PRACTICE EXAM

SCH3U1 – Chemistry 11 University

Final Examination

STUDENT'S NAME: _____
(PLEASE PRINT IN BLOCK LETTERS)

Time: 2.0 hours	Pages: 13

Teacher's Name	
Course Code and Section	SCH3U1-
Period	
Number of Students	

Instructions:

1. Print your full name on the examination booklet, scantron card and every sheet that you hand in to your teacher.
2. Check that your exam contains <u>all pages</u>.
3. Use pencil only on the scantron card.
4. Please read all instructions and questions carefully.
5. Calculators cannot be shared during the examination.
6. Do not separate the exam booklet unless given permission.

EVALUATION

Section/Part	Category	Student Score	Total
Section 1: Multiple Choice	K/U		30
Section 2: Problem Solving	T/I		42
Section 3: Lab based / Short Answer	APP		30
Section 4: Short Answer Response	COMM		10
Correct use of units and significant digits.	COMM		8
		TOTAL:	**120**

Section 1: Multiple Choice (Knowledge & Understanding)   [30 marks]

*(Please select the **MOST** correct response and record your answer directly on the scantron provided.)* **Suggested Time = 30 minutes.**

1. Calculate the following to the correct number of significant figures.
   (5.15 + 82.3) x (0.024 + 3.000) = _____

   a) 264.3
   b) 264
   c) 298
   d) 2.6×10^2
   e) 264.30

2. Consider the data obtained for the length of an object as measured by three students. The length is known to be 14.54 cm. Which of the conclusions summarizes the data?

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
A	14.8	14.1	14.5	14.6	14.2
B	14.8	14.2	14.6	14.5	14.8
C	14.6	14.5	14.5	14.4	14.6

   a) Student B has done the most precise work and student C the most accurate.
   b) Student C has done the most precise work and student B the most accurate.
   c) Student C has done the most precise work and student A the most accurate.
   d) Student C has done the most precise and accurate work.
   e) Student A has done the most precise work and student C the most accurate.

3. Which of the following discoveries served to modify Dalton's Atomic Theory?
   a) electrons, neutrons, and protons.
   b) isotopes.
   c) nuclear reactions.
   d) all of the above.
   e) none of the above.

4. Which set contains only diatomic elements?
   I.   silver, iron, lead, mercury
   II.   bromine, oxygen, fluorine, nitrogen
   III.   magnesium, calcium, strontium, barium

   a) I
   b) II
   c) III
   d) None of the above.
   e) All of the above.

5. The numbers of protons, neutrons, and electrons in $^{226}Ra^{2+}$ are:
   a) $113p^+$, $113n^0$, $111e^-$
   b) $88p^+$, $138n^0$, $86e^-$
   c) $88p^+$, $88n^0$, $88e^-$
   d) $88p^+$, $88n^0$, $86e^-$
   e) $88p^+$, $226n^0$, $138e^-$

6. Which of the following elements **does not** belong to the family or classification indicated?
   a) Cl, halogen
   b) Ar, noble gas
   c) Os, transition metal
   d) Rb, alkali metal
   e) In, lanthanides

7. The total number of electrons that can be accommodated in the 3rd energy level is:
   a) 2   b) 8   c) 18
   d) 32   e) 50

8. List the following atoms in order of increasing ionization energy: Li, Na, C, O, and F.
   a) Li < Na < C < O < F
   b) Na < Li< C < O < F
   c) F < O < C < Li < Na
   d) Na < Li < F < O < C
   e) Na < Li < C < F < O

9. A student recorded the following evidence in a lab book:

UNKNOWN SUBSTANCE	PURE STATE	SOLUBILITY IN WATER	SOLUTION CONDUCTIVITY
I	Solid	High	Low
II	Solid	Low	Low
III	Solid	High	None
IV	Solid	High	High

   Which of the substances shown in the table above is most likely an ionic compound?
   a) I
   b) II
   c) III
   d) IV
   e) none of the above

10. Consider the formulas NiF_2 and NIF_2. These symbols represent species
    a) having the same molar mass.
    b) which contain different number of atoms.
    c) having the same composition.
    d) having equal number of atoms.
    e) which are identical.

