

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. $n(\text{Al}_2(\text{SO}_4)_3) = (1.5 \times 0.10) \text{ mol} = 0.15 \text{ mol}$ $n(\text{SO}_4^{2-}) = (3 \times 0.15) \text{ mol} = 0.45 \text{ mol}$

$$n(\text{K}_2\text{SO}_4) = (2.0 \times 0.10) \text{ mol} = 0.20 \text{ mol} \quad n(\text{SO}_4^{2-}) = 0.20 \text{ mol}$$

$$\text{total } n(\text{SO}_4^{2-}) = (0.45 + 0.20) \text{ mol} = 0.65 \text{ mol}^*$$

$$c(\text{SO}_4^{2-}) = 0.65/0.20 \text{ mol} = 3.25 \text{ mol} \quad = 3.3 \text{ mol (correct to 2 sig. figs.)}^*$$

- b. i. $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})^*$

ii. mol ratio $\text{Ba}^{2+} : \text{SO}_4^{2-} = 1:1$ $n(\text{Ba}^{2+}) = (3.0 \times 0.2) \text{ mol} = 0.6 \text{ mol}^*$

$$n(\text{SO}_4^{2-}) = 0.65 \text{ mol} \quad \text{therefore } \text{SO}_4^{2-} \text{ is in excess by } 0.05 \text{ mol}^*$$

iii. $n(\text{BaSO}_4) = n(\text{Ba}^{2+})$ $m(\text{BaSO}_4) = (0.60 \times (137.3 + 32.1 + 64)) = 140.04 \text{ g}$
 $= 1.4 \times 10^2 \text{ (correct to 2 sig figs.)}^*$

- c. i. $n(\text{K}_2\text{SO}_4) = 5.72/174.3 \text{ mol} = 0.0328 \text{ mol}^*$

$$c(\text{K}_2\text{SO}_4) = 0.0328/0.1 = 0.328 \text{ M (corr. 3 sig figs.)}^*$$

ii. total volume of water = $(100 + 60) = 160 \text{ mL}$

$$c(\text{K}_2\text{SO}_4) = 0.0328/0.16 = 0.205 \text{ M (corr. 3 sig figs.)}^*$$

$$\text{iii. } m(\text{K}_2\text{SO}_4) = (0.205 \times 174.3) \text{ g} = 35.73 \text{ g L}^{-1*}$$

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

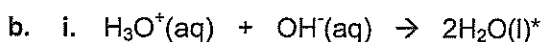
Question 3 (7 marks)

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*



ii. $[\text{H}_3\text{O}^+] = 10^{-4} \text{ M}^*$ total mol $\text{H}_3\text{O}^+ = 30,000 \times 10^{-4} \text{ mol} = 3.0 \text{ mol}^*$

iii. $n(\text{Ca}(\text{OH})_2) = 3.0/2 = 1.5 \text{ mol}^*$

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

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

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 $\text{Zn}(\text{s}) \rightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{e}^-$ *

b.

Reaction	Redox (Yes/No)	Oxidant
$\text{Ba}(\text{NO}_3)_2(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow 2\text{HNO}_3(\text{aq}) + \text{BaSO}_4(\text{s})$	No	*
$2\text{Mg}(\text{s}) + \text{Cl}_2(\text{g}) \rightarrow \text{MgCl}_2(\text{s})$	Yes	Cl_2^*
$2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$	Yes	O_2^*
$\text{NaCl}(\text{s}) \rightarrow \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq})$	No	*

Question 5 (6 marks)

a. $n(\text{Cu}(\text{NO}_3)_2) = 20/(63.6+28+96) = 20/187.6 = 0.1066 \text{ mol}^*$

mol ratio $(\text{Cu}(\text{NO}_3)_2) : \text{CuO} = 1 : 1$ $n(\text{CuO}) = 0.1066 \text{ mol}^*$

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

b. mol ratio $(\text{Cu}(\text{NO}_3)_2) : \text{NO}_2 : \text{O}_2 = 2 : 4 : 1^*$

$$\text{total mol gas} = 2.5 \times 0.1066 = 0.2665 \text{ mol}^*$$

$$v = nRT/P \quad v(\text{total gas}) = \frac{0.2665 \times 8.314 \times 333}{1.10 \times 101.3} \text{ L}^* \quad v(\text{total gas}) = 6.62 \text{ L}^* \quad (\text{corr. 3 sig. figs.})$$

Question 6 (10 marks)

a. Either: $2\text{H}_2\text{O}_2(\text{aq}) \xrightarrow{\text{MnO}_2} 2\text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})^{**}$

or $\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})^{**}$

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. $\text{Cu}(\text{s}) + 4\text{HNO}_3(\text{l}) \rightarrow \text{Cu}(\text{NO}_3)_2(\text{aq}) + 2\text{NO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})^{**}$

ii. $\text{Zn}(\text{s}) + 2\text{H}_2\text{SO}_4(\text{l}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})^{**}$

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. *