AQA – Atomic structure – A2 Chemistry P3

1. June/ 2019/Paper_3/No.1

0 1 Sodium thiosulfate reacts with dilute hydrochloric acid as shown.

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + SO_2(g) + S(s) + H_2O(l)$$

0 1 . 1 Give the simplest ionic equation for this reaction.

[1 mark]

_____

0 1 . 2 The gas SO_2 is a pollutant.

State the property of SO_2 that causes pollution when it enters rivers.

Give an equation to show the reaction of SO_2 with water.

[2 marks]

Property _____

Equation _____

0 1 . 3 Draw a diagram to show the shape of a molecule of H_2O
Include any lone pairs of electrons.

State the H–O–H bond angle.

Explain this shape and bond angle.

[4 marks]

Diagram

Bond angle _____

Explanation _____

_____

_____

_____

_____

_____

_____

_____

0 1 . 4 The initial rate of the reaction between sodium thiosulfate and hydrochloric acid can be monitored by measuring the time taken for a fixed amount of sulfur to be produced.

Describe an experiment to investigate the effect of temperature on the initial rate of this reaction.

Include

- a brief outline of your method
- how you will measure the time taken for a fixed amount of sulfur to be formed
- how you will present your results in graphical form
- a sketch of the graph that you would expect.

[6 marks]

2. June/ 2019/Paper_3/No.6

Which amount of sodium hydroxide would react exactly with 7.5 g of a diprotic acid, H_2A (M_r = 150)?

[1 mark]

A 50 cm^3 of 0.05 mol dm^{-3} NaOH(aq) ⬭

B 100 cm^3 of 0.50 mol dm^{-3} NaOH(aq) ⬭

C 100 cm^3 of 1.0 mol dm^{-3} NaOH(aq) ⬭

D 100 cm^3 of 2.0 mol dm^{-3} NaOH(aq) ⬭

3. June/ 2019/Paper_3/No.7

Lead(II) nitrate and potassium iodide react according to the equation

$$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

In an experiment, 25.0 cm^3 of a 0.100 mol dm^{-3} solution of each compound are mixed together.

Which amount, in mol, of lead(II) iodide is formed?

[1 mark]

A 1.25×10^{-3} ⬭

B 2.50×10^{-3} ⬭

C 1.25×10^{-2} ⬭

D 2.50×10^{-2} ⬭

4. June/2021/Paper_3/No.1(1.3-1.8)

0 1 . 3 Sodium ethanedioate is used to find the concentration of solutions of potassium manganate(VII) by titration. The equation for this reaction is

$$2\,MnO_4^- + 16\,H^+ + 5\,C_2O_4^{2-} \rightarrow 2\,Mn^{2+} + 8\,H_2O + 10\,CO_2$$

A standard solution is made by dissolving 162 mg of $Na_2C_2O_4$ (M_r = 134.0) in water and making up to 250 cm^3 in a volumetric flask.

25.0 cm^3 of this solution and an excess of sulfuric acid are added to a conical flask.
The mixture is warmed and titrated with potassium manganate(VII) solution.
The titration is repeated until concordant results are obtained.
The mean titre is 23.85 cm^3

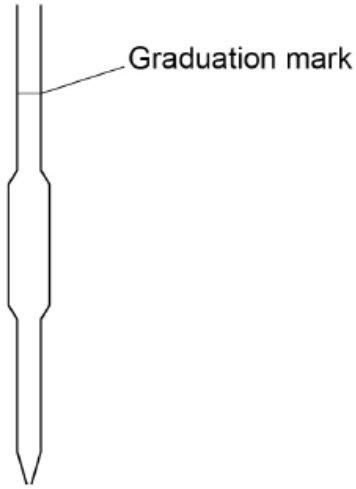
Calculate the concentration, in mol dm^{-3}, of the potassium manganate(VII) solution.

[4 marks]

Concentration _____ mol dm^{-3}

0 1 . 4 **Figure 1** shows the 25.0 cm^3 pipette used to measure the sodium ethanedioate solution.

Figure 1



On **Figure 1**, draw the meniscus of the solution when the pipette is ready to transfer 25.0 cm^3 of the sodium ethanedioate solution.

[1 mark]

0 1 . 5 Potassium manganate(VII) is oxidising and harmful.
Sodium ethanedioate is toxic.

Suggest safety precautions, other than eye protection, that should be taken when:

- filling the burette with potassium manganate(VII) solution
- dissolving the solid sodium ethanedioate in water.

[2 marks]

Filling the burette _____

_____

Dissolving the solid _____

_____

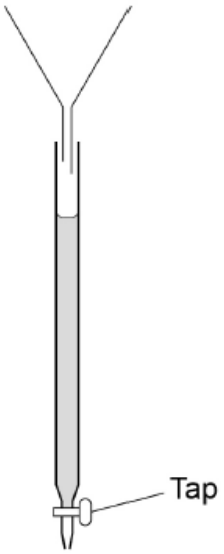
0 1 . 6 State the colour change seen at the end point of each titration.

[1 mark]

_____

0 1 . 7 **Figure 2** shows the burette containing potassium manganate(VII) solution.

Figure 2



Give **two** practical steps needed before recording the initial burette reading.

[2 marks]

1 _____

2 _____

0 1 . 8 When $Na_2C_2O_4(aq)$ is added to a solution containing $[Fe(H_2O)_6]^{3+}$ ions, a reaction occurs in which all six water ligands are replaced by ethanedioate ions.

Explain why the replacement of the water ligands by ethanedioate ions is favourable.
In your answer refer to:

- the enthalpy and entropy changes for the reaction
- how the enthalpy and entropy changes influence the free-energy change for the reaction.

[6 marks]

5. June/2021/Paper_3/No.9

What is the mole fraction of 1.0 g of a compound of relative molecular mass 100.0 dissolved in 30.0 g of a solvent of relative molecular mass 50.0?

[1 mark]

A 6.0×10^{-3} ⬭

B 1.6×10^{-2} ⬭

C 1.7×10^{-2} ⬭

D 3.0×10^{-2} ⬭

6. June/2021/Paper_3/No.25

Which compound needs the greatest amount of oxygen for the complete combustion of 1 mol of the compound?

[1 mark]

A ethanal ⬭

B ethanol ⬭

C ethane-1,2-diol ⬭

D methanol ⬭

7. June/2021/Paper_3/No.29

Nitration of 1.70 g of methyl benzoate (M_r = 136.0) produces methyl 3-nitrobenzoate (M_r = 181.0). The percentage yield is 65.0%

What mass, in g, of methyl 3-nitrobenzoate is produced?

[1 mark]

A 0.830 ⬭

B 1.10 ⬭

C 1.47 ⬭

D 2.26 ⬭