

Write your name here

Surname

Other names

Centre Number

Candidate Number

**Edexcel GCE**

**Chemistry**

**Advanced**

**Unit 6B: Chemistry Laboratory Skills II Alternative**

Tuesday 22 May 2012 – Morning

**Time: 1 hour 15 minutes**

Paper Reference

**6CH08/01**

**Candidates may use a calculator.**

Total Marks

### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*

### Information

- The total mark for this paper is 50.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- A Periodic Table is printed on the back cover of this paper.

### Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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**PEARSON**

Answer ALL the questions. Write your answers in the spaces provided.

- 1 (a) The colours of aqueous solutions containing chromium(III) chloride and nickel(II) chloride are similar.

What colour are these solutions?

(1)

- (b) Tests were carried out on a dilute aqueous solution of chromium(III) chloride. Complete the table below.

You may use **either** names **or** formulae unless only **one** of these is specified.

	Test	Observations	Inferences	
(i)	Add a few drops of dilute sodium hydroxide solution to the chromium(III) chloride solution.	A precipitate forms.	The precipitate is ..... .....	(1)
(ii)	Add dilute sodium hydroxide to the mixture made in (i), until the sodium hydroxide is present in excess.	..... ..... .....	The complex ion $[\text{Cr}(\text{OH})_6]^{3-}$ forms.	(1)
(iii)	Add a few drops of dilute ammonia to another sample of the chromium(III) chloride solution.	..... .....	The substance containing chromium which is observed on adding the ammonia is ..... .....	(2)



	Test	Observations	Inferences	
(iv)	Continue to add dilute ammonia to the mixture in (iii) until the ammonia is present in excess.	A solution forms.	The <b>formula</b> of the chromium containing ion in the solution is .....	(1)
(v)	Warm another sample of the chromium(III) chloride solution with alkaline hydrogen peroxide solution, which acts as an oxidizing agent.  Add sulfuric acid to the resulting mixture.	A yellow solution forms.  The solution goes orange when sulfuric acid is added.	The <b>formula</b> of the ion causing the yellow colour is .....  The ion causing the orange colour is dichromate(VI), $\text{Cr}_2\text{O}_7^{2-}$ .	(1)

(c) Tests (i) and (ii) above were repeated on an aqueous solution of nickel(II) chloride.

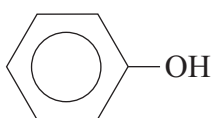
In what way, other than any difference in colour, does the reaction of dilute sodium hydroxide solution with nickel(II) chloride differ from its reactions with chromium(III) chloride?

(1)

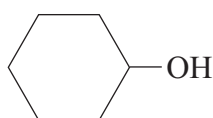
(Total for Question 1 = 8 marks)



2 This question is about some reactions of phenol and cyclohexanol.



phenol



cyclohexanol

(a) Give **two** observations you would make when bromine water is added, drop by drop, to an aqueous solution of phenol.

(2)

(b) (i) What is observed when cyclohexanol is warmed with a mixture of aqueous potassium dichromate(VI) and sulfuric acid?

(1)

(ii) Give the skeletal formula of the organic product of the reaction in (b)(i).

(1)

(iii) What change, if any, is observed when the organic product of the reaction in (b)(i) is mixed with the following reagents?

(2)

