/150

Name: ___**SAMPLE EXAM**_____

BLUEVALE COLLEGIATE INSTITUTE
COURSE: SCH 3UI
TEACHERS: Mr. Arthur
DATE: June, DD, YYYY
TIME: 2 HOURS
NOTE: *Calculators are permitted but are not to be shared during the exam.
**The standard periodic table may be used.
*** Use of cell phones and or MP3 players is prohibited.

The following exam contains **10 pages**, **50 multiple choice** questions, **20 Quicks** and **15 short answer** questions. **Total Marks: 150.** Remember to read ALL questions carefully, answer all parts, **show equations** and **include units**. Failure to do so will result in loss of marks. **Good Luck**!

Part A MULTIPLE CHOICE (50 Marks)
Answer the following questions on the SCANTRON card provided. Remember to write your name and to use pencil on the SCANTRON.

1. Barium has a higher first ionization energy than strontium, based on their positions in the periodic table.
   A) true
   B) false

2. Element 120 will be an alkaline earth metal.
   A) true
   B) false

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

4. In which pair of elements is the element with the smaller radius listed first?
   A) potassium, calcium
   B) oxygen, sulfur
   C) aluminum, silicon
   D) iodine, bromine

5. Which molecule is not linear?
   A) H-C=C-H
   B) SO_2
   C) H_2S
   D) CO_2

6. Which ion has the correct name and formula?
   A) nitrite, NO_3^-
   B) phosphite, PO_3^{3-}
   C) hydrogen carbonate, HCO_3^-
   D) chlorite, ClO_2^{2-}

7. What is the valence of iron in the compound FeN?
   A) -3
   B) +1
   C) +3
   D) +2

8. Which bond is most polar?
   A) H-O
   B) I-Br
   C) F-Cl
   D) O-S

9. Which element will form a covalent bond with nitrogen?
   A) Be
   B) Li
   C) K
   D) O

10. A metal reacts with an ionic compound in a single displacement or substitution reaction. What does the metal atom replace?
   A) the anion
   B) the cation
   C) either the anion or the cation
   D) the less electronegative atom, if the compound contains a complex anion

11. When the following skeleton equation is correctly balanced, what is the coefficient in front of silicon tetrachloride?
   $C_6H_5Cl_{(l)} + SiCl_{4(l)} + Na(s) \rightarrow (C_6H_5)_4Si_{(l)} + NaCl_{(s)}$
   A) 1
   B) 2
   C) 4
   D) 6

12. Which equation represents the decomposition reaction that occurs during the electrolysis of molten aluminum oxide?
   A) $AlO_{(l)} \rightarrow Al_{(l)} + O_{2(g)}$
   B) $2Al_2O_{3(l)} \rightarrow 4Al_{(l)} + 3O_{2(g)}$
   C) $Al_2O_{3(l)} \rightarrow 2Al_{(l)} + 3O_{(g)}$
   D) $2AlO_{(l)} \rightarrow 2Al_{(l)} + O_{2(g)}$

13. According to the activity series for metals, which three elements are correctly listed in order of decreasing reactivity?
   A) Hg, Cu, Pt
   B) Mn, Fe, Pb
   C) Al, Ca, Li
   D) Sn, Fe, H2

14. Consider the following reaction:
   $Sn(s) + FeSO_4(aq) \rightarrow SnSO_4(aq) + Fe(s)$
   Which statement about this reaction is correct?
   A) It is an example of a double displacement reaction.
   B) It is incorrect because one of the formulas is incorrect.
   C) It cannot occur because Sn is below Fe in the activity series for metals.
   D) It cannot occur because $FeSO_4$ is insoluble.

