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

Paper Reference(s)

6244/01

Edexcel GCE

Chemistry

Advanced

Unit Test 4

Thursday 12 June 2008 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
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.
Check that you have the correct question paper. The paper reference is shown above.
Answer **ALL** the questions. Write your answers in the spaces provided in this question paper.
Do not use pencil. Use blue or black ink.
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 20 pages in this question paper. Any 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.

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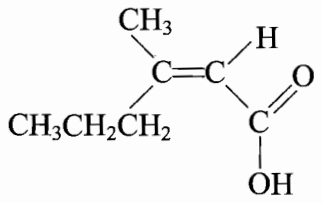
Answer ALL the questions. Write your answers in the spaces provided.

1. Compound **V**, the structure of which is shown below, is found in human sweat.



Compound **V**

(a) Compound **V** contains two functional groups.

Identify both functional groups and state a chemical test for each. The result of each test should also be included in your answer.

One functional group in **V** .....

Test and result .....

.....

.....

The other functional group in **V** .....

Test and result .....

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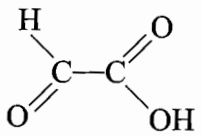
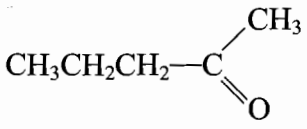
(4)

Leave blank

(b) Compound **V** can be converted into two carbonyl compounds **W** and **X**, shown below.



W



X

(i) Which of the compounds **W** or **X** would react when warmed with Fehling's solution to give a red precipitate? Justify your answer.

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.....

(1)

(ii) Compound **W** can be reduced in two steps to compound **Y** of molecular formula $C_2H_6O_2$.

Identify **Y**.

.....

(1)

(iii) Compound **W** can be oxidised to compound **Z** of molecular formula $C_2H_2O_4$.

Identify **Z**.

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(1)

Leave blank

(c) The compounds **Y** and **Z** react together under suitable conditions to form a polymer.

(i) Draw the structural formula of the repeating unit for the polymer formed.

(2)

(ii) What type of polymerisation reaction occurs between compounds **Y** and **Z**?

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(1)

Q1

(Total 10 marks)

Leave blank

2. (a) Complete the table by writing the formula of **one** oxide of sodium, phosphorus and sulphur.

Element	sodium	phosphorus	sulphur
Formula of the oxide			

(3)

(b) For each of the oxides that you wrote in the table for part (a), write an equation to show its reaction with water. State symbols are **not** required.

(i) Equation for the reaction of the oxide of sodium with water.

.....

(1)

(ii) Equation for the reaction of the oxide of phosphorus with water.

.....

(1)

(iii) Equation for the reaction of the oxide of sulphur with water.

.....

(1)

(c) Suggest why tin(II) chloride reacts with a solution containing Fe^{3+} ions, whereas lead(II) chloride does **not** react with Fe^{3+} ions.

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(2)

(d) Silicon tetrachloride, $SiCl_4$, hydrolyses rapidly in cold water.

Give an equation for this reaction. State symbols are **not** required.

.....

(2)

Q2

(Total 10 marks)

Leave blank

3. Consider the equilibrium

$$N_2O_4(g) \rightleftharpoons 2NO_2(g) \qquad \Delta H = +58\ kJ\ mol^{-1}$$

(a) Write the expression for the equilibrium constant, K_p, for the above reaction.

(1)

(b) (i) An equilibrium mixture contains a mole fraction of dinitrogen tetroxide, $N_2O_4 = 0.20$, and nitrogen dioxide, $NO_2 = 0.80$. The total pressure of this mixture is 1.1 atm.

Calculate K_p at this temperature, stating its units.

(3)

(ii) Calculate the total pressure required to reduce the mole fraction of N_2O_4 to 0.10.

(3)

Leave blank

(c) (i) What is the effect on K_p, if any, of raising the temperature?

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(1)

(ii) Use your answer to (c)(i) to explain the effect of increasing the temperature on the position of equilibrium.

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(2)

