

Candidate Name _____

Centre Number

Candidate
Number

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CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CHEMISTRY

PAPER 2 Theory

5070/2

MAY/JUNE SESSION 2002

1 hour 30 minutes

Additional materials:
Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page and on any separate answer paper used.

Sections A

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Section B

Answer any **three** questions.

Write your answers on the separate answer paper.

At the end of the examination, fasten any separate answer paper used securely to the question paper.

INFORMATION FOR CANDIDATES

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

A copy of the Periodic Table is printed on page 16.

FOR EXAMINER'S USE	
Section A	
B6	
B7	
B8	
B9	
TOTAL	

This question paper consists of 14 printed pages and 2 blank pages.

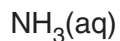
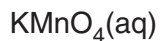
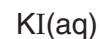
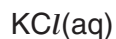


Section A

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

The total mark for this section is 45.

A1 Choose from the following solutions to answer the questions below.



Each solution can be used once, more than once, or not at all.

Write the formula for a solution which

(a) is alkaline,

..... [1]

(b) has an orange colour,

..... [1]

(c) is used to test for an oxidising agent,

..... [1]

(d) reacts with iron powder to give a pink-brown solid,

..... [1]

(e) can be used to test for sulphur dioxide,

..... [1]

(f) reacts with acidified lead(II) nitrate to give a yellow precipitate.

..... [1]

A2 Hydrogen reacts with chlorine to make hydrogen chloride. The reaction is exothermic.

The reaction can be represented by the equation below.



(a) A mixture of 2.5 g of hydrogen and 142 g of chlorine is allowed to react.

(i) Which gas, hydrogen or chlorine, is in excess?

Explain your answer.

.....
.....
.....
.....

(ii) Calculate the energy released when 2.5 g of hydrogen reacts completely with chlorine gas.

[3]

(b) Explain why the reaction is exothermic, in terms of the energy changes that take place during bond breaking and bond making.

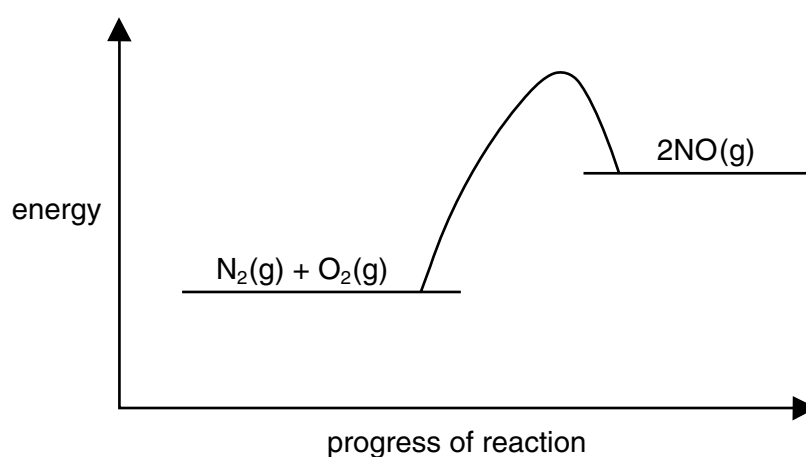
.....
.....
.....
..... [3]

(c) Draw a 'dot and cross' diagram to show the bonding in hydrogen chloride.

You only need to draw the outer (valence) electrons of chlorine.

[2]

(d) Nitrogen reacts with oxygen to form nitrogen(II) oxide. The energy profile diagram for the reaction is shown below.



(i) Is the reaction exothermic or endothermic?

Explain your answer.

.....
.....

(ii) Label on the diagram the activation energy for the reaction.

