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Surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Chemistry

Advanced Subsidiary

Unit 3: Chemistry Laboratory Skills I

Wednesday 25 January 2017 – Morning

Time: 1 hour 15 minutes

Paper Reference

WCH03/01

Candidates may use a calculator.

Total Marks

Instructions

- Use **black** ink or **black** 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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Answer ALL the questions. Write your answers in the spaces provided.

- 1** A student carried out the tests described to distinguish between the pairs of compounds named in parts (a) to (d).

State what you would **see** when the test is carried out. Identify by name or formula any **gases** evolved during the reactions in parts (b) to (d).

- (a) Solid potassium chloride and solid sodium chloride.

Test: A flame test.

(2)

Observation with potassium chloride.....

Observation with sodium chloride.....

- (b) Aqueous potassium sulfate and aqueous potassium carbonate.

Test: Addition of excess dilute hydrochloric acid followed by aqueous barium chloride. Identify any **gas** evolved.

(2)

Observation with potassium sulfate.....

Observation with potassium carbonate.....

- (c) Solid ammonium sulfate and solid potassium sulfate.

Test: Warm the solid with aqueous sodium hydroxide and use damp red litmus paper to test any gas released. Identify any **gas** evolved.

(3)

Observation with ammonium sulfate.....

Observation with potassium sulfate.....

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(d) Solid sodium chloride and solid sodium bromide.

Test: Add concentrated sulfuric acid.
Identify all of the **gases** evolved.

(4)

Observation with sodium chloride.....

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Observation with sodium bromide.....

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.....

(Total for Question 1 = 11 marks)

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2 A halogenoalkane, **G**, has the molecular formula C_4H_9X , where X represents a halogen atom.

On heating **G** with excess dilute aqueous sodium hydroxide, compound **G** is converted into compound **J**, $C_4H_{10}O$.

Complete the tables.

(a)

Test	Observation	Inference
To the solution remaining after heating G with excess dilute aqueous sodium hydroxide, add followed by aqueous silver nitrate.	White precipitate forms.	The atom X is

(2)

(b)

Test	Observation	Inference
Add phosphorus(V) chloride to pure J . Test any gas evolved with	White smoke	The formula of the white smoke is Compound J is an alcohol.

(2)

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(c)

Test	Observation	Inference
Warm J with acidified potassium dichromate(VI) solution.	Compound J is not oxidised.
	Compound J is a alcohol.

(2)

(d) On the basis of the observations and inferences made in parts (a) to (c), draw the structure of compound **J**.

(1)

(Total for Question 2 = 7 marks)



- 3 A student carried out two similar, separate experiments to determine the enthalpy changes for the reactions of sodium hydrogencarbonate and sodium carbonate with excess dilute hydrochloric acid.

(a) The first experiment was to find the enthalpy change ΔH_1 for the reaction



Results

Measurement	Value
Mass of solid sodium hydrogencarbonate added to hydrochloric acid	4.20 g
Volume of hydrochloric acid	50.0 cm ³
Initial temperature of hydrochloric acid before addition of solid sodium hydrogencarbonate	21.0 °C
Final temperature of solution	14.0 °C
Molar mass of sodium hydrogencarbonate	84.0 g mol ⁻¹
Specific heat capacity of solution	4.18 J g ⁻¹ °C ⁻¹

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- (i) Calculate the number of moles of sodium hydrogencarbonate used in the experiment. (1)

moles of $\text{NaHCO}_3 = \dots\dots\dots$ mol

- (ii) Calculate the heat energy absorbed in the reaction between sodium hydrogencarbonate and hydrochloric acid.

Use the expression:

Energy absorbed (J) = $50.0 \times \text{specific heat capacity of solution} \times \text{temperature change}$ (1)

energy absorbed = $\dots\dots\dots$ J

- (iii) Calculate the value of ΔH_1 .

Your answer should be in units of kJ mol^{-1} , expressed to **three** significant figures, and include a sign.

(3)

$\Delta H_1 = \dots\dots\dots$ kJ mol^{-1}

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- (b) In the second experiment, the enthalpy change for the reaction between sodium carbonate and dilute hydrochloric acid was determined.



