Aga Khan University Examination Board

Notes from E-Marking Centre on SSC I Chemistry Examination May 2013

Introduction

This document has been produced for the teachers and candidates of the SSC I course in Chemistry. It contains comments on candidates' responses to the 2013 Secondary School Certificate I Examination, indicating quality of the responses and highlighting their relative strengths and weaknesses.

General Comments

Teachers and candidates should be aware that examiners may ask questions that address the syllabus outcomes in a manner that requires candidates to respond by integrating knowledge, understanding and skills they have developed through studying the course.

Candidates need to be aware that the mark allocated to the question and the answer space, are a guide to the length of the required response. A longer response will not itself lead to higher marks. Writing far beyond the indicated space may reduce the time available for answering other questions.

Candidates need to be familiar with the command words in the student learning outcomes which contain some terms commonly used in examination questions. However, candidates should also be aware that not all questions will start with or contain one of the key words from the glossary. Questions such as 'how?', 'why?' or 'to what extent?' may be asked as well.

Question 1a

$C_2H_4 + O_2 \Leftrightarrow CO_2 + H_2O$

i. Balance the given equation using the simplest possible whole numbers.

ii. How many moles of oxygen are required to react with 2.5 moles of ethene (C_2H_4)?

[Hint: Use balanced chemical equation for the calculation]

Responses

Better responses correctly balanced equation and used simplest possible whole numbers for balancing. They identified the number of moles for ethene and oxygen from the balanced chemical equation and related precisely for calculating the number of moles of oxygen.

Average responses were able to balance the equation correctly but in some cases balanced the equation using larger coefficients. They tried to find the number of moles of oxygen from the balanced chemical equation but could not relate it with the given number of moles of ethene to calculate the number of moles of oxygen required.

Weaker responses left the equation unbalanced or used coefficients incorrectly. They were unable to calculate the number of moles of oxygen. This depicted their lack of knowledge regarding stoichiometric calculations.

Question 1b

Draw the structures of any TWO isotopes of carbon specifying the number of protons, neutrons and electrons of each.

Isotopes of Carbon	

Responses

Better responses drew the two isotopes of carbon with the correct number of subatomic particles. They mostly drew C – 12 & C -14.

Average responses showed the correct number of protons and neutrons but drew electrons equal to neutrons or in some responses students wrongly put number of electrons in shells.

Weaker responses showed misconception regarding isotopes and their structures because students drew structures showing 12 electrons 12 protons and 12 neutrons for carbon -12 and repeated the similar pattern for carbon - 13 and carbon - 14.

Question 1c

Describe why sodium chloride has high melting and boiling points.

Responses

Better responses gave the correct reason for high melting and boiling points of NaCl. They clearly stated that it is an ionic compound having stronger electrostatic force of attraction between the ions which require high energy to break apart.

Average responses identified NaCl as an ionic compound but missed the statement regarding stronger electrostatic force of attractions. Instead, they responded that particles are closely packed and being ionic compound it has high melting and boiling points. They didn't write about the requirement of high amount of energy for bond breakage.

Weaker responses mostly wrote that NaCl is a metal and discussed all the properties of metals such ductility, strength, high melting and boiling points etc.

Question 2a

Describe why electronegativity of elements increases from left to right in a period and decreases down a group in the periodic table.

Responses

Better responses were quite impressive as they precisely wrote the exact reasons behind the trends of electro negativity within group and period of the periodic table. They mentioned the key features responsible for change in electronegativity such as effective nuclear charge and atomic size.

Average responses related the electro negativity with multiple properties like shielding effect, ionization potential, electron affinity etc.

Weaker responses depicted very poor concept regarding electronegativity trends. Such responses related electronegativity with atomic number and number of valence electrons/ electrons. In some responses electronegativity was described with reference to shielding effect and ionization energy but relation with period and group was totally wrong.

Question 2b

If an element belongs to group 17 and period 3 of the periodic table, what will be its electronic configuration?

Responses

Better responses identified the element from the given situation and wrote its correct electronic configuration using Aufbau principle.

Average responses gave electronic arrangement instead of electronic configuration or drew atomic structure placing electrons in respective shells as per the data provided in the question.

