

Second Variant Question Paper



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CHEMISTRY

0620/32

Paper 3 (Extended)

May/June 2009

1 hour 15 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 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.

Answer **all** questions.

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

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 questions.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **15** printed pages and **1** blank page.



1 Some grass is crushed and mixed with the solvent, propanone. The colour pigments are extracted to give a deep green solution.

(a) (i) Draw a labelled diagram to describe how you could show that there is more than one coloured pigment in the green solution.

[3]

(ii) Given a pure sample of chlorophyll, how could you show that the green solution from the grass contained chlorophyll?

.....
.....
.....
..... [2]

(b) Explain the role of chlorophyll in green plants.

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

[Total: 8]

2 The results of experiments on electrolysis using inert electrodes are given in the table.

Complete the table; the first line has been completed as an example.

For
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Use

electrolyte	change at negative electrode	change at positive electrode	change to electrolyte
molten lead(II) bromide	lead formed	bromine formed	used up
.....	lithium formed	chlorine formed	used up
dilute aqueous sodium chloride
aqueous copper(II) sulfate
.....	hydrogen formed	bromine formed	potassium hydroxide formed

[Total: 8]

3 The following is a list of the electron distributions of atoms of unknown elements.

For
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Use

element	electron distribution
A	2,6
B	2,8,4
C	2,8,8,2
D	2,8,18,8
E	2,8,18,8,1
F	2,8,18,18,7

(a) Choose an element from the list for each of the following descriptions.

- (i) It is a noble gas. [5]
- (ii) It is a soft metal with a low density.
- (iii) It can form a covalent compound with element **A**.
- (iv) It has a giant covalent structure similar to diamond.
- (v) It is a diatomic gas with molecules of the type X_2 [5]

(b) Elements **C** and **A** can form an ionic compound.

- (i) Draw a diagram that shows the formula of this compound, the charges on the ions and the arrangement of the valency electrons around the negative ion.
Use **o** to represent an electron from an atom of **C**.
Use **x** to represent an electron from an atom of **A**.

[3]

(ii) Predict **two** properties of this compound.

.....

.....

..... [2]

[Total: 10]

- 4 The reactivity series of metals given below contains both familiar and unfamiliar elements. For most of the unfamiliar elements, which are marked *, their common oxidation states are given.

For
Examiner's
Use

* barium	Ba
* lanthanum	La (+3)
magnesium	
zinc	
* chromium	Cr (+2), (+3), (+6)
iron	
copper	
* palladium	(+2)

Choose metal(s) from the above list to answer the following questions.

- (i) Which **two** metals would not react with dilute hydrochloric acid?

..... [2]

- (ii) Which **two** unfamiliar metals (*) would react with cold water?

..... [2]

- (iii) What is the oxidation state of barium?

..... [1]

- (iv) Name an unfamiliar metal (*) whose oxide cannot be reduced by carbon.

..... [1]

- (v) Why should you be able to predict that metals such as iron and chromium have more than one oxidation state?

.....
..... [1]

[Total: 7]

5 Insoluble salts are made by precipitation.

For
Examiner's
Use

(a) A preparation of the insoluble salt iron fluoride is described below.

To 15 cm³ of aqueous iron(III) chloride, 45 cm³ of aqueous sodium fluoride is added. The concentration of both solutions is 1.00 mol / dm³. The mixture is filtered and the precipitate washed with distilled water. Finally, the precipitate is heated in an oven.

(i) Complete the equation.



(ii) Why is the volume of sodium fluoride solution three times that of the iron(III) chloride solution?

.....
..... [1]

(iii) Why is the mixture washed with distilled water?

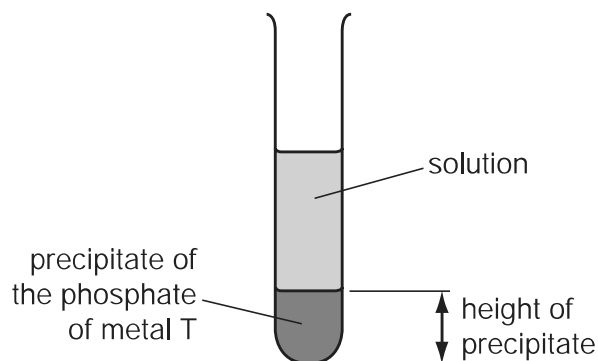
.....
..... [1]

(iv) Why is the solid heated?