Q3

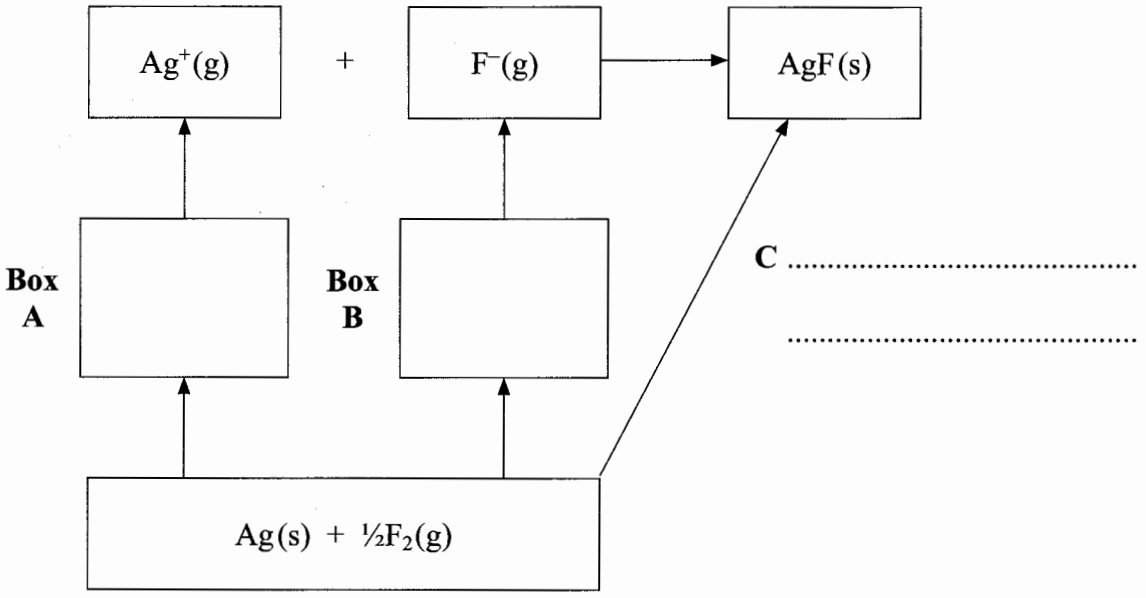
(Total 10 marks)

Leave blank

4. (a) The following data were collected to use in a Born-Haber cycle for silver fluoride, AgF.

	Value / kJ mol^{-1}
enthalpy of atomisation of silver	+285
first ionisation energy of silver	+731
enthalpy of atomisation of fluorine	+79
enthalpy of formation of silver fluoride	–205
lattice energy of silver fluoride	–958

(i) On the following outline of a Born-Haber cycle, complete boxes **A** and **B** by adding the formula **and** state symbol for the appropriate species. Write the name of the enthalpy change at **C**.



(3)

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(ii) Use the data to calculate the first electron affinity of fluorine.

(2)

QUESTION 4 CONTINUES ON THE NEXT PAGE

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(b) ΔH_{latt} (theoretical) is the lattice energy calculated assuming the crystal lattice is completely ionic.
ΔH_{latt} (experimental) is the lattice energy determined experimentally using the Born-Haber cycle.

Values for the silver halides are listed below.

Formula of halide	ΔH_{latt} (theoretical) / kJ mol^{-1}	ΔH_{latt} (experimental) / kJ mol^{-1}	ΔH_{latt} (theoretical) minus ΔH_{latt} (experimental) / kJ mol^{-1}
AgF	–920	–958	38
AgCl	–833	–905	72
AgBr	–816	–891	75
AgI	–778	–889	111

(i) Explain why the **theoretical** lattice energies become less exothermic from AgF to AgI.

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(3)

(ii) Explain why the values of the theoretical and experimental lattice energies are different.

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(2)

Leave blank

(iii) Explain why the difference between the theoretical and experimental lattice energies increases from AgF to AgI.

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(2)

(c) (i) Use the data below to calculate a value for the enthalpy change of solution, $\Delta H_{solution}$, for silver fluoride.

	Value / kJ mol^{-1}
lattice energy of AgF (s)	–958
enthalpy of hydration of Ag^+(g)	–464
enthalpy of hydration of F^-(g)	–506

(2)

(ii) Use your answer to part (c)(i) to suggest whether you would expect silver fluoride, AgF, to be soluble or insoluble in water at room temperature.

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(2)

Q4

(Total 16 marks)

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5. (a) The values of the ionic product of water, K_w, at two different temperatures are shown in the table below.

Temperature / °C	K_w / $mol^2 dm^{-6}$
25	1.00×10^{-14}
50	5.48×10^{-14}

(i) Write an equation to represent the ionisation of water.

.....

(1)

(ii) Write the expression for K_w.

.....

(1)

(iii) Define the term **pH**.

.....

.....

(1)

(iv) Calculate the pH of pure water **at 50 °C**.

(2)

(v) Explain why pure water at 50 °C is neutral despite the fact that its pH is not 7.

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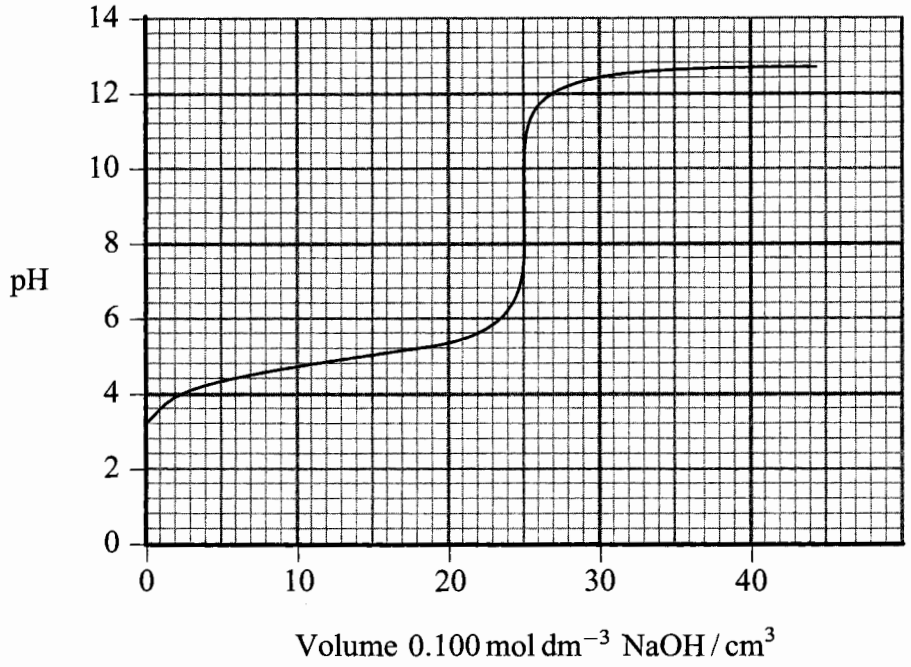
(1)

