

Aga Khan University Examination Board

Notes from E-Marking Centre on SSC-I Chemistry Examination May 2017

Introduction

This document has been produced for the teachers and candidates of Secondary School Certificate (SSC-I) Chemistry. It contains comments on candidates' responses to the 2017 SSC-I Examination indicating the quality of the responses and highlighting their relative strengths and weaknesses.

E-Marking Notes

This includes overall comments on candidates' performance on every question and *some* specific examples of candidates' responses which support the mentioned comments. Please note that the descriptive comments represent an overall perception of the better and weaker responses as gathered from the e-marking session. However, the candidates' responses shared in this document represent some specific example(s) of the mentioned comments.

Teachers and candidates should be aware that examiners may ask questions that address the Student Learning Outcomes (SLOs) in a manner that requires candidates to respond by integrating knowledge, understanding and application skills they have developed during the course of study. Candidates are advised to read and comprehend each question carefully before writing the response to fulfil the demand of the question.

Candidates need to be aware that the marks allocated to the questions are related to the answer space provided on the examination paper as a guide to the length of the required response. A longer response will not in itself lead to higher marks. Candidates need to be familiar with the command words in the SLOs which contain terms commonly used in examination questions. However, candidates should also be aware that not all questions will start with or contain one of the command words. Words such as 'how', 'why' or 'what' may also be used.

General Observations

In comparison to previous years, candidates attempted the paper well. However, there is still room for improvement. Mentioned below are few concepts that teachers need to focus and give candidates more drill and practice to have a strong grip.

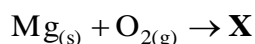
- a. Balancing and construction of chemical equations and ionic equations.
- b. Drawing of dot and cross structures representing different types of chemical bonds.
- c. Drawing of atomic structures for different elements, ions and atoms of isotopes.
- d. Problem solving which involves use of correct formula, manipulation of formula as per the data given and substitution of values to obtain the correct answer.

Detailed Comments:

Constructed Response Questions (CRQs)

Question 1:

Given below is a chemical equation showing the reaction between magnesium ribbon and oxygen gas.



- Identify the product **X** and balance the given chemical equation.
- Name the type of chemical reaction taking place in this equation.

Better responses showed correct identification of product **X** with accurate balancing of the given equation. Furthermore, candidates identified the type of chemical reaction using multiple names such as combustion reaction/ oxidation reaction/ addition reaction/ synthesis reaction/ combination reaction.

Example:

- a. Identify the product **X** and balance the given chemical equation. (2 Marks)

The product X is "MgO" and the balanced chemical equation is: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

- b. Name the type of chemical reaction taking place in this equation. (1 Mark)

The type of chemical reaction taking place in the above equation is addition reaction.

Weaker responses demonstrated poor conceptual knowledge about the type of chemical reactions. A few of these responses displayed correct identification of the product but failed to balance the equation and name the type of chemical reaction. The answer to part 'b' included incorrect reaction types, such as, additional/ reduction/ covalent bond/ transitional reaction/ displacement reaction.

Example:

a. Identify the product X and balance the given chemical equation. (2 Marks)

Product X is Mg_3O_2
 $Mg(s) + O_2(g) \rightarrow Mg_3O_2$
 $3Mg(s) + O_2(g) \rightarrow Mg_3O_2$

b. Name the type of chemical reaction taking place in this equation. (1 Mark)

The type of chemical reaction taking place in this equation is Reduction reaction.



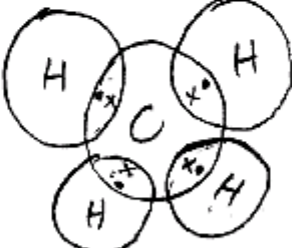

Question 2:

Complete the table for the given substances.

Substance	Dot and Cross Diagram
Oxygen gas	
Nitrogen gas	
Methane gas	
Carbon dioxide gas	

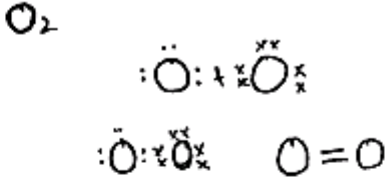
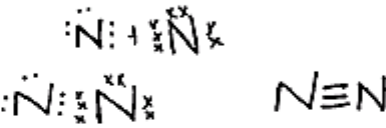
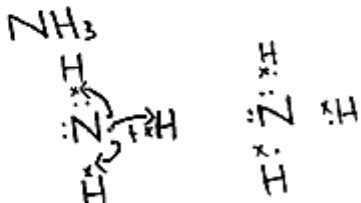
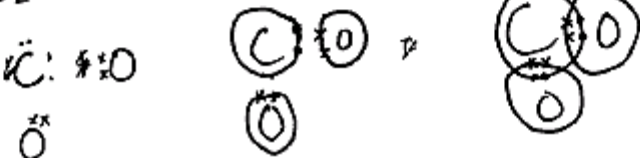
Better responses managed to draw the dot and cross structures of the given substances highlighting correct number of valence electrons and proper sharing of electrons between atoms.