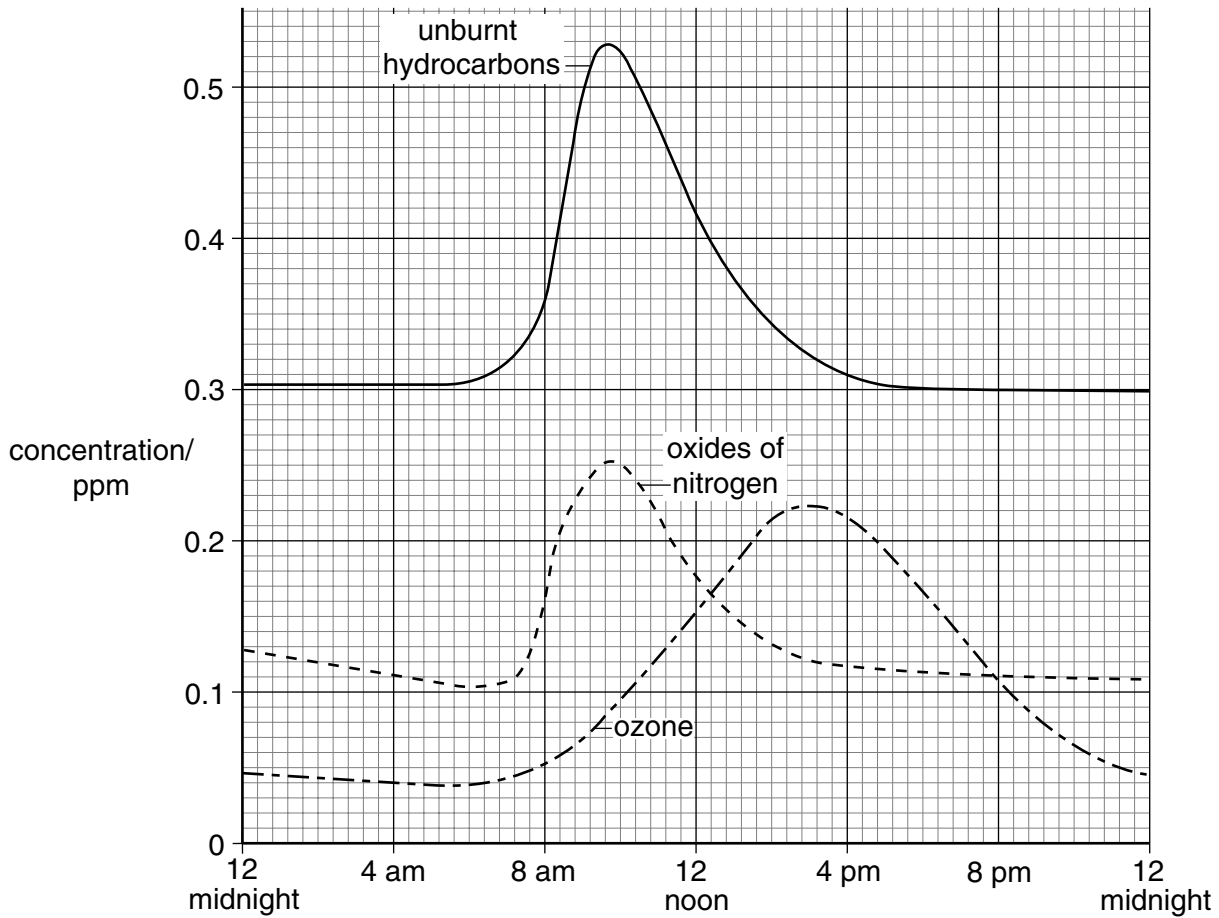
[2]

A3 (a) Complete the following table about atmospheric pollutants.

atmospheric pollutant	source of pollutant	effect of pollutant
carbon dioxide	complete combustion of fossil fuels	greenhouse effect
carbon monoxide		poisonous
methane		
sulphur dioxide		

[5]

- (b) The graph below shows the concentrations of some atmospheric pollutants in a city over a twenty-four hour period.



