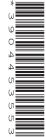


UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS General Certificate of Education Ordinary Level

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		



CHEMISTRY 5070/22

Paper 2 Theory

May/June 2013

1 hour 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer all questions.

Write your answers in the spaces provided in the Question Paper.

Section B

Answer any three questions.

Write your answers in the spaces provided in the Question Paper.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 20.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.



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

The total mark for this section is 45.

Α1	Cho	ose from the following elements to answer the questions below.
		barium
		calcium
		carbon
		copper
		helium
		hydrogen
		iron
		lead
		lithium
		sulfur
		zinc
	Eac	h element can be used once, more than once or not at all.
	Nan	ne an element which
	(a)	forms two acidic oxides,
		[1]
	(b)	has an ion which, in aqueous solution, reacts with aqueous sodium hydroxide to give a green precipitate,
		[1]
	(c)	has an atom with an electronic configuration with only four occupied shells,
		[1]
	(d)	has two giant molecular structures,
		[1]
	(e)	has an ion which, in aqueous solution, is used to test for sulfate ions,
		[1]
	(f)	reacts with water to form an alkaline solution.

[Total: 6]

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[Total: 7]

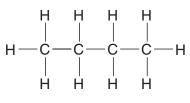
A2	Botl	n res	piration and comb	oustion add carbon dioxide to the atmosphere.
	(a)	Give	e one reason why	scientists are concerned about the increasing use of fossil fuels.
				[1]
	(b)		piration is a proce oxygen.	ess that occurs in living organisms where glucose, $C_6H_{12}O_6$, reacts
		Wri	te the overall equa	ation that represents respiration.
				[1]
	(c)	Res	piration is an exo	thermic reaction.
		(i)		of the energy changes that occur during bond breaking and bond piration is an exothermic reaction.
				[2]
		(ii)	Complete the en	ergy profile diagram for respiration.
			On your diagram product	
				y change for the reaction, ΔH , on energy, $E_{ m a}$.
			energy	reactants
			chergy	
				progress of reaction
				[3]

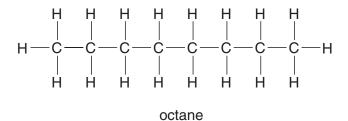
(a) How does the number of valency electrons help to explain why aluminium is a metal and iodine and bromine are non-metals? [2] (b) At room temperature iodine is a solid and bromine is a liquid. Describe the difference between both the arrangement and the motion of particles in a solid and a liquid. [2] (c) Iodine and bromine form the compound iodine bromide, IBr. Draw the 'dot-and-cross' diagram for IBr. Only draw the outer shell electrons.	iodine and bromine are non-metals? (b) At room temperature iodine is a solid and bromine is a liquid. Describe the difference between both the arrangement and the motion of particles in solid and a liquid. (c) Iodine and bromine form the compound iodine bromide, IBr. Draw the 'dot-and-cross' diagram for IBr. Only draw the outer shell electrons.	
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		[1]
[1]	[-	I) Describe how bromine is used to test for unsaturation in organic compounds.
[1]	[
[.1		[1]

e)	aluminium is used to make alloys for the aircraft industry. One reason for this is that aluminium does not corrode very easily.		
	(i)	State one other reason why aluminium is used in the manufacture of aircraft.	
		[1]	
	(ii)	Explain why aluminium does not corrode very easily.	
		[2]	
		[2]	
		[Total: 9]	

A4 The structures of some of the compounds that can be manufactured from crude oil are shown.

For Examiner's Use





(a) Octane is found in the petrol fraction separated from crude oil.

property which allows this process to be carried out.	nysicai

(b) Hexadecane, C₁₆H₃₄, can be cracked to produce a mixture of alkanes and alkenes.
 Construct an equation to show the cracking of hexadecane to produce octane.

[2]

(c) Propene can be polymerised to make poly(propene).

Draw a section of the structure of poly(propene).

П	TO.	1
	_	ı
	_	ı

(d) Ethanol is manufactured by a hydration reaction.

State both the reagents and conditions for this reaction.

	[2]

[Total: 8]

A5 Analysis of compound **X** shows it has the following composition.

For
Examiner's
Use

[2]

[Total: 8]

element	percentage by mass
hydrogen	3.40
nitrogen	12.0
oxygen	41.0
vanadium	43.6

(a) Show that ${\bf X}$ has the formula ${\bf H_4NO_3V}$.

