**Unit 2 Topic test 4: Concentration & volumetric analysis Student name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**SECTION A – Multiple-choice questions**

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| **Instructions for Section A**  Answer **all** questions.  Choose the response that is **correct** or **best answers** the question.  A correct answer scores 1, an incorrect answer scores 0.  No mark will be given if more than one answer is completed for any question.  Marks will **not** be deducted for incorrect answers. |

**Question 1**

A supersaturated solution can be prepared by

**A**. adding the solute and stirring it vigorously until no further solid dissolves.

**B**. forming a saturated solution at 70 0C and slowly adding a small volume of water.

**C**. forming a saturated solution at 60 0C and heating it slowly to 70 0C.

**D**. forming a saturated solution at 70 0C and allowing to cool slowly to 60 0C.

**Question 2**

Calculate the volume of water that needs to be added to 50 mL of 2.0 M KCl to lower the concentration to 0.40 M.

**A**. 10 mL

**B**. 50 mL

**C**. 200 mL

**D**. 250 mL

**Question 3**

The label of a 500 mL hand sanitiser lists the contents at 74%(v/v) propan-2-ol. The amount of propan-2-ol required to prepare this container is

**A**. 74 g

**B**. 148 mL

**C**. 370 mL

**D**. 370 g

**Question 4**

What mass of NaCl is required to prepare a 100 mL solution of concentration 0.50 M?

**A**. 2.93 g

**B**. 5.00 g

**C**. 7.93 g

**D**. 50.0 g

**Question 5**

Which of the following solutions contains the greatest mass of NaOH? (M = 40.0 g mol-1)

**A**. 500 mL of 2.0 M NaOH

**B**. 500 mL of NaOH solution of concentration 20 g L-1

**C**. 50 mL of 0.1 M NaOH

**D**. 1.0 L of 0.05 M NaOH

*Use the following information to answer Questions 6 to 8*

A titration is conducted to determine the concentration of an oxalic acid (C2H2O4) solution. The oxalic acid is titrated against a 0.12 M KOH solution. The oxalic acid is added to the burette and 20.0 mL aliquots of KOH are used in the flasks under the burette. The mean titre obtained is

The equation for the reaction is 15.0 mL

C2H2O4(aq) + 2KOH(aq) 🡪 K2C2O4(aq) + 2H2O(l)

**Question 6**

The concentration of the oxalic solution is, in M,

**A**. 0.080

**B**. 0.16

**C**. 0.32

**D**. 0.64

**Question 7**

Oxalic acid is a weak acid that does not fully ionise when added to water. In a titration

**A**. this will make the method invalid as weak acids will react too quickly.

**B**. the titre will be very low.

**C**. the fact that oxalic acid is a weak acid will not impact the calculations.

**D**. the base used must also be a weak base to compensate for the acid being weak.

**Question 8**

In this titration

**A**. any indicator used should lead to the same mean titre.

**B**. the indicator will change colour when the equivalence point is reached.

**C**. the endpoint is when the acid and base are in the required mole ratio.

**D**. the equivalence point is when the acid and base are in the required mole ratio

**Question 9**

Underground water in many parts of Australia has a high calcium ion concentration. The calcium ions in the dam

**A**. cannot be removed through precipitation as all calcium compounds are soluble in water.

**B**. could be precipitated if a more reactive metal is added to the water.

**C**. could be precipitated from the water through the addition of sodium carbonate.

**D**. could be precipitated from the water through the addition of sodium nitrate.

**Question 10**

The arsenic level in a water supply is measured as 8 ppm. This is equivalent to

**A**. 8 mg of arsenic in every litre of water.

**B**. 8 mg of arsenic in 1.0 kg of water.

**C**. 8 mg of arsenic in every g of water.

**D**. 8 g of arsenic in every kg of water.

**SECTION B- Short-answer questions**

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| **Instructions for Section B**  Questions must be answered in the spaces provided in this book. To obtain full marks for your responses you should   * Give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full marks. * Show all workings in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.   Make sure chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, H2(g); NaCl(s) |

**Question 1** (7 marks)

15 g of sodium hydroxide is dissolved in water, forming a 100 mL solution.

