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 ISA MARK (max 50)	

General Certificate of Education
Advanced Level Examination
June 2013

Chemistry CHM6T/P13/test

Unit 6T A2 Investigative Skills Assignment

Written Test

For submission by 15 May 2013

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 spaces 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 are expected to use a calculator, where appropriate. • 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 .....

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Section A

These questions are about the task, an investigation of some organic compounds.

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

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

When answering questions **1**, **2** and **3** you should assume that in **Test 2** potassium manganate(VII) behaves as an oxidising agent in a similar way to potassium dichromate(VI). When the potassium manganate(VII) reacts as an oxidising agent it forms a solution that appears colourless.

1 Use your observations from the Task to identify the functional group most likely to be present in **B** and the functional group most likely to be present in **D**.

Functional group in **B** .....

Functional group in **D** .....

(2 marks)

2 State, with a reason, whether or not your observations from **Tests 1**, **2** and **3** allow you to identify the functional group most likely to be present in **C**.

.....

.....

.....

(1 mark)

3 State, with a reason, whether or not your observations from **Tests 1**, **2** and **3** allow you to deduce that **A** contains more than one functional group.

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.....

.....

(1 mark)

4 Infrared spectroscopy can be used to distinguish between organic compounds.
Use **Table 1** on the Data Sheet to identify the wavenumber of an absorption that would allow you to distinguish between an aldehyde and a carboxylic acid.

.....

(1 mark)

5 Aldehydes can be prepared from acyl chlorides.

State how an aldehyde could be tested to show whether it is contaminated with traces of unreacted acyl chloride.
State what you would observe.

Test .....

Observation .....

.....

(2 marks)

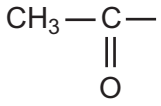
6 Suggest **one** reason why Tollens' reagent is used as the oxidising agent in the specific test for aldehydes rather than the less expensive acidified potassium dichromate(VI).

.....

.....

(1 mark)

7 The triiodomethane reaction is often used as a test for aldehydes and ketones that contain the CH_3CO group shown.



The aldehyde or ketone is reacted with an alkaline solution of iodine. Triiodomethane (CHI_3) is formed as a precipitate. Compounds that contain a group that can be oxidised to the CH_3CO group will also give a positive result in this test.

7 (a) State, with a reason, whether or not ethanol will give a positive result in the triiodomethane reaction.

.....

.....

.....

(1 mark)

7 (b) The equation for the reaction of ethanal with an alkaline solution of iodine is

$$CH_3CHO + 3I_2 + 4NaOH \longrightarrow CHI_3 + HCOONa + 3NaI + 3H_2O$$

In an experiment using this reaction, the yield of triiodomethane (CHI_3) obtained by a student was 83.2%.

Calculate the minimum mass of iodine that this student would have used to form 10.0 g of triiodomethane.
Give your answer to the appropriate precision.
Show your working.

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(5 marks)

7 (c) Triiodomethane can be separated from the reaction mixture by filtration.
State **one** reason why the solid residue is then washed with water after the filtration.

.....

.....

(1 mark)

7 (d) State **one** reason, other than cost or availability, why water is suitable for washing this solid residue after the filtration.

.....

.....

(1 mark)