15. Magnesium has three naturally occurring isotopes in the following ratios: 79% magnesium-24, 10% magnesium-25, and 11% magnesium-26. If a 60.0 g sample of magnesium is massed out, how many grams are magnesium-25?
   A) 54 g
   B) 47 g
   C) 6.6 g
   D) 6.0 g

16. What is the molar mass of $Ca_3(PO4)_2$?
   A) 87.05 g/mol
   B) 215.20 g/mol
   C) 309.97 g/mol
   D) 430.39 g/mol

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

18. Which statement explains why chemists do not count atoms and molecules individually?
   A) Atoms and molecules are extremely small.
   B) Matter is neither created nor destroyed in a chemical reaction.
   C) All of the relationships in a chemical reaction can be expressed as mass ratios.
   D) Reactions take place one atom at a time.

19. 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

20. What is the average atomic mass of neon?
A) 18.184 u
B) 20.124 u
C) 20.179 u
D) 20.180 u

21. The average of the total mass of all an element's isotopes is called:
A) the isotopic abundance
B) the weighted average
C) the average molar mass
D) the average atomic mass

22. What is the empirical formula for benzene, C_6H_6?
A) C_3H_3
B) C_6H_6
C) CH
D) C_2H_2

23. What is the empirical formula of a compound that is 25.9% nitrogen and 74.1% oxygen?
A) NO
B) N_2O_5
C) NO_2
D) N_2O

24. Diethyl oxalate is a solvent that is used in some perfumes. Its empirical formula is $C_3H_5O_2$, and its molecular mass is 146.14 u. What is the molecular formula of diethyl oxalate?
A) $C_{12}H_2O_8$
B) $C_9H_{15}O_6$
C) $C_6H_5O_4$
D) $C_6H_{10}O_4$

25. What is the mass percent of water in the compound $BaC_{l2}•H_2O$?
A) 33.3%
B) 17.3%
C) 14.8%
D) 7.96%

26. What is the percent composition of phosphorus in ammonium phosphate?
A) 63.2%
B) 36.4%
C) 28.2%
D) 20.8%

27. A sample of the hydrate of thallium(III) chloride has a mass of 64.5 g. The sample is found to contain 12.1 g of water. What is the formula of the hydrate?
A) $TlCl_3•H_2O$
B) $TlCl_3•2H_2O$
C) $TlCl_3•3H_2O$
D) $TlCl_3•4H_2O$

28. Consider the following balanced chemical equation:
$2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$
If 4.12 mol of chlorine react with sodium metal, how many moles of sodium metal are consumed?
A) 23.0 mol
B) 8.24 mol
C) 4.12 mol
D) 2.06 mol

29. In an experiment, the total mass of all the reactants is 4.20 g. Three products are formed. The masses of two of the products add to 3.65 g. What is the mass of the third product?
A) 7.85 g
B) 4.20 g
C) 3.65 g
D) 0.55 g

30. The results of a precipitation reaction are given below:
Theoretical mass of precipitate = 1.62 g
Mass of filter paper = 0.85 g
Mass of filter paper and dry precipitate = 2.42 g
Calculate the percentage yield for these results.
A) 100%
B) 96.9%
C) 66.9%
D) 52.5%

31. The percentage yield of a particular reaction needs to be 82% for the reaction to be cost efficient. If the theoretical yield is 950 kg, what does the actual yield need to be?
A) 171 kg
B) 779 kg
C) 950 kg
D) 1158 kg

32. Which term means the amount of product that is predicted by stoichiometry?
A) theoretical yield
B) actual yield
C) percentage purity
D) percentage yield

33. Water has a special type of attraction between its molecules. What is this attraction called?
A) dipole-dipole attraction
B) hydrogen bonding
C) ion-ion attraction
D) dipole-ion attraction

34. 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
B) 2.0 mol/L
C) 1.0 mol/L
D) 0.50 mol/L

35. Which factor does not affect the rate of dissolving?
A) agitation
B) amount of solvent
C) particle size
D) temperature

36. Which term describes a substance that is able to conduct electricity in an aqueous solution?
A) miscible
B) immiscible
C) electrolyte
D) non-electrolyte