Example:

Substance	Dot and Cross Diagram
Oxygen gas	 <p style="text-align: right;">$O=O$ double covalent bond</p>
Nitrogen gas	 <p style="text-align: right;">$N \equiv N$ Triple covalent bond</p>
Methane gas	 <p style="text-align: right;"> $\begin{array}{c} H \\ \\ H-C-H \\ \\ H \end{array}$ Single covalent bond </p>
Carbon dioxide gas	 <p style="text-align: right;">$O=C=O$ Double covalent bond</p>

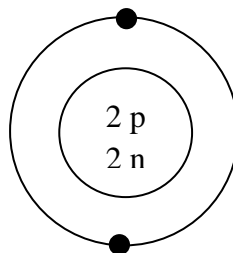
Weaker responses failed to draw the correct dot and cross structures for the given substances. These responses showed lack of understanding of the type of covalent bonding present between different atoms in compounds. A few of these responses displayed accurate structures for one or two substances such as oxygen and nitrogen or oxygen and methane or oxygen and carbon dioxide. Such responses represented clarity about the structure of oxygen but made errors in the rest of the structures with reference to the number of valence electrons and chemical formula of substances.

Example:

Substance	Dot and Cross Diagram
Oxygen gas	O_2 
Nitrogen gas	N_2 
Methane gas	CH_4 
Carbon dioxide gas	CO_2 

Question 3:

Consider the given structure of an atom of an element **X** to answer the following questions.



- Identify the element **X**.
- Name another element belonging to the same group as element **X**.
- State any **THREE** properties that all the elements of this group have in common.

Better responses accurately identified the element **X**, named another element, such as, neon/ argon/ krypton/ xenon/ radon from the same group and stated three distinctive properties common to group VIII elements. These responses included characteristics, such as, they are all colourless gases at room temperature and pressure/ have a complete outer electron shell (duplet or octet)/ exist as monoatomic gases/ are non-metals/ are unreactive/ do not form ions/ do not make bonds/ have zero valency.

Example:

- a. Identify the element **X**. (1 Mark)

Helium (He)

- b. Name another element belonging to the same group as element **X**. (1 Mark)

Argon.

- c. State any **THREE** properties that all the elements of this group have in common. (3 Marks)

- * They do not react with any other element.
- * They have complete outer most shell.
- * They all are gases known as noble gases.

Weaker responses showed poor understanding about the characteristics of different groups of the periodic table. These responses identified the element incorrectly and carried forward their mistakes. For example, they identified the element in part 'a' as hydrogen/ calcium/ beryllium, then mentioned sodium/ potassium/ magnesium as an answer to part 'b' and gave irrelevant characteristics of group I or II in part 'c'.

Example:

a.	Identify the element X.	(1 Mark)
	Beryllium	
b.	Name another element belonging to the same group as element X.	(1 Mark)
	Magnesium	
c.	State any THREE properties that all the elements of this group have in common.	(3 Marks)
	1- They have very high melting and boiling points.	
	2- Their valence shell contains two electrons which they lose to become M^{+2} ions.	
	3- They are less reactive than alkali metals. They don't react with oxygen readily and form stable nitrides.	

Question 4a:

- i. State the relationship between volume and temperature of a gas presented by J. Charles.
- ii. Give mathematical representation of Charles's law to support your answer in part i.

Better responses correctly stated the law of J. Charles regarding the direct relationship between volume and temperature at constant pressure. These responses displayed accurate mathematical expression in support of their answer to part i.

Example:

i. State the relationship between volume and temperature of a gas presented by J. Charles. (1 Mark)

J. Charles states that, "Volume of a gas is directly proportional to the temperature when the pressure is kept constant."

ii. Give mathematical representation of Charles's law to support your answer in part i. (1 Mark)

$$\begin{array}{l} V_1 \propto T_1 \quad V_1 = KT_1 \quad K = V_1/T_1 \quad \Rightarrow \quad \frac{V_1}{T_1} = \frac{V_2}{T_2} \\ V_2 \propto T_2 \quad V_2 = KT_2 \quad K = V_2/T_2 \end{array}$$

Weaker responses exhibited lack of knowledge about Charles's law. These responses showed confusion between Boyle's and Charles's law. Some candidates stated and mathematically represented direct relationship between volume and pressure while others mentioned inverse relationship between volume and temperature.

