**2021 Unit 2 Chemistry trial exam**

**Name**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Total: \_\_\_\_\_\_/83

**Section A: Multiple Choice section**

**Question 1**

The dashed bonds shown in the diagram are examples of

**A**. dispersion forces.

**B**. intramolecular forces.

**C**. hydrogen bonds.

**D**. covalent bonds.

**Question 2**

Which of the following will require the most energy?

**A**. heating 60 g of water from 60 ºC to 80 ºC

**B**. heating 20 g of water by 60 ºC

**C**. heating 80 g of olive oil by 22 ºC

**D**. heating 80 g of water by 22 ºC

**Question 3**

All of the following substances are soluble in water. Which one dissolves through dissociation?

**A**. ethanol

**B**. NaCl

**C**. HCl

**D**. NH3

**Question 4**

Select the correct statement about the properties of water.

**A**. Energy is released when steam condenses to water.

**B**. The density of water will increase as it turns to ice.

**C**. Water will always boil at exactly 100 ºC.

**D**. All ionic solids will dissolve in water.

**Question 5**



The diagram above can be used to explain

**A**. that ethanoic acid is a strong acid.

**B**. that ethanoic acid is a weak acid.

**C**. that hydrogen bonds can form when ethanoic acid is added to water.

**D**. that ethanoic acid dissociates in water.

**Question 6**

This substance is a molecular compound. It

* is soluble in water
* will have a low pH in water
* will react with magnesium to produce magnesium sulfate as one of the products.

The substance is

**A**. NaCl

**B**. NaOH

**C**. HCl

**D**. H2SO4

**Question 7**

Which of the following will have a pH of 13?

**A**. 0.1 M HCl

**B**. 0.1 M H2SO4

**C**. 0.1 M NaOH

**D**. 1.0 M KOH

**Question 8**

The products of a reaction are potassium chloride and water. The reactants were

**A**. KOH and HCl

**B**. K2CO3 and HCl

**C**. K and HCl

**D**. KOH and H2SO4

**Question 9**

In which of the following is the oxidation number of sulfur highest?

**A**. S8

**B**. H2SO4

**C**. SO2

**D**. H2S

**Question 10**

Which alternative is a correctly balanced half-equation?

**A**. O2 + 2e- 🡪 O2-

**B**. MnO4-  + 2H2 + 2e- 🡪 Mn2+ + 4OH-

**C**. 2FeCl2  + Cl2 🡪 2FeCl3

**D**. ClO3- + 6H+ + 6e- 🡪 Cl- + 3H2O

**Question 11**

The oxidising agent in a redox reaction

**A**. will lose electrons as it is reduced.

**B**. will gain electrons as it is oxidised.

**C**. will gain electrons as it is reduced.

**D**. will always be a non-metal atom as it will gain electrons.

*Use the following solubility curves to answer questions 12 to 14.*

 **temperature**

**Question 12**

Which of these substances is the least impacted by temperature?

**A**. NaNO3

**B**. KCl

**C**. KClO3

**D**. NaCl

**Question 13**

Which of the following is most likely to be a gas?

**A**. NH3

**B**. KCl

**C**. NaCl

**D**. KNO3

**Question 14**

The mass of NH4Cl that can be dissolved in 500 g of water at 70 ºC is closest to

**A**. 62 g

**B**. 100 g

**C**. 310 g

**D**. 372 g

*Use the following information to answer questions 15 and 16.*

The equation for the reaction between butane and oxygen is

2C4H10(g) + 13O2(g) 🡪 8CO2(g) + 10H2O(l)

**Question 15**

The number of mole of CO2 that can be formed from 52 mole of oxygen is

**A**. 32

**B**. 52

**C**. 64

**D**. 85

**Question 16**

The mass of water that can be formed from 116 g of butane is, in g,

**A**. 10

**B**. 180

**C**. 240

**D**. 360



**Question 17**

This HPLC diagram shown can be used to explain

**A**. how the retention time changes with concentration.

**B**. how the peak area changes with concentration.

**C**. how the peak area changes with temperature.

**D**. how the choice of stationary phase impacts retention time.

**Question 18**

The chromatogram below was produced when a sample of ink was spotted onto the base of a sample of chromatography paper.



**D**

**A**

Select the statement below that can be made with the most certainty.

**A**. The ink contains four components only.

**B**. Substance A will be more soluble than substance D in all solvents.

**C**. Substance D spends more time on the stationary phase than substance A.

**D**. Substance A contains smaller molecules than substance D.

**Question 19**

A student uses gravimetric analysis to determine the concentration of a 100 mL solution of MgCl2. She takes a 10 mL sample from the solution and adds excess AgNO3 solution to it. The number of mole of precipitate formed is 0.02 mol. The number of mole of MgCl2 in the original solution is

**A**. 0.01

**B**. 0.02

**C**. 0.1

**D**. 0.2

**Question 20**

A 0.20 M NaOH solution is used in a titration to determine the concentration of a sulfuric acid solution. 20.0 mL aliquots of NaOH are used and the mean titre of sulfuric acid is 15.0 mL. The concentration of the sulfuric acid solution is, in M,

**A**. 0.13

**B**. 0.15

**C**. 0.20

**D**. 0.26

**Section B: Short answer questions**

**Question 1** (12 marks)

**a**. What is the oxidation number of the element in bold? 4 marks

 **i**. **N**2O4 \_\_\_\_\_\_\_\_ **ii**. NH3 \_\_\_\_\_\_\_\_\_ **iii**. **Br**O3- \_\_\_\_\_\_\_\_\_ **iv**. **S**O32- \_\_\_\_\_\_\_\_\_\_\_\_\_