- (i) What is the maximum concentration, in ppm, of unburnt hydrocarbons?
.....
- (ii) Suggest the source of the unburnt hydrocarbons.
.....
- (iii) At what time of day is the concentration of ozone highest?
.....
- (iv) Ozone in the lower atmosphere is a pollutant. State **one** effect of ozone in the lower atmosphere.
.....

[4]

(c) Ozone also occurs in the upper atmosphere.

(i) Why is ozone in the upper atmosphere important?

.....

(ii) State **one** type of compound that is responsible for ozone depletion.

.....

[2]

A4 Antacid tablets neutralise acids. A student investigated the time taken for an antacid tablet to react completely with excess hydrochloric acid (the reaction time) under different conditions.

The table shows the results.

experiment number	volume of acid / cm ³	concentration of acid in mol / dm ³	temperature of acid / °C	reaction time / seconds
1	50	1.0	25	132
2	50	2.0	25	65
3	100	2.0	25	65
4	50	2.0	35	33

(a) Which **two** experiments show that the volume of acid used does **not** affect the rate of reaction?

..... and [1]

(b) Describe and explain the effect of increasing the temperature on the rate of reaction, in terms of collisions between reacting particles.

.....

 [2]

(c) The antacid tablet contains calcium carbonate.

(i) Write down the equation for the reaction between calcium carbonate and hydrochloric acid.

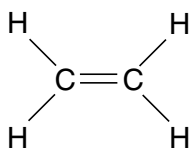
.....

(ii) Calculate the number of moles of hydrochloric acid used in experiment 2.

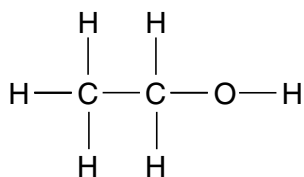
(iii) Calculate the mass of calcium carbonate that will react with this number of moles of hydrochloric acid.

Mass of calcium carbonate. [4]

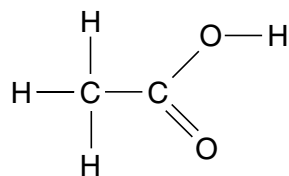
A5 The structures of three organic molecules are shown below.



ethene



ethanol



ethanoic acid

(a) Describe an industrial process to make ethanol from ethene.

.....

 [3]

(b) Name a reagent that can be used to convert ethanol into ethanoic acid.

..... [1]

(c) Ethanol and concentrated ethanoic acid react to form the ester ethyl ethanoate.

(i) Name the other product formed.

.....

(ii) Name the catalyst used in this reaction.

.....

(iii) The reaction between ethanol and ethanoic acid can reach dynamic equilibrium.

What is meant by the term *dynamic equilibrium*?

.....

 [4]

(d) Ethanoic acid is a weak acid. It reacts with magnesium giving a gas and a magnesium salt.

(i) What is meant by the term *weak acid*?

.....
.....
.....

(ii) Name the gas formed.

.....

(iii) What is the formula of the magnesium salt formed?

..... [3]

Section B

Answer **three** questions from this section. The total mark for this section is 30.

B6 Sodium chloride is used in making many important chemicals including chlorine and hydrogen.

(a) Write the electrode reactions for the electrolysis of **molten** sodium chloride.

Which electrode reaction is an oxidation? Explain your answer. [3]

(b) Explain why the electrolysis of **aqueous** sodium chloride using inert electrodes gives hydrogen. [1]

(c) Explain the three stages in the purification of water supplies. [3]

(d) Hydrogen is used to manufacture ammonia, NH_3 . Calculate the volume of hydrogen needed to react completely with 240 dm^3 of nitrogen, all gas volumes measured at room temperature and pressure. [3]

B7 Nitrogenous fertilisers are used to increase crop yield. Potassium nitrate, KNO_3 , and ammonium sulphate, $(\text{NH}_4)_2\text{SO}_4$, are two nitrogenous fertilisers.

