Centre Number						Candidate Number				
Surname						Other Names				

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Teacher's Use	
Section	Mark
PSA	
Task	
Section A	
Section B	
TOTAL (max 50)	

General Certificate of Education
Advanced Level Examination
June 2011

Chemistry CHM6T/Q11/test

Unit 6T A2 Investigative Skills Assignment

For submission by 15 May 2011

For this paper you must have:	**Time allowed**
• the Periodic Table/Data Sheet provided at the end of this paper • the Task Sheet and your Candidate Results Sheet • a ruler with millimetre measurements • a calculator.	• 1 hour
Instructions:	**Information**
• Use black ink or black ball-point pen. • Fill in the boxes at the top of this page. • Answer **all** questions. • You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages. • Do all rough work in this book. Cross through any work you do not want to be marked.	• The marks for questions are shown in brackets. • The maximum mark for this paper is 30. • You will be marked on your ability to: – organise information clearly – use scientific terminology accurately.

Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.

Yes ☐ No ☐

Teacher Declaration:
I confirm that the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

Signature of teacher ..... Date .....

Do not write outside the box

Section A

These questions are about the task, some reactions of iron(II) and iron(III) compounds.

You should use your Task Sheet and your Candidate Results Sheet to answer them.

Answer **all** questions in the spaces provided.

1 *Prussian Blue* dye is an insoluble complex with the formula $KFe[Fe(CN)_6]$.
Calculate the M_r of this complex using data from the Periodic Table. Give your answer to one decimal place.

.....

.....

(1 mark)

2 In one investigation a student obtained 1.65 g of *Prussian Blue*.
Calculate the amount, in moles, of *Prussian Blue* obtained in this investigation.

.....

.....

(1 mark)

3 The iron(III) salt used in the Task was in excess. The 10.0 cm^3 solution of potassium hexacyanoferrate(II) had a concentration of 0.75 mol dm^{-3}. The equation for the formation of *Prussian Blue* from iron(III) sulfate and potassium hexacyanoferrate(II) is shown below.

$$2K_4[Fe(CN)_6] + Fe_2(SO_4)_3 \longrightarrow 2KFe[Fe(CN)_6] + 3K_2SO_4$$

Calculate the maximum amount, in moles, of *Prussian Blue* that could have been formed in the reaction.
Show your working.

.....

.....

.....

(2 marks)

4 Use your answers to Question **2** and Question **3** to calculate the percentage yield of *Prussian Blue* obtained in this experiment.

.....

.....

(1 mark)

Do not write outside the box

5 *Prussian Blue* dye is an insoluble solid and when prepared as described in **Part 1** it is impure.
Suggest how the impurities present in the dye could be removed.

.....

.....
(1 mark)

6 Give the formula for each of the iron-containing products formed in **Test 2**.

Product using iron(II) sulfate solution .....

Product using iron(III) nitrate solution .....
(2 marks)

7 Write an ionic equation for the reaction of aqueous $[Fe(H_2O)_6]^{3+}$ ions with hydroxide ions to form a brown precipitate.

.....
(1 mark)

9

Turn over for the next question

Do not write outside the box

Section B

Answer **all** questions in the spaces provided.