The molar enthalpy change of this reaction ΔH_2 was found to be $-36.0 \text{ kJ mol}^{-1}$.

- (i) Describe **two** ways in which the temperature change differs when equal numbers of moles of sodium hydrogencarbonate and sodium carbonate are reacted separately with the same volume of excess dilute hydrochloric acid.

(2)

First difference.....

.....

Second difference.....

.....

- (ii) State **one** assumption that has been made when calculating the values of ΔH_1 and ΔH_2 from the experimental results.

(1)

.....

.....

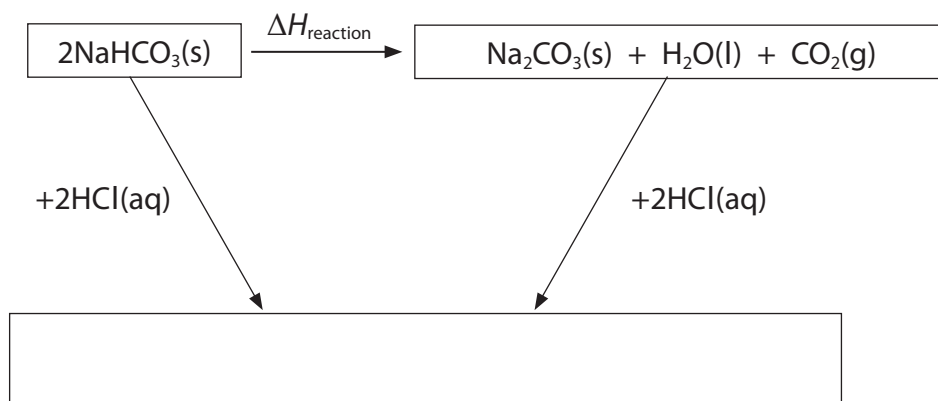


- (c) The results of the experiments in parts (a) and (b) may be used to calculate the enthalpy change of reaction for the thermal decomposition of sodium hydrogencarbonate. The equation for the reaction is



- (i) Complete the Hess cycle. Include state symbols with any formulae.

(2)



- (ii) Using the Hess cycle, or otherwise, complete the expression for $\Delta H_{\text{reaction}}$ in terms of enthalpy changes ΔH_1 and ΔH_2 .

(1)

$$\Delta H_{\text{reaction}} =$$

- (iii) Use your value for ΔH_1 calculated in part (a)(iii), the value of $\Delta H_2 = -36.0 \text{ kJ mol}^{-1}$ and your expression in (c)(ii), to calculate a value for $\Delta H_{\text{reaction}}$ in kJ mol^{-1} .

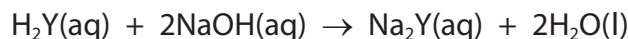
(1)

$$\Delta H_{\text{reaction}} = \dots\dots\dots \text{kJ mol}^{-1}$$

(Total for Question 3 = 12 marks)



- 4 A titration is carried out to determine the concentration of a solution of sodium hydroxide, NaOH(aq), using the organic acid H₂Y. The equation for the reaction is



Sodium hydroxide solution is added from a burette to 25.0 cm³ of a 0.0500 mol dm⁻³ solution of H₂Y, to which several drops of phenolphthalein have been added.

- (a) State the colour change for the phenolphthalein indicator at the end-point of this titration.

(2)

From to

- (b) A student obtained the readings shown.

Titration number	1	2	3
Burette reading (final) / cm ³	24.90	23.60	23.65
Burette reading (initial) / cm ³	1.00	0.00	0.15
Volume of NaOH used / cm ³	23.90	23.60	23.50
Used to calculate mean (✓)			

- (i) Calculate the mean titre in cm³.

Show which titres you have used in your calculation by putting a tick (✓) in the appropriate boxes.