(b)	Suggest one property of aqueous X caused by the presence of vanadium.
	[1]
(c)	Aqueous sodium hydroxide is added to solid X and the mixture is warmed.
	A colourless gas that turns moist red litmus blue is evolved.
	Deduce the formula of each of the two ions present in \mathbf{X} .
	[2]
(d)	An acidified aqueous solution of ${\bf X}$ reacts with aqueous potassium iodide to form iodine.
	State and explain what you can deduce about the chemical nature of ${\bf X}$.
	[2]
(e)	When solid ${\bf X}$ is heated only ${\bf V_2O_5}$, water and gas ${\bf Z}$ are formed.
	Name gas Z .
	[1]

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A6	A 0	.250 g sample of iron filings is added to 25.0 cm ³ of 0.100 mol/dm ³ aqueous copper(II) ate.	For Examiner's Use
		$Cu^{2+}(aq) + Fe(s) \rightarrow Fe^{2+}(aq) + Cu(s)$	
	(a)	Explain, using electron transfer, why iron is oxidised in this reaction.	
		[1]	
	(b)	Show, by calculation, which reactant is in excess.	
		[3]	
	(c)	What would you observe in this reaction?	
		[2]	
	(d)	Copper powder is added to aqueous silver nitrate.	
		Predict whether or not a reaction will take place. Explain your answer.	
		[1]	
		[Total: 7]	

Section B

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Answer three questions from this section in the spaces provided.

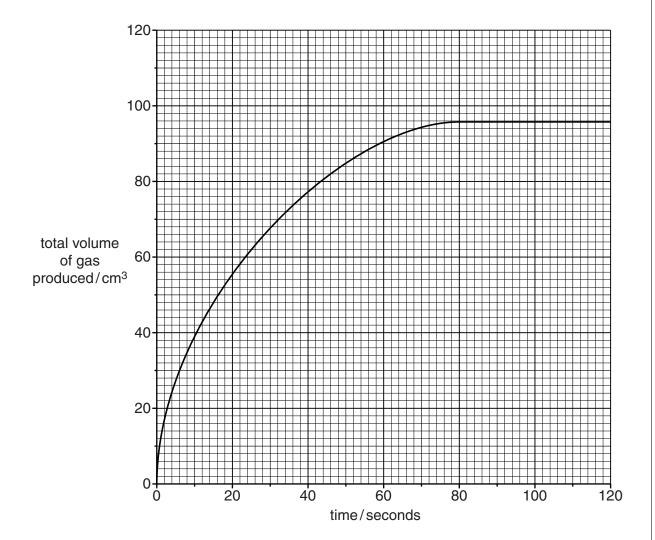
The total mark for this section is 30.

B7 An antacid tablet contains a mixture of magnesium hydroxide, ${\rm Mg(OH)_2}$, and calcium carbonate, ${\rm CaCO_3}$.

Stomach acid contains dilute hydrochloric acid.

A student adds a 0.500 g antacid tablet to $50.0\,\mathrm{cm^3}$ of $1.00\,\mathrm{mol/dm^3}$ hydrochloric acid, HCl. The acid is in excess.

The graph shows how the total volume of gas produced at r.t.p. changes with time.



		Question B7 continues on page 12.	
		mass of CaCO ₃ = g [2	2]
	(111 <i>)</i>	Calculate the mass of CaCO ₃ in the tablet.	
ı	(iii)	amount in moles =[2	2]
	(ii)	Calculate the amount, in moles, of carbon dioxide formed at r.t.p. once the reaction had stopped.	-
		CaCO ₃ [2	2]
(b)	(i)	Write equations for the reactions of HCl with $Mg(OH)_2$ and also with $CaCO_3$. $Mg(OH)_2$	
<i>a</i>			2]
			Examiner's Use
(a)	Des	scribe, with the aid of a labelled diagram, the apparatus needed to collect this data.	101

(c)	The student repeats the experiment. This time she uses a 0.500 g antacid tablet and $50.0 \mathrm{cm^3}$ of $2.00 \mathrm{mol/dm^3}$ HC l instead of $50.0 \mathrm{cm^3}$ of $1.00 \mathrm{mol/dm^3}$ HC l .	For Examiner's Use
	Describe and explain what will happen to the rate of reaction.	
	[2]	
	[Total: 10]	

Question B8 starts on page 14.

B8 Alcohols are a homologous series of organic compounds.