37. What is the general equation for a double displacement reaction?
A) A +B → AB
B) CD → C + D
C) A + XY → AY + X
D) AB + XY → AY + XB

38. What type of reaction is a precipitation reaction?
A) synthesis reaction
B) decomposition reaction
C) single displacement reaction
D) double displacement reaction

39. What are the spectator ions in the following reaction?
$SrCl2 + MgSO_4 \rightarrow SrSO_4 + MgCl_2$
A) Sr^{2+} and Cl^-
B) Mg^{2+} and SO_4^{2-}
C) Mg^{2+} and Cl^-
D) Sr^{2+} and SO_4^{2-}

40. In the following unbalanced equation, 2 mol of aluminum sulfate are mixed with an excess of sodium phosphate:

$Al_2(SO4)_3 + Na_3PO_4 \rightarrow Na_2SO_4 + AlPO_4$

How many moles of precipitate are formed?

A) 2 mol
B) 3 mol
C) 4 mol
D) 6 mol

41. Which oxide is most likely to form a basic solution?

A) NO
B) MgO
C) SO_3
D) CO_2

42. Which compound is an oxyacid?

A) H_2S
B) Na_2CO_3
C) HCl
D) H_2SO_3

43. What should you do when handling acids and bases?

A) Wear gloves.
B) Wear safety glasses.
C) Wear an apron.
D) Wear gloves, safety glasses, and an apron.

44. If a sealed 1 L jar is cooled, what happens to the gas molecules?

A) They move more slowly.
B) They collide more often with the walls of the jar.
C) Their vibration increases.
D) They move farther apart.

45. Which statement best accounts for the fact that gases can be easily compressed?

A) Molecules occupy space.
B) The collisions of molecules are elastic.
C) Molecules of gases are in constant motion.
D) Molecules of gases are relatively far from each other

46. 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

47. 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

48. The density of a gas is 1.23 g/L at STP. What is the molar mass of the gas?

A) 27.6 g/mol
B) 3.76 g/mol
C) 37.6 g/mol
D) 17.6 g/mol

49. Which of the following relationships represent Boyle's Law?

A) P α1/T
B) V α T
C) V α 1/P
D) P α T

50. 358 Torr is equivalent to ____ atm?

A) 358 atm
B) 85 atm
C) 0.471 atm
D) 0.358 atm

Part B: Quicks 20 marks

Place your answer in the space provided. Rough work is NOT required.

51. The name of the shape of ammonia, NH_3 is _____

52. In order to have hydrogen bonding which three types of polar bonds must there be? _____

53. Magnesium oxide plus water will produce _____

54. Water, a precipitate, or bubbles are three clues that which type of reaction has occurred? _____

55. What type of solvent would be necessary for carbon tetrachloride to be dissolved? _____

56. On a shipment of 10000kg of oranges, 50 g of mould was found. Express this in ppm. _____

57. In order to make a 50 mL solution of 0.1 M NaOH, how much of a 2.5 M solution is needed? _____

58. During a titration, the point at which the indicator changes colour is called the _____

59. The conjugate acid of $H_2PO_4^-$ is _____

60. A Bronsted-Lowry base is a proton _____

61. What is the pH of a 0.010 M HCl solution? _____

62. A compound is found to be 26.12% C, 5.05% H, and 68.93% O. What is the empirical formula? _____

63. If the multiple of the EF in question 12 is 2, what is the molecular formula mass? _____

64. 0.86 atm is equivalent to how many mm Hg? _____

65. Weak intermolecular forces between non-polar molecules are called _____

66. How much solvent was used in a 12.5 v/v% solution that contained 10 mL of solvent? _____

67. What is the actual yield in a 72% yield that should have recovered 80 g or product? _____

68. A closed cylinder contains 2.0 mol O_2, 5 mol CO_2, and 3 mol N_2. If the total pressure is 1 atm, what is the partial pressure of CO_2? _____

69. The volume of 1 mol of an ideal gas at STP is _____

70. What is the limiting reactant in a synthesis reaction between 2 mol of silver and 3 mol of chlorine _____

PART C SHORT ANSWER 80 Marks

Answer the following questions in the space provided. Remember to include the equation used and units for all calculations. Show all of your work!

