SCH3U0 – Practice Final Examination (1.5 hours)

YOUR NAME: _____

YOUR STUDENT #: _____

Teacher:

PLEASE NOTE:

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

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)

C) X D) X 2. How many electrons, protons, and neutrons are in [$^{120} s_0 s_1 $] 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, 54 p ⁺ , 70 n ⁰ C) 46 e, 50 p ⁺ , 70 n ⁰ D) 50 e, 54 p ⁺ , 70 n ⁰ C) 46 e, 50 p ⁺ , 70 n ⁰ D) 50 e, 54 p ⁺ , 70 n ⁰ B) copper nitrogen intrate heptahydrate B) copper nitrogen dioxide heptahydrate C) copper nitrate heptahydrate D) copper(II) nitrite heptahydrate C) copper nitrate heptahydrate D) copper(II) nitrite heptahydrate A) a halogen B) an alkali metal C) a noble gas D) a Group 16 (VIA) clement 5. How many ions are represented in the formula (NH ₄) ₂ HPO ₄ ? A) 0 DJ 4 B) 2 D) 16 C) 3 6. Consider the reaction shown below: N ₂ O ₄ \rightarrow 2NO ₂ This reaction is an example of: A) synthesis reaction C) combustion reaction D) decomposition reaction 7. Which of the following equations is correctly balanced? A) 2H ₂ O \rightarrow H ₂ + O ₂ D) 2Mg + Cl ₂ \rightarrow MgCl ₂ B) HGO \rightarrow Hg + O ₂ D) 2Mg + Cl ₂ \rightarrow MgCl ₂ B) HGO \rightarrow Hg + O ₂ D) 2D3 + S10 ² 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) 3 Cho mol B) The hydrogen is limiting by less than 2 mol 10. How many moles are in 2.55 g of sodium? A) S8.6 mol B) 0.111 mol
2. How many electrons, protons, and neutrons are in [120 so Sn] ⁴⁺ A) 54 c, 50 p ⁺ , 70 n ⁰ B) 50 c, 54 p ⁺ , 70 n ⁰ C) 46 c, 50 p ⁺ , 70 n ⁰ D) 50 c, 50 p ⁺ , 120 n ⁰ 3. The name corresponding to the compound with the formula Cu(NO ₂) ₂ + 7 H ₂ O is, A) copper nitrate heptahydrate B) copper nitrog code the ptahydrate C) copper nitrate septahydrate D) copper (II) nitrite heptahydrate C) copper nitrate septahydrate D) copper nitrog code the ptahydrate C) a noble gas D) a Group 16 (VIA) element S. How many ions are represented in the formula (NH ₄) ₂ HPO ₄ ? A) 0 D) 4 B) 2 E) 16 C) 3 6. Consider the reaction shown below: N ₂ O 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 C) combustion reaction D) decomposition reaction C) combustion reaction D) a Group 16 (VIA) element 5. How many nolecules of sulfur dioxide are present in 1.60 mol of sulfur dioxide? A) 2H ₂ O \rightarrow H ₂ + O ₂ B) H ₂ O \rightarrow H ₂ + O ₂ C) 3.76 x 10 ²³ B) 1.54 x 10 ² C) 3.76 x 10 ²³ B) 1.54 x 10 ² C) 3.76 x 10 ²³ B) 1.54 x 10 ² C) 3.76 x 10 ²³ B) 2.65 x 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 less than 2 mol 10. How many molecules are in 2.55 g of sodium? A) 0 58.6 mol B) 0.111 mol
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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) ₂ HPO ₄ ? A) 0 D) 4 B) 2 E) 16 C) 3 6. Consider the reaction shown below: N ₂ O ₄ \rightarrow 2NO ₂ This reaction is an example of: A) synthesis reaction D) decomposition reaction C) combustion reaction D) decomposition reaction 7. Which of the following equations is correctly balanced? A) 2H ₂ O \rightarrow H ₂ + O ₂ D) 2Mg + Cl ₂ \rightarrow MgCl ₂ B) HgO \rightarrow Hg + O ₂ D) 2Mg + Cl ₂ \rightarrow MgCl ₂ B) HgO \rightarrow Hg + O ₂ D) 2.65 x 10 ⁻²⁴ 8. How many molecules of sulfur dioxide are present in 1.60 mol of sulfur dioxide? A) 9.63 x 10 ²³ B) 1.54 x 10 ² C) 3.76 x 10 ²³ D) 2.65 x 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 less than 2 mol 10. How many moles are in 2.55 g of sodium? A) 58.6 mol B) 0.111 mol
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 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 ₂ Z ₂
C) $X_2Y_3Z_4$ D) $X_6Y_4Z_3$
12. What is the percentage composition of aluminum in aluminum sulfide? A) 36% C) 11% D) 25%
 13. Which property is <i>not</i> characteristic of an acid? A) turns phenolphthalein pink B) turns litmus paper red C) conducts electricity 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:
$C\Omega_2^{2-}(a\alpha) + HN\Omega_2(a\alpha) \rightarrow HC\Omega_2^{-}(a\alpha) + N\Omega_2^{-}(a\alpha)$
$A) CO_{2}^{2} B) HNO_{2}$
C) HCO_3^- D) NO_3^-

