**2021 chemistry Unit 2 exam solutions**

**Section A: Multiple choice**

**Question 1**

C. Hydrogen bonds form between water molecules.

**Question 2**

D. It takes more energy to heat water than olive oil due to its high specific heat capacity.

**Question 3**

B. Ionic compounds dissolve though dissociation.

**Question 4**

A. Energy will be released when gases condense or liquids freeze.

**Question 5**

B. The reversible arrow shows the weak acid nature of ethanoic acid.

**Question 6**

D. The substance is an acid and the production of magnesium sulfate is due to the sulfate ions in the sulfuric acid.

**Question 7**

C. A pH of 13 indicates a base with concentration of 0.1 M.

**Question 8**

A. The reaction of KOH and HCl is neutralisation reaction that forms a salt and water.

**Question 9**

B.  The oxidation number of sulfur in H2SO4 is +6.

**Question 10**

D. Option D is the only correctly balanced half-equation. You don’t have to be able to write the equation, just check the balancing.

**Question 11**

C. The oxidising agent is reduced, meaning it will gain electrons.

**Question 12**

D. As the temperature increases the solubility of the NaCl does not change much.

**Question 13**

A. The solubility of gases will decrease as the temperature increases. The descending graph for NH3 shows it is a gas.

**Question 14**

C. The mass of NH4Cl that can be dissolved in 100 g of water at 70 ºC is close to 62 g so the amount in 500 g will be 5 times as much.

**Question 15**

A. n(CO2) = 52 x 8/13 = 32 that can be formed from 52 mole of oxygen is

**Question 16**

B. n(butane) =116/58 = 2 mol. n(H2O) = 10 mol which weighs 180 g

**Question 17**

B. Increases in concentration will lead to the peak getting larger each time. The retention time is unchanged.

**Question 18**

C. Substance D has a lower retardation factor. It is spending more time on the stationary phase and less time in the mobile phase.

**Question 19**

C. The precipitate is AgCl. A precipitate of 0.02 mol indicates a number of mol of MgCl2 of 0.01 mol.

The number of mol of MgCl2 in the whole solution will be ten times the sample = 0.1 mol.

**Question 20**

A. n(NaOH) = 0.2 x 0.02 = 0.004 mol n(H2SO4) = 0.002 mol c = 0.002/0.015 = 0.13 M

**Section B: Short answer questions**

**Question 1** (12 marks)

**a**. **i**. **N**2O4 +4 **ii**. NH3 -3 **iii**. **Br**O3- +5 **iv**. **S**O32- +4 4 marks

**b**. **i**. Fe2+  🡪 Fe3+ + e Oxidation 1 mark

 **ii**. 2Br- 🡪 Br2 + 2e Oxidation 1 mark

  **iii**. MnO4- + 8H+  + 5e 🡪 Mn2+ + 4H2O(l)Reduction 2 marks

**c**.  **i**. Ca + ZnCl2 1 mark

 **ii**. The more reactive metal (calcium) can replace the less reactive metal in solution 1 mark

 **iii**. Ca(s) 🡪 Ca2+(aq) + 2e Zn2+(aq) + 2e 🡪 Zn(s) 2 marks

**Question 2** (11 marks)

**a**. LiOH base HNO3 acid CH3CH2OH neutral 3 marks

**b**. **i**. 0.001 M HNO3 pH = 3 **ii**. 0.25 M HCl pH = 0.60 iii. 0.01 M NaOH pH = 12 3 marks

**c**. 0.001 M HCl is a dilute acid – there are not many particles in a given volume 2 marks

 CH3COOH(aq) + H2O(l) ⇄ CH3COO + H3O+(aq) weak acid as the reaction with water is reversible.

**d**. **i.** Zn(s) + 2HCl(aq) 🡪 ZnCl2(aq) + H2(g) 1 mark

 **ii**. H2SO4 + CaCO3(s) 🡪 CaSO4(aq) + H2O(l) + CO2(g) 1 mark

 **iii**. 2HNO3(aq) + Mg(OH)2(aq) 🡪 Mg(NO3)2(aq) + 2H2O(l) 1 mark

**Question 3** (9 marks)

**a**.  **i**. Potassium nitrate is soluble (all nitrates are soluble) 1 mark

 **ii**. The negative dipoles on the oxygen atoms of water will attract to the K+ ions while the positive hydrogen

 dipoles will attract to the NO3- ions. 2 marks

**b**. HNO3(aq) + H2O(l) 🡪 H3O+(aq) + NO3-(aq) 1 mark

**c**. Methanol forms hydrogen bonds with water 2 marks

**d**. energy = 4.18 x 650 x 66.6 = 181000 J = 181 kJ 1 mark

**e**. Once thawed the volume will be smaller – the density of liquid water is higher than that of ice 2 marks

**Question 4** (10 marks)

**a**. **i**. oxygen required 35 mol **ii**. CO2 formed 20 mol **iii**. H2O formed 30 mol 3 marks

**b**. n(O2) = 2 => n(CO2) = 1.14 mass = 1.14 x 44 = 5.03 g 2 marks

**c**. **i**. 2NaOH(aq) + CuSO4(aq) 🡪 Cu(OH)2(s) + Na2SO4(aq) 1 mark

  **ii**. Ba(NO3)2(aq) + CuSO4(aq) 🡪 Cu(NO3)2(aq) + BaSO4(s) 1 mark

  **iii**. Add excess Ba(NO3)2 solution to your sample. Filter the BaSO4 precipitate. Wash and dry it. Weigh it. Use this

 mass to determine the concentration of the solution. 3 marks

**Question 5** (10 marks)

**a**. **i**. n = 20/106 = 0.189 mol c = n/V = 0.189/0.4 = 0.472 M 3 marks

 **ii**. 20 g in 400 mL = 20 x 1000/400 in g L-1 = 50

 **iii**. as a %(m/V) = 20/400 x 100 = 5 %(m/V)

**b. i**. 520 g in 2000g = 26 g/100 g 2 marks

 **ii**. Prepare a saturated solution, then cool is carefully. This will make the solution supersaturated. 2 marks

**c**. n(NaOH) = 0.0246 x 0.105 = 0.00258 mol n(H2SO4) = ½ n(NaOH) = 0.00129 mol

 c = n/V = 0.00129/0.02 = 0.0646 M 3 marks

**Question 6** (11 marks)

**a. i**. ionic solutions 1 mark

 **ii**. Metal atoms will absorb radiation. It is the outer shell electrons that absorb the energy, as the electrons

 move from a ground state to an excited state. 1 mark

 **iii**. No, the electron jumps in each atom are slightly different or involve a different amount of energy. 2 marks

 **iv**. As the concentration increases the percentage of the light absorbed will increase. 1 mark

**b**. **i**. By preparing a series of standard solutions of differing concentrations and testing their absorbance. 1 mark

 **ii**. absorbance reading gives a concentration of 0.5 ppm. Since the sample was diluted by a factor of 10, the concentration will be 5 ppm or 5 mg per litre. The volume of the sample is 1 mL so the mass is 0.005 mg. 2 marks

 **c**. There are at least 3 substances in the sample. The peak on the left represents the component with the highest solubility leading to the lowest retention time. It is difficult to comment on concentrations as it is hard to judge the areas of each peak. 3 marks