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Cambridge AS & A Level

CHEMISTRY

Paper 2

Topical Past Paper Questions

+ Answer Scheme

2015 - 2021

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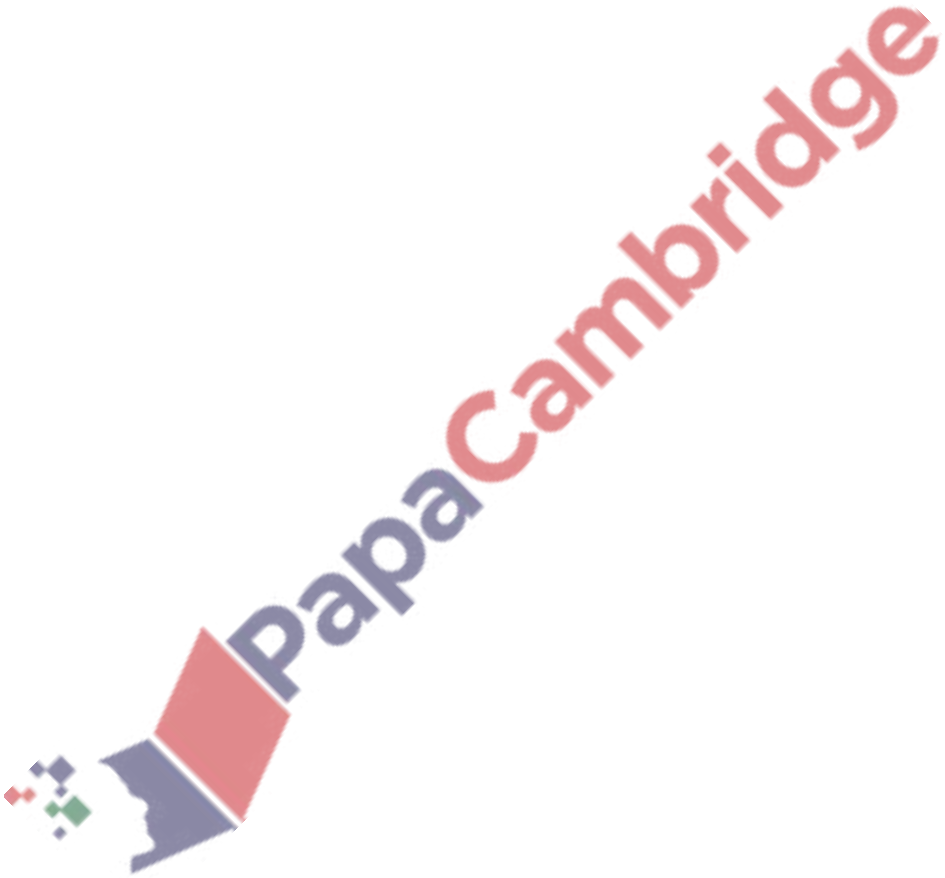
Chapter 6

Electrochemistry



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6.1 Redox processes: electron transfer and changes in oxidation number

23. 9701_s20_qp_21 Q: 2

(a) The equation shown in **(a)(i)** describes the reaction which occurs when aqueous potassium iodide is added to aqueous copper(II) sulfate. A white precipitate of copper(I) iodide forms in a brown solution of iodine and potassium sulfate.

(i) Balance the equation and include state symbols.

.....$CuSO_4$(.....) + ...KI(.....) → .....CuI(.....) + ...I_2(.....) + ...K_2SO_4(.....)

[2]

The table gives the oxidation numbers of iodine in the different species in the equation.

iodine-containing species	oxidation number of iodine
KI	–1
CuI	–1
I_2	0

(ii) Deduce the oxidation number of copper in $CuSO_4$ and CuI.

- oxidation number of copper in $CuSO_4$ .....
- oxidation number of copper in CuI .....

[1]

(iii) Describe the type of reaction shown by the equation in **(a)(i)**. Explain your answer in terms of electron transfer.

.....

.....