Example:

i. State the relationship between volume and temperature of a gas presented by J. Charles. (1 Mark)

In Charles's Law, volume is inversely (\propto) proportional to temperature.

ii. Give mathematical representation of Charles's law to support your answer in part i. (1 Mark)

$$V \propto \frac{1}{T} \quad \text{or} \quad V = \frac{k}{T} \quad \text{or} \quad VT = k$$

Question 4b:

A doctor prescribed milk of magnesia, a suspension of magnesium hydroxide, to a patient in order to be used as a neutraliser for stomach acidity.

How would you determine that milk of magnesia is a suspension? Give THREE reasons.

Better responses interpreted the given information correctly and gave distinctive characteristics which proved magnesium hydroxide as a suspension. The points evident in these responses were nature of the mixture is heterogeneous/ appearance of the solution is opaque/ particles are larger than 10^{-5} cm in diameter/ it will not allow light to pass through it/ particles of it can be separated through filtration/ particles in milk of magnesia can be seen with naked eyes.

Example:

1. The milk of magnesia is a suspension because its particles are large enough and can be seen with naked eye.
2. Its particles are not completely dissolved thus it is a heterogeneous mixture.
3. The particles of milk of magnesia cannot pass through the filter paper.

Weaker responses presented the characteristics of true solution and colloids rather than suspension. A few gave one correct characteristic which mostly highlighted suspension as a heterogeneous mixture. Others mentioned irrelevant answers without understanding the demand of the question. For example, milk of magnesia gives more energy/ contains protein/ works as a base that neutralises acidity of the stomach/ needs to be boiled before taking it/ has large volume/ particles are not arranged.

Example:

- ① Particles are easily dissolved.
- ② It is a heterogeneous mixture.
- ③ And it is made of milk adding something with it.

Question 5a:

150 cm³ of an aqueous sodium chloride solution contains 3 g sodium chloride. Calculate the mass/ volume percentage of the given solution.

Better responses showed in-depth understanding of the concept of percentage composition of different solutions. These responses calculated the correct mass by volume percentage of the given solution using the appropriate formula.

Example:

$$\begin{aligned} \text{m/v \%} &= \frac{\text{mass of solute (g)}}{\text{volume of solution (cm}^3\text{)}} \times 100. \\ &= \frac{3\text{g}}{150\text{cm}^3} \times 100 = 2\% \text{ g/cm}^3 \end{aligned}$$

Weaker responses exhibited poor conceptual knowledge and used a variety of irrelevant formulae to calculate the desired percentage. These responses used either incomplete formula, such that, candidates divided mass by volume but didn't multiply the value by 100 or they divided volume by mass and multiplied the answer by 100. Some responses showed division of mass by mass ($3 \div 153$) and then multiplication by 100. A few responses used the correct formula but showed wrong calculation of percentage or unnecessary conversions from cubic centimetre to cubic decimetre/ gram to kilogram which led to incorrect answer.

Example:

$$\begin{aligned} \text{aqueous solution} &= 150 \text{ cm}^3, 3\text{g sodium chloride} \\ \frac{150 \text{ cm}^3}{3\text{g}} \times 100 &= 5000. \text{ Answer.} \end{aligned}$$

Question 5b:

If 15 cm³ of 5 M hydrochloric acid solution has been diluted to 100 cm³, then what will be the molarity of the prepared solution?

Better responses demonstrated clarity about the dilution of solutions from concentrated solutions of known molarity. These responses calculated the correct molarity using the dilution formula of $M_1V_1 = M_2V_2$. A few candidates who remembered the molar mass of hydrogen and chlorine applied the formula of $\text{Molarity} = \frac{\text{Mass}}{\text{Molar mass}} \times \frac{1000}{\text{Volume in cm}^3}$ and, by manipulating it in the correct manner, reached the desired answer.

Example:

Data: $M_1 = 5\text{ M}$	Solution: $M_1V_1 = M_2V_2$
$M_2 = ??$	$\frac{M_1V_1}{V_2} = M_2 ; M_2 = \frac{15 \times 5}{100}$
$V_1 = 15\text{ cm}^3$	
$V_2 = 100\text{ cm}^3$	$M_2 = 0.75\text{ M}$ Ans

Weaker responses displayed lack of mathematical skills. A few of these responses used the correct formula but failed to substitute the values correctly or showed incorrect use of number operations which resulted in wrong answers. Again in this question, unnecessary conversion caused distraction and confusion which led the students towards incorrect answer.

Example:

$M_1V_1 = M_2V_2$	$V_2 = 25\text{ M}$
$15 \times 5 = 100V_2$	
$75 = 100V_2$	
$100 - 75 = V_2 =$	

Question 6:

An element **X** has relative atomic number of 11. It loses one electron and acquires +1 oxidation state. It gives a violent reaction with cold water.

