Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	2	4	5	/	0	1	Signature	

Paper Reference(s)

6245/01

Edexcel GCE

Chemistry

Advanced

Unit Test 5

(including synoptic assessment)

Tuesday 22 January 2008 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Candidates may use a calculator.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Answer **ALL** the questions in the spaces provided in this question paper.
Show all the steps in any calculations and state the units.

Information for Candidates

The total mark for this paper is 75. The marks for individual questions and parts of questions are shown in round brackets: e.g. **(2)**. There are 16 pages in this question paper. All blank pages are indicated.
A Periodic Table is printed on the back cover of this booklet.

Advice to Candidates

You are reminded of the importance of clear English and careful presentation in your answers.
You will be assessed on your Quality of Written Communication in this paper.

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

1. (a) (i) Complete the electronic configuration of

Cr [Ar] .....

Cr^{3+} [Ar] .....

(1)

(ii) State and explain the shape of the hexaaquachromium(III) ion, $[Cr(H_2O)_6]^{3+}$.

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(3)

(iii) State what you would see when dilute sodium hydroxide is added to a solution containing hexaaquachromium(III) ions, until it is present in excess.

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(2)

(iv) Give the equations for the reactions taking place in (iii).

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(2)

(b) (i) Give the structural formulae of an organic compound that can be oxidised by potassium dichromate(VI) in dilute sulphuric acid and of an organic product of the reaction.

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(2)

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(ii) Both dichromate(VI) ions and manganate(VII) ions need hydrogen ions in order to act as oxidising agents in titration experiments.

Explain, by calculating $E^{\ominus}_{cell}$ values, whether hydrochloric acid could be used to provide the H^+ ions for these oxidations.

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O \qquad E^{\ominus} = +1.33\ V$$

$$Cl_2 + 2e^- \rightleftharpoons 2Cl^- \qquad E^{\ominus} = +1.36\ V$$

$$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O \qquad E^{\ominus} = +1.51\ V$$

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(4)

(iii) When aqueous alkali is added to an aqueous solution containing dichromate(VI) ions, the following change takes place

$$Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$$

Explain in terms of oxidation numbers why this is **not** a redox reaction.

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(1)

Q1

(Total 15 marks)

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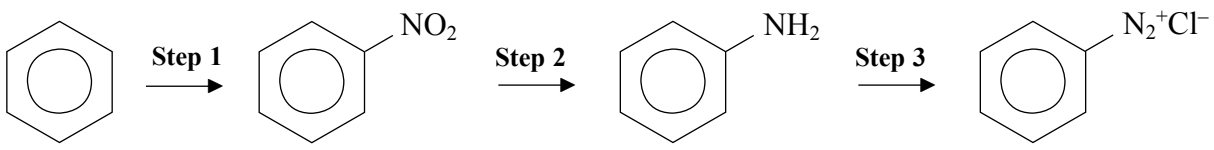
2. A reaction sequence, starting from benzene, C_6H_6, is shown below.



Compound X

(a) (i) Give the reagents and a temperature for **Step 1**.

Reagents .....

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Temperature .....

(3)

(ii) Give the mechanism for **Step 1**, including the formation of the electrophile.

(4)

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(b) Give the reagents for **Step 2** and state the type of reaction occurring.

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(2)

(c) Give the reagents and temperature for **Step 3** and name the product, compound **X**.

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(3)

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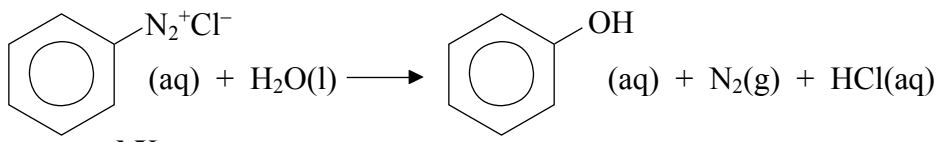
(d) At 25 °C, an aqueous solution of **X** decomposes.



Compound X

Outline an experiment you could perform to show that this reaction is first order with respect to **compound X**.

You should:

- describe or draw the apparatus you would use,
- include the measurements you would take,
- sketch the graph you would expect on the axes below and label the axes,
- explain how you would use the graph to confirm the reaction is first order.