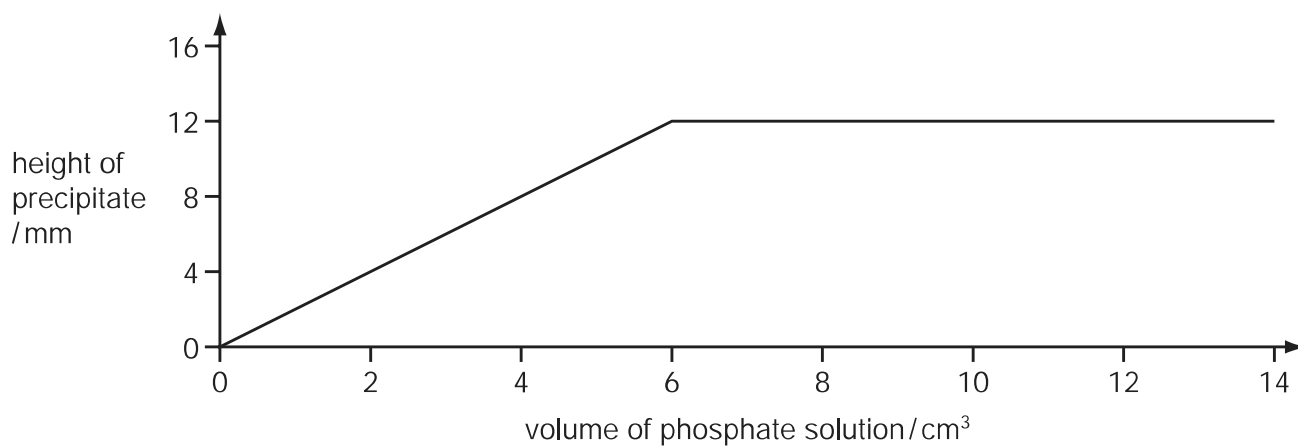
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(b) The formulae of insoluble compounds can be found by precipitation reactions.

To 18.0 cm^3 of an aqueous solution of the nitrate of metal T was added 2.0 cm^3 of aqueous sodium phosphate, Na_3PO_4 . The concentration of both solutions was 1.00 mol/dm^3 . When the precipitate had settled, its height was measured.



The experiment was repeated using different volumes of the phosphate solution. The results are shown on the following graph.



What is the formula of the phosphate of metal T? Give your reasoning.

.....

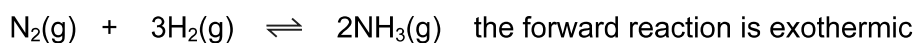
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..... [3]

[Total: 8]

6 Ammonia is manufactured by the Haber process.



For
Examiner's
Use

(a) (i) Name the raw materials from which nitrogen and hydrogen are obtained.

nitrogen from

[1]

hydrogen from

[1]

(ii) Name the catalyst used in this process.

.....

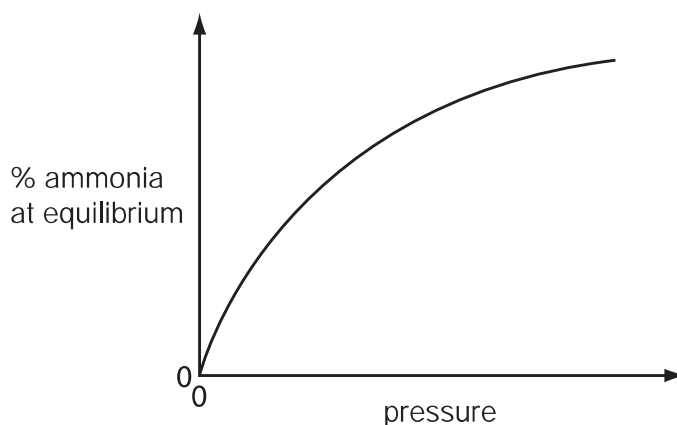
[1]

(iii) What is the most important use of ammonia?

.....

[1]

(b) The following graph shows how the percentage of ammonia in the equilibrium mixture changes with pressure.



(i) Explain the term *equilibrium*.

.....

[2]

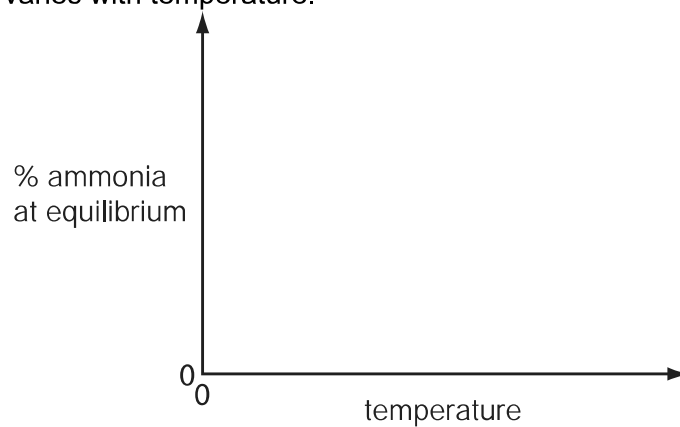
(ii) How does the percentage of ammonia vary with pressure?

.....

[1]

9

- (c) (i) Sketch a graph which shows how the percentage of ammonia in the equilibrium mixture varies with temperature.



