

Name: _____

Teacher: _____

***DO NOT OPEN THE EXAMINATION PAPER UNTIL
YOU ARE TOLD BY THE SUPERVISOR TO BEGIN***

CHEMISTRY 2202

SAMPLE FINAL EXAMINATION

Value: 100%

Time: 2 hours

General Instructions

This examination consists of two parts. Both parts are contained in this booklet and further general instructions are provided on appropriate pages.

Part I - Multiple Choice (40%)

Select the letter of the correct response from those provided. **EITHER** shade the letter on your computer scorable card OR place the letter in the blank provided on your Multiple Choice Answer Sheet, whichever format is being used by your school for this exam.

Do ALL questions in this section.

Part II - Constructed Response (60%)

Answer ALL questions fully and concisely in the space provided. Show all work, and use correct units and significant digits in all final answers.

A Periodic Table and a Chemistry Data Sheet are provided.

Student Checklist

The items below are your responsibility. Please ensure that they are completed.

Write your name and teacher's name on the top of this page.

Write your name, teacher's name, course name and number on the Part I answer sheet.

Check the exam to see that there are no missing pages.

ALL MATERIALS MUST BE PASSED IN WITH THIS EXAM. Use your time wisely. Good luck!

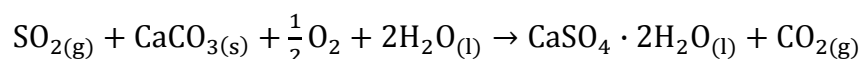
Part 1

Total Value: 40%

- How many neutrons are in an atom of magnesium-25?
 - 12
 - 13
 - 25
 - 37
- How many moles are in a sample that contains 2.71×10^{24} atoms of aluminum?
 - 0.222 mol
 - 4.50 mol
 - 6.02×10^{23} mol
 - 1.63×10^{48} mol
- What is the molar mass of lead (II) sulfate, PbSO_4 ?
 - 162.00 g/mol
 - 255.26 g/mol
 - 303.26 g/mol
 - 1021.04 g/mol
- How many moles are in 7.500 g of NH_4Br (Molar mass = 97.95 g/mol)?
 - 0.07657 mol
 - 13.06 mol
 - 97.95 mol
 - 734.6 mol
- The molar mass of a compound with the empirical formula of CH_2O is 180.16 g/mol. What is the molecular formula of the compound?
 - CH_2O
 - $\text{C}_4\text{H}_4\text{O}_8$
 - $\text{C}_4\text{H}_8\text{O}_4$
 - $\text{C}_6\text{H}_{12}\text{O}_6$

6. Which unit expresses molar concentration?
- (A) g/mol
(B) L/mol
(C) mol/g
(D) mol/L
7. Which is the correct dissociation equation for Na_2SO_4 ?
- (A) $\text{Na}_2\text{SO}_{4(s)} \rightarrow 2\text{Na}_{(aq)}^+ + \text{SO}_{4(aq)}^{2-}$
(B) $\text{Na}_2\text{SO}_{4(s)} \rightarrow \text{Na}_{(aq)}^+ + \text{SO}_{4(aq)}^{2-}$
(C) $\text{Na}_2\text{SO}_{4(s)} \rightarrow 2\text{Na}_{(aq)}^+ + \text{S}_{(aq)}^{2-} + 4\text{O}_{(aq)}^{2-}$
(D) $\text{Na}_2\text{SO}_{4(s)} \rightarrow 2\text{Na}_{(aq)}^+ + 4\text{SO}_{(aq)}^{2-}$
8. A salt solution has a concentration of 0.700 mol/L. How many moles of salt are present in a 2.63 L sample of the solution?
- (A) 0.266 mol
(B) 0.700 mol
(C) 1.84 mol
(D) 3.76 mol
9. What is the mass of 4.76×10^{24} formula units of Al_2O_3 (Molar mass = 101.96 g/mol)?
- (A) 0.0776 g
(B) 12.9 g
(C) 806 g
(D) 2.92×10^{50} g
10. Given the balanced equation
- $$3\text{Mg}(\text{NO}_3)_2 + \text{Al}_2(\text{SO}_4)_3 \rightarrow 3\text{MgSO}_4 + 2\text{Al}(\text{NO}_3)_3$$
- what mass of MgSO_4 (Molar Mass = 120.38 g/mol) would be produced from a reaction of 4.50 mol of $\text{Al}_2(\text{SO}_4)_3$ with sufficient $\text{Mg}(\text{NO}_3)_2$?
- (A) 0.112 g
(B) 181 g
(C) 542 g
(D) 1630 g

