CSE CENTRE FOR STRATEGIC EDUCATION
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IARTV

CSE TEST – OCTOBER 2010

YEAR 11 – CHEMISTRY

Written test 2

ANSWERS & SOLUTIONS BOOK

SECTION A – Multiple choice questions (20 marks)

1	**D**	5	**C**	9	**A**	13	**B**	17	**B**
2	**C**	6	**A**	10	**D**	14	**A**	18	**D**
3	**B**	7	**D**	11	**A**	15	**A**	19	**C**
4	**D**	8	**B**	12	**C**	16	**C**	20	**B**

SECTION B – Short answer questions (55 marks)

1 mark is indicated by *

Question 1 (8 marks)

a. Hydrogen bonding between highly polar water molecules is stronger than the intermolecular dipole-dipole bonding between the other polar Group 16 hydrides.*

Intermolecular bonding is overcome during boiling thus water has a higher boiling point *

b. **A.** The energy added to liquid water at A increases the average kinetic energy of the molecules and hence the water temperature. Hydrogen bonds are weakened.*

B. At B water is boiling to steam. Added energy overcomes the forces of attraction between water molecules. Average kinetic energy is unchanged and the temperature remains constant*

c. From -5°C to 0°C water has the hydrogen bonded structure of ice. The Hydrogen bonds are weakened as the temperature increases.*

At 0°C the solid hydrogen bonded structure is overcome. Water molecules become closer together and density increases, then decreases due to increased kinetic energy of molecules.*

d. **X** a gas. As the temperature of the solution increases the solubility of gases decreases.*
Y a typical salt. Solubility of salts usually increases with increasing temperature.*

Question 2 (11 marks)

a. $n(Al_2(SO_4)_3)$ = (1.5 x 0.10) mol = 0.15 mol $n(SO_4^{2-})$ = (3 x 0.15) mol = 0.45 mol

$n(K_2SO_4)$ = (2.0 x 0.10) mol = 0.20 mol $n(SO_4^{2-})$ = 0.20 mol

total $n(SO_4^{2-})$ = (0.45 + 0.20) mol = 0.65 mol*

$c(SO_4^{2-})$ = 0.65/0.20 mol = 3.25 mol **= 3.3 mol (correct to 2 sig. figs.)***

b. i. **$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$***

ii. mol ratio $Ba^{2+} : SO_4^{2-}$ = 1: 1 $n(Ba^{2+})$ = (3.0 x 0.2) mol = 0.6 mol*

$n(SO_4^{2-})$ = 0.65 mol therefore **SO_4^{2-} is in excess by 0.05 mol***

iii. $n(BaSO_4) = n(Ba^{2+})$ $m(BaSO_4)$ = (0.60 x (137.3+32.1+64)) = 140.04 g

= **1.4×10^2 (correct to 2 sig figs.)***

c. i. $n(K_2SO_4)$ = 5.72/174.3 mol = 0.0328 mol*

$c(K_2SO_4)$ = 0.0328/0.1 = **0.328 M (corr. 3 sig figs.)***

ii. total volume of water = (100 + 60) = 160 mL

$c(K_2SO_4)$ = 0.0328/0.16 = **0.205 M (corr. 3 sig figs.)***

iii. $m(K_2SO_4) = (0.205 \times 174.3)\ g = 35.73\ gL^{-1}$*

$= 3.75\ g\ 100mL^{-1}$ = **3.58% m/v (corr. 3 sig figs.)***

Question 3 (7 marks)

a. i. one of carbonic acid, nitrous acid, nitric acid.

Effect: for example, reaction with minerals causing erosion, introduction of soluble salts into water courses, steps in natural carbon or nitrogen cycles.*

ii. one of sulfuric acid, nitrous acid, nitric acid.

Effect: for example, renders soil sterile, damages growing plants, damages lungs, reacts with concrete, stone and metals*

b. i. $H_3O^+(aq) + OH^-(aq) \rightarrow 2H_2O(l)$*

ii. $[H_3O^+] = 10^{-4}$ M* total mol $H_3O^+ = 30{,}000 \times 10^{-4}$ mol = 3.0 **mol***

iii. $n(Ca(OH)_2) = 3.0/2 = 1.5$ mol*

$m(Ca(OH)_2)$ required $= 1.5 \times (40.1 + 32 + 2) = 111.15$ g

$= 1.1 \times 10^2$ g (correct to 2 sig figs.)*

Question 4 (9 marks)

a.

	Error	Explanation
1.	Direction of electron flow is incorrect.*	Zn is a stronger reductant than Ni so electrons flow from Zn to Ni.*
2.	Copper chloride is not appropriate for the salt bridge.*	Salt bridge must be inert with respect to the half cell chemicals. Cu^{2+} will react with both Zn and Ni.*
3.	Zn^{2+}/Zn half cell equation should be written as an oxidation half equation.*	Zn is the stronger reductant so donates electrons $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$*

b.

Reaction	Redox (Yes/No)	Oxidant
$Ba(NO_3)_2(aq) + H_2SO_4(aq) \rightarrow 2HNO_3(aq) + BaSO_4(s)$	No	*
$2Mg(s) + Cl_2(g) \rightarrow MgCl_2(s)$	Yes	Cl_2*
$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$	Yes	O_2*
$NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$	No	*

Question 5 (6 marks)

a. $n(Cu(NO_3)_2) = 20/(63.6+28+96)$ $= 20/187.6$ $= 0.1066$ mol*

mol ratio $(Cu(NO_3)_2)$: CuO = 1 : 1 $n(CuO) = 0.1066$ mol*

$m(CuO) = 0.1066 \times 79.6 = 8.485$ g= **8.49 g (corr. 3 sig. figs.)***

b. mol ratio $(Cu(NO_3)_2) : NO_2 : O_2 = 2 : 4 : 1$*

total mol gas = 2.5 x 0.1066 = 0.2665 mol*

v = nRT/P v(total gas) = $0.\frac{2665 \times 8.314 \times 333}{1.10 \times 101.3}$ L* **v(total gas) = 6.62 L* (corr. 3 sig. figs.)**

Question 6 (10 marks)

a. **Either:** $2H_2O_2(aq) \xrightarrow{MnO_2} 2H_2O(l) + O_2(g)$**

or $CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$**

or fractional distillation of liquid air. **

Either i. oxygen: collect over water.*

ii. only slightly soluble in water.*

or i. carbon dioxide: collect by downward delivery (upward displacement of air)*

ii. soluble in water and more dense than air*

or i. separation from other gases of air according to boiling point*

ii. nitrogen has the lowest boiling point and rises to the top of the column. *

b. i. $Cu(s) + 4HNO_3(l) \rightarrow Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O(l)$ **

ii. $Zn(s) + 2H_2SO_4(l) \rightarrow ZnSO_4(aq) + SO_2(g) + 2H_2O(l)$ **

Question 7 (4 marks)

a. UV radiation or $h\nu$ * O_3 *

b. For example, ozone is a poisonous pollutant at ground level and may cause, for example, lung damage and damage plants.*

c. For example, ozone in the stratosphere absorbs UV radiation from the sun which otherwise can kill or damage living tissue, for example, by causing cancerous growths.*

or Ozone can be used to purify water by killing any micro organisms present.*