- Identify element **X** based on the given characteristics.
- Which period of the periodic table does element **X** belong to?
- What products are formed on reaction of element **X** with cold water?

Better responses demonstrated good analytical skills of candidates. Candidates interpreted the information well which enabled them to identify the element **X** correctly. Using the atomic number, they were able to gauge the period number and worked out the products by writing a balanced chemical equation.

Example:

- a. Identify element **X** based on the given characteristics. (1 Mark)

Sodium.

- b. Which period of the periodic table does element **X** belong to? (1 Mark)

3rd period.

- c. What products are formed on reaction of element **X** with cold water? (2 Marks)



Weaker responses identified the alkali metal from the given information but failed to attempt part 'b' and 'c' accurately. These responses represented the period number as 1, 2, 17 or VII. Furthermore, the answers to part 'c' included wrong product including, incorrect formula of sodium hydroxide (NaH_2O , NaOH_2)/ oxygen is formed/ liquid is formed/ $\text{NaH} + \text{HO}_2$. Yet others did not understand the term 'product' and mentioned observations, which were incorrect. For example, bubbling in water/ discolouration/ violent reaction.

Example:

a. Identify element X based on the given characteristics. (1 Mark)

Sodium

b. Which period of the periodic table does element X belong to? (1 Mark)

Period 1 of the Periodic table element X belongs to

c. What products are formed on reaction of element X with cold water? (2 Marks)

It gives a violent reaction

Extended Response Questions (ERQs)

The following questions (7 and 8) offered a choice between part **a** and **b**.

Approximately, equal number of candidates attempted part 'a' and 'b' of question 7. This shows their interest and strong understanding of both concepts, i.e. 'atomic structure' and 'structure of molecules'. However, in question 8, more inclination of candidates was observed in part 'a' than part 'b'. This reflects their confidence over the concept of 'states of matter' more than their risk taking in 'electrochemistry'.

Question 7a:

- i. Mention any FOUR medical uses of isotopes of any element.
- ii. Draw the atomic structures of three isotopes of oxygen, specifying their number of protons, neutrons and electrons.

Better responses specified the various uses of isotopes in the field of medicine. For example, cobalt-60 (Co-60) is used to damage the cancer cells without surgery/ skin cancer is treated with the help of beta rays from phosphorus-32 (P-32) and strontium-90 (Sr-90)/ small amount of sodium-24 (Na-24) is injected into the patient to detect the tumors and blood clots/ iodine-131 (I-131) is used to diagnose and treat cancers of the thyroid glands/ technetium-99m (Tc-99m) is used to monitor the bone growth. Moreover, these responses included clear representation of the atomic structures of the three isotopes of oxygen along with accurate count of their protons, electrons and neutrons.

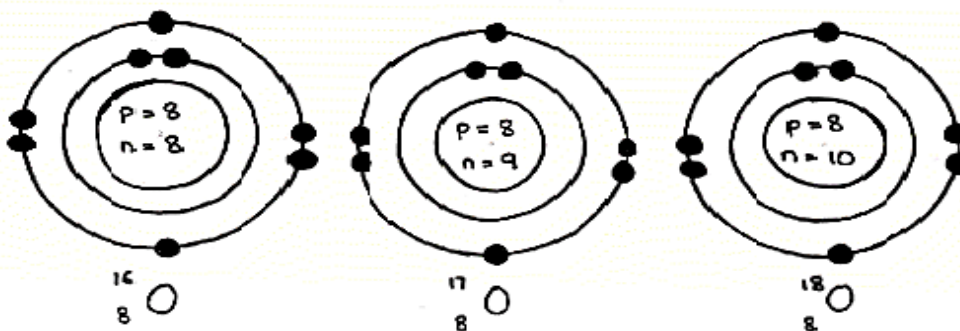
Example:

①. Isotopes are the atoms of an element that have same atomic numbers but different mass numbers. They have ~~same~~ similar electronic configuration and number of protons but they differ in the number of neutrons. They have various uses in medical, power generation, radiotherapy and for treatment of various diseases. Isotopes of P-32 and Sr-90 are used in the treatment of skin cancer because they emit less penetrating beta radiations. Similarly, for the treatment of cancer Co-60 affecting within the body is used because it emits strongly penetrating gamma rays. The radioactive isotopes are also used as tracers of medicine for diagnosis of the presence of tumour in the body. Isotopes of Iodine-131 are used for the diagnosis of goiter in the thyroid gland. Similarly technetium is used to monitor the bone growth.