11. Which of the following is **NOT** the correct chemical formula for the compound named?
    a) Calcium phosphate $Ca_3(PO_4)_2$
    b) Lithium sulfide Li_2S
    c) Potassium dichromate $K_2Cr_2O_7$
    d) Potassium nitrate K_2NO_3
    e) Calcium carbonate $CaCO_3$

12. Which pair is correct?
    a) PNO_3 potassium nitrate
    b) HNO_2 nitrous acid
    c) NH_3 ammonium
    d) $MgNO_3$ magnesium nitrate
    e) Fe_2O_3 iron II oxide

13. Which of the following formulas is **INCORRECT**?
    a) $CaPO_4$
    b) $(NH_4)_2SO_4$
    c) $NaNO_3$
    d) $NaHCO_3$
    e) All of these are correct.

14. Which of the following is **NOT** the correct chemical formula for the compound named?
    a) Ammonium nitrate NH_4NO_3
    b) Sodium sulphite Na_2SO_3
    c) Magnesium oxide Mg_2O
    d) Ammonia NH_3
    e) Copper (II) acetate $Cu(CH_3COO)_2$

15. How many bonding pairs of electrons are in the molecule CO_2?
    a) 2
    b) 4
    c) 6
    d) 8
    e) none of these

16. In the oxygen molecule each oxygen atom shares:
    a) one pair of electrons
    b) two pairs of electrons
    c) three pairs of electrons
    d) all its electrons
    e) none of its electrons

17. Which of the following is a polar molecule?
    a) CO_2
    b) BF_3
    c) CH_4
    d) HCN
    e) None of the above.

18. The chemical properties of atoms depend primarily upon:
    a) the atomic masses of the atoms.
    b) the masses of the atoms.
    c) the numbers of valence electrons.
    d) the masses of the nuclei.
    e) the shape of the atoms.

19. A piece of zinc is placed in hydrochloric acid. A vigorous bubbling action occurs producing hydrogen gas. The type of reaction occurring is:
    a) decomposition
    b) synthesis
    c) single displacement
    d) double displacement
    e) neutralization

20. How many moles are in 48.5×10^{23} atoms of calcium?
    a) 1 moles
    b) 6.02×10^{23} moles
    c) 8.06 moles
    d) 48.5 moles
    e) 1.21 moles

21. Which of the following contains the greatest number of moles:
    a) 4 g CH_4
    b) 8 g H_2
    c) 64 g O_2
    d) 28 g N_2
    e) 2 g He

22. The percentage of hydrogen by mass in propanol (C_3H_7OH) is:
    a) 5.9 %   b)   11.7 %
    c) 13.3 %   d)   26.6 %
    e) None of the above

23. A compound has the empirical formula CH_2O, and a molar mass of 90.0 g/mol.
    What is its molecular formula?
    a) CH_2O
    b) $C_2H_4O_2$
    c) $C_3H_6O_3$
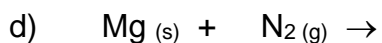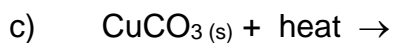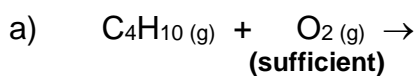   d) $C_4H_8O_4$
    e) $C_{10}H_{20}O_{10}$

24. A solution that contains more solute than ordinarily required for saturation is said to be:
    a) dilute.
    b) unsaturated.
    c) saturated.
    d) supersaturated.
    e) concentrated.

25. What mass of NaCl are contained in 350 mL of a 0.250 mol/L solution of sodium chloride?
    a) 41.7 g
    b) 5.11 g
    c) 14.6 g
    d) 87.5 g
    e) none of the above

26. If two containers of ideal gases under the same conditions of temperature and pressure have the same number of molecules, the gas samples must also:
    a) be of the same substance.
    b) have the same numbers of atoms.
    c) have the same mass.
    d) have the same volume.

27. Boyle's Law relates the:
    a) pressure and volume of gases (number of molecules and temperature constant).
    b) partial pressure of gases (temperature and volume constant).
    c) temperature and volume of gases (number of molecules and pressure constant).
    d) temperature and pressure of gases (number of molecules and volume constant).

28. If 276 mL of a fixed mass of gas is heated from 30°C to 60°C at constant pressure, the resulting volume would be:
    a) 552 mL.
    b) 5.52 L.
    c) 303 mL.
    d) 251 mL.
    e) 188 mL.