**a**. Determine the concentration of the sodium hydroxide in

**i**. g L-1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**ii**. %(m/v) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**iii**. molarity, M \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**b**. 5 mL of the above solution is added to a 250 mL volumetric flask and deionised water is

added to make the volume 250 mL.

Calculation the molar concentration of the diluted solution. 2 marks

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**c**. Calculate the mass of sodium hydroxide required to prepare 600 mL of 3.0 M NaOH. 2 marks

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**Question 2** (10 marks)

The graph below shows the solubility curves for three ionic substances.

**A graph with different colored lines

Description automatically generated**

**a. i**. State two conclusions you can draw from the shape of the graphs provided. 2 marks

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**ii**. Explain how the solubility curve for potassium chlorate could be obtained. 3 marks

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**iii**. Describe how you could prepare a supersaturated solution of potassium nitrate. (Include

the amounts you would use) 2 marks

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**b. i**. Determine the mass of sodium chloride that will dissolve in 40 g of water at 60 0C. 1mark

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**ii**. After considerable stirring, a student is able to dissolve 10 g of potassium chlorate in 50 g

of water. Determine the likely temperature of the water. 2 marks

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**Question 3** (11 marks)

Water supplies near lead smelters usually contain elevated levels of lead ions. The lead ions can be removed from a water sample by adding sodium sulfate to precipitate the lead ions.

**a. i**. Write an equation for the reaction between lead ions and sodium sulfate solution. 2 marks

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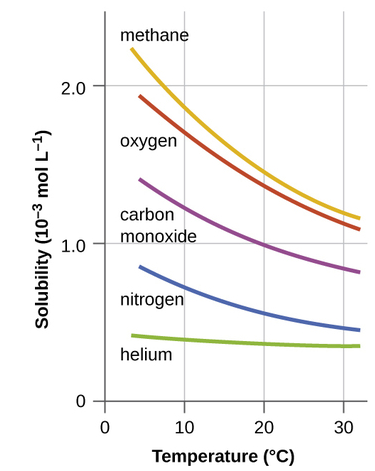
**ii**. Explain how this reaction can be used to purify a water sample. 3 marks

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**b**. The graph below is taken from a university chemistry textbook.

**i**. Explain what this graph is showing. 2 marks

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**ii**. How is the trend in this graph different from the trend in solubility of most ionic compounds? 2 marks

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**iii**. Global warming is leading to increased temperatures of our water supplies. Use this graph to explain one

reason why this temperature increase will add challenge to the survival of various marine species.

2 marks

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**Question 4** (12 marks)

Ethanoic acid is the main active ingredient in vinegar. It is a weak acid with a chemical formula of CH3COOH.

A student prepares a 0.15 M solution of sodium hydroxide to use in a titration to determine the concentration of ethanoic acid in a commercial vinegar solution.

**a**. **i**. Describe how the student could prepare a 250 mL of 0.100 M NaOH solution. 3 marks

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**ii**. What is the likely pH of the solution at the equivalence point of this titration? 1 mark

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**iii**. Suggest a suitable indicator for this titration. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

**iv**. NaOH is used for this titration but it is not normally considered a suitable solution to use as a primary

standard. Explain what this statement means. 2 marks

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**b**. The vinegar solution is added to the burette and 20.0 mL aliquots of NaOH are added to several flasks to be

placed under the burette. The titres obtained are 13.9 mL, 13.1 mL, 12.9 mL and 13.0 mL.

**i**. What should each of these pieces of equipment be rinsed with before the titration? 2 marks

burette \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conical flasks \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**ii**. Use appropriate titres to determine the concentration of the ethanoic acid in M. 3 marks

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**END OF KEY TOPIC TEST**