**b**. Complete the following half-equations and label each as oxidation or reduction. 4 marks

 **i**. Fe2+  🡪 Fe3+ Oxidation or reduction? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 **ii**. Br- 🡪 Br2 Oxidation or reduction? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

  **iii**. MnO4- + H+  🡪 Mn2+ Oxidation or reduction? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**c**.  **i**. Which one of the following reactions will occur spontaneously? 1 mark

 Ca + ZnCl2 🡪

 Zn + CaCl2 🡪

 **ii**. Explain how you arrived at your decision. 1 mark

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 **iii**. For the reaction that occurs write the half-equations. 2 marks

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**Question 2** (11 marks)

**a**. Categorise the following as acid, base or neutral.

 LiOH \_\_\_\_\_\_\_\_ HNO3 \_\_\_\_\_\_\_\_\_\_\_ CH3CH2OH \_\_\_\_\_\_\_\_\_\_ 3 marks

**b**. Calculate the pH of the following solutions: 3 marks

 **i**. 0.001 M HNO3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **ii**. 0.25 M HCl \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 iii. 0.01 M NaOH \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**c**. Use examples to explain the difference between a weak acid and a dilute acid. 2 marks

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**d**. Write balanced equations for the reactions below: 3 marks

 **i.** zinc + hydrochloric acid \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 **ii**. sulfuric acid (H2SO4) + calcium carbonate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 **iii**. nitric acid (HNO3) + magnesium hydroxide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 3** (9 marks)

**a**. One of potassium nitrate and zinc carbonate is soluble in water and the other is not.

  **i**. Which one will be soluble? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 mark

 **ii**. Draw how the particles are arrangement when it dissolves in water. 2 marks

**b**. Nitric acid, HNO3, is soluble in water.

 Write an equation to show the reaction between nitric acid and water. 1 mark

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**c**. Methanol is soluble (or miscible) in water.

 Draw the bonding that occurs between methanol molecules and water molecules. 2 marks

**d**. Calculate the energy required to heat 650 g of water from 18.4º C to 85.0 ºC. 1 mark

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**e**. The volume of 2.0 g of an ice sample is calculated and then the ice is allowed to thaw. How will the volume of

 the ice, once thawed, compare to what is was before thawing? Justify your answer. 2 marks

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**Question 4** (10 marks)

The equation for the reaction between ethane and oxygen is:

 2C2H6(g) + 7O2(g) 🡪 4CO2(g) + 6H2O(g)

**a**. Given a sample of 10 mol of ethane, calculate the number of mol of 3 marks

 **i**. oxygen required for the reaction \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 **ii**. CO2 formed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **iii**. H2O formed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**b**. Given a sample of 64.0 g of O2, calculate the mass of CO2 that can be formed. 2 marks

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**c**. The concentration of a copper sulfate, CuSO4, solution can be analysed using gravimetric analysis.

 **i**. Write a balanced equation to show the precipitate that will form if NaOH is added to CuSO4. 1 mark

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  **ii**. Write a balanced equation to show the precipitate that will form if Ba(NO3)2 is added to CuSO4. 1 mark

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  **iii**. Given a 50 mL solution of CuSO4, outline a procedure you would follow to gravimetrically determine the

 concentration of the CuSO4. 3 marks

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**Question 5** (10 marks)

**a**. 20.0 g of sodium carbonate is dissolved in water to make a 400 mL solution.

 Calculate the concentration of the NaCl 3 marks

 **i**. in molarity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 **ii**. in g L-1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 **iii**. as a %(m/V) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**b. i**. A student is able to dissolve 520 g of CuSO4 in 2.0 litres of water at 12 ºC. Calculate the solubility in g/100 g of

 solution for the CuSO4 at that temperature. (assume 1 mL = 1 g for the solution) 2 marks

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 **ii**. Explain how the student could make a supersaturated solution of CuSO4. 2 marks

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**c**. A student uses a titration to determine the concentration of a sulfuric acid solution. A 20.0 mL aliquot of sulfuric

 acid requires a titre of 24.6 mL of 0.105 M NaOH for neutralisation.

 Use a balanced equation for the reaction to determine the concentration of the acid. 3 marks

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**Question 6** (11 marks)



The diagram above shows an outline of the procedure involved in atomic absorption spectroscopy.

**a. i**. What type of substances is AAS best suited to? 1 mark

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 **ii**. Explain clearly why some atoms will absorb radiation? 1 mark

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 **iii**. Do sodium and calcium absorb the same radiation? Explain your answer. 2 marks

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 **iv**. How will the machine respond differently to a 0.1 M solution of LiCl compared to a 0.5 M solution of LiCl? 1 mark

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**b**. A calibration curve is shown below for lead solutions. (ppm can be assumed to be mg L-1)



 **i**. How was this curve produced? 1 mark

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 **ii**. A lead sample is diluted by making 1 mL up to 10 mL. The absorbance of the diluted solution is 0.025.

 Determine the mass of lead in the sample. 2 marks

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 **c**. A HPLC chromatogram for a solution is shown below.



 Explain what you can deduce from this chromatogram. 3 marks

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 **End of exam**

Section A: 20 marks

Section B: 63 marks