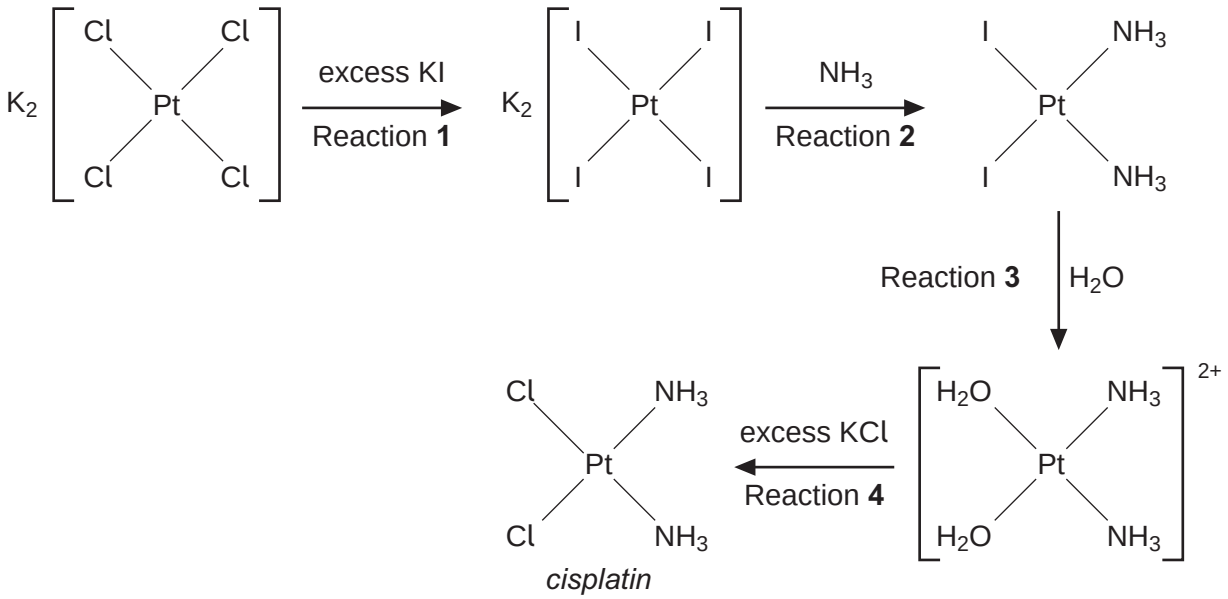
Introduction

Complexes containing transition elements have a wide variety of uses including acting as dyestuffs like *Prussian Blue*.

Cisplatin is a platinum-based chemotherapy drug used to treat various types of cancers. It was the first member of a class of anti-cancer drugs that react with DNA in tumour cells.

Cisplatin is prepared from K_2PtCl_4 according to the following scheme.

All the reactions shown are reversible.



cisplatin

8 Name the type of reaction occurring in all four steps of the scheme.

.....

(1 mark)

9 Explain why an excess of potassium iodide is used in Reaction **1**.

.....

.....

.....

(2 marks)

Do not write outside the box

10 (a) Write an equation for Reaction **1**.

.....

.....

(1 mark)

10 (b) Calculate the percentage atom economy for the formation of K_2PtI_4 in Reaction **1**. Show your working.

.....

.....

.....

.....

(2 marks)

11 In Reaction **3**, silver nitrate solution is added to improve the yield of product.

11 (a) Write the **simplest ionic** equation for the reaction of iodide ions with silver nitrate.

.....

(1 mark)

11 (b) Suggest why addition of silver nitrate improves the yield of product from Reaction **3**.

.....

.....

(1 mark)

12 Suggest two reasons, other than poor practical technique, why the overall yield of *cisplatin* in this synthesis may be low.

Reason 1 .....

.....

Reason 2 .....

.....

(2 marks)

Turn over ▶

Do not write outside the box

13 The *cisplatin* formed in Reaction **4** is impure. Outline how the impure solid is purified by recrystallisation.

.....

.....

.....

.....

.....

(3 marks)

14 Platinum compounds are highly toxic.

14 (a) State why *cisplatin* is used in cancer treatment despite its toxicity.

.....

.....

(1 mark)

14 (b) Suggest a suitable precaution that should be taken by medical staff when using *cisplatin*.

.....

(1 mark)

15 Other metal ions are also toxic to humans. A substance that can be used to treat such poisoning contains the ion $EDTA^{4-}$
$EDTA^{4-}$ forms very stable complexes with metal ions. These complexes are **not** toxic.

15 (a) Write an equation for the reaction of $EDTA^{4-}$ with aqueous copper(II) ions, $[Cu(H_2O)_6]^{2+}$

.....

(1 mark)

Do not write outside the box

15 (b) A solution containing $EDTA^{4-}$ can also be used in a titration to determine the concentration of metal ions in solution.
A river was polluted with copper(II) ions. When a 25.0 cm^3 sample of the river water was titrated with a 0.0150 mol dm^{-3} solution of $EDTA^{4-}$, 6.45 cm^3 were required for complete reaction.
Calculate the concentration, in mol dm^{-3}, of copper(II) ions in the river water.
Show your working.

.....

.....

.....

.....

