

Grenfell Campus
MEMORIAL UNIVERSITY OF NEWFOUNDLAND
CHEMISTRY 1810
Sample Midterm Examination

Time: **Two Hours**

Name: _____

Student Number: _____

Instructor: _____

This Examination has 11 Pages
(including the Periodic Table)

Read the following carefully

Answer each question in the space provided. When answering problems, show all your calculations. Note: a ½ mark will be deducted for any final answer with the incorrect number of significant figures.

You are provided with a Periodic Table and data sheet on the last page of the examination. You may detach this sheet.

HAND IN THIS PAPER IN ITS ENTIRITY AT THE END OF THE EXAMINATION.

Page	Value	Mark
3	11	
4	11	
5	12	
6	7	
7	8	
8	12	
9	8	
10	6	
Total	75	

Note: each question which requires as an answer the name of a chemical element or compound or a scientific term, that word must be spelled correctly in order to obtain any mark.

[marks]

[5] 1. Provide the correct full **name** for each of the following terms:

- (a) The most perfect form of a solid is called a **crystal**
- (b) If a compound turns red litmus blue, it must be a **base**
- (c) When a solid turns directly to a gas, the process is called
sublimation
- (d) When a liquid is easy to pour, it is said to have a low
viscosity
- (e) When a liquid turns to a gas below its boiling point, the process is called
evaporation

[3] 2. Identify each of the following by **name**:

- (a) The group 2 elements **alkaline earth metals**
- (b) The group 15 elements **pnicogens**
- (c) The elements 90-103 **actinoids**

[3] 3. Complete the following table of electron configuration:

Element	$n=1$	$n=2$	$n=3$
sulfur	2	8	6
sulfide ion	2	8	8

- [3] 4. Answer each of the following parts:
An atom of a particular isotope of an element has an atomic number of 15 and a mass number of 33.
- (a) What is the name of the element? phosphorus
- (b) How many neutrons does this particular isotope possess? 18
- (c) How many electrons does the neutral atom possess? 15
- [2] 5. What is the common charge (e.g., +1, -1) on each of the following ions:
- (a) lead (two values) +2 +4
- (b) aluminum +3
- [3] 6. What is the ion formula (e.g. oxide, answer O^{2-}) for each of the following ions:
- (a) nitride N^{3-}
- (b) nitrite NO_2^-
- (c) nitrate NO_3^-
- [3] 7. Write the correct formulas corresponding to each of the following names:
- (a) tin(IV) fluoride SnF_4
- (b) tetraphosphorushexasulfide P_4S_6
- (c) zinc oxide ZnO

[5] 8. Write correct names corresponding to each of the following formulas:

(a) K_2O potassium oxide

(b) Cu_2O copper(I) oxide

(c) N_2O dinitrogen oxide

(d) NH_4Br ammonium bromide

(e) $HBr(aq)$ hydrobromic acid

[4] 9. Draw the electron-dot formulas for:

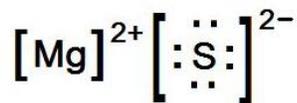
(a) Mg



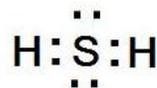
(b) S



(b) MgS



(c) H_2S



[3] 10. Identify, with correct spelling:

(a) The generic name for a substance that forms an electrically conducting solution when dissolved in water electrolyte.

(b) A pair of electrons in a molecule that is not being used in a covalent bond is called a lone pair.

(c) The type of covalent bond that involves six shared electrons triple bond.

11. Argon is found to have three naturally-occurring isotopes: Ar-36, atomic mass 35.9675 u, abundance 0.3365%; Ar-38, atomic mass 37.9627 u, abundance 0.0632%; and Ar-40, atomic mass 39.9624 u, abundance 99.6003%. Calculate the average atomic mass of argon.