(ii). There are three isotopes of oxygen namely: ${}^{16}_8\text{O}$, ${}^{17}_8\text{O}$, ${}^{18}_8\text{O}$. They have same no. of protons but they differ in the number of neutrons. Due to their difference in mass numbers, their physical properties are different.

\odot ${}^{16}_8\text{O}$	\odot ${}^{17}_8\text{O}$	\odot ${}^{18}_8\text{O}$
$p^+ = 8$	$p^+ = 8$	$p^+ = 8$
$e^- = 8$	$e^- = 8$	$e^- = 8$
$n^0 = 8$	$n^0 = 9$	$n^0 = 10$

Space for drawing



For all; $p^+ = 8$
 $e^- = 8$

Weaker responses mentioned the general uses of isotopes rather than the medical uses. These responses drew the atomic structures of the isotopes of hydrogen and carbon instead of oxygen. A few responses wrote one or two correct medical uses of isotopes but made errors in the structures with reference to the number of protons, neutrons and electrons for each isotope of oxygen

Example:

Q7 a) → i) 'Four medical uses of oxygen isotopes'

- 1) Oxygen is most important part of life, Patients having asthma problems uses oxygen for^{to} breath.
- 2) Oxygen Isotope is also used for plants and animals they inhale it, It is used to keep living organisms alive, which also helps in medication, plants are used to provide herbs as well
- 3) Water is main source of life, It is mixture of Hydrogen & Oxygen. Water is necessary for all living organisms.
- 4) Oxygen is also used in carbon dioxide & Oxygen is also a source to treat asthma, and heart problems.

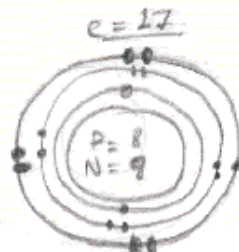
Q7 a) → ii) Isotopes :- It is a chemical reaction which have same number of atomic number but different atomic mass, Isotopes depends on electronic configuration, They are used in chemical reaction, Some of Isotopes of Oxygen are drawn below, with proton, neutron & no. of electron of outer most shell.

Space for drawing

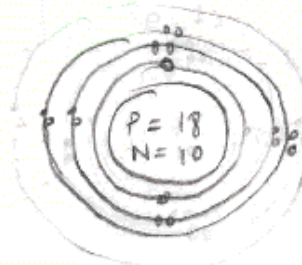
Q7 a → ii)



$^{16}_8\text{O}$



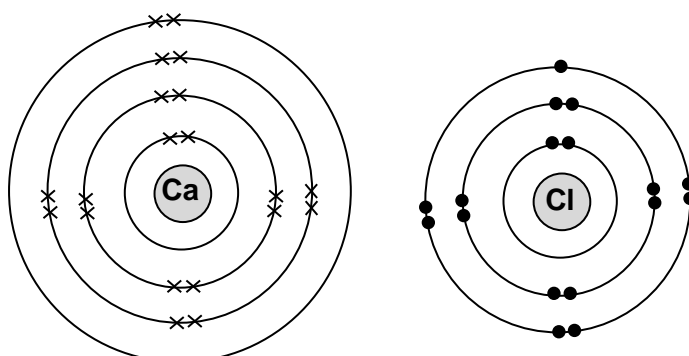
$^{17}_8\text{O}$



Isotopes of Oxygen

Question 7b:

Given are the atomic structures of calcium and chlorine. These two elements form a compound called calcium chloride.



- Name the bond that joins calcium and chlorine atoms together.
- Explain the formation of bond between calcium and chlorine atoms.
- Draw a dot and cross diagram to represent the bond in calcium chloride.

Better responses identified the ionic bond and gave in-depth explanation of the bond formation in calcium chloride. Furthermore, candidates justified their response by giving a proper illustration representing transference of valence shell electrons and charges for the gain and loss of electrons.

Example:

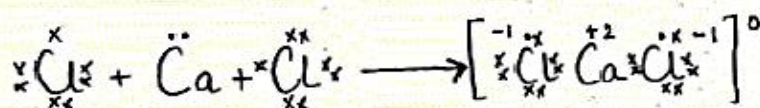
(b) (i) The bond that joins calcium and chlorine atoms together is Ionic bond.

(ii) A bond is form between Calcium and chlorine atoms so that they could get their outermost shell complete. This bonding is Ionic bonding which occurs between metals and non-metals. This bond is formed by the complete transference of electron from an electropositive elements to an electronegative element. In this case calcium and chlorine will form a compound calciumchloride. Calcium has two electrons in it last shell and chlorine needs only one electron to complete it outermost shell. Therefore two chlorine ~~the~~ atoms will form a bond with calcium and each chlorine atom will take one electron ~~each~~ ^{that} from one calcium atom.