(2 marks)

16 The determination of the concentration of copper(II) ions in a single sample of river water gives an unreliable value for the copper(II) ion pollution in the river.
Give **one** reason why this value is unreliable.

.....

.....

(1 mark)

17 Silver complexes can be used to identify a particular organic functional group.
Give **one** example of a silver complex that can be used in this way and state the organic functional group it identifies.

Silver complex .....

Organic functional group .....

(2 marks)

21

END OF QUESTIONS

GCE Chemistry Data Sheet

Table 1

Infrared absorption data

Bond	Wavenumber /cm^{-1}
N — H (amines)	3300 – 3500
O — H (alcohols)	3230 – 3550
C — H	2850 – 3300
O — H (acids)	2500 – 3000
C ≡ N	2220 – 2260
C = O	1680 – 1750
C = C	1620 – 1680
C — O	1000 – 1300
C — C	750 – 1100

Table 2

^{1}H n.m.r. chemical shift data

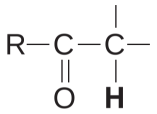
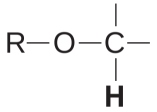
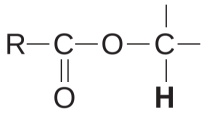
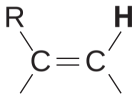
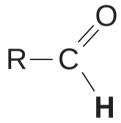
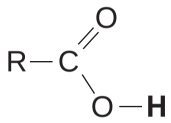
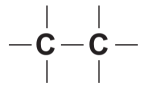
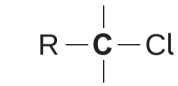
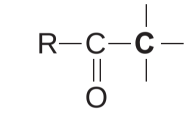
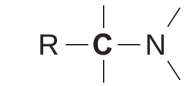
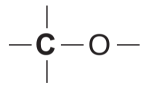
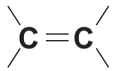
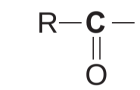
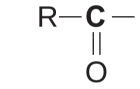
Type of proton	δ/ppm
RO**H**	0.5 – 5.0
RC**H**$_3$	0.7 – 1.2
RN**H**$_2$	1.0 – 4.5
R$_2$C**H**$_2$	1.2 – 1.4
R$_3$C**H**	1.4 – 1.6
	2.1 – 2.6
	3.1 – 3.9
RC**H**$_2$Cl or Br	3.1 – 4.2
	3.7 – 4.1
	4.5 – 6.0
	9.0 – 10.0
	10.0 – 12.0

Table 3

^{13}C n.m.r. chemical shift data

Type of carbon	δ/ppm
	5 – 40
	10 – 70
	20 – 50
	25 – 60
 alcohols, ethers or esters	50 – 90
	90 – 150
	110 – 125
	110 – 160
 esters or acids	160 – 185
 aldehydes or ketones	190 – 220

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
(1)	(2)											(13)	(14)	(15)	(16)	(17)	(18)
			Key				1.0 H hydrogen 1										4.0 He helium 2
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass **symbol** name atomic (proton) number									10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	96.0 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La * lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac † actinium 89	[267] Rf rutherfordium 104	[268] Db dubnium 105	[271] Sg seaborgium 106	[272] Bh bohrium 107	[270] Hs hassium 108	[276] Mt meitnerium 109	[281] Ds darmstadtium 110	[280] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

140.1 Ce cerium 58	140.9 Pr praseodymium 59	144.2 Nd neodymium 60	[145] Pm promethium 61	150.4 Sm samarium 62	152.0 Eu europium 63	157.3 Gd gadolinium 64	158.9 Tb terbium 65	162.5 Dy dysprosium 66	164.9 Ho holmium 67	167.3 Er erbium 68	168.9 Tm thulium 69	173.1 Yb ytterbium 70	175.0 Lu lutetium 71
232.0 Th thorium 90	231.0 Pa protactinium 91	238.0 U uranium 92	[237] Np neptunium 93	[244] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[247] Bk berkelium 97	[251] Cf californium 98	[252] Es einsteinium 99	[257] Fm fermium 100	[258] Md mendelevium 101	[259] No nobelium 102	[262] Lr lawrencium 103

* **58 – 71** Lanthanides

† **90 – 103** Actinides