2,4-dinitrophenylhydrazine solution

Tollens' reagent

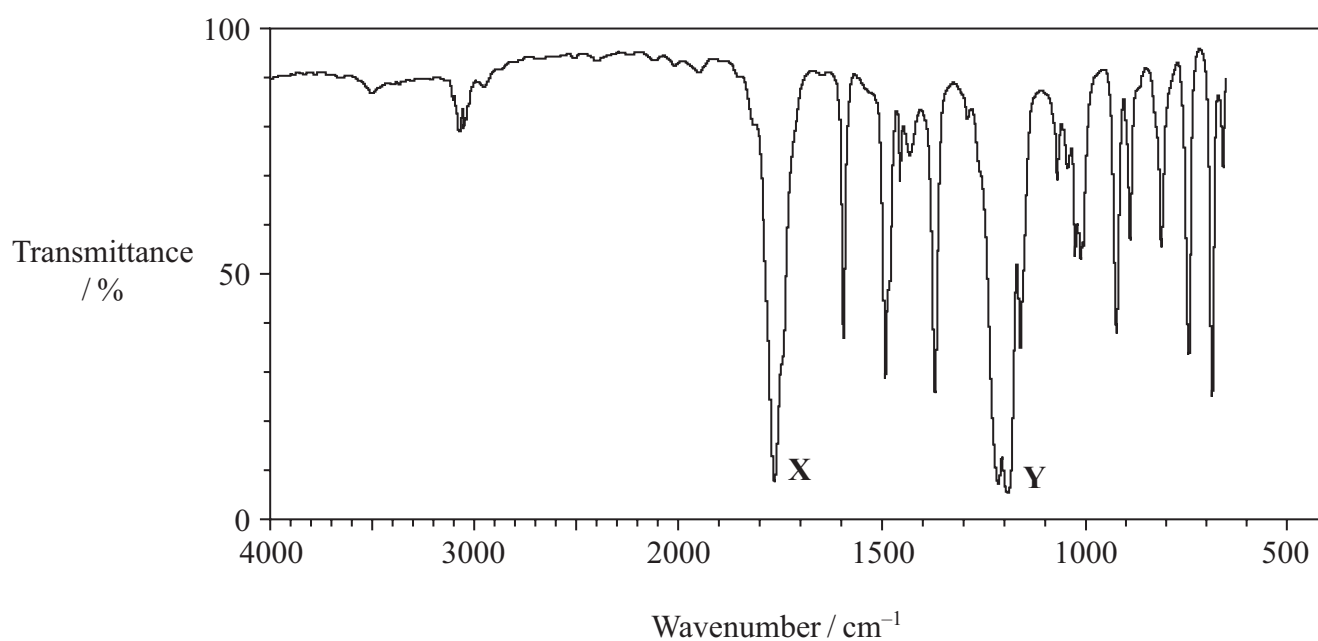
(c) Both phenol and cyclohexanol react with ethanoyl chloride to produce steamy fumes and an ester. Phenol behaves like an alcohol in this reaction.

(i) How could you show that the steamy fumes were due to the presence of a hydrogen halide, which in this case is hydrogen chloride?

(2)



(ii) The infrared spectrum below is for the ester produced in the reaction of ethanoyl chloride with phenol.



Bond	Group	Wavenumber range / $\text{cm}^{-1}$
C—H	alkanes	2962 – 2853
	arenes	3030
O—H	alcohols and phenols	3750 – 3200
C—O	ethanoates	1250 – 1190
	benzoates	1310 – 1250 and 1150 – 1100
C=C	arenes	1600, 1580, 1500, 1450
C=O	ketones	1700 – 1680
	esters	1770 – 1715

Identify the bond and group which cause each of the absorptions X and Y.

(2)

X .....

Y .....



(iii) Draw the structural formula of the ester produced in the reaction of ethanoyl chloride with phenol.

(1)

(Total for Question 2 = 11 marks)

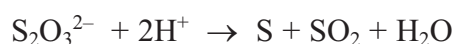
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3 Some old coins with a high copper content were analysed as follows.

**Procedure**

1. The coins were weighed and dissolved in concentrated nitric acid, producing a solution which contained copper(II) nitrate.
  2. The solution containing copper(II) nitrate was neutralized by adding sodium carbonate solution until a precipitate of copper(II) carbonate just appeared. Dilute ethanoic acid was then added, drop by drop, until the copper(II) carbonate precipitate just dissolved.
  3. The solution containing copper(II) nitrate was transferred to a volumetric flask and made up to 250 cm<sup>3</sup> with distilled water.
  4. 25 cm<sup>3</sup> portions of this solution were transferred to separate conical flasks. Then 10 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> potassium iodide (an excess) was added to each flask.
  5. The liberated iodine was titrated with 0.125 mol dm<sup>-3</sup> sodium thiosulfate solution.
- (a) One reason why the solution for titration must be neutralized is because sodium thiosulfate reacts with acid as shown below.