At the end calcium will lose its two electrons and will become stable and will become cation containing a positive charge and each chlorine will gain one electron and will complete its outermost shell and become anion containing a negative charge.

Space for drawing

(iii)



Weaker responses demonstrated poor concepts with respect to chemical bonding. Candidates were unable to identify the type of bonding in calcium chloride. These responses identified the bonding as covalent or coordinate covalent. However, their explanation comprised of few points which focused on the correct number of gain or loss of electrons/ charges that appear on ions after gain or loss of electrons. Mostly, their points included irrelevant information such as mutual sharing between calcium and chlorine/ donation of lone pair of electrons by calcium/ calcium is donor of 2 electrons and chlorine is acceptor of 2 electrons. Furthermore, these responses were unable to give appropriate dot and cross structures of calcium chloride. In these structures, candidates did not mention the charges nor showed complete transfer of electrons. These responses mostly showed sharing of electrons between calcium and chlorine.

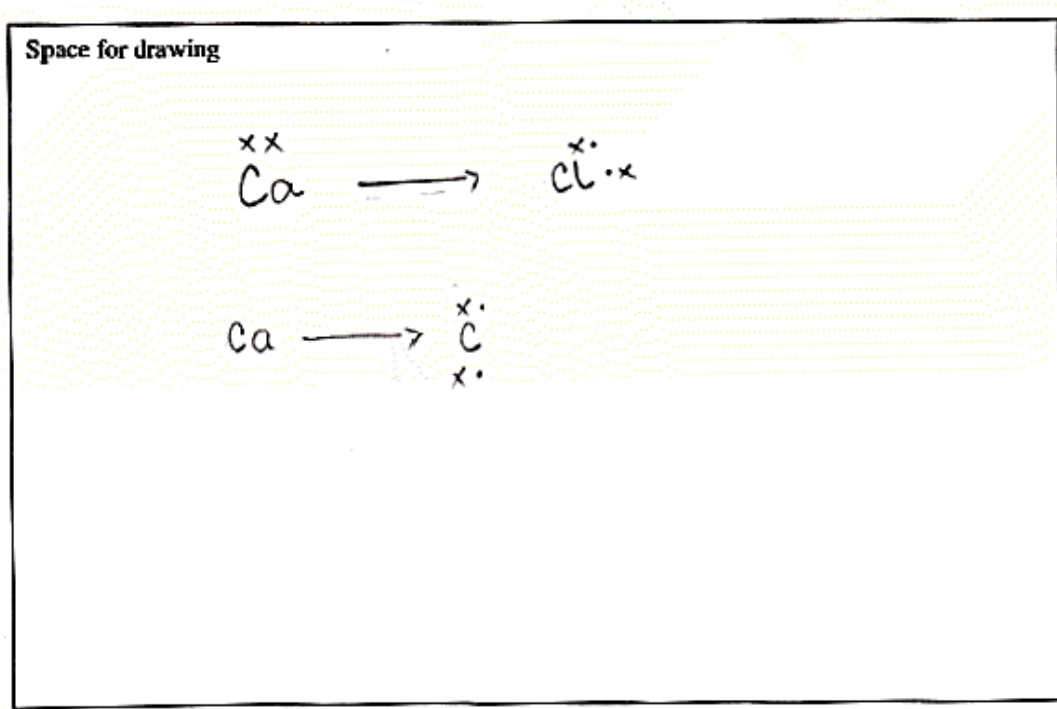
Example:

i) coordinate covalent bonding.

ii) coordinate covalent bonding means that the shared pairs of electron is donated by one bonded atom only. In calcium and chloride bond the calcium will lose its two electron and it will form +2 charge on him. This bond is a type of covalent bonding.

In this bond (coordinate covalent) there is one donor and one acceptor. The atom which accept the electron

will form (-) negative charge on ~~it~~ and ~~the atom~~ ~~which~~ ~~accept~~ it is called "acceptor" and the atom which donate the the electron and form positive (+) charge on him is called "donor". In calcium chloride bond the calcium is a donor and the chlorine is acceptor.



Question 8a:

- i. Define amorphous and crystalline solids.
- ii. Differentiate between gases and solids on the basis of the following properties.
 - Volume
 - Compressibility
 - Density
 - Boiling point
 - Ease of flow

Better responses correctly defined amorphous and crystalline solids. These responses included appropriate distinguishing points about gases and solids with reference to the attributes/ parameters given in the question.

Example:

① Solids in which particles are not regularly arranged or their regular shapes are destroyed are called amorphous solids. They do not have sharp melting points. Plastic, rubber, glass are examples of amorphous solids. Solids in which particles are regularly arranged forming a definite three-dimensional structure are called crystalline solids. They have sharp melting points. Diamond, crystal of NaCl are examples of crystalline solids.