- 16. What's the $[H^+]$ of a solution with a pOH of 5.1? A) 1.2 x 10⁻⁹ mol/L B) 7.9 x 10⁻⁶ mol/L C) 4.5 x 10⁻² mol/L D) 3.1 x 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? C) 10.7 A) 11.8 B) 10.9 D) 9.8

18. For the equation below, the volume of NH₃ 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, NH₃, at STP?

- A) 0.25 g
- B) 4.3 g
- C) 8.5 g
- D) 22.4 g

22. Nitrogen gas, N₂, and hydrogen gas, H₂, react to produce ammonia, NH₃, 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 LC) 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.

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 con	mpounds (1	mark	each, 5	marks total)

Chemical Formul	a	IUPAC Name
N_2S_3		
$Sn(SO_4)_2$		
H ₃ AsO _{3(aq)}		
$MgO_2 \bullet 6H_2O$		
H ₂ S _{aq})		

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

i) SO ₂	ii) NH4CN
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). LiOH a) \rightarrow b) C₅H₉O O_2 + Fe_2O_3 c) Mg + d) CO_2 H_2O + AlI₃ $HgCl_2$ e) +4. Calculate the average mass, in grams, of one atom of mercury (2 marks)
 - 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:_____

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)

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



Figure 1: Solubility Curve

a) What mass of NH₄Cl will dissolve in 100 mL of water at 50 °C? (1 mark)

ANS:

- b) What minimum temperature is required to dissolve 24 g of KNO₃ 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 H₂O at 80 °C? (1 mark)
- e) Briefly explain why the curve for NH₃ 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, CH₄, is released from a deep bog. The temperature at the bottom of the bog is 12°C 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 35°C 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)

 $\mathrm{C_{2}H_{4(g)}+3O_{2(g)}\rightarrow 2CO_{2(g)}+2H_{2}O_{(g)}}$

ANS:_____

Inorganic Nomenclature Reference Sheet

Ion	Name	Ion	Name
CN ⁻	cyanide	$H_2PO_3^-$	dihydrogen
			phosphite
CH ₃ COO ⁻	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

Table 1.1: Common Polyatomic Ions

Ion	Name	Ion	Name
CO3 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	PO3 ³⁻	phosphite
AsO4 ³⁻	arsenate	PO4 ³⁻	phosphate

Ion	Name
NH4 ⁺	ammonium

Table 1.2: Naming oxyions (polyatomic ions containing oxygen)

	· · · · · · · · · · · · · · · · · · ·
Prefix and suffix	Number of oxygen atoms
hypoite	x-2 oxygen atoms
ite	x-1 oxygen atoms
ate	x oxygen atoms
perate	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

Halogen Series

Halogens Fluorine Chlorine Bromine Iodine

*displace hydrogen from cold water



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 (NH4⁺) salts are soluble.

e.g. NH₄ X, (NH₄)₂X, (NH₄)₃X, etc. are soluble regardless of what X is.