11. What volume of a 6.00 mol/L $\text{HCl}_{(\text{aq})}$ solution is required to prepare 500.0 mL of a 2.00 mol/L $\text{HCl}_{(\text{aq})}$ solution?
- (A) 0.167 mL
 (B) 0.150 L
 (C) 167 mL
 (D) 1.50 L
12. Sulfur dioxide, SO_2 , which is produced as a result of burning fuel, is a compound that causes acid rain. It can be removed from smokestacks by reacting it with calcium carbonate, CaCO_3 .



How many moles of water are needed to react with 50 moles of $\text{SO}_{2(\text{g})}$?

- (A) 2 mol
 (B) 50 mol
 (C) 52 mol
 (D) 100 mol
13. What is the concentration of a 0.375 L solution that has 7.90 g of NaCl (Molar mass = 58.44 g/mol) dissolved?
- (A) 0.0507 mol/L
 (B) 0.135 mol/L
 (C) 0.360 mol/L
 (D) 2.77 mol/L
14. What is the average atomic mass of the newly found element *Nonamium* (No) given the following percent abundances:

Isotope (amu)	% Abundance
No – (280) – 279.54 amu	26.25 %
No – (281) – 280.85 amu	13.55%
No – (282) – 281.94 amu	60.20%

- (A) 93.72 amu
 (B) 280.78 amu
 (C) 280.85 amu
 (D) 281.16 amu

15. Which compound has a high solubility in water?
- (A) Ag_2SO_4
 - (B) $\text{Ca}(\text{CH}_3\text{COO})_2$
 - (C) MgSO_3
 - (D) $\text{Zn}(\text{OH})_2$
16. What is the volume of 1.25 g of sulfur dioxide, $\text{SO}_2(\text{g})$ (Molar mass = 64.07 g/mol), at STP?
- (A) $8.71 \times 10^{-4} \text{ L}$
 - (B) 0.437 L
 - (C) $1.79 \times 10^3 \text{ L}$
 - (D) $1.15 \times 10^3 \text{ L}$
17. A 20.0 g sample of $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ (Molar mass = 147.02 g/mol) is heated to remove the water. What mass of anhydrous CaCl_2 will be present after all the water is removed?
- (A) 0.217 g
 - (B) 0.783 g
 - (C) 4.35 g
 - (D) 15.1 g
18. A piece of copper metal is immersed in a beaker containing silver nitrate solution. After 2 days the beaker contained copper metal, silver metal, and copper (II) nitrate. Which of the following was the limiting reagent?
- (A) copper metal
 - (B) copper (II) nitrate
 - (C) silver metal
 - (D) silver nitrate
19. What is an ionic bond?
- (A) The attraction of oppositely charged ions
 - (B) The attraction of positive ions for mobile valence electrons
 - (C) The attraction of positive nuclei for shared pairs of electrons
 - (D) The attraction of opposite dipoles of neighbouring molecules

20. Which bond is non-polar?

- (A) C-F
- (B) C-N
- (C) C-O
- (D) C-S

21. How many lone pairs of electrons are in a molecule of HCl?



- (A) 1
- (B) 3
- (C) 6
- (D) 8

22. Which substance has hydrogen bonding intermolecular forces?

- (A) CH₄
- (B) HBr
- (C) MgH₂
- (D) NH₃

23. Which molecular compound has a tetrahedral shape?

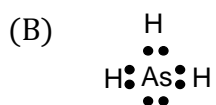
- (A) CH₄
- (B) HCl
- (C) H₂O
- (D) NH₃

24. An unknown substance has a melting point of 675°C. It is found to be a good conductor of heat and electricity in both its liquid and solid states. How would you classify this substance?