State **one** observation you would make when an acid reacts with sodium thiosulfate solution.

(1)

(b) (i) What colour is the diluted solution containing copper(II) nitrate?

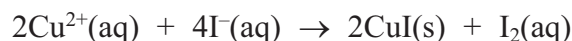
(1)

(ii) What would you observe in Step 2, before the formation of the copper(II) carbonate precipitate, when the sodium carbonate was added?

(1)



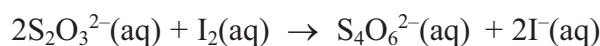
(c) The equation for the reaction producing iodine in Step 4 is shown below.



(i) Give the name of the precipitate formed in this reaction. (1)

(ii) Suggest, by considering the electronic configuration of the relevant ion, why the precipitate is white. (1)

(d) The equation for the reaction of thiosulfate ions in the titration is



**Results:**

Mass of coins	2.10 g
Mean (average) volume of 0.125 mol dm <sup>-3</sup> sodium thiosulfate used in titration	24.40 cm <sup>3</sup>

(i) Calculate the number of moles of sodium thiosulfate used in the titration. (1)

(ii) Calculate the number of moles of Cu<sup>2+</sup> in the 25 cm<sup>3</sup> samples used for the titration. (2)





(iii) Hence calculate the mass of copper present in the original mass of coins. (2)

(iv) What is the percentage of copper in the coins? (1)

(e) (i) The balance used to weigh the coins produced a **total** error in the weighing of  $\pm 0.01$  g. Calculate the percentage error in the weighing. (1)

(ii) The error in the mean titre of  $24.40 \text{ cm}^3$  was  $\pm 0.10 \text{ cm}^3$ . Show, by calculation, that the percentage error in the titration reading is less than the percentage error in the balance reading. (1)

(f) Starch solution can be used to show the end point for this titration, or the titration can be self-indicating.

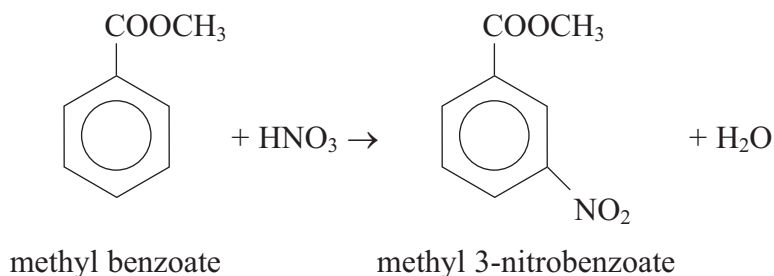
What colour change would be observed at the end point if starch was **not** used? (1)

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(Total for Question 3 = 14 marks)



- 4 A student attempted to make a sample of methyl 3-nitrobenzoate using the following reaction.



### Procedure

1. Transfer 9 cm<sup>3</sup> of concentrated sulfuric acid into a 100 cm<sup>3</sup> conical flask and cool it to below 10 °C in an ice bath. Add 5.0 g of methyl benzoate, swirling the flask. Mix 3 cm<sup>3</sup> of concentrated nitric acid with 3 cm<sup>3</sup> of concentrated sulfuric acid in another small flask and cool it in ice.
  2. Add the mixture of nitric and sulfuric acids, drop by drop, to the methyl benzoate solution, making sure that the temperature stays below 15 °C.
  3. Take the mixture out of the ice bath and leave it to stand for 10 minutes at room temperature. Pour the mixture over 40 g of crushed ice and collect the solid product by filtering the mixture under suction. Wash the precipitate, first with cold water, then with ice-cold ethanol. Keep the washings obtained with the ethanol for a further experiment.
  4. Purify the impure methyl 3-nitrobenzoate by recrystallization, using ethanol as the solvent, cooling the solution in an ice bath to assist recrystallization.
  5. Dry the recrystallized product and determine the yield.
- (a) The student wore goggles and a laboratory coat. For each of the processes below, state the hazard and give one further safety precaution which should be taken.

(i) Working with concentrated nitric and sulfuric acids.