Weaker responses tried to write the electronic configuration or even arrangement but could not figure out the exact sequence of orbital / energy levels. If sequence was correct then placement of electrons was wrong. For example, some wrote $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$ instead of $3p^5$ or others wrote $1s^2$, $2s^2$, $3s^2$, $2p^6$, $3d^6$ etc.

Question 3a

Kerosene oil and honey are both liquids. When added to water why does kerosene oil float over water while honey settles down?

Responses

Better responses clearly related the floating and settling down of liquids in water with the density of liquids. They wrote the correct difference between densities of water and the liquids added to it i.e. kerosene and honey.

Average responses mentioned weights of liquids instead of densities. In some cases, the concept of solubility was mixed by mentioning polar and non-polar relationships. In few cases students just wrote that this happens due to the difference in densities but could not explain in detail why one settled while the other substance floated on water.

Weaker responses swapped the information and stated that the density of kerosene is more than water and honey is less dense.

Question 3b

A student added potassium nitrate (KNO_3) in water and during dissolution of the salt he/she observed that the test tube became cold.

i. Describe why the test tube became cold.

ii. What will happen to the solubility of this salt on increasing the temperature?

Responses

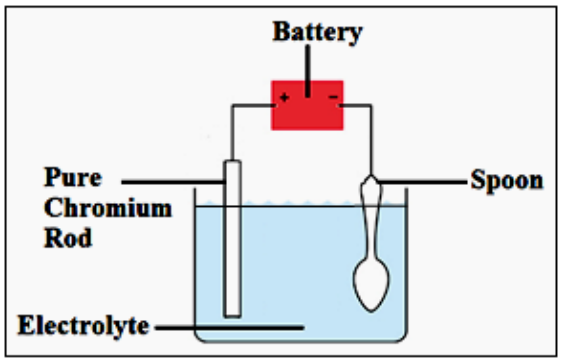
Better responses showed clear concept of endothermic reactions which involve absorption of energy from the surrounding for the breaking of bonds (strong electrostatic force of attraction). They also stated that with the rise in temperature solubility of the salt (potassium nitrate) increases.

Average responses mentioned endothermic reaction but could not explain the concept behind absorption of energy. These responses stated that the solubility of potassium nitrate increases with the rise in temperature.

Weaker responses could not figure out the correct reason for the test tube to become cold. They were also unable to relate solubility of potassium nitrate with temperature and wrote it decreases with temperature.

Question 3c

The diagram below shows the electroplating of chromium.



i. Which of the two electrodes connected to the battery acts as a cathode?

ii. Name the electrolyte used in the given electrolytic cell.

iii. Show the reactions at cathode and anode using balanced chemical equations.

Reaction at anode: _____

Reaction at cathode: _____

Responses

Better responses showed a clear concept of electroplating with reference to the arrangement of electrodes in the electrolytic cell, electrolyte and redox reactions occurring at anode and cathode.

Average responses identified the cathode and the electrolyte. Some mentioned the loss (oxidation) and gain (reduction) taking place at the two electrodes but were unable to show the same through chemical equations.

Weaker responses wrote names of both electrodes without stating which one acts as cathode. They identified the electrolyte as chromium solution and mentioned pure chromium rod as cathode. They wrote completely irrelevant / illogical equations for the reactions at anode and cathode such as:

Reaction at anode: $Cu^{+2} + CuSO_4^{+} \rightarrow CuSO_4^{+2}$

Reaction at cathode: $CuSO_4^{-2} \rightarrow Cu^{+2} + CuSO_4^{-2}$

Question 4

Give reasons for the following statements about metals and non-metals.

i. Non-metals do not react with dilute acids.

ii. Metals are electropositive in nature.

iii. Potassium is always found in nature as cations with +1 oxidation state.

iv. Fluorine is the most non-metallic among elements.

Responses

Better responses wrote the correct reasons for the given statements. They were able to justify non metals as electron deficient, metals with the capacity of losing electrons, potassium as active alkali metal that readily reacts, loses its valence electron and attains +1 oxidation state and last but not the least fluorine as the most electronegative of all elements.

Average responses gave partly correct reasons. They were able to justify why non-metals do not react with dilute acids, metals are electropositive and potassium is always found in nature as cation with +1 oxidation state but were unable to figure out the reason behind fluorine being most non-metallic among elements.

Weaker responses gave the reason for the electropositivity of metals or +1 oxidation state of potassium but were unable to justify the rest of the statements. They wrote illogical answers such as fluorine is a metal; non-metals are electropositive; and concepts of electroplating and corrosion etc.