- (A) ionic
- (B) metallic
- (C) molecular
- (D) network solid

25. Which is the strongest force found in a crystal of sodium chloride, NaCl?
- (A) Dipole-Dipole
 - (B) Hydrogen Bonding
 - (C) Ionic Bonding
 - (D) London Dispersion
26. Which compound has Dipole-Dipole Forces?
- (A) C_2F_4
 - (B) C_8H_8
 - (C) H_2S
 - (D) $SiCl_4$
27. Which molecule contains a double bond?
- (A) AsI_3
 - (B) CH_2O
 - (C) CH_3F
 - (D) HCN
28. Which bond is most polar?
- (A) C-F
 - (B) N-O
 - (C) P-I
 - (D) S-Br
29. Which substance dissolves in water?
- (A) CCl_4
 - (B) C_5H_{12}
 - (C) C_2Br_4
 - (D) CH_3OH

30. Which Lewis diagram is drawn correctly?



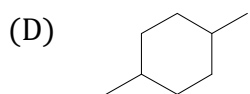
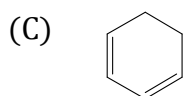
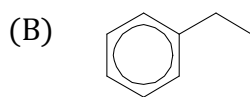
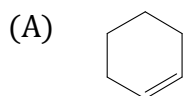
31. A student has 3 colourless aqueous solutions (X, Y and Z). The student does a conductivity test on the solution and finds that only solution Z conducts electricity. Which list identifies the solutes?

	X	Y	Z
(A)	$\text{CH}_3\text{OH}_{(l)}$	$\text{NaCl}_{(s)}$	$\text{C}_6\text{H}_{12}\text{O}_6_{(s)}$
(B)	$\text{CH}_3\text{OH}_{(l)}$	$\text{C}_6\text{H}_{12}\text{O}_6_{(s)}$	$\text{NaCl}_{(s)}$
(C)	$\text{CCl}_4_{(l)}$	$\text{C}_6\text{H}_{12}\text{O}_6_{(s)}$	$\text{NaCl}_{(s)}$
(D)	$\text{CCl}_4_{(l)}$	$\text{NaCl}_{(s)}$	$\text{C}_6\text{H}_{12}\text{O}_6_{(s)}$

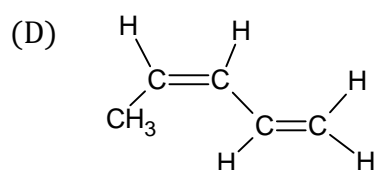
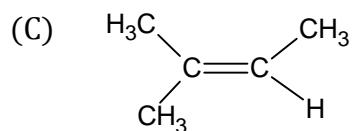
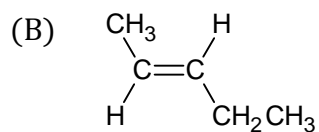
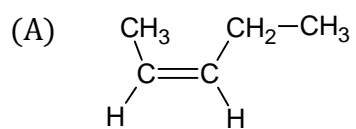
32. Which is an organic compound?

- (A) Na_2CO_3
(B) $\text{C}_2\text{H}_5\text{OH}$
(C) MgSO_4
(D) $\text{Be}(\text{ClO})_2$

33. Which compound is aromatic?



34. Which is cis -2-pentene ?



35. Which compound has a double bond?

- (A) butene
- (B) cyclohexane
- (C) ethyne
- (D) propane

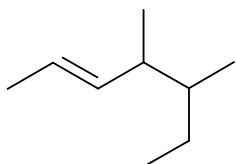
36. Which compound is a hydrocarbon derivative?

- (A) C_2H_6
- (B) C_4H_8
- (C) C_2H_5OH
- (D) C_5H_8

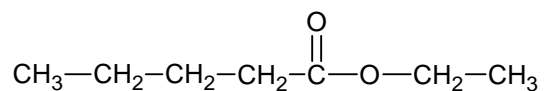
37. Which is an isomer of cyclononane?

- (A) 2,4 - dimethyl-heptane
- (B) 2 - nonene
- (C) cyclononene
- (D) nonyne

38. What is the name of this compound ?



- (A) 4,5-dimethyl-2-heptene
(B) 3,4-dimethyl-5-heptene
(C) 3,4-dimethyl-3-heptene
(D) 3,4-dimethyl-2-heptene
39. A student picks up a bottle containing four hydrocarbons. If the cover is left off the bottle, which hydrocarbon will vapourize last?
- (A) 2-methyl-3-ethylpentane
(B) 2,3-dimethylhexane
(C) 2-methyl-3-ethylheptane
(D) 3-methyloctane
40. Which substance reacts with ethanol to produce the compound below?



- (A) propanoic acid
(B) pentanol
(C) pentanoic acid
(D) propanol

End of Part 1

Part II- Constructed Response

Total Value : 60%

Answer ALL questions in the space provided. All necessary workings must be shown to receive full marks.

Value

4 41. a. A compound is found to have a % composition of 72.71% oxygen and 27.29% carbon. Determine the empirical formula of the compound.