(1)

(ii) Carrying out the recrystallization using ethanol.

(1)



(b) What is the purpose of adding sulfuric acid to the nitric acid in this reaction?

(1)

(c) (i) Calculate the number of moles in 5.0 g of methyl benzoate.

Assume the molar mass of methyl benzoate is  $136 \text{ g mol}^{-1}$ .

(1)

(ii) Methyl benzoate is a liquid at room temperature. What is the volume of 5.0 g of methyl benzoate?

The density of methyl benzoate is  $1.09 \text{ g cm}^{-3}$ .

(1)

(iii) After recrystallization and drying, 3.4 g of methyl 3-nitrobenzoate was obtained.

Calculate the percentage yield of methyl 3-nitrobenzoate, assuming that an excess of nitric and sulfuric acids was present.

(3)



(d) One reason for the low yield in this experiment is that methyl 2-nitrobenzoate is also formed. This compound dissolves in ethanol and would be present in the ethanol washings from **step 3**. Methyl 2-nitrobenzoate and methyl 3-nitrobenzoate are both pale yellow.

(i) Describe how to make a chromatogram with the ethanol washings from **step 3** in order to separate methyl 2-nitrobenzoate and methyl 3-nitrobenzoate. The chromatogram can be made on a plate covered with a layer of silica, and you may assume that a suitable solvent is available.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) How would you improve the chromatogram to confirm that both methyl 2-nitrobenzoate and methyl 3-nitrobenzoate are present in the washings? You may show this on a diagram if you prefer.

(1)

.....

.....



(e) The table below gives data about the solubility of methyl 3-nitrobenzoate in two solvents. This data may be used to select the best solvent for recrystallization.

Temperature / °C	Solubility of methyl 3-nitrobenzoate / g per 100 g solvent	
	Solvent 1	Solvent 2
10	6.0	2.0
70	11.0	9.5

(i) Explain why using Solvent 1, rather than Solvent 2, would lead to a lower yield of recrystallized methyl 3-nitrobenzoate.

(1)

(ii) 50 g of Solvent 2 was saturated with methyl 3-nitrobenzoate at 70 °C, and the solution was then cooled to 10 °C. Calculate the mass of methyl 3-nitrobenzoate crystals which would be obtained.

(1)

(f) What method, other than spectroscopy or chromatography, could be used to assess the purity of the methyl 3-nitrobenzoate? How would the result of the experiment indicate if it was pure?

(2)

(Total for Question 4 = 17 marks)

TOTAL FOR PAPER = 50 MARKS



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# The Periodic Table of Elements