[3]

$$\begin{aligned}\text{Average atomic mass} &= (35.9675 \text{ u} \times 0.003365) + (37.9627 \text{ u} \times 0.000632) \\ &\quad + (39.9624 \text{ u} \times 0.996003) \\ &= (0.1210 \text{ u}) + (0.0240 \text{ u}) + (39.8027 \text{ u}) \\ &= 39.9477 \text{ u}\end{aligned}$$

12. Calculate the percentage by mass of chlorine in phosphorus pentachloride.

[2]

Formula of phosphorus pentachloride = PCl_5

$$\text{Molar mass} = [(1 \times 31.0) + (5 \times 35.5)] \text{ g}\cdot\text{mol}^{-1} = 208.5 \text{ g}\cdot\text{mol}^{-1}$$

$$\text{Percentage by mass of chlorine} = \left(\frac{177.5 \text{ g}}{208.5 \text{ g}} \right) \times 100\% = 70.74\%$$

13. A compound has an empirical formula of CH_2 and a molar mass of $84 \text{ g}\cdot\text{mol}^{-1}$. What is the molecular formula of the compound?

[2]

$$\text{Empirical formula mass} = [(1 \times 12.0) + (2 \times 1.01)] \text{ g} = 14.0 \text{ g}$$

$$\text{Ratio, } \frac{\text{molar mass}}{\text{empirical formula mass}} = \frac{84 \text{ g}}{14 \text{ g}} = 6$$

$$\text{Molecular formula} = (\text{CH}_2)_6 = \text{C}_6\text{H}_{12}$$

14. When 8.72 g of iron are heated with chlorine gas, 25.36 g of a compound of iron and chlorine is formed. What is its empirical formula?

[4]

Mass of chlorine = 16.64 g

$$\text{Mole Fe} = 8.72 \text{ g} \times \left(\frac{1 \text{ mol}}{55.85 \text{ g}} \right) = 0.156 \text{ mol Fe}$$

$$\text{Mol Cl} = 16.64 \text{ g} \times \left(\frac{1 \text{ mol}}{35.45 \text{ g}} \right) = 0.4694 \text{ mol Cl}$$

$$\text{Ratio} = \frac{0.156 \text{ mol Fe}}{0.156 \text{ mol}} : \frac{0.4694 \text{ mol Cl}}{0.156 \text{ mol}} = 1 \text{ Fe} : 3.01 \text{ Cl}$$

Empirical formula = FeCl₃

15. Calculate the number of atoms of oxygen in 7.32 g of sulfur trioxide.
(Avogadro's constant = $6.02 \times 10^{23} \text{ molecules} \cdot \text{mol}^{-1}$)

[4]

Strategy

Relationship

Mass of SO₃ → mol SO₃

1 mol SO₃ ≡ 80.1 g

Mol of SO₃ → # of molecules SO₃

1 mol ≡ 6.02×10^{23} molecules

of molecules SO₃ → # of atoms O

1 molecule SO₃ ≡ 3 atom O

$$\text{Mol of SO}_3 = 7.32 \text{ g SO}_3 \times \left(\frac{1 \text{ mol}}{80.1 \text{ g}} \right) = 9.14 \times 10^{-2} \text{ mol SO}_3$$

$$\begin{aligned} \text{\# of molecules SO}_3 &= 9.14 \times 10^{-2} \text{ mol SO}_3 \times \left(\frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \right) \\ &= 5.50 \times 10^{22} \text{ molecules SO}_3 \end{aligned}$$

$$\begin{aligned} \text{\# of atom O} &= 5.50 \times 10^{22} \text{ molecule SO}_3 \times \left(\frac{3 \text{ atoms O}}{1 \text{ molecule SO}_3} \right) \\ &= 1.65 \times 10^{23} \text{ atoms O} \end{aligned}$$

