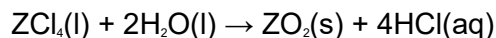


**Q1.** The chloride of an element **Z** reacts with water according to the following equation.



A 1.304 g sample of  $\text{ZCl}_4$  was added to water. The solid  $\text{ZO}_2$  was removed by filtration and the resulting solution was made up to  $250 \text{ cm}^3$  in a volumetric flask. A  $25.0 \text{ cm}^3$  portion of this solution was titrated against a  $0.112 \text{ mol dm}^{-3}$  solution of sodium hydroxide, of which  $21.7 \text{ cm}^3$  were required to reach the end point.

Use this information to calculate the number of moles of  $\text{HCl}$  produced and hence the number of moles of  $\text{ZCl}_4$  present in the sample. Calculate the relative molecular mass,  $M_r$ , of  $\text{ZCl}_4$ .

From your answer deduce the relative atomic mass,  $A_r$ , of element **Z** and hence its identity.

**(Total 9 marks)**

**Q2.** On heating, magnesium reacts vigorously with element **X** to produce compound **Y**. An aqueous solution of **Y**, when treated with aqueous silver nitrate, gives a white precipitate that is readily soluble in dilute aqueous ammonia. What is the minimum mass of **X** that is needed to react completely with 4.05 g of magnesium?

- A** 11.83 g
- B** 5.92 g
- C** 5.33 g
- D** 2.67 g

**(Total 1 mark)**

**Q3.** 1,3-dinitrobenzene can be prepared by heating nitrobenzene with a mixture of fuming nitric acid and concentrated sulphuric acid. The reaction can be represented by the following equation.



If the yield of the reaction is 55%, the mass of 1,3-dinitrobenzene produced from 12.30 g of nitrobenzene is

- A 16.90 g
- B 16.80 g
- C 9.30 g
- D 9.24 g

(Total 1 mark)

**Q4.0.00125** mol of a compound was heated with an excess of a solution of potassium hydroxide and the ammonia evolved required 17.0 cm<sup>3</sup> of 0.220 M hydrochloric acid for neutralisation. Which one of the following could be the formula of this compound?

- A BF<sub>3</sub>NH<sub>3</sub>
- B VCl<sub>3</sub>(NH<sub>3</sub>)<sub>3</sub>
- C CrCl<sub>2</sub>(NH<sub>3</sub>)<sub>2</sub>
- D [Be(NH<sub>3</sub>)<sub>4</sub>]Cl<sub>2</sub>

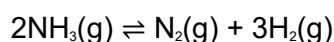
(Total 1 mark)

**Q5.** Which one of the following compounds contains the smallest percentage, by mass, of oxygen?

- A CH<sub>3</sub>OCH<sub>2</sub>CH<sub>3</sub>
- B CH<sub>3</sub>OCH<sub>2</sub>NH<sub>2</sub>
- C COS
- D C<sub>4</sub>H<sub>9</sub>Al(OH)<sub>2</sub>

(Total 1 mark)

**Q6.** When one mole of ammonia is heated to a high temperature, 50% dissociates according to the following equilibrium.

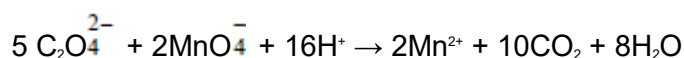


What is the total number of moles of gas present in the equilibrium mixture?

- A 1.5
- B 2.0
- C 2.5
- D 3.0

(Total 1 mark)

**Q7.** Aqueous  $\text{C}_2\text{O}_4^{2-}$  ions react with  $\text{MnO}_4^-$  ions in acidic solution according to the equation



Under the same conditions  $\text{Fe}^{2+}$  ions also react with  $\text{MnO}_4^-$  ions. How many moles of  $\text{MnO}_4^-$  ions are required to react exactly with one mole of  $\text{Fe}(\text{C}_2\text{O}_4)_2 \cdot 2\text{H}_2\text{O}$ ?