② The differences between gases and solids are shown in the table.

Properties	Gases	Solids
• Volume	Gases do not have fixed volumes as the particles move freely and occupy all the available space.	Solids have fixed volumes. The particles are regularly arranged giving a definite shape and volume.
• Compressibility	Gases are highly compressible. The molecules are far apart. There is enough space between molecules ^{that can be} occupied under pressure.	Solids are incompressible. They are rigid. They ^{molecules} are tightly packed leaving no space for compression.

• Density	Gases have lowest density due to their light mass. Density of a gas is expressed in g/dm^3 . They are thousand times less dense than solids e.g. air = 0.001 g/cm^3	Solids have high density because their masses are greater and volumes are less so their density is high. for e.g. Al = 2.7 g/cm^3 and Au = 19.3 g/cm^3
• Boiling Point	Gases have low boiling points because they have weak intermolecular forces and large spaces among the molecules.	Solids have a high boiling point. They have strong intermolecular force of attraction. So more energy required to break these forces.
• Ease of flow	Gas particles can easily flow from one place to another due to the weak intermolecular forces of attraction between molecules.	Solids possess only vibrational motion. They vibrate about their mean positions and cannot move.

Weaker responses demonstrated lack of knowledge regarding the properties of gases and solids. These responses mostly depicted correct definition of amorphous and crystalline solids but produced wrong explanation of the given attributes. Some of these responses also distinguished between amorphous and crystalline solids/ gases and liquids/ solids and liquids rather than the difference asked in the question. Yet others gave irrelevant definitions of each attribute instead of writing distinctive characteristics for gases and solids as was specified by the use of the command word 'differentiate' in the question.

Example:

(i) Amorphous Solid:
 Amorphous Solid are those solid which don't have a regular shape. They have a irregular shape and lost their structure if broken. They don't have a sharp melting or boiling point. The common example of amorphous solids are, plastic, rubber, glass etc. The amorphous solids have sharp melting point due to their structure.

(ii) Crystalline solid:

Crystalline solids are those which particles are arranged in a regular pattern. Due to this regular pattern, ~~the~~ and crystalline nature the crystalline solids have sharp melting point. They ~~do not lose their structure when broken~~

(iii) Volume:

(1) The liquid have a fixed volume but does not have fixed shape while the gases does not have fixed volume as well as fixed shape.

(2) Compressibility:

(i) The gas molecules can be compressed easily as they many space between their molecules and as the gas is compressed its particles come closer together and the volume decrease while like ^{molecules} ~~do not~~ have spaces in their particles as much as gas.

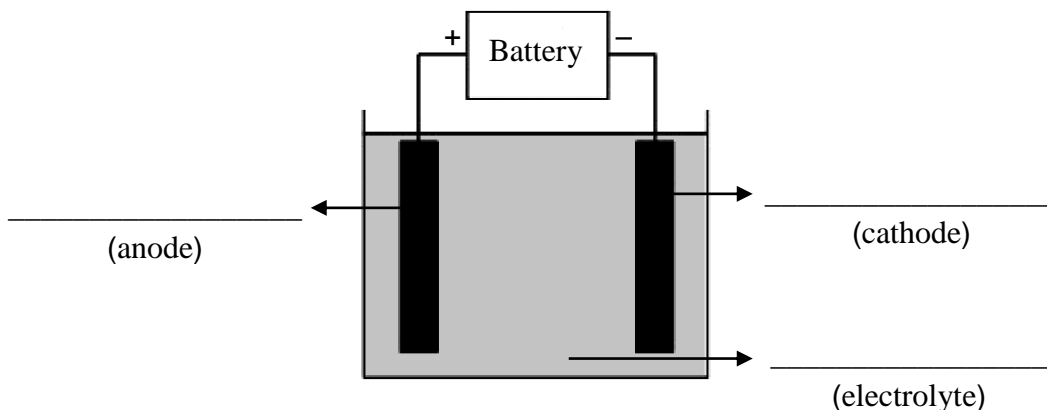
(3) Density:

(1) The density of gas is less than the density of liquid due to the light mass and more volume. The density of gas is ^{represented} ~~one~~ gm/lit while density of liquid is ^{represented} gm/dm^3 .

(4) Boiling point: The boiling point of liquid is ~~the~~ done when the vapour pressure of liquid become equal to ^{external} pressure of liquid. Boiling point is only associated with liquid not with gas. (5) Ease of flow: The flow is only associated with liquid ^{when} there is a slope water flows but the gas cannot flow as it occupy all the space.