..... [2]

(b) In the reaction described in **(a)(i)**, a student uses 17.43 g of $CuSO_4$•**y**H_2O. By further titration of the reaction products the student concludes that the total amount of $CuSO_4$ in the sample is 0.0982 mol.

Use the *Data Booklet* to complete the table to calculate the value of **y**, where **y** is an integer. Show your working.

mass of 0.0982 mol $CuSO_4$	..... g
amount of H_2O in 17.43 g of $CuSO_4$•**y**H_2O	..... mol H_2O
value of **y**	**y** = ...

[4]

[Total: 9]

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24. 9701_s19_qp_23 Q: 2

Iodine is an element in Group 17 of the Periodic Table.

(a) (i) At room temperature, iodine solid has a lattice structure.

Describe the arrangement of the iodine molecules within the solid.

.....

..... [1]

(ii) List **all** of the forces of attraction present in solid iodine and identify which of these are overcome when solid iodine is heated to produce iodine vapour.

force(s) of attraction present

.....

.....

force(s) of attraction overcome

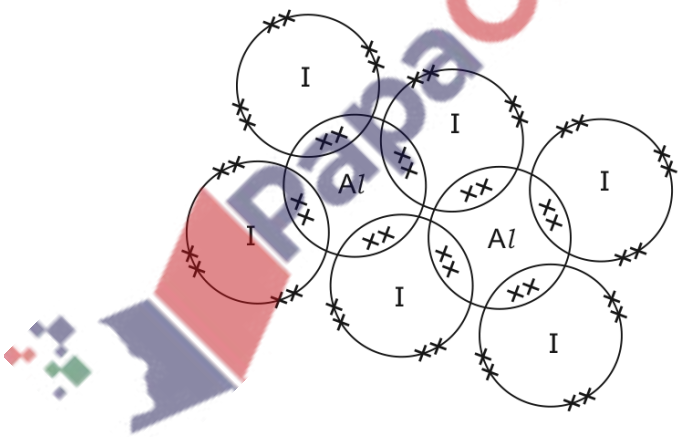
.....

.....

[2]

Iodine reacts with aluminium to form a white solid, Al_2I_6.

(b) The diagram shows the arrangement of the outer electrons within a molecule of Al_2I_6.



(i) How many co-ordinate (dative covalent) bonds are made when a molecule of Al_2I_6 is formed from its atoms?

..... [1]

(ii) Describe how co-ordinate (dative covalent) bonds form within this molecule.

.....

.....

..... [1]

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(c) In a reaction between hydrogen iodide and concentrated sulfuric acid, the products are hydrogen sulfide, sulfur, iodine and water.

(i) Write an equation for this reaction.

You may wish to use oxidation numbers to help you.

..... [2]

(ii) Explain, with reference to oxidation numbers, why this reaction is a redox reaction.

.....

.....

..... [2]

[Total: 9]

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25. 9701_s16_qp_22 Q: 3

Acidified potassium dichromate(VI) can oxidise ethanedioic acid, $H_2C_2O_4$.
The relevant half-equations are shown.

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

$$H_2C_2O_4 \rightarrow 2CO_2 + 2H^+ + 2e^-$$

(a) State the overall equation for the reaction between acidified dichromate(VI) ions and ethanedioic acid.

..... [2]

(b) In an experiment a 0.242 g sample of hydrated ethanedioic acid, $H_2C_2O_4.\boldsymbol{x}H_2O$, was reacted with a 0.0200 mol dm^{-3} solution of acidified potassium dichromate(VI).

32.0 cm^3 of the acidified potassium dichromate(VI) solution was required for complete oxidation of the ethanedioic acid.

(i) Calculate the amount, in moles, of dichromate(VI) ions used to react with the sample of ethanedioic acid.

amount = ... mol [1]

(ii) Calculate the amount, in moles, of ethanedioic acid in the sample.

amount = ... mol [1]

(iii) Calculate the relative molecular mass, M_r, of the hydrated ethanedioic acid.

M_r = ... [1]

(iv) Calculate the value of $\boldsymbol{x}$ in $H_2C_2O_4.\boldsymbol{x}H_2O$.

$\boldsymbol{x}$ = ... [1]

[Total: 6]

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