3. Nitrates (NO₃⁻) are soluble.

e.g. MNO3, M(NO3)2, M(NO3)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⁺, Hg²⁺, Cu⁺, Pb²⁺ e.g. If X = Cl, Br or I, then MX, MX₂, MX₃, etc. are soluble unless M = Pb, Hg or Ag.

5. Sulfates (SO4²⁻) are soluble Exceptions: Ca²⁺, Sr²⁺, Ba²⁺, Pb²⁺, Hg²⁺, Ag⁺ e.g. M₂SO₄, MSO₄, M₂(SO₄)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.

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Elem	charge	ynthe	1	29 Cu copper 63.5	47 Ag Silver 107.9	79 Au _{Gold} 197.0	111 Rg Roentger (272)		64 Gd Gadolini 157.3	96 Cm ^{Curium} (247)
he E	S S	s s	10	2+ 3+ 1	2+ 4+ dium 3.4	4+ 2+ 1um 5.1) stadtium 1)		3+ 2+ pium 2.0	3+ 1 4+ 5+ 3)
of t	4°			+ + 28 Nicke 58.	+ + 46 P d 106	+ 78 P t 78	110 DS Darr (28		+ 63 + Eu Euro	+ 95 + An + Aneric (24;
able	1 Titanium	41.9	6	27 27 Cobait 58.9	45 3- Rh 4- ^{3hodium} 102.9	77 3. r 4. 192.2	109 Mt Aeitnerium (266)		52 3- 5 m 4- Samarium 150.4	94 4- Pu 6- Pu 3- Putonium 5- (244)
lic T		tural		2+3 2+3	ю́4 ё -	^ω ⁴	5 - 2 - 0		hium 3+	5+ 3+ 3+ 5+ 3+ 3+ 5+ 3+ 5+ 5+ 5+ 5+ 5+ 5+ 5+ 5+ 5+ 5
erioc	umber	na l	00	26 Fe Iron 55.8	44 Ru Rutheni 101.	76 OS Osmiun 190.2	108 HS Hassiur (265)		61 Pm Prometh (145)	93 Np Neptuni (237)
P	mic Nu Ibol me Mair Ma		2	2+ 3+ 3+ ganese .9	7+ netium	6.2 4+	7 1 1 1 22)		3 + dymium 4.2	6+ 4+ 5+ 8.0
	Atc Syr Na			8+ 25 + M Man 54	(96	18 He	10 B ^B (26		++ 60 ++ 14 80	++ ++ 23 23
	metal	r le	9	24 3 Cr 2 Chromium 52.0	42 2 Mo Molybdenu 95.9	74 6 V Tungsten 183.8	106 Sg ^{Seaborgiur} (263)		59 3 Pr ⁴ Praseodym 140.9	91 5 Pa ² Protactiniu 231.0
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			_ ,	23 Vanad 50.9	41 Nidbiu 92.9	73 Ta Tantal	105 Db Dbniu (262		58 Cerium 140.	90 Th Thoriu 232
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				+8 22 ⊢ ≣ 12	+6 +6 0 ⊈ N 5	3, T 7,	3+ 10 Bu Ru		12.00.	pe for natu
			ŝ	21 (2 Sc Scandium 45.0	39 ⊀ttrium 88.9	57 La Lanthanur 138.9	89 3 AC Actinium (227)		12 at '	ieses ost i isoto t occur
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		+ 4 Beryll 9.0	+ 12 Magn 24.5	+ 20 Calcit 40.	+ 38 Stron [*] 87.6	+ 56 Ba Bariu	+ 88 Radiu (22t		ו mas	ie in p ass of best that
-	1 1+ Hydrogen 1.0	3 1+ Lithium 6.9	11 14 Na Sodium 23.0	19 14 K Potassium 39.1	37 1+ Rb Rubidium 85.5	55 1+ Cs _{Cesium} 132.9	87 1 ₁ Fr Francium (223)		ased or	ny valu the mé table or lements
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