3 b. (i). What mass of potassium sulfate, K_2SO_4 , is required to produce 2.50 L of 1.25 mol/L solution?

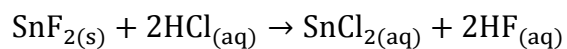
2 (ii). With reference to **appropriate equipment**, outline the steps you would use to make the potassium sulfate solution described above.

41. (continued)

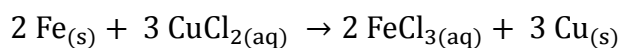
Value

3. c. What is the mass of 4.00 L of ammonia gas ($\text{NH}_3(\text{g})$) at STP?

4. d. Given a reaction between 80.0 g of tin (II) fluoride (SnF_2) and excess hydrochloric acid, what mass of tin (II) chloride would be obtained from the chemical reaction below?



4. e. In the laboratory, a student reacts 0.179 mol of solid iron with 50.0 mL of 1.50 mol/L copper (II) chloride solution,



Using appropriate calculations, identify the limiting reagent.

41. (continued)

Value

- 4 f. Calcium ion, Ca^{2+} , is one of the ions in human blood. Using the solubility table, determine which substances below, if swallowed, would result in a significant decrease in calcium ion concentration in the blood. Give reasons for choices in the space provided.

Substance	Decrease in Ca^{2+} (Yes/No)	Reason
sodium acetate ($NaCH_3COOH$)		
sodium chloride ($NaCl$)		
sodium nitrate ($NaNO_3$)		
sodium sulfate (Na_2SO_4)		

- 3 g. Copper exists as two naturally occurring isotopes. One isotope has an atomic mass of 62.93 amu and a relative abundance of 69.1%. The percent abundance of the other isotope is 30.9%. If the average atomic mass of copper is 63.55 amu, calculate the atomic mass of the other isotope.

Value

42. a. For the molecule SCl_2 ,

2 (i) Draw the electron dot diagram.

2 (ii) Name and draw the VSEPR shape diagram.

2 (iii) Explain why SCl_2 is a polar molecule.

3 b. Explain why diamond has a higher melting point than graphite, yet both are made up of only carbon atoms.

c. For the 2 compounds CH_3OH and CH_3F ,

3 (i) List the intermolecular forces present in each compound

Bonding Forces	CH_3OH (Yes/No)	CH_3F (Yes/No)
LDF		
Dipole-Dipole		
Hydrogen Bonding		

1 (ii) Identify which compound has the higher boiling point based on the forces present.

- 4 d. Consider the following data for four different substances:

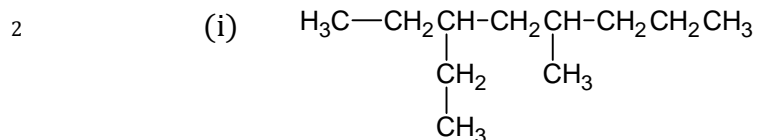
Substance	Melting Point °C	Boiling Point °C	Electrical Conductivity	
			In Solid	In Water
W	636	1300	Poor	Good
X	2730	Very High	Poor	Poor
Y	-101	-34	Poor	Poor
Z	961	2155	Good	Good

Use the information provided in the table to **identify and explain** which substance has:

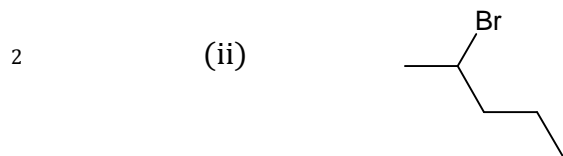
(i) Network Covalent Bonding

(ii) Ionic Bonding

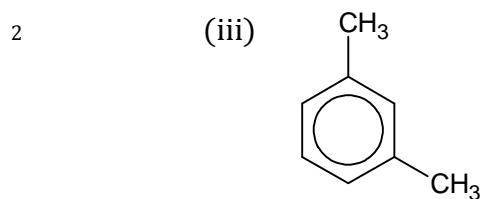
43. A. **Name** each compound using the IUPAC naming rules.



Name: _____



Name: _____



Name: _____

Value

- B. Draw structural diagrams for each of the following compounds:
- 2 (i). 2-hexanol
- 2 (ii). 4-ethyl-4-methyl-2-heptyne
- 2 (iii). 3-pentanone
- 4 C. A reaction between ethene and water produces Compound A. Compound A is further reacted with ethanoic acid to produce Compound B.
Use **structural diagrams** to show Compound A and Compound B.