- A 0.4
- B 0.6
- C 2.5
- D 7.5

(Total 1 mark)

**Q8.** On complete combustion, 0.0150 mol of an organic acid produced 735 cm<sup>3</sup> of carbon dioxide (measured at 101 kPa and 298 K). The same amount of acid required 15.0 cm<sup>3</sup> of 2.00 M sodium hydroxide solution for neutralisation. Which one of the following could be the formula of the acid?

- A HCOOH
- B CH<sub>3</sub>COOH
- C HOCCOH
- D HOOCCH<sub>2</sub>CH<sub>2</sub>COOH

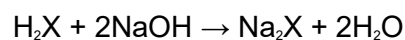
(Total 1 mark)

**Q9.** An excess of methanol was mixed with 12 g of ethanoic acid and an acid catalyst. At equilibrium the mixture contained 8 g of methyl ethanoate. The percentage yield of ester present was

- A 11
- B 20
- C 54
- D 67

(Total 1 mark)

**Q10.** In a titration, 0.52 g of a diprotic acid,  $H_2X$ , reacts exactly with 100 cm<sup>3</sup> of 0.10 M sodium hydroxide.

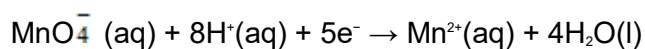
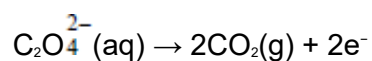


The acid could be

- A ethanedioic
- B propanedioic
- C butanedioic
- D pentanedioic

(Total 1 mark)

**Q11.** The oxidation of ethanedioate (*oxalate*) ions by manganate(VII) ions can be represented by the half equations:



What volume (in cm<sup>3</sup>) of 0.02 M  $KMnO_4$  is required to oxidise completely a solution containing 0.02 mol of ethanedioate ions?

- A 25
- B 40
- C 250
- D 400

(Total 1 mark)

**Q12.**Hydrolysis of the ester,  $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3$ , produces ethanoic acid. In an experiment, 2.04 g of the ester was used and 0.90 g of ethanoic acid was produced. The percentage yield of ethanoic acid was:

- A 44
- B 59
- C 75
- D 90

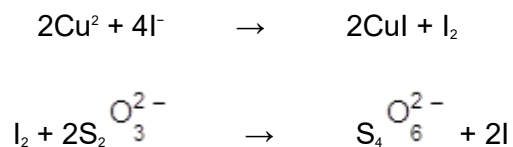
(Total 1 mark)

**Q13.**When vanadium reacts with chlorine at  $400^\circ\text{C}$ , a brown compound is obtained. When an aqueous solution containing 0.193 g of this compound was treated with aqueous silver nitrate all the chlorine in the compound was precipitated as silver chloride. The mass of silver chloride ( $\text{AgCl}$ ) produced was 0.574 g. Which one of the following could be the formula of the brown compound?

- A  $\text{VCl}$
- B  $\text{VCl}_2$
- C  $\text{VCl}_3$
- D  $\text{VCl}_4$

(Total 1 mark)

**Q14.**Copper(II) ions can be estimated volumetrically by the addition of an excess of potassium iodide followed by titration of the liberated iodine with sodium thiosulphate solution. The following equations apply:



What volume (in  $\text{cm}^3$ ) of 0.1 M  $\text{Na}_2\text{S}_2\text{O}_3$  would be required to react with the iodine produced from 1.249 g of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  ( $M_r$  249.7)?

- A 10
- B 25
- C 50
- D 100

(Total 1 mark)

**Q15.**A “drink-driving” offence is committed if the blood alcohol level of a driver is over 80 mg of ethanol per 100 cm<sup>3</sup> of blood.

What is the concentration (in mol dm<sup>3</sup>) of ethanol if there are 80 mg of ethanol per 100 cm<sup>3</sup> of blood?

- A** 0.0017
- B** 0.017
- C** 0.080
- D** 0.80

(Total 1 mark)