71. Explain what type of solvent would be required in order to make a solution of carbon tetrachloride solution. (3 marks).

72. Complete the following chart (9 marks)

Compound	**Lewis line structure** (include $\varsigma^{+/-}$ if appropriate)	**3-D Drawing**	**Polarity of Molecule and name of 3-D shape**
CBr_4			
O_2			
H_2O			

73. Identify the most reactive metal and non-metal on the periodic table. Explain why each element is the most reactive (6 marks).

74. Write the molecular formulae for each of the following: (5 marks)

a) magnesium hydroxide

b) potassium sulfite

c) silver iodide

d) boron tetrabromide

e) iodic acid

75. Write the names for each of the following compounds (5 marks)

a) $H_2SO_{(aq)}$

b) Ca_2C

c) KCl

d) Al_2O_3

e) CO

76. **Complete** the following chemical equations by filling in the blanks or writing out the skeleton equation, as required and **balance**. (10 marks)

a) $C_{12}H_{26} + O_2 \rightarrow$ _____
(complete combustion)

b) $NH_{3(aq)} + H_2O_{(l)} \rightarrow$ _____

c) $HCl_{(aq)} + H_2O_{(l)} \rightarrow$ _____

d) Ammonium nitrite decomposes into nitrogen gas and water.

e) Mercury(II)oxide is prepared from its elements.

f) $BaCl_{2(aq)} + Na_2CO_{3(aq)} \rightarrow$ _____

g) $Zn + Pb(NO_3)_2 \rightarrow$ _____

h) $Ca_{(s)} + Cl_{2(g)} \rightarrow$ _____

i) Aluminum metal reacts with zinc sulfate (write out the complete balanced equation)

j) $HClO_{4(aq)} + Ca(OH)_{2(aq)} \rightarrow$ _____

77. Write the net ionic equation for the reaction between aqueous solutions of barium chloride and sodium sulfate. Be sure to include the state of each reactant and product. (3 marks)

78. Explain the trend for first ionization energy across a period and down a group on the periodic table (4 marks)

79. How many milliliters of sodium hydroxide solution are required to neutralize 20 ml of 1.0 mol/L acetic acid if 32 mL of the same sodium hydroxide solution neutralized 20 mL of 1.0 mol/L hydrochloric acid? (6 marks)

80. What is the difference between a strong acid and a weak acid? Can they have the same pH value? (3 marks)

81. Using the appropriate gas law, explain why it is important to add air to your car tires in the winter time and sometimes to deflate some air in the summer time (4 marks)

82. Pryidine, C_5H_5N, is a slightly yellow liquid with a nauseating odour. It is flammable and toxic by ingestion and inhalation. Pyridine is used in the synthesis of vitamins and drugs, and has many other uses in industrial chemistry. Determine the percentage composition of pyridine. (5 marks)

83. Calculate the percentage by mass of water in potassium sulfite dehydrate, $K_2SO_3 \cdot 2H_2O$. (4 marks)

84. If the following reaction proceeds with a 75% yield, how much diborane, B_2H_6, will be produced when 23.5 g of sodium borohydride, $NaBH_4$ reacts with 50.0 g of boron trifluoride, BF_3? (8 marks)

____$NaBH_{4(s)}$ + ____$BF_{3(g)}$ → ____$B_2H_{6(g)}$ + ____$NaF_{(s)}$

85. A 3.34 g sample of a hydrate has the formula $SrS_2O_3 \cdot xH_2O$, and contains 2.30 g of SrS_2O_3. Find the value of x. (10 marks)