
CHEMISTRY VCE UNITS 1&2 DIAGNOSTIC TOPIC TESTS 2007

TEST 5: WATER AND AQUEOUS SOLUTIONS

SUGGESTED SOLUTIONS AND MARKING SCHEME

SECTION A: MULTIPLE-CHOICE QUESTIONS

Question 1 **B**

The boiling point of water depends on the atmospheric pressure. While water boils at 100°C at sea level, at higher altitudes where air pressure is decreased the boiling point is below 100°C. Therefore, statement **B** is incorrect and so is the required response. The statements in **A**, **C** and **D** are correct.

Question 2 **B**

Sand (SiO_2), ethane (C_2H_6), iron(II) oxide (FeO) and ethene (C_2H_4) are insoluble in water, hence the answer is not **A**, **C** or **D**. NaNO_3 , glucose and hydrogen chloride are all water soluble.

Question 3 **C**

0.13 g in 200 mL of solution

$\therefore 0.13 \times 5 = 0.65$ g in 1000 mL of solution

$\therefore 0.65 \text{ g L}^{-1}$ (therefore **A** is an equivalent concentration)

0.13 g in 200 mL of solution

$\therefore 0.065$ g in 100 mL of solution

$\therefore 0.065\%$ w/v (therefore **B** is an equivalent concentration)

0.13 g in 200 mL of solution

$\therefore 0.65 \text{ g L}^{-1}$

$\therefore 650 \text{ mg L}^{-1}$ or 650 ppm (therefore **C** is not an equivalent concentration)

0.13 g in 200 mL of solution

$\therefore \frac{0.13}{200} \times 1000$ mg in 1 mL of solution

$\therefore 0.65 \text{ mg mL}^{-1}$ (therefore **D** is an equivalent concentration)

Question 4 A

Gas solubility in water increases as pressure increases. For example, dissolving CO_2 in soft drinks under pressure.

Question 5 D

All nitrate salts are soluble, hence the answer is not **A** or **C**. All sodium salts are soluble, hence the answer is not **B** or **C**. BaSO_4 is insoluble and so will precipitate as a solid.

Question 6 D

$$n(\text{AlCl}_3) = \frac{m}{M} = \frac{52.9}{133.5}$$

$$c(\text{AlCl}_3) = \frac{n}{V} = \frac{52.9}{133.5 \times 0.250}$$

$$c(\text{Cl}^-) = 3 \times c(\text{AlCl}_3) = \frac{3 \times 52.9}{133.5 \times 0.250} = 4.76 \text{ M}$$

Question 7 A

The use of energy to force the movement of water by diffusion (through a semi-permeable membrane) is the technique of desalination by reverse osmosis, not flash distillation. Thus **A** does not occur in flash distillation and so is the required response. Statements in **B**, **C** and **D** all describe aspects of desalination by flash distillation.

Question 8 C

At 50°C , 455 g dissolves in 100 g of water

$\therefore \left(455 \times \frac{150}{100}\right)$ g dissolves in 150 g of water

$\therefore 683$ g will dissolve in 150 g of water

We have 786 g of AgNO_3 , hence 683 g will dissolve, leaving $(786 - 683) = 103$ g undissolved.

Question 9 B

At 50°C , 455 g dissolves in 100 g of water

$\therefore 455$ g dissolves in 555 g of solution

$\therefore \left(455 \times \frac{300}{555}\right)$ dissolves in 300 g of solution

$\therefore 246$ g is dissolved.

Question 10 C

Lower water temperature would decrease the solubility, hence **A** is not the answer. The beaker size is irrelevant, hence **B** is not the answer. Lack of stirring would decrease solubility, hence **D** is not the answer. Using more solvent at a given temperature would increase the amount of solute which would dissolve, therefore **C** is the answer.