29. A quantity of gas collected at 298 K and 101 kPa occupies a volume of 200 mL. If the pressure on the gas is doubled and its temperature is raised to 596 K, the volume occupied by the gas will be:
    a) 50 mL.
    b) 100 mL.
    c) 200 mL.
    d) 800 mL.

30. Absolute zero refers to:
    a) - 273 K
    b) 0°C
    c) 0 K
    d) 273

End of SCANTRON Section

Section 2: Problem Solving (Thinking & Inquiring)   [42 marks]

(Please answer all questions in the space provided. Be sure to include the correct number of significant digits and units where applicable.) Suggested Time = 45 minutes.

1. Complete the following chemical equations by writing in the correct products and balancing where necessary. **[4 marks]**

   a) $C_4H_{10\ (g)}$ + $O_{2\ (g)}$ →
                    (sufficient)

   b) $Ag_{(s)}$ + $CuSO_{4\ (aq)}$ →

   c) $CuCO_{3\ (s)}$ + heat →

   d) $Mg_{(s)}$ + $N_{2\ (g)}$ →

2. Consider the mixture resulting in the combination of sodium sulphate and barium nitrate. Complete the following chart. **[4 marks]**

Balanced Chemical Equation	$Na_2SO_{4\ (aq)}$ + $Ba(NO_3)_{2\ (aq)}$ →
Ionic Equation	
Net Ionic Equation	
Identify any spectator ions	

3. Balance and classify the following chemical equations. **[4 marks]**

   a) $KOH_{(aq)}$ + $BaCl_{2\ (g)}$ → $Ba(OH)_{2\ (g)}$ + $KCl_{(aq)}$

   Reaction Type: _____

   b) $LiAlH_{4\ (s)}$ + $H_2O_{(l)}$ → $LiOH_{(aq)}$ + $Al(OH)_{3\ (aq)}$ + $H_{2\ (g)}$
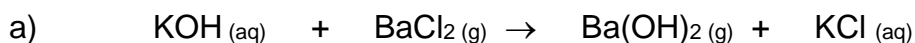
   Reaction Type: _____

4. Complete the following table: **[6 marks]**

Chemical Formula	Type of Molecule	Lewis Structure
OCl_2		
H_2S		
$CaCl_2$		

5. Complete the following table: (8 marks)

Chemical Formula	Lewis Structure (with dots)	VSEPR Diagram with net Dipole	Name of VSEPR Shape	Polar or Non-Polar
CH_3Cl				
H_2S				

6. Ammonia gas reacts with oxygen to produce water and nitrogen oxide. How many molecules of oxygen are required to react with 34.0 g of ammonia? **[4 marks]**

$$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H2O_{(l)}$$
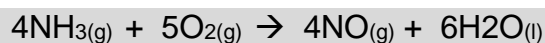
7. Aluminum reacts with copper (II) sulfate solution as seen in the chemical equation below. If 450 mL of a 0.35 mol/L solution of $CuSO_4$ are combined with 3.3 g of aluminum metal, which is the limiting reagent? **[4 marks]**

$$2Al_{(s)} + 3CuSO_{4(aq)} \rightarrow Al_2(SO_4)_{3(aq)} + 3Cu_{(s)}$$

8. Use your calculator to the pH of Blackberries having a $[H^+] = 4.0 \times 10^{-4}$ mol/L. **[2 marks]**

9. A sugar contains 39.95% C, 6.71% of H and 53.34% of O by mass. If the molar mass of the sugar was found experimentally to have a molar mass of 180.0 g/mol, calculate its molecular formula. **[4 marks]**

10.   If a certain mass of gas occuples 50 mL at 20°C and 800 mmHg, what will be its new volume under STP conditions?   [4 marks]

Section 3:   Lab Based/Short Answer Questions (Application)   [30 marks]

(Please answer all questions in the space provided. Be sure to include the correct number of significant digits and units where applicable.) Suggested Time = 30 minutes.