(2)

Mean titre = cm³

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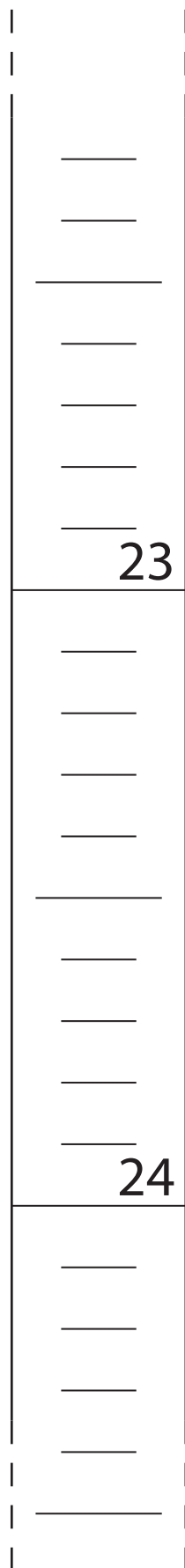
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- (ii) On the diagram below, show how the level of the sodium hydroxide solution appears when the final burette reading of 23.65 cm^3 is recorded in titration 3.

(2)



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(c) (i) Calculate the number of moles of the acid, H_2Y , in 25.0 cm^3 of a $0.0500\text{ mol dm}^{-3}$ solution. (1)

(ii) Calculate the number of moles of sodium hydroxide, $NaOH$, in the mean titre. (1)

(iii) Calculate the concentration of the sodium hydroxide solution in mol dm^{-3} . (1)

(iv) Describe **two** things you would do when using a burette to ensure that a particular reading is as accurate as possible. (2)

.....

.....

.....

.....

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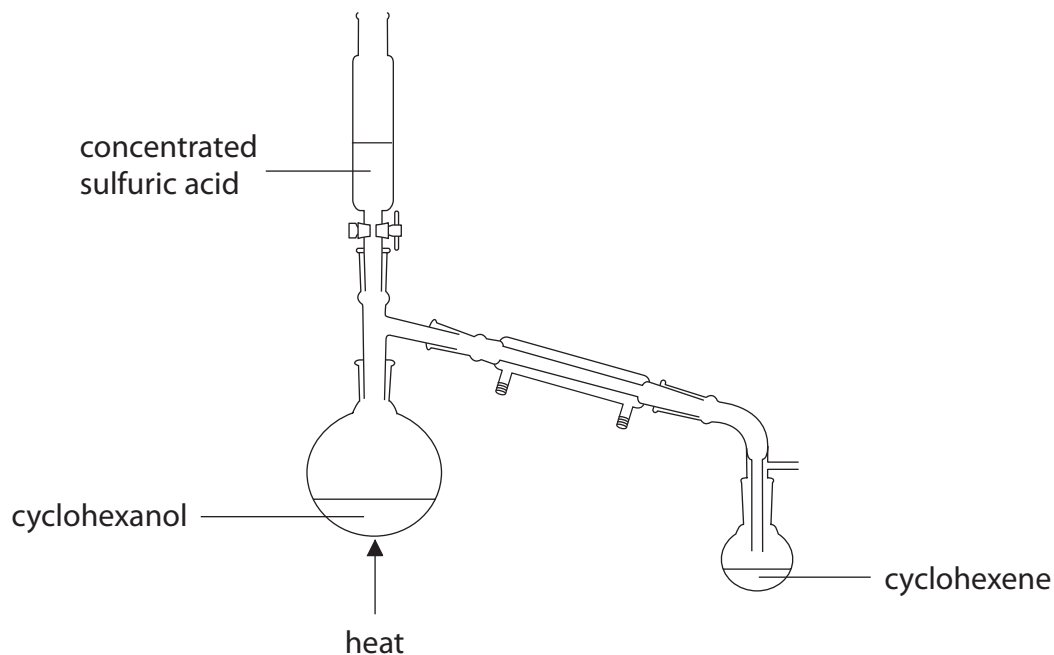
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(Total for Question 4 = 11 marks)

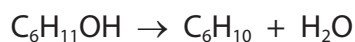


- 5 In an experiment to prepare cyclohexene, C_6H_{10} , concentrated sulfuric acid, H_2SO_4 , was added slowly to 6.24 g of cyclohexanol, $C_6H_{11}OH$, in the apparatus shown in the diagram. The mixture was heated.



As the reaction took place, an impure liquid distilled over into the collection flask.