16

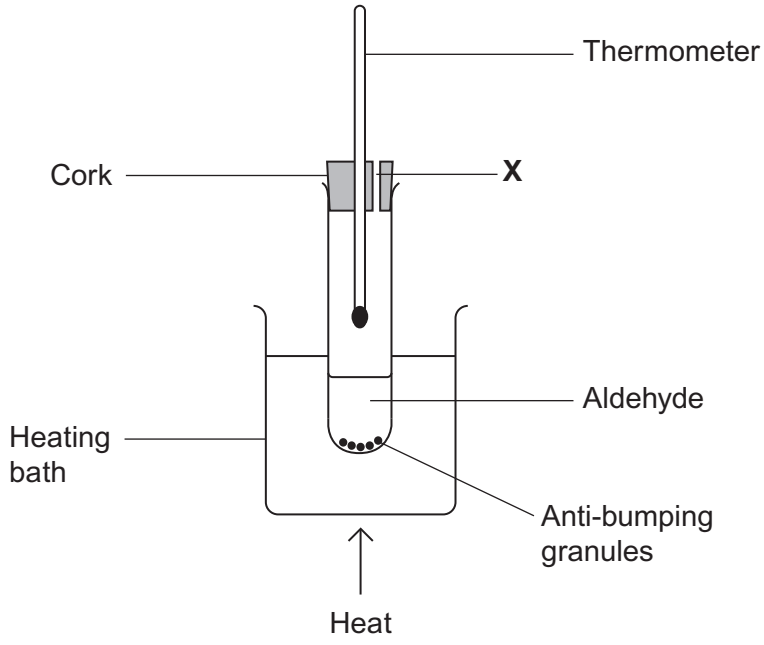
Section B

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

8 At a given pressure, a pure liquid boils at a constant temperature. This boiling point can be used to help identify the liquid. One procedure for measuring the boiling point of an aldehyde is shown in the diagram.

Procedure

- Set up the apparatus as shown in the diagram.
  Make sure that the bulb of the thermometer is about 3 cm above the level of the aldehyde.



- Add a few anti-bumping granules to the aldehyde.
- Heat the liquid in the beaker gently until the aldehyde begins to boil. The boiling point of the aldehyde is greater than 150 °C.
- Adjust the heat source so that the aldehyde boils gently.
- Record the temperature when it becomes steady.
- Record the atmospheric pressure.

8 (a) State the purpose of the anti-bumping granules.

.....

(1 mark)

8 (b) Give **one** reason why it is essential for the cork to have the hole, labelled **X**, in it.

.....

.....

(1 mark)

8 (c) State **two** properties that a liquid must have to make it suitable for use in the heating bath in this boiling point determination.

Property 1 .....

.....

.....

Property 2 .....

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.....

(2 marks)

8 (d) State why the atmospheric pressure was recorded.

.....

(1 mark)

8 (e) State why the boiling point of a compound may be insufficient on its own to identify the compound.

.....

.....

(1 mark)

9 Explain how infrared spectroscopy can be used to show that an aldehyde is definitely pentanal.

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(2 marks)

10 In order to obtain a pH curve, you are provided with a conical flask containing 25.0 cm^3 of a 0.100 mol dm^{-3} carboxylic acid solution and a burette filled with 0.100 mol dm^{-3} sodium hydroxide solution. You are also provided with a calibrated pH meter.

10 (a) State why calibrating a pH meter just before it is used improves the accuracy of the pH measurement.

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(1 mark)

10 (b) Describe how you would obtain the pH curve for the titration.

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(5 marks)

14

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

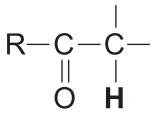
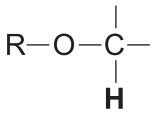
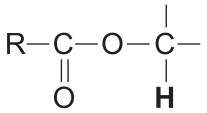
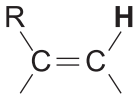
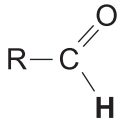
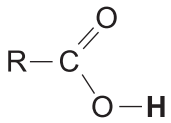
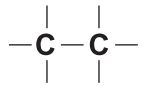
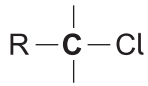
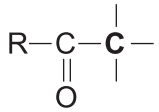
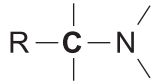
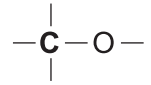
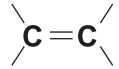
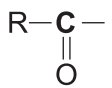
Type of proton	δ/ppm
ROH	0.5 – 5.0
RCH$_3$	0.7 – 1.2
RNH$_2$	1.0 – 4.5
R$_2$CH$_2$	1.2 – 1.4
R$_3$CH	1.4 – 1.6
	2.1 – 2.6
	3.1 – 3.9
RCH$_2$Cl or Br	3.1 – 4.2
	3.7 – 4.1
	4.5 – 6.0
	9.0 – 10.0
	10.0 – 12.0

Table 3

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

Type of carbon	δ/ppm
	5 – 40
 Cl or Br	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
							1.0 H hydrogen 1										(18) 4.0 He helium 2
(1)	(2)		Key: relative atomic mass / symbol / name / atomic (proton) number									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4											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