SECTION B: SHORT-ANSWER QUESTIONS

Question 1

- a. For example:
- i. Water rises by capillary action in plant vessels. 1 mark
 - ii. The 'low' density ice floats to the surface and prevents freezing of the lower lake water. 1 mark
 - iii. Animals use evaporative cooling. 1 mark
- b. i. $\text{Mg}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Mg}(\text{OH})_2(\text{s})$ 1 mark
- ii. $\text{Pb}^{2+}(\text{aq}) + 2\text{I}^{-}(\text{aq}) \rightarrow \text{PbI}_2(\text{s})$ 1 mark
- c. Water is a polar solvent which readily dissolves polar solutes. Ammonia is a polar molecule which forms hydrogen bonds with water. 1 mark
- Methane is a non-polar molecule which only forms very weak bonds (dispersion forces) with water. It is therefore insoluble. 1 mark

Total 7 marks

Question 2

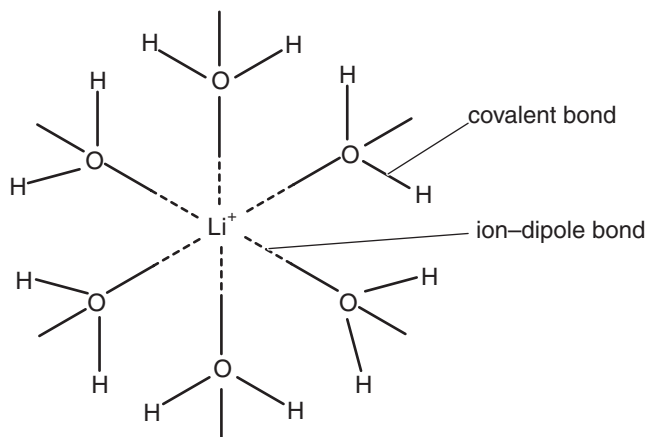
- a. i. At 20°C, 1.75 g per 1000 g dissolves
(1.75 × 1.5) g per 1500 g dissolves
At 60°C, 0.6 g per 1000 g dissolves
(0.6 × 1.5) g per 1500 g dissolves 1 mark
Therefore, the change in mass expected is $(1.75 - 0.6) \times 1.5 = 1.7$ g 1 mark
- ii. Some water evaporates from the beaker. 1 mark
- b. i. At 40°C, solubility is 15 g of KClO_3 in 100 g of water
7.5 g KClO_3 in 50 g of water
We have 10 g dissolved in 50 g, hence the solution is supersaturated. 1 mark
- ii. 50 mL of solution = 50 mL of water = 50 g of water
At 40°C, $\frac{15}{2}$ g per 50 g dissolves
At 90°C, $\frac{50}{2}$ g per 50 g dissolves 1 mark
Mass deposited is $25 - 7.5 = 17.5$ g 1 mark

Total 6 marks

Question 3

- a. i. $\text{LiCl(s)} \xrightarrow{\text{H}_2\text{O(l)}} \text{Li}^+(\text{aq}) + \text{Cl}^-(\text{aq})$ 1 mark
 ii. ionic bonds 1 mark

iii.



2 marks

- b. Test the electrical conductivity of each solution using power supply, light globe and electrodes.
 LiCl(aq) conducts, while $\text{C}_6\text{H}_{12}\text{O}_6(\text{aq})$ does not.

1 mark

1 mark

Total 6 marks

Question 4

- a. 0.32% w/w means 0.32 g of NaF in 100 g of paste

$$\therefore \left(0.32 \times \frac{120}{100}\right) \text{ g of NaF in 120 g of paste}$$

$$\therefore 0.38 \text{ g of NaF}$$

1 mark

$$m(\text{F}^-) = \frac{19.0}{42.0} \times 0.38 = 0.17 \text{ g}$$

1 mark

- b. 250 mL of wine, $\therefore 11 \times \frac{250}{100}$ mL of ethanol

$$x \text{ mL of vodka, } \therefore 35 \times \frac{x}{100} \text{ mL of ethanol}$$

1 mark

$$\frac{35 \times x}{100} = \frac{11 \times 250}{100}, x = 79 \text{ mL}$$

1 mark

- c. $n(\text{CuSO}_4) = c \times V = 0.150 \times \frac{250.0}{1000}$

1 mark

$$m(\text{CuSO}_4) = n \times M = 0.150 \times \frac{250.0}{1000} \times 159.6 = 5.99 \text{ g}$$

1 mark

Total 6 marks