(a) Which fertiliser, potassium nitrate or ammonium sulphate contains the greater percentage mass of nitrogen? Explain your answer. [3]

(b) Explain some of the pollution problems that can be caused by the over-use of nitrogenous fertilisers. [3]

(c) Explain why adding calcium hydroxide to a soil can cause a loss of nitrogen. [2]

(d) A water supply is contaminated with ammonium sulphate.

Describe a chemical test for the sulphate ion in the water. [2]

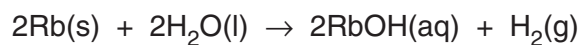
B8 The table shows the energy released when one gram of an alkane or an alkene is completely burned.

molecular formula	Energy released per gram / kJ
CH ₄	55.6
C ₂ H ₄	50.3
C ₄ H ₈	42.5
C ₄ H ₁₀	49.6
C ₂₀ H ₄₂	47.2

- (a) Draw **two** possible structures for the compound with molecular formula C₄H₈. [2]
- (b) Explain how you can tell that C₂₀H₄₂ is an alkane. [1]
- (c) Select data from the table to show how the energy released per gram varies with the number of carbon atoms in one molecule of an **alkane**. [1]
- (d) Write the equation for the complete combustion of C₄H₈. [2]
- (e) A sample of a hydrocarbon contains 0.240 g of carbon and 0.050 g of hydrogen.
- (i) Calculate the empirical formula of this hydrocarbon.
- (ii) The hydrocarbon is one of the compounds in the table. Which one? [3]
- (f) State a reagent used to distinguish between an alkane and an alkene. [1]

B9 The Periodic Table is arranged in groups.

- (a) Rubidium, Rb, is in Group I of the Periodic Table. It reacts with water according to the equation below.



Predict what you would **see** when a small piece of rubidium is added to cold water. [3]

- (b) Chlorine is in Group VII of the Periodic Table.

Chlorine, Cl_2 , reacts with aqueous sodium bromide.

(i) Predict what you would **see** in this reaction.

(ii) Write a balanced ionic equation for this reaction. [2]

- (c) Lithium reacts with fluorine to form lithium fluoride.

(i) Draw a 'dot and cross' diagram to show the bonding in lithium fluoride.

You should show all the electrons.

(ii) Explain why lithium fluoride conducts electricity when molten but not as a solid.

(iii) State **one other** physical property of lithium fluoride. [5]

DATA SHEET
The Periodic Table of the Elements

		Group											
I	II	III	IV	V	VI	VII	0						
		1 H Hydrogen 1										4 He Helium 2	
7 Li Lithium 3	9 Be Beryllium 4											20 Ne Neon 10	
23 Na Sodium 11	24 Mg Magnesium 12											35.5 Cl Chlorine 17	
39 K Potassium 19	40 Ca Calcium 20	55 Mn Manganese 25	52 Cr Chromium 24	51 V Vanadium 23	59 Co Cobalt 27	58 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36	
85 Rb Rubidium 37	88 Sr Strontium 38	91 Zr Zirconium 40	96 Mo Molybdenum 42	93 Nb Niobium 41	101 Ru Ruthenium 44	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54	
133 Cs Caesium 55	137 Ba Barium 56	178 Hf Hafnium 72	184 W Tungsten 74	181 Ta Tantalum 73	190 Os Osmium 76	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	209 Bi Bismuth 83	207 Pb Lead 82	208 Po Polonium 84	222 Rn Radon 86	
87 Fr Francium	226 Ra Radium	227 Ac Actinium											86
*58-71 Lanthanoid series													
†90-103 Actinoid series													
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="border: 1px solid black; padding: 5px;"> a X b </div> <div style="text-align: right;"> a = relative atomic mass X = atomic symbol b = proton (atomic) number </div> </div>													
140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	150 Sm Samarium 62	157 Gd Gadolinium 64	162 Dy Dysprosium 66	165 Ho Holmium 67	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71	159 Tb Terbium 65	167 Er Erbium 68	171 Yb Ytterbium 70	
232 Th Thorium 90	238 U Uranium 92	238 Pa Protactinium 91	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).