- [3] 16. Identify **by name** (spelled correctly) the following elements:
- (a) The most reactive gaseous element Fluorine
- (b) The halogen which is a purple-black solid Iodine
- (c) 78% of the atmosphere is this gas Nitrogen
- [2] 17. Write the molecular equation corresponding to the following word equation:
Lithium metal burns in nitrogen gas to give solid lithium nitride.
- $$6 \text{Li}(s) + \text{N}_2(g) \rightarrow 2 \text{Li}_3\text{N}(s)$$
- [2] 18. Complete the following chemical equations, including the phases of the products:
- (a) $\text{H}_2\text{CO}_3(aq) \rightarrow \text{H}_2\text{O}(l) + \text{CO}_2(g)$
- (b) $\text{K}_2\text{S}(aq) + 2 \text{HCl}(aq) \rightarrow 2 \text{KCl}(aq) + \text{H}_2\text{S}(aq)$ or (g)
- [2] 19. Insert the correct term:
- (a) A substance which alters the rate of a chemical reaction but which is unchanged at the end of the reaction is called a: catalyst
- (b) Different forms of a chemical element are called: allotropes
- [2] 20. Write the correctly-spelled **name** of:
- (a) **Any** metal which reacts with water sodium, lithium, or calcium
- (b) **Any** metal which does not react with acid or water copper, silver, or gold
- [1] 21. Identify the generic class of the following reaction:
- $$\text{CaO}(s) + \text{CO}_2(g) \rightarrow \text{CaCO}_3(s)$$
- Combination

[2] 22. Answer each of the following by name:

- (a) All ionic compounds of this polyatomic *anion* are soluble Nitrate
- (b) Name any *one* of the metal *cations* which always forms soluble ionic compounds.

Sodium, potassium, or lithium (or cesium or rubidium)

[3] 23. Identify *by name* the following gases:

- (a) The dark red-brown gas Nitrogen dioxide
- (b) The gas with a “rotten egg” smell Hydrogen sulfide
- (c) The only basic gas Ammonia

24. 0.500 g of a noble gas occupies 0.582 L at a temperature of 18°C and a pressure of 103 kPa. What is the identity of the gas? Show your calculations.

$$(R = 8.31 \text{ kPa}\cdot\text{L}\cdot\text{mol}^{-1}\cdot\text{K}^{-1})$$

[3]

Strategy

Relationship

Vol, T, P gas → mol gas

$$n = PV/RT$$

Mol, mass gas → molar mass gas

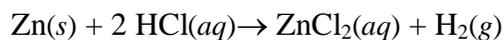
$$\text{m.m.} = m/n$$

$$\text{Mol gas} = \frac{(103 \text{ kPa}) \times (0.582 \text{ L})}{(8.31 \text{ kPa}\cdot\text{L}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}) \times (291 \text{ K})} = 2.48 \times 10^{-2} \text{ mol}$$

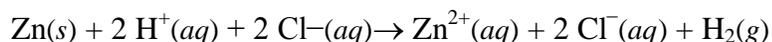
$$\text{Molar mass} = \frac{0.500 \text{ g}}{2.48 \times 10^{-2} \text{ mol}} = 20.2 \text{ g}\cdot\text{mol}^{-1}$$

The gas must be *neon*

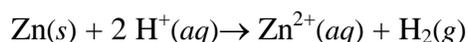
- [2] 25. Write a balanced net ionic equation corresponding to the following formula equation:



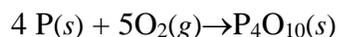
Total ionic equation:



Net ionic equation:



26. Phosphorus reacts with oxygen gas to form tetraphosphorusdecaoxide.



If 26.8 g of phosphorus are used, what mass of oxygen gas is consumed?

[4]

Strategy

Mass of P \rightarrow mol P

Mol of P \rightarrow mol of O₂

Mol of O₂ \rightarrow mass of O₂

Relationship

1 mol P \equiv 31.0 g

4 mol P \equiv 5 mol O₂

1 mol O₂ \equiv 32.0 g

$$\text{Mol P} = 26.8 \text{ g P} \times \left(\frac{1 \text{ mol}}{31.0 \text{ g}} \right) = 8.90 \times 10^{-2} \text{ mol P}$$

$$\text{Mol O}_2 = 8.90 \times 10^{-2} \text{ mol P} \times \left(\frac{5 \text{ mol O}_2}{4 \text{ mol P}} \right) = 0.111 \text{ mol O}_2$$

$$\text{Mass O}_2 = 0.111 \text{ mol O}_2 \times \left(\frac{32.0 \text{ g}}{1 \text{ mol}} \right) = 3.56 \text{ g O}_2$$