Question 5a

Write any SIX characteristics in a tabular form distinguishing a compound from a mixture, giving ONE example of each.

Responses

Better responses stated clearly six reasonable differences between compounds and mixtures along with valid examples of each.

Average responses wrote some differences between compounds and mixtures but repeated the same characteristics to complete the requirement of six differences. They gave correct examples of each.

Weaker responses hardly differentiated using 1 to 2 basic characteristics giving one common examples of either compound or mixture such as sugar for compounds and air for mixtures.

Question 5b

Describe the types of bonds and their formation in the following species. Also give ONE similarity between their bonds.

i. A water molecule (H_2O)

ii. A hydronium ion (H_3O^+)

Responses

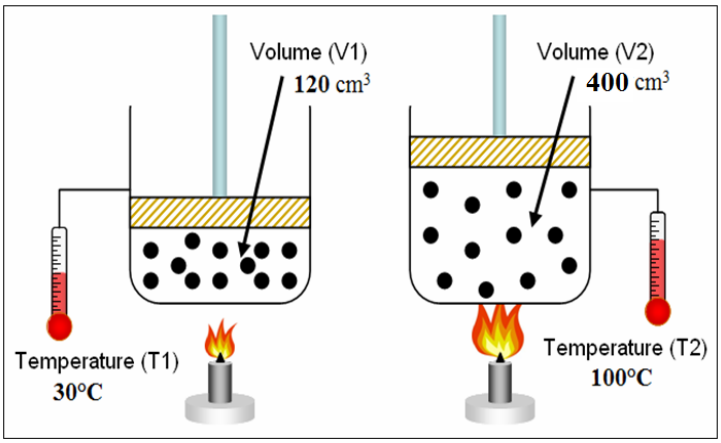
Better responses clearly identified the type of bonding in H_2O and H_3O^+. They described the formation of bonds in each species in detail and presented the description through diagram as well. They were able to state the basic similarity between the covalent and coordinate covalent bonds.

Average responses identified the type of bonding in water molecule and hydronium ion. They explained covalent bonding in detail but briefly wrote about coordinate covalent bond ignoring the details about donors and acceptors. This reflected in drawing the structures. The structure of water molecule was correct but the structure of H_3O^+ was shown with three single covalent bonds. No arrow was shown to represent dative covalent bond.

Weaker responses gave the definitions of all types of chemical bonds. In that too, some of the definitions were incorrect. For example, in coordinate covalent bond they wrote about mutual sharing of electrons between atoms. They were unable to identify the differences between water molecule and hydronium ion and they could even not draw their structures.

Question 6a

The figure shows an experimental verification of a certain gas law with estimated values. Based on this experiment, describe the relevant gas law in detail showing mathematical and graphical representations of it.



Responses

Better responses identified and elaborated Charles's law with reference to its statement, mathematical and graphical representations.

Average responses gave the details of Charles's laws with errors in graphical representation. Some wrote statements and explanation of both Boyle's and Charles's laws. In few cases

numerical calculations were done which were not required. X and Y axis variable were also changed but a straight line was drawn.

Weaker responses identified the law incorrectly. They recognized it as Boyle's law and gave complete description of it. Few identified it as Charles's law but wrote wrong statement with incorrect mathematical form. Diagrammatic representation was also wrong showing temperature on Y-axis and rather than a straight line a curve was drawn.

Question 6b

What is meant by the term 'electroplating'? Describe in detail the electrolytic refining of impure copper showing reactions at anode and cathode with the help of chemical equations.

Responses

Better responses defined the term electroplating and gave detailed description of the electrolytic refining of copper. The reactions at anode and cathode were well explained through chemical equations.

Average responses showed that students had the concept of electroplating and setting of the cell. However, they made errors in showing redox reaction at anode and cathode. Mostly they swapped the equations.

Weaker responses defined the term electroplating but had no concept of arrangement of the cell. In particular, they were unable to describe the electrolyte and the material used as cathode and anode. The number of electrons was wrongly mentioned in equations. In many cases, incorrect equations were given such as:

Reaction at anode: $Zn^{+2} + CO_2 \rightarrow ZnCO_2$

Reaction at cathode: $Zn^{-2} + CO^{-} \rightarrow ZnCO^{-2}$