For
Examiner's
Use

[1]

- (ii) Explain why the graph has the shape shown.

.....

.....

..... [2]

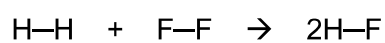
[Total: 10]

7 Hydrogen reacts with the halogens to form hydrogen halides.

(a) Bond energy is the amount of energy, in kJ, that must be supplied (endothermic) to break one mole of a bond.

bond	bond energy in kJ/mol
H—H	+436
F—F	+158
H—F	+562

Use the above data to show that the following reaction is exothermic.



.....

.....

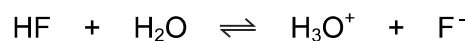
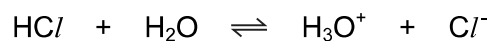
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.....

..... [3]

For
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Use

(b) They react with water to form acidic solutions.



For
Examiner's
Use

(i) Explain why water behaves as a base in both of these reactions.

.....
..... [2]

(ii) At equilibrium, only 1% of the hydrogen chloride exists as molecules, the rest has formed ions. In the other equilibrium, 97% of the hydrogen fluoride exists as molecules, only 3% has formed ions.

What does this tell you about the strength of each acid?

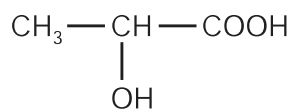
.....
..... [2]

(iii) How would the pH of these two solutions differ?

..... [1]

[Total: 8]

8 Lactic acid can be made from corn starch.



lactic acid

It polymerises to form the polymer, polylactic acid (PLA) which is biodegradable.

(a) Suggest **two** advantages that PLA has compared with a polymer made from petroleum.

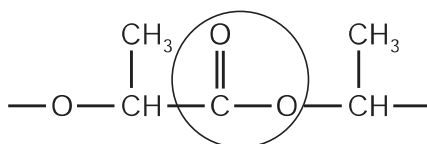
.....

.....

.....

..... [2]

(b) The structure of PLA is given below.



(i) What type of compound contains the group that is circled?

..... [1]

(ii) Complete the following sentence.

Lactic acid molecules can form this group because they contain both an

..... group and an group. [2]

(iii) Is the formation of PLA, an addition or condensation polymerisation? Give a reason for your choice.

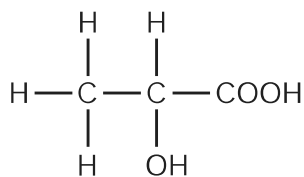
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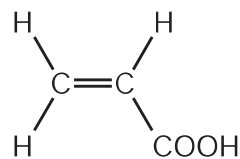
..... [2]

For
Examiner's
Use

(c) When lactic acid is heated, acrylic acid is formed.



lactic acid



acrylic acid

For
Examiner's
Use

(i) Complete the word equation for the action of heat on lactic acid.

lactic acid → + [1]

(ii) Describe a test that would distinguish between lactic acid and acrylic acid.

test

result for lactic acid

result for acrylic acid [3]

(iii) Describe a test, other than using an indicator, which would show that both chemicals contain an acid group.

test

result

..... [2]

[Total: 13]

9 Quantities of chemicals, expressed in moles, can be used to find the formula of a compound, to establish an equation and to determine reacting masses.

For
Examiner's
Use

(a) A compound contains 72% magnesium and 28% nitrogen. What is its empirical formula?

.....

 [2]

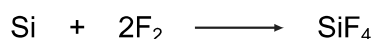
(b) A compound contains only aluminium and carbon. 0.03 moles of this compound reacted with excess water to form 0.12 moles of $Al(OH)_3$ and 0.09 moles of CH_4 .

Write a balanced equation for this reaction.

.....

 [2]

(c) 0.08 moles of silicon reacts with 7.2 g of fluorine.



(i) Which one is the limiting reagent? Explain your choice.

.....

 [3]

(ii) How many moles of SiF_4 are formed?

..... [1]

[Total: 8]

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DATA SHEET
The Periodic Table of the Elements

		Group																																																																																																																											
I	II	III	IV	V	VI	VII	0																																																																																																																						
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18	19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	58 Ce Cerium 58	59 Pr Praseodymium 59	60 Nd Neodymium 60	61 Pm Promethium 61	62 Sm Samarium 62	63 Eu Europium 63	64 Gd Gadolinium 64	65 Tb Terbium 65	66 Dy Dysprosium 66	67 Ho Holmium 67	68 Er Erbium 68	69 Tm Thulium 69	70 Yb Ytterbium 70	71 Lu Lutetium 71	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	146 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71	226 Ra Radium 88	227 Ac Actinium 89	232 Th Thorium 90	238 U Uranium 92	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	238 Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

a	X
b	

 a = relative atomic mass
 X = atomic symbol
 b = proton (atomic) number

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

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