Leave blank

(b) The pH curve shown below was obtained when a 0.100 mol dm^{-3} solution of sodium hydroxide was added to 25.0 cm^3 of a 0.100 mol dm^{-3} solution of ethanoic acid.



(i) What volume of sodium hydroxide solution is required to neutralise half of the ethanoic acid in this reaction?

Volume added = ... cm^3

(1)

(ii) Use the graph to determine the pH when the volume of sodium hydroxide you have stated in part (i) has been added.

pH is .....

(1)

(iii) Write an expression for the acid dissociation constant, K_a, of ethanoic acid, CH_3COOH.

(1)

Leave blank

(iv) Use your answers to parts (ii) and (iii) to determine the value of K_a for ethanoic acid at the temperature of the titration. Give your answer to **two** significant figures.

(2)

(c) Phenolphthalein is a suitable indicator for a titration between ethanoic acid and sodium hydroxide solutions whereas methyl orange is **not** a suitable indicator.

Explain why this is so.

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(2)

Leave blank

(d) The standard enthalpy change of neutralisation, $\Delta H^{\ominus}_{neut}$, of some acids with sodium hydroxide solution is shown below.

Acid	$\Delta H^{\ominus}_{neut}$ / kJ mol^{-1}
hydrochloric acid, HCl	–57
nitric acid, HNO_3	–57
hydrocyanic acid, HCN	–12
propanoic acid, CH_3CH_2COOH	–51

(i) Explain why the $\Delta H^{\ominus}_{neut}$ values for the two strong acids are the same.

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.....

(1)

(ii) What conclusion can you draw from the fact that the $\Delta H^{\ominus}_{neut}$ value of hydrocyanic acid is so much less exothermic than that of hydrochloric acid?

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(2)

Q5

(Total 16 marks)

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6. (a) (i) Ethanal, CH_3CHO, can be converted into 2-hydroxypropanoic acid, $CH_3CH(OH)COOH$.

State the reagents and conditions needed for **each** step in this synthesis.

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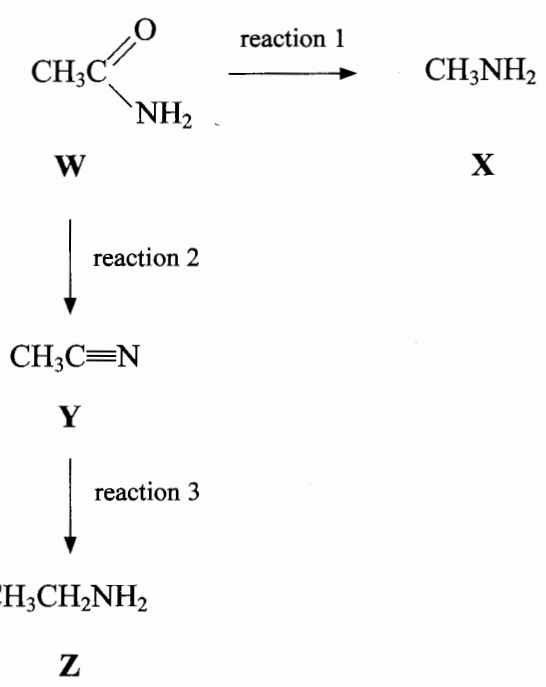
(4)

(ii) Draw the structural formula of the organic product of the reaction between ethanal and ethylmagnesium bromide, C_2H_5MgBr, followed by acidification.

(1)

(b) Consider the following reaction scheme involving several compounds, labelled **W**, **X**, **Y** and **Z**.



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(i) Give the **names** of compounds **W**, **X** and **Y**.

Name of **W** is .....

Name of **X** is .....

Name of **Y** is .....

(3)

(ii) Identify the reagents used for

Reaction 1 .....

.....

Reaction 2 .....

.....

Reaction 3 .....

.....

(3)

(iii) State the **type** of reaction which occurs in

Reaction 2 .....

Reaction 3 .....

(2)

Q6

(Total 13 marks)

TOTAL FOR PAPER: 75 MARKS

END

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