IB Chemistry Initial Diagnostic Test

Time: 2 hours

Introduction

This test covers knowledge, ideas and skills from a range of topics across the IB chemistry syllabus. It does not test every section of the syllabus, but performance on this first test will give helpful feedback as to:

- gaps in basic understanding,
- which type of question needs practice,
- topic areas that will need further revision.

This test should ideally be written by hand by the student and his/her written answers seen by the tutor, who can analyse how the student is approaching the exam as well as grade the answers themselves.

There are further diagnostic tests available that focus on each particular topic of the SL and HL IB syllabus to aid further revision of specific topics.

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Test

No	Question	Marks	Answer
	Write a balanced equation for: a) the reaction of aqueous sodium carbonate with dilute nitric acid b) the complete combustion of methanol c) reaction of magnesium oxide with water	6	
	State the formulae of the following substances: a) propane b) potassium sulfate c) silicon dioxide d) rubidium e) barium hydroxide f) bromine	6	
	The picture below represents the arrangement of atoms in steam, $H_2O_{(g)}$.  Draw similar pictures to show the arrangement of atoms in: a) a metal, such as copper, $Cu_{(s)}$ b) molten potassium bromide, $KI_{(l)}$ c) solid iodine, $I_{2(s)}$ d) aqueous sodium chloride, $NaCl_{(aq)}$ e) aqueous ammonia, $NH_{3(aq)}$ (Do not show any particular bonds or electrons in these simple pictures, but use some type of shading to distinguish between atoms of different elements)	5	
	0.050 mol of hydrogen chloride gas, $HCl_{(g)}$, is dissolved in water to give 200 cm^3 of hydrochloric acid. Calculate: a) the volume of the hydrogen chloride gas at s.t.p. before dissolving (Molar volume of gas is 22.4 $dm^3\ mol^{-1}$ at s.t.p.) b) the total amount of ions, in moles, in the solution c) the concentration of the hydrochloric acid in mol dm^{-3} d) the increase in mass of the water, in g	4	

	Nitric oxide reacts with oxygen to form nitrogen dioxide according to the equation below. $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$. Calculate: a) the expected final volume of the mixture after reaction if 30 cm^3 of $NO_{(g)}$ was added to 40 cm^3 of $O_{2(g)}$ and all volumes are measured at the same temperature and pressure, b) the % uncertainty if the 30 cm^3 of $NO_{(g)}$ was measured using a gas syringe with an absolute uncertainty of ± 0.1 cm^3 c) the % nitrogen by mass in nitrogen dioxide	3	
	Explain why: a) carbon dioxide has a low melting point, while silicon dioxide has a very high melting point, b) sodium oxide conducts electricity when molten but not when solid c) chlorine dissolves better in hexane than in water	6	
	State the definition of: a) relative atomic mass b) first ionisation energy c) average bond enthalpy d) rate of reaction e) Lewis acid f) heterolytic bond fission	6	
	Draw the Lewis structure of the following molecules. State the shape of each molecule and estimate the bond angle. a) sulfur dioxide, SO_2 b) the hydroxonium ion, H_3O^+ c) hydrogen cyanide, HCN	6	
	Explain why dichloromethane, CCl_2H_2 is polar, but tetrachloromethane, CCl_4, is not.	4	
	Given the standard enthalpy changes for the following combustion reactions: $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} \quad \Delta H^o = -394\ kJmol^{-1}$ $2C_{(s)} + O_{2(g)} \rightarrow 2CO_{(g)} \quad \Delta H^o = -566\ kJmol^{-1}$ Calculate the standard enthalpy change for the reaction: $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$	2	
	Explain why increasing the temperature increases the rate of a chemical reaction	3	
	The following reversible reaction is allowed to reach equilibrium: $CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} \quad 3H_{2(g)}$ a) explain what is meant by the term: dynamic equilibrium, b) write the expression for K_c, c) state and explain the effect on the position of equilibrium of increasing the total pressure of the mixture	4	

	A solution of 0.100 mol dm^{-3} hydrochloric acid has a pH of 1.0 while a solution of 0.100 mol dm^{-3} dimethylpropanoic acid has a pH of 3.0. a) calculate the ratio of hydrogen ion concentration between the two acids b) explain why one acid has a lower hydrogen ion concentration than the other	2	
	Use oxidation numbers to deduce which elements have been oxidised and reduced in the following reaction: $2H_2SO_{4(l)} + 2KBr_{(s)} \rightarrow K_2SO_{4(g)} + 2H_2O_{(aq)} + SO_{2(g)} + Br_{2(g)}$	3	
	Butan-1-ol is a primary alcohol with structural formula, $CH_3CH_2CH_2CH_2OH$ a) draw and name the other three isomers of butan-1-ol, b) state whether each isomer you have drawn is primary, secondary or tertiary	6	
	Draw structures, including curly arrows to describe the S_N1 mechanism for the reaction of 2-chloropropane with sodium hydroxide.	4	
	Total Marks	70	