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(6)

Q2

(Total 18 marks)

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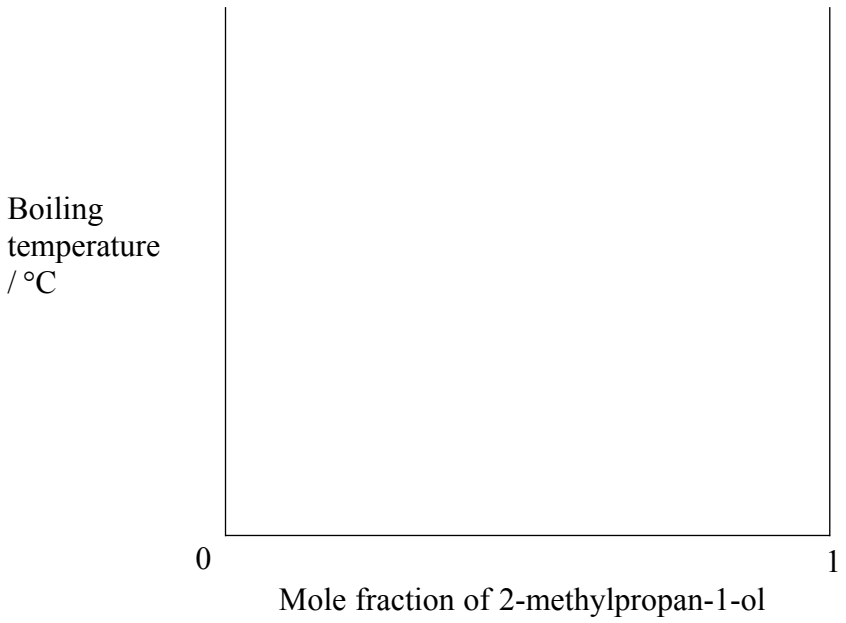
3. Propan-1-ol boils at 82 °C and 2-methylpropan-1-ol at 109 °C.

(a) Draw a labelled boiling point/composition diagram for the mixture of propan-1-ol and 2-methylpropan-1-ol.



(3)

(b) Use your diagram to explain how fractional distillation separates the mixture containing 0.75 mole fraction of 2-methylpropan-1-ol.

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(4) **Q3**

(Total 7 marks)

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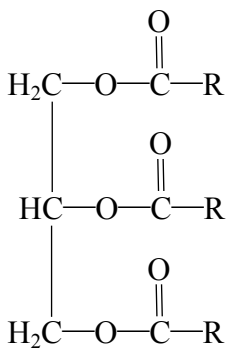
4. Fats have the general formula



(a) What type of organic compound are fats?

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(1)

(b) **R** can be a saturated hydrocarbon chain or the cis isomer of an unsaturated hydrocarbon chain.

(i) Explain, with a simple example, the meaning of **cis isomer**.

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(2)

(ii) At room temperature, saturated fats are generally solids whereas unsaturated fats are generally liquids.

Suggest a reason for the difference in melting temperatures.

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(2)

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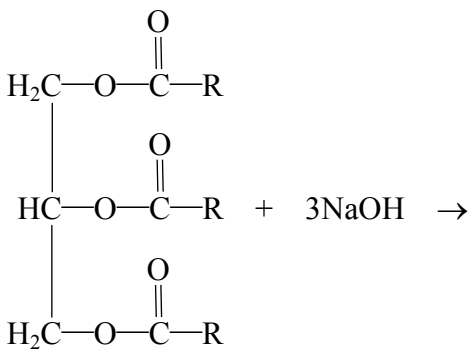
(c) (i) Complete the equation below for the alkaline hydrolysis of a fat.



(2)

(ii) State an important use of the reaction in (c)(i).

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(1)

(d) Describe simple **chemical** tests (other than the use of indicators) to distinguish between each of the following pairs of compounds.

Include the reagents used and an observation for each substance.

(i) 2-methylpropan-2-ol and propanoic acid

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(3)

(ii) propanal and propanone

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(3)

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(e) (i) Propanone and hydrogen cyanide, in the presence of cyanide anions, react to form $(CH_3)_2C(OH)CN$.

Give the mechanism for this reaction.

(4)

(ii) Explain what happens to the rate of the reaction in (e)(i) if the pH of the solution is lowered.