1. Iron (III) phosphate is a hydrated salt. When a sample of this salt was heated to drive off the water of crystallization, the following evidence was obtained:

    Mass of crucible & lid   24.80 g
    Mass of crucible, lid and hydrated salt   29.93 g
    Mass of crucible, lid and dehydrated salt   28.27 g

    What is the formula of the hydrate of iron (III) phosphate?   **[6 marks]**

2. If 109.6 g of sodium hydroxide was the amount obtained in a reaction for which the theoretical yield was 170.5 g, determine the percentage yield.   **[2 marks]**

3.   In a titration experiment, 25.0 mL of an aqueous solution of sodium hydroxide was required to neutralize 50.0 mL of 0.010 mol/L hydrochloric acid. What is the molar concentration of the sodium hydroxide solution?   **[4 marks]**

4. A balloon is brought to the top of Mt. Logan where it occupies a volume of 775mL at a temperature of -28°C and a pressure of 92.5 kPa. What is the pressure at the bottom of the mountain if the same balloon has a volume of 825 mL at a temperature of 15°C? **[4 marks]**

5. A chemistry student was given the task of identify four colourless solutions of which all labels have come off the bottles. The four solutions are glucose, potassium chloride, sulfuric acid, and calcium hydroxide. The student decides to do a litmus test and an electrical conductivity test of each solution –A,B,C,D. The results were recorded in the table below. Identify each solution and explain your reasoning for your selections.   **[6 marks]**

Solution	Red Litmus	Blue Litmus	Conductivity
A	Stays red	Blue to red	High
B	Stays red	Stays blue	None
C	Red to blue	Stays blue	High
D	Stays red	Stays blue	High

6. Magnesium oxide, also known as "Magnesia", has been used in many applications, such as insulators in industrial cables, and in protective films for plasma display screens. Using your knowledge of types of chemical reactions, state two reactions that could be used to make Magnesia. Classify each reaction and provide a balance chemical equation for each.   [4 marks]

7. The label on a box of baking soda ($NaHCO_3$) claims that there is 150 mg of sodium per 0.500 mg of baking soda. Comment of the validity of this claim.   [4 marks]

Section 4:   Short Answer Response Questions (Communication)   [12 marks]
(Please answer all questions in the space provided. Suggested Time = 15 min.)

1. Explain why water is a liquid at room temperature, while a molecule of similar size, like methane (CH_3) is gaseous. Use a diagram to aid your response.   **[4 marks]**

2. Sodium phosphate (Na_3PO_4) is used as a cleaning solution for oil and grease spills. You are asked to make 2.5 L of a 0.320 mol/L solution of Na_3PO_4. Fully describe showing any calculations, how you would prepare this solution. Be sure to include any materials and lab equipment you will use.   **[4 marks]**

3. Real gases behave in an ideal fashion under most conditions. State under what conditions real gases <u>do not</u> behave ideally and explain specifically how these deviations result in differences in measured quantities.   **[4 marks]**

> **CONGRATULATIONS!**
>
> **YOU HAVE REACHED THE END OF THE EXAM!**
>
> *Good luck next semester!*