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The table shows information about some alcohols.

alcohol	molecular formula	melting point /°C	density /g/cm ³
methanol	CH ₄ O	-98	0.79
ethanol	C ₂ H ₆ O	-114	0.79
	C ₃ H ₈ O	-126	0.80
butanol	C ₄ H ₁₀ O		
decanol		7	0.83

(a)		ch group of atoms (functional group) must be present in the homologous series phols?	of
			[1]
(b)	Nar	ne the alcohol with the molecular formula C ₃ H ₈ O.	
			[1]
(c)	(i)	Deduce the general formula for an alcohol.	
			[1]
	(ii)	A molecule of decanol has ten carbon atoms.	
		What is the molecular formula for decanol?	
			[1]
(d)		more difficult to estimate the melting point of butanol than to estimate its density. the data in the table to explain why.	
			 [1]

(e)	When warmed in the presence of concentrated sulfuric acid, butanol reacts with ethanoic acid to form an ester.	For Examiner's Use
	Name and draw the structure, showing all the atoms and all the bonds, of this ester.	
	name	
	structure	
	[0]	
	[2]	
(f)	Ethanol reacts with oxygen in the air to form ethanoic acid.	
	Describe another method by which ethanol can be converted into ethanoic acid.	
	[2]	
(g)	Butanol can burn in a limited supply of air.	
	Name two products of this reaction.	
	[1]	
	[Total: 10]	

B9 Methane reacts with water to produce hydrogen and carbon monoxide.

For
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llse

$$CH_4(g) + H_2O(g) \Longrightarrow 3H_2(g) + CO(g)$$
 $\Delta H = +210 \,\text{kJ/mol}$

This reaction is endothermic.

The reaction is normally carried out at a pressure of 30 atmospheres and a temperature of

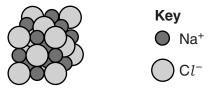
000	O.	
(a)	The	reaction is carried out at 30 atmospheres pressure and at 600 °C rather than 850 °C.
	Pred	lict and explain the effect of lowering the temperature on
	(i)	the rate of reaction,
		[2]
	(ii)	the position of equilibrium.
		[2]
(b)	The 850	reaction is carried out at 50 atmospheres rather than 30 atmospheres, and at °C.
	Pred	dict and explain the effect of raising the pressure on the position of equilibrium.
		[2]
(c)	The	reaction uses a catalyst.
	(i)	What effect does a catalyst have on the position of equilibrium?
		[1]
	(ii)	Explain how a catalyst causes the rate of reaction to increase.
		[1]

For Examiner's Use	Calculate the energy absorbed by the reaction when 560g of CO is formed.	(a)
	energy absorbed =kJ [2]	
	[Total: 10]	

B10 Solid sodium chloride and magnesium oxide have the same structure and bonding.

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Use

This is the structure of sodium chloride.



The table shows the melting point of these two compounds.

compound	melting point/°C
magnesium oxide	2852
sodium chloride	801

(a)	(i)	What are the formulae for a magnesium ion and an oxide ion?
		[1]
	(ii)	Suggest why magnesium oxide has a much higher melting point than sodium chloride.
		[1]
(b)	(i)	Explain why pure sodium chloride can be electrolysed at 1000 °C but not at 600 °C.
		[2]
	(ii)	Construct an equation for the anode reaction in the electrolysis of pure sodium chloride at 1000 °C.
		ran

(c)	Sodium chloride is dissolved in distilled water.								
		cess aqueous silver nitrate is added to this solution and 0.232 g of a white precipitate ormed.							
	(i)	Construct an ionic equation, including state symbols, for the formation of the white precipitate.							
		[2]							
(ii) Calculate the mass of sodium chloride present in the solution.									
		mass of sodium chloride = g [3]							
		[Total: 10]							

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DATA SHEET

The Periodic Table of the Elements			0	Heium	14 16 19 Nitrogen Oxygen Fluorine	31 32 35.5 40 P S C1 Phosphorus 16 Sulfur 17 Chlorine 18 Argon		Arsenic Selenium Bromine Krypton 33 34 35 36	Sb Te I Xe Antimony Tellurium Iodine 53 Xenon	209 209 210 222 Bi Po At Rn Bismuth Polonium Astatine Radon 83 84 85 86		167 169 173 175
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252 **ES** Einsteinium The volume of one mole of any gas is 24dm³ at room temperature and pressure (r.t.p.). 247 **BK**Berkelium
1 97

260 **Lr**Lawrencium

Nobelium

258
Md
Mendelevium
101

257 **Fm** Fermium 100

251 Californium 98

Curium

243 **Am**Americium

Pu Plutonium

Neptunium

231 **Pa**

232 **Tho** Thorium

a = relative atomic mass X = atomic symbol

в 🗙

Key

90

b = atomic (proton) number

р