

#### **OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Advanced GCE** 

**CHEMISTRY** 

Transition Elements



Monday

**26 JUNE 2006** 

Morning

50 minutes

Candidates answer on the question paper.
Additional materials:

Data Sheet for Chemistry
Scientific calculator

Candidate Name		
Centre Number	Candidate Number	

TIME 50 minutes

#### **INSTRUCTIONS TO CANDIDATES**

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer all the questions.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Pencil may be used for diagrams and graphs only.
- Do not write in the bar code. Do not write in the grey area between the pages.
- DO NOT WRITE IN THE AREA OUTSIDE THE BOX BORDERING EACH PAGE. ANY WRITING IN THIS AREA WILL NOT BE MARKED.

#### INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You may use a scientific calculator.
- You may use the Data Sheet for Chemistry.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE			
Qu	Max.	Mark	
1	10		
2	6		
3	10		
4	10		
5	9		
TOTAL	45		

This question paper consists of 11 printed pages and 1 blank page.

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### Answer all the questions.

1 Some standard electrode potentials are shown below.

$$Ag^{+} + e^{-} \rightleftharpoons Ag \qquad +0.80$$

$$\frac{1}{2}Cl_{2} + e^{-} \rightleftharpoons Cl^{-} \qquad +1.36$$

$$Cu^{2+} + 2e^{-} \rightleftharpoons Cu \qquad +0.34$$

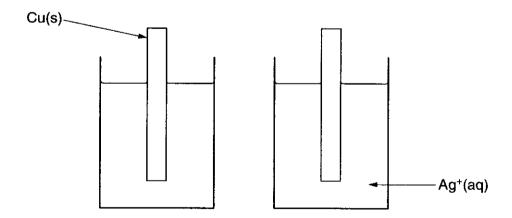
$$Fe^{3+} + e^{-} \rightleftharpoons Fe^{2+} \qquad +0.77$$

$$\frac{1}{2}I_{2} + e^{-} \rightleftharpoons I^{-} \qquad +0.54$$

(a)	Define the term standard electrode potential.

(b) The diagram below shows an incomplete cell consisting of Cu/Cu<sup>2+</sup> and Ag/Ag<sup>+</sup> half-cells.

.....[3]



(i) Complete and label the diagram to show how the cell potential of this cell could be measured.

3

	(ii)	On the diagram, show the direction of <b>electron</b> flow in the circuit if a current was allowed. [1]
	(iii)	Calculate the standard cell potential.
		standard cell potential =V [1]
	(iv)	Write the overall cell reaction.
		[1]
(c)	Chl data	orine will oxidise $Fe^{2+}$ to $Fe^{3+}$ but iodine will not. Explain why, using the electrode potential $a$ .
	••••	
	••••	
	••••	[2]
		[Total: 10]

[Turn over



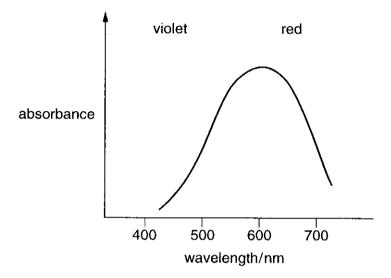
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2 The edta<sup>4-</sup> ion forms complex ions with Ni<sup>2+</sup>(aq).

(a) Complete the electronic configuration of the Ni<sup>2+</sup> ion.

Is<sup>2</sup>2s<sup>2</sup>2p<sup>6</sup>......[1]

(b) The visible spectrum of the complex formed between Ni<sup>2+</sup> and edta<sup>4-</sup> is shown below.



What colour is the complex? Explain.	
	[2]



5

(c) The edta<sup>4-</sup> ion has the following structure.

- (i) Put a ring around two different types of atom in the edta<sup>4–</sup> ion that are capable of forming a dative covalent bond with the Ni<sup>2+</sup> ion. [2]
- (ii) What feature of these atoms allows them to form a bond with Ni<sup>2+</sup>?