1																	2
H 2.2																	**He** Helium
1.01																	4.00
3 **Li** 1.0	4 **Be** 1.6											5 **B** 2.0	6 **C** 2.6	7 **N** 3.0	8 **O** 3.4	9 **F** 4.0	10 **Ne**
6.94	9.01											10.81	12.01	14.01	16.00	19.00	20.18
11 **Na** 0.9	12 **Mg** 1.3											13 **Al** 1.6	14 **Si** 1.9	15 **P** 2.2	16 **S** 2.6	17 **Cl** 3.2	18 **Ar**
22.99	24.31											26.98	28.09	30.97	32.06	35.45	39.95
19 **K** 0.8	20 **Ca** 1.0	21 **Sc** 1.4	22 **Ti** 1.5	23 **V** 1.6	24 **Cr** 1.7	25 **Mn** 1.6	26 **Fe** 1.8	27 **Co** 1.9	28 **Ni** 1.9	29 **Cu** 1.9	30 **Zn** 1.7	31 **Ga** 1.8	32 **Ge** 2.0	33 **As** 2.2	34 **Se** 2.6	35 **Br** 3.0	36 **Kr**
39.10	40.08	44.96	47.90	50.94	52.00	54.94	55.85	58.93	58.71	63.55	65.37	69.72	72.59	74.92	78.96	79.90	83.80
37 **Rb** 0.8	38 **Sr** 1.0	39 **Y** 1.2	40 **Zr** 1.3	41 **Nb** 1.6	42 **Mo** 2.2	43 **Tc** 1.9	44 **Ru** 2.2	45 **Rh** 2.3	46 **Pd** 2.2	47 **Ag** 1.9	48 **Cd** 1.7	49 **In** 1.8	50 **Sn** 2.0	51 **Sb** 2.1	52 **Te** 2.1	53 **I** 2.7	54 **Xe**
85.47	87.62	88.91	91.22	92.91	95.94	98.91	101.07	102.91	106.42	107.87	112.40	114.82	118.69	121.75	127.60	126.90	131.30
55 **Cs** 0.8	56 **Ba** 0.9	57 **La** 1.1	72 **Hf** 1.3	73 **Ta** 1.5	74 **W** 2.4	75 **Re** 1.9	76 **Os** 2.2	77 **Ir** 2.2	78 **Pt** 2.3	79 **Au** 2.5	80 **Hg** 2.0	81 **Tl** 2.0	82 **Pb** 2.3	83 **Bi** 2.0	84 **Po** 2.0	85 **At** 2.2	86 **Rn**
132.91	137.34	138.91	178.49	180.95	183.85	186.21	190.21	192.22	195.09	196.97	200.59	204.37	207.19	208.98	210.00	210.00	222.00
87 **Fr** 0.7	88 **Ra** 0.9	89 **Ac** 1.1	104 **Rf**	105 **Db**	106 **Sg**	107 **Bh**	108 **Hs**	109 **Mt**	110 **Uun**	111 **Uuu**	112 **Uub**	113	114 **Uuq**				
223.00	226.00	227.00	261.00	262.00	263.00	262.00	265.00	266.00	269.00	272.00	277.00		289.00				

Example:

56 **Ba** 0.9 electronegativity
137.30

58 **Ce** 1.1	59 **Pr** 1.1	60 **Nd** 1.1	61 **Pm** 1.1	62 **Sm** 1.2	63 **Eu** 1.2	64 **Gd** 1.2	65 **Tb** 1.2	66 **Dy** 1.2	67 **Ho** 1.2	68 **Er** 1.2	69 **Tm** 1.3	70 **Yb** 1.1	71 **Lu** 1.3
140.12	140.91	144.24	146.92	150.35	151.96	157.25	158.92	162.50	164.93	167.26	168.93	173.04	174.97
90 **Th** 1.3	91 **Pa** 1.5	92 **U** 1.4	93 **Np** 1.4	94 **Pu** 1.3	95 **Am** 1.3	96 **Cm** 1.3	97 **Bk** 1.3	98 **Cf** 1.3	99 **Es** 1.3	100 **Fm** 1.3	101 **Md** 1.3	102 **No** 1.3	103 **Lr**
232.04	231.04	238.03	237.00	242.00	243.00	247.00	247.00	251.00	254.00	257.00	258.00	259.00	260.00

Table 4.2 Activity Series of Metals

Metal	Displaces hydrogen from acids	Displaces hydrogen from cold water	
lithium			Most Reactive
potassium			
barium			
calcium			
sodium			
magnesium			
aluminum			
zinc			
chromium			
iron			
cadmium			
cobalt			
nickel			
tin			
lead			
hydrogen			
copper			
mercury			
silver			
platinum			
gold			Least Reactive

Table 9.1 General Solubility Guidelines

GUIDELINE	CATIONS	ANIONS	RESULT	EXCEPTIONS
1	Li^+, Na^+, K^+, Rb^+, Cs^+, NH_4^+	NO_3^-, CH_3COO^-, ClO_3^-	soluble	$Ca(ClO_3)_2$ is insoluble
2	Ag^+, Pb^{2+}, Hg^+	CO_3^{2-}, PO_4^{3-}, O^{2-}, S^{2-}, OH^-	insoluble	BaO and $Ba(OH)_2$ are soluble. Group 2 sulfides tend to decompose.
3		Cl^-, Br^-, I^-	soluble	
4	Ba^{2+}, Ca^{2+}, Sr^{2+}		insoluble	
5	Mg^{2+}, Cu^{2+}, Zn^{2+}, Fe^{2+}, Fe^{3+}, Al^{3+}	SO_4^{2-}	soluble	