1	2	3	4	5	6	7	0 (8)
18	18	18	18	18	18	18	18
(1)	(2)	Key		(8)	(9)	(10)	(11)
(13)	(14)	(15)	(16)	(17)	(18)		
1.0	H	hydrogen	1				
relative atomic mass	atomic symbol	name	atomic (proton) number				
6.9	Li	lithium	3	45.0	47.9	49.0	50.9
9.0	Be	beryllium	4	52.0	54.9	58.9	55.8
23.0	Na	sodium	11	24.3	23.0	26	27
24.3	Mg	magnesium	12	52.0	54.9	58.9	55.8
39.1	K	potassium	19	40.1	47.9	49.0	50.9
40.1	Ca	calcium	20	58.9	58.9	63.5	63.5
85.5	Rb	rubidium	37	88.9	91.2	101.1	106.4
87.6	Sr	strontium	38	88.9	91.2	101.1	106.4
132.9	Cs	caesium	55	137.3	178.5	190.2	197.0
137.3	Ba	barium	56	137.3	178.5	190.2	197.0
173.0	La*	lanthanum	57	173.0	173.0	173.0	173.0
226	Ra	radium	88	226	226	226	226
87	Fr	francium	87	87	87	87	87
227	Ac*	actinium	89	227	227	227	227
104	Rf	rutherfordium	104	104	104	104	104
105	Db	dubnium	105	105	105	105	105
106	Sg	seaborgium	106	106	106	106	106
107	Bh	bohrium	107	107	107	107	107
108	Hs	hassium	108	108	108	108	108
109	Mt	meitnerium	109	109	109	109	109
110	Ds	darmstadtium	110	110	110	110	110
111	Rg	roentgenium	111	111	111	111	111
112	Cn	copernicium	112	112	112	112	112
113	Nh	nihonium	113	113	113	113	113
114	Fl	flerovium	114	114	114	114	114
115	Mc	moscovium	115	115	115	115	115
116	Lv	livermorium	116	116	116	116	116
117	Ts	tennessine	117	117	117	117	117
118	Og	oganesson	118	118	118	118	118
119	Uue	unbinilium	119	119	119	119	119
120	Uub	ununbium	120	120	120	120	120
121	Uut	ununtrium	121	121	121	121	121
122	Uuq	ununquadium	122	122	122	122	122
123	Uuq	ununquadium	123	123	123	123	123
124	Uuq	ununquadium	124	124	124	124	124
125	Uuq	ununquadium	125	125	125	125	125
126	Uuq	ununquadium	126	126	126	126	126
127	Uuq	ununquadium	127	127	127	127	127
128	Uuq	ununquadium	128	128	128	128	128
129	Uuq	ununquadium	129	129	129	129	129
130	Uuq	ununquadium	130	130	130	130	130
131	Uuq	ununquadium	131	131	131	131	131
132	Uuq	ununquadium	132	132	132	132	132
133	Uuq	ununquadium	133	133	133	133	133
134	Uuq	ununquadium	134	134	134	134	134
135	Uuq	ununquadium	135	135	135	135	135
136	Uuq	ununquadium	136	136	136	136	136
137	Uuq	ununquadium	137	137	137	137	137
138	Uuq	ununquadium	138	138	138	138	138
139	Uuq	ununquadium	139	139	139	139	139
140	Uuq	ununquadium	140	140	140	140	140
141	Uuq	ununquadium	141	141	141	141	141
142	Uuq	ununquadium	142	142	142	142	142
143	Uuq	ununquadium	143	143	143	143	143
144	Uuq	ununquadium	144	144	144	144	144
145	Uuq	ununquadium	145	145	145	145	145
146	Uuq	ununquadium	146	146	146	146	146
147	Uuq	ununquadium	147	147	147	147	147
148	Uuq	ununquadium	148	148	148	148	148
149	Uuq	ununquadium	149	149	149	149	149
150	Uuq	ununquadium	150	150	150	150	150
151	Uuq	ununquadium	151	151	151	151	151
152	Uuq	ununquadium	152	152	152	152	152
153	Uuq	ununquadium	153	153	153	153	153
154	Uuq	ununquadium	154	154	154	154	154
155	Uuq	ununquadium	155	155	155	155	155
156	Uuq	ununquadium	156	156	156	156	156
157	Gd	gadolinium	64	157	157	157	157
158	Tb	terbium	65	158	158	158	158
159	Dy	dysprosium	66	159	159	159	159
160	Ho	holmium	67	160	160	160	160
161	Er	erbium	68	161	161	161	161
162	Tm	thulium	69	162	162	162	162
163	Yb	ytterbium	70	163	163	163	163
164	Lu	lutetium	71	164	164	164	164
165	Hf	hafnium	72	165	165	165	165
166	Ta	tantalum	73	166	166	166	166
167	W	tungsten	74	167	167	167	167
168	Re	rhenium	75	168	168	168	168
169	Os	osmium	76	169	169	169	169
170	Ir	iridium	77	170	170	170	170
171	Pt	platinum	78	171	171	171	171
172	Au	gold	79	172	172	172	172
173	Hg	mercury	80	173	173	173	173
174	Tl	thallium	81	174	174	174	174
175	Pb	lead	82	175	175	175	175
176	Bi	bismuth	83	176	176	176	176
177	Po	polonium	84	177	177	177	177
178	At	astatine	85	178	178	178	178
179	Rn	radon	86	179	179	179	179
180	Ac	actinium	89	180	180	180	180

Elements with atomic numbers 112-116 have been reported but not fully authenticated

\* Lanthanide series

\* Actinide series