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(2)

Q4

(Total 20 marks)

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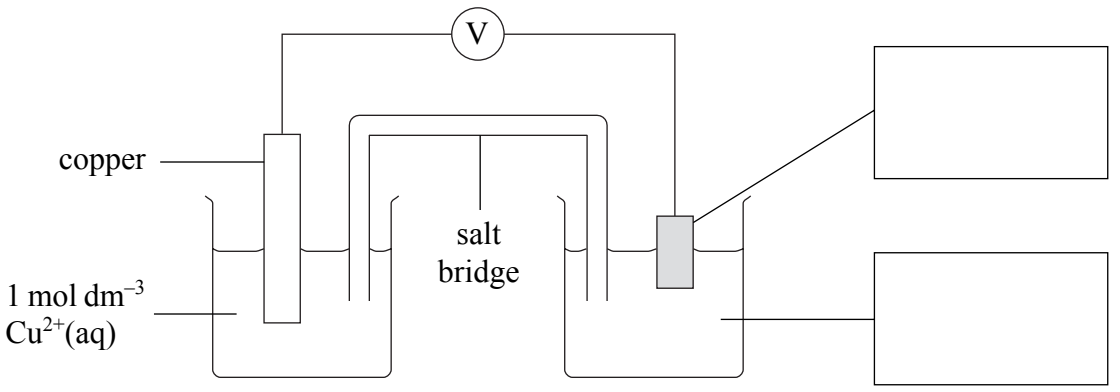
5. (a) The apparatus below was used to measure the standard emf of the cell formed from Fe^{3+}/Fe^{2+} and Cu^{2+}/Cu half-cells.



(i) Complete the labelling of the diagram of the Fe^{3+}/Fe^{2+} half-cell.

(3)

(ii) Why is a salt bridge used?

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(1)

(iii) What solution is contained in the salt bridge?

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(1)

(iv) Copper is the negative electrode.

The standard emf of the cell is +0.43 V and the standard electrode potential of the Cu^{2+}/Cu half-cell is +0.34 V.

Calculate the standard electrode potential of the Fe^{3+}/Fe^{2+} half-cell.

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(2)

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(v) Write the ionic half-equations for the reactions occurring in each half-cell.

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(2)

(vi) Write the equation which represents the overall cell reaction.

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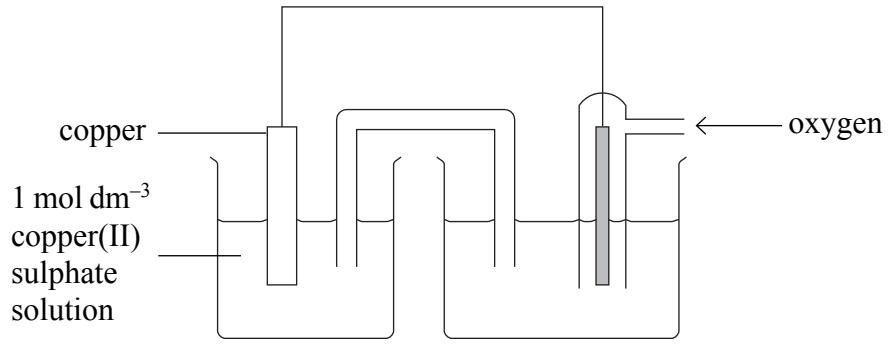
(1)

(b) The cell below was set up. Copper is the negative electrode. The solution in the right hand beaker contained a suitable electrolyte and phenolphthalein. After some time the solution turned pink.



Write the ionic half-equation for the reaction at the oxygen electrode which caused the phenolphthalein to turn pink.

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(2)

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(c) 25.0 cm^3 of a solution of copper(II) sulphate was added to an excess of potassium iodide solution. The following reaction occurred

$$2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$$

The iodine produced was reduced by 16.50 cm^3 of 0.100 mol dm^{-3} of sodium thiosulphate solution.

$$2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$$

Calculate the concentration of the copper(II) sulphate solution in mol dm^{-3}.

(3) **Q5**

(Total 15 marks)

TOTAL FOR PAPER: 75 MARKS

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THE PERIODIC TABLE

Period	1	2											3	4	5	6	7	0
	Group																	
1	1 H Hydrogen 1																	4 He Helium 2
2	7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
4	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65.4 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
5	85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Molar mass g mol^{-1}

Symbol

Name

Atomic number

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	(147) Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	163 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	(231) Pa Protactinium 91	238 U Uranium 92	(237) Np Neptunium 93	(242) Pu Plutonium 94	(243) Am Americium 95	(247) Cm Curium 96	(245) Bk Berkelium 97	(251) Cf Californium 98	(254) Es Einsteinium 99	(253) Fm Fermium 100	(256) Md Mendelevium 101	(254) No Nobelium 102	(257) Lr Lawrencium 103