[Total: 6]

[Turn over



6

n forms complexes with a co-ordination number of 4.	
State the shape of these platinum complexes.	
$[PtCl_4]^x + 2NH_3 \rightleftharpoons [Pt(NH_3)_2Cl_2]^y + 2Cl^2$	
What type of reaction is this?	
Suggest values for x and y in the equation.	
x =	
y =	
complex [Pt(NH <sub>3</sub> ) <sub>2</sub> Cl <sub>2</sub> ] <sup>y</sup> exists in two isomeric forms.	
Draw diagrams to show the structure of these isomers.	
t	tetrachloroplatinate(II) ion readily undergoes the following reaction. $[PtCl_4]^x + 2NH_3 \iff [Pt(NH_3)_2Cl_2]^y + 2Cl^-$ What type of reaction is this? $Suggest \ values \ for \ x \ and \ y \ in \ the \ equation. x = \dots  y = \dots  the complex [Pt(NH_3)_2Cl_2]^y \ exists \ in \ two \ isomeric \ forms.$

of
••••
••••
[2]
10]



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8

		0
4	amı	nadium can exist in a number of different oxidation states. One compound of vanadium is monium vanadate(V) and this contains the ion $VO_3^-$ . This can be reduced to $V^{2+}$ in several as, using zinc metal and aqueous sulphuric acid.
	(a)	Describe the colour changes during the stepwise reduction of $VO_3^-$ to $V^{2+}$ .
		State the formula of the ions responsible for each colour.
		[4]
	(b)	$25.0\mathrm{cm^3}$ of $0.100\mathrm{moldm^{-3}}$ ammonium vanadate(V) is completely reduced to V²+(aq) using zinc and aqueous sulphuric acid. The resulting solution is titrated with $0.0500\mathrm{moldm^{-3}}$ $\mathrm{MnO_4^{-}(aq)}$ and $30.0\mathrm{cm^3}$ is required to oxidise the V²+(aq) back to VO₃^-(aq).
		The half equation for acidified MnO <sub>4</sub> <sup>-</sup> acting as an oxidising agent is shown below.
		$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$
		Show that the vanadium has changed oxidation state from +2 to +5 in this titration.
	(c)	[4] Suggest an equation for the oxidation of $V^{2+}(aq)$ to $VO_3^-(aq)$ by $MnO_4^-(aq)$ under acid conditions.
		[2]
		[Total: 10]



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9

5	In this question, one mark is available for the quality of spelling, punctuation and grammar.	
	Cobalt forms aqueous ions with oxidation states of +2 and +3.	
	Illustrate the chemistry of cobalt ions, in both oxidation states, by referring to the following.	
	• colour	
	• geometry	
	ligand substitution	
	the relative stability of each oxidation state with different ligands	

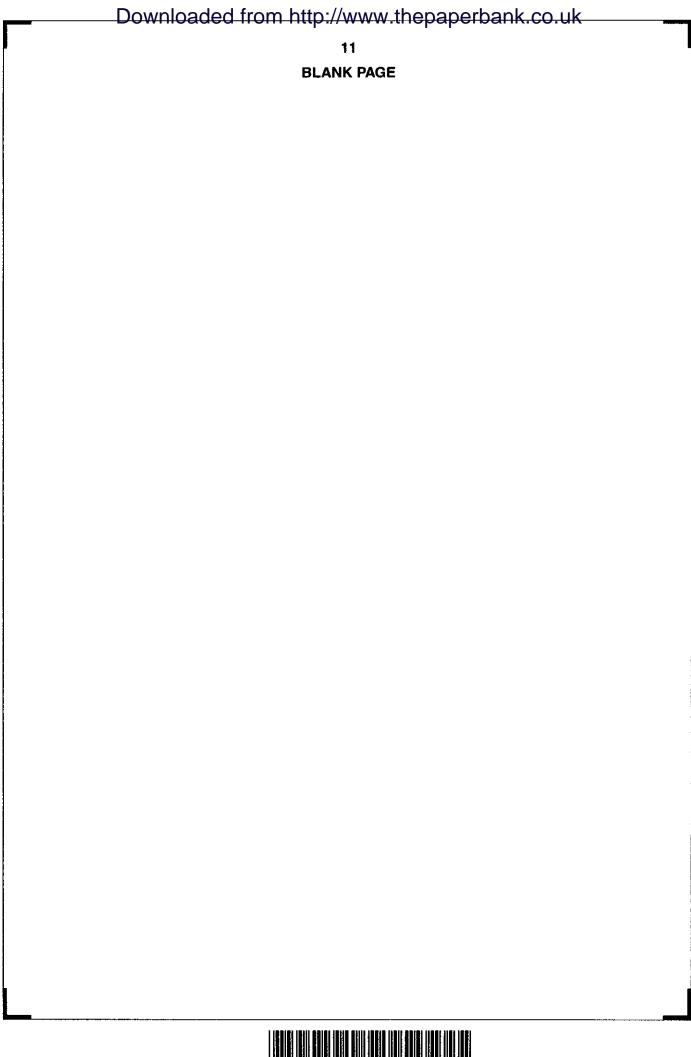


[Turn over

10
***************************************
[8]
Quality of Written Communication [1]
[Total: 9]

**END OF QUESTION PAPER** 







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