Question 8b:

The given diagram shows an electrolytic cell that is used for refining of copper.

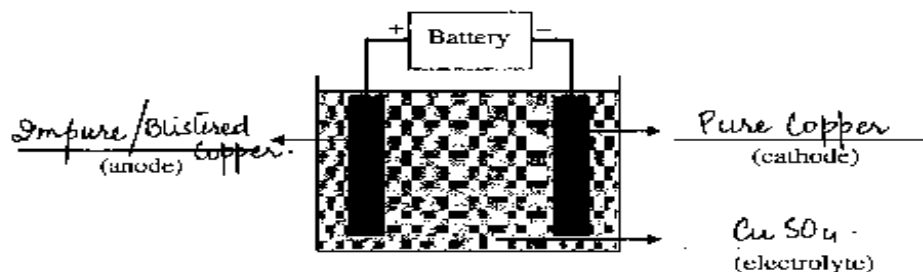


- Name the anode, cathode and electrolyte used for the given electrolytic cell.
- How is copper purified through the process of electrolytic refining? Support your answer using balanced chemical equation for the reactions occurring at the anode and the cathode.

Better responses demonstrated correct identification of anode, cathode and the electrolyte. These responses showed coherence in the process that occurs in an electrolytic refining of copper. Candidates explained stepwise loss and gain of electrons at the anode and the cathode respectively which enables purification and deposition of copper at cathode. These responses were well supported by balanced chemical equations representing reactions at the anode and the cathode.

Example:

b. The given diagram shows an electrolytic cell that is used for refining of copper.



- Name the anode, cathode and electrolyte used for the given electrolytic cell. (3 Marks)
- How is copper purified through the process of electrolytic refining? Support your answer using balanced chemical equation for the reactions occurring at the anode and the cathode. (4 Marks)

Electrolytic Refining Of Copper:-

Impure or Blistered Copper is purified by the process of Electrolysis. In the electrolytic cell here, the anode is impure copper and the cathode is an electrode where

pure copper has to get deposited. The electrolyte is of the same metal that is CuSO_4 .

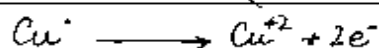
When the current is allowed to flow the electrons leave the copper ions leave the anode and dissolves in the electrolyte. The cathode attracts Cu^{2+} ions towards itself. Here the copper ions get discharged and deposited.

Reduction Occurs at Cathode.

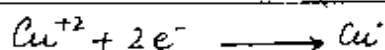
The impure copper known as the anode ~~is~~ mud or anode silt settles down. It contains valuable metals like Ag (silver), Au (gold), etc which is then purified and sold in the markets.

In this way pure copper is obtained from the electrolysis of blistered copper. This copper is 99.99% pure.

At the Anode :- (oxidation).



At the Cathode :- (reduction).

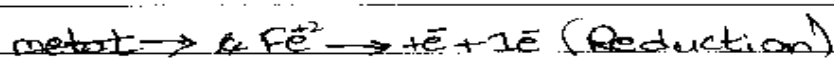
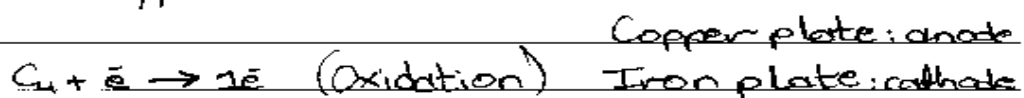


Weaker responses exhibited poor knowledge regarding electrolytic refining of copper. Candidates just stated about oxidation at anode and reduction at cathode without relating it to the refining of copper. They even struggled with the identification of the anode and the cathode. However, a few of these responses showed correct naming of the electrolyte. These responses showed confusion between electrolytic and Daniel cell and even mixed up the concept of electrolytic refining of copper with the electroplating of copper on iron. The ambiguity caused wrong identification of electrodes and inaccurate explanation of the process. Moreover, error in the equations included incorrect charge on copper ions and the number of lost/ gained electrons.

Example:

i) Anode is the Copper plate (Cu) plate. Cathode is the metal on which copper is to be deposited. And the electrolyte is ~~CuSO₄~~ CuSO₄ solution.

ii) The two electrodes cathode and anode are dipped in electrolyte which is CuSO₄ solution. The two electrodes Cathode and Anode are connected electrically with a battery. When current is passed through the electrodes the negative ions (Anions) migrate from cathode to anode which do not bring any change. In the mean time the positive ions (Cations) migrate towards Cathode which is metal on which copper is to be deposited and cations loses its electrons over here and oxidation takes place here. And redox. The Copper ions from the electrolyte is deposited on Cathode and metal is plated with Copper.



Overall redox reaction (Oxidation-Reduction Reaction).