The equation for the preparation of cyclohexene is



- (a) (i) Calculate the volume of cyclohexanol used in this experiment.
The density of cyclohexanol is 0.962 g cm^{-3} .

(2)



- (ii) Calculate the mass of cyclohexene that would be formed if **all** 6.24 g of cyclohexanol were converted into cyclohexene.

(2)

- (iii) After purifying the liquid, 1.64 g of cyclohexene was collected. Calculate the percentage yield of cyclohexene in this preparation.

(1)

- (b) The mixture in the collection flask contains impure cyclohexene, which is immiscible with water.

- (i) Three steps, shown in the table below, are then carried out for the purposes shown.

Complete the table by identifying suitable substances for each step.

(3)

Step	Purpose of step	Suitable substance to use
1	To remove acidity	
2	To remove inorganic impurities	
3	To dry the product	

- (ii) Identify the final step required in order to obtain pure cyclohexene from the dry product.

(1)

(Total for Question 5 = 9 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

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6.9	9.0	39.1	40.1	45.0	47.9	50.9	52.0	54.9	55.8	58.9	58.7	63.5	65.4	69.7	72.6	74.9	79.0	79.9	83.8	85.5	87.6	88.9	91.2	91.2	92.9	95.9	101.1	102.9	106.4	107.9	112.4	114.8	118.7	127.6	126.9	131.3	132.9	137.3																																																																																																																			
Li lithium 3	Be beryllium 4	K potassium 19	Ca calcium 20	Sc scandium 21	Ti titanium 22	V vanadium 23	Cr chromium 24	Mn manganese 25	Fe iron 26	Co cobalt 27	Ni nickel 28	Cu copper 29	Zn zinc 30	Ga gallium 31	Ge germanium 32	As arsenic 33	Se selenium 34	Br bromine 35	Kr krypton 36	Rb rubidium 37	Sr strontium 38	Y yttrium 39	Zr zirconium 40	Nb niobium 41	Mo molybdenum 42	Tc technetium 43	Ru ruthenium 44	Rh rhodium 45	Pd palladium 46	Ag silver 47	Cd cadmium 48	In indium 49	Sn tin 50	Sb antimony 51	Te tellurium 52	I iodine 53	Xe xenon 54	Cs caesium 55	Ba barium 56	La* lanthanum 57	Hf hafnium 72	Ta tantalum 73	W tungsten 74	Re rhenium 75	Os osmium 76	Ir iridium 77	Pt platinum 78	Au gold 79	Hg mercury 80	Tl thallium 81	Pb lead 82	Bi bismuth 83	Po polonium 84	At astatine 85	Rn radon 86	Fr francium 87	Ra radium 88	Ac* actinium 89	Rf rutherfordium 104	Db dubnium 105	Sg seaborgium 106	Bh bohrium 107	Hs hassium 108	Mt meitnerium 109	Ds darmstadtium 110	Rg roentgenium 111	Ce cerium 58	Pr praseodymium 59	Nd neodymium 60	Pm promethium 61	Sm samarium 62	Eu europium 63	Gd gadolinium 64	Tb terbium 65	Dy dysprosium 66	Ho holmium 67	Er erbium 68	Tm thulium 69	Yb ytterbium 70	Lu lutetium 71	Th thorium 90	Pa protactinium 91	U uranium 92	Np neptunium 93	Pu plutonium 94	Am americium 95	Cm curium 96	Bk berkelium 97	Cf californium 98	Es einsteinium 99	Fm fermium 100	Md mendelevium 101	No nobelium 102	Lr lawrencium 103	232	Th	231	Pa	238	U	141	Ce	144	Nd	150	Sm	152	Eu	157	Tb	159	Dy	163	Ho	165	Er	167	Tm	169	Yb	173	Lu	175	[223]	Fr	[226]	Ra	[227]	Ac*	[261]	Rf	[262]	Db	[266]	Sg	[264]	Bh	[277]	Hs	[268]	Mt	[271]	Ds	[272]	Rg	[253]	Fm	[254]	Md	[255]	No	[257]	Lr

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

* Lanthanide series
* Actinide series



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