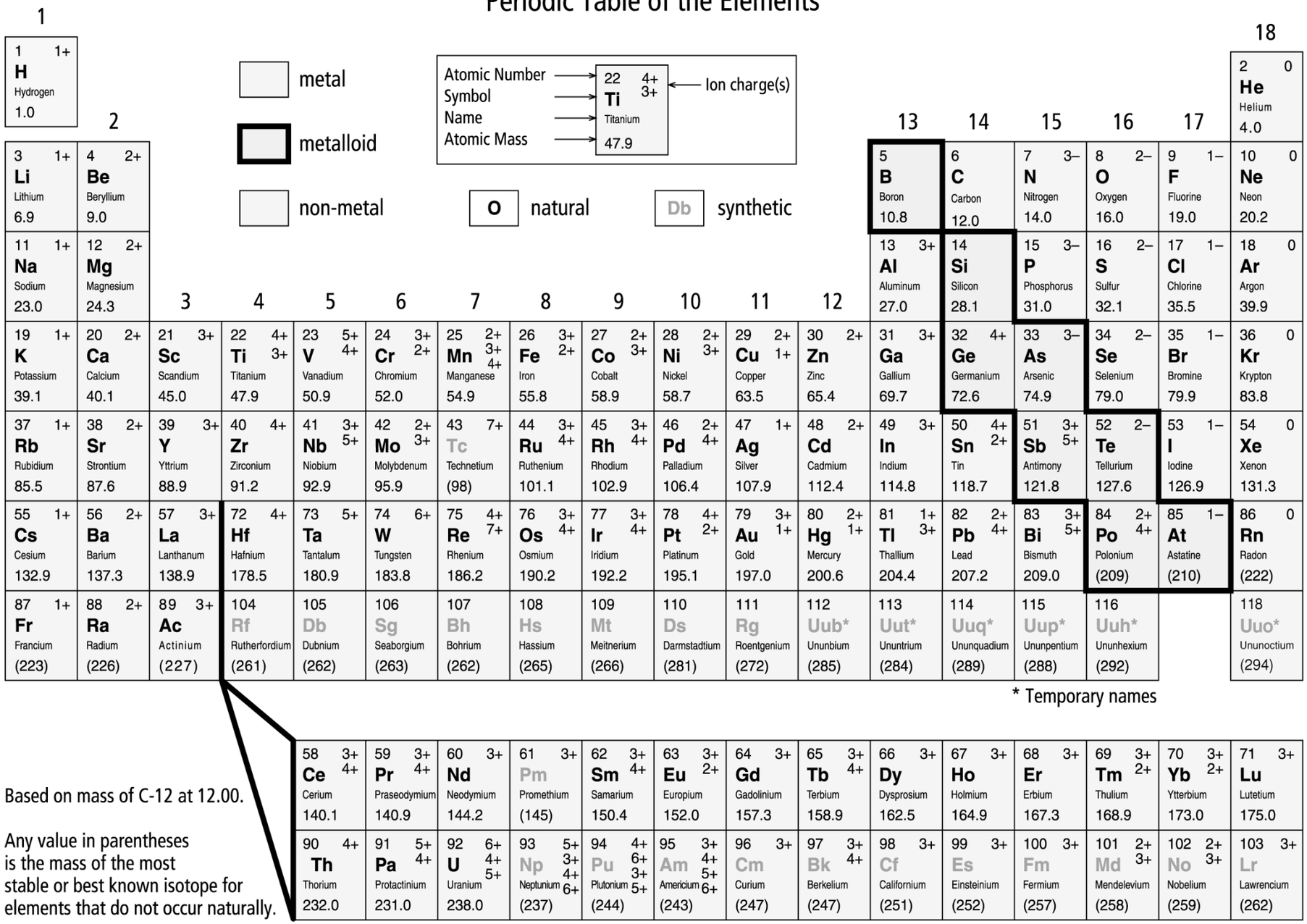
4. Halides i.e. chlorides (Cl^-), bromides (Br^-) and iodides (I^-) are soluble
Exceptions: Ag^+, Hg^+, Hg^{2+}, Cu^+, Pb^{2+}
e.g. If X = Cl, Br or I, then MX, MX_2, MX_3, etc. are soluble unless M = Pb, Hg or Ag.

5. Sulfates (SO_4^{2-}) are soluble
Exceptions: Ca^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+}, Hg^{2+}, Ag^+
e.g. M_2SO_4, MSO_4, $M_2(SO_4)_3$, etc. are soluble unless M is from group 2 (the alkaline earths) or M = Pb, Hg or Ag.

6. Carbonates (CO_3^{2-}), phosphates (PO_4^{3-}), and sulfides (S^{2-}) are insoluble except for
(i) the carbonates/phosphates/sulfides of the alkalis (because of Rule 1), and
(ii) ammonium carbonate/phosphate/sulfide (because of Rule 2).

7. Hydroxides (OH^-) are insoluble or slightly soluble except for the hydroxides of the alkalis (because of Rule 1).
Note: The hydroxides of group 2 (the alkaline earth metals) are slightly soluble. Virtually all other hydroxides are insoluble. Also, ammonium hydroxide is slightly soluble.

Periodic Table of the Elements



* Temporary names

Based on mass of C-12 at 12.00.

Any value in parentheses is the mass of the most stable or best known isotope for elements that do not occur naturally.