



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)

October/November 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	
Total	

This document consists of **14** printed pages and **2** blank pages.



1 (a) The major gases in unpolluted air are 79% nitrogen and 20% oxygen.

(i) Name another gaseous element in unpolluted air.

..... [1]

(ii) Name **two** compounds in unpolluted air.

..... [2]

(b) Two common pollutants in air are sulfur dioxide and the oxides of nitrogen.

(i) Name another pollutant in air.

..... [1]

(ii) Describe how sulfur dioxide is formed.

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

(iii) How are the oxides of nitrogen formed?

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

(c) How is oxygen obtained from air?

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

[Total: 10]

2 Oxides are classified as acidic, basic, neutral and amphoteric.

(a) Complete the table.

type of oxide	pH of solution of oxide	example
acidic		
basic		
neutral		

[6]

(b) (i) Explain the term *amphoteric*.

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

(ii) How could you distinguish between an acidic oxide and an amphoteric oxide using hydrochloric acid and aqueous sodium hydroxide?

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

[Total: 9]

3 (a) An important ore of zinc is zinc blende, ZnS.

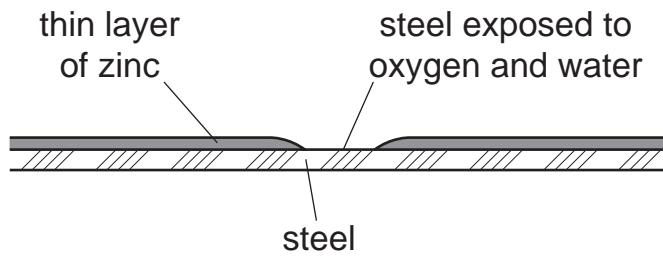
(i) How is zinc blende changed into zinc oxide?

..... [1]

(ii) Write a balanced equation for the reduction of zinc oxide to zinc by carbon.

..... [2]

(b) A major use of zinc is galvanizing; steel objects are coated with a thin layer of zinc. This protects the steel from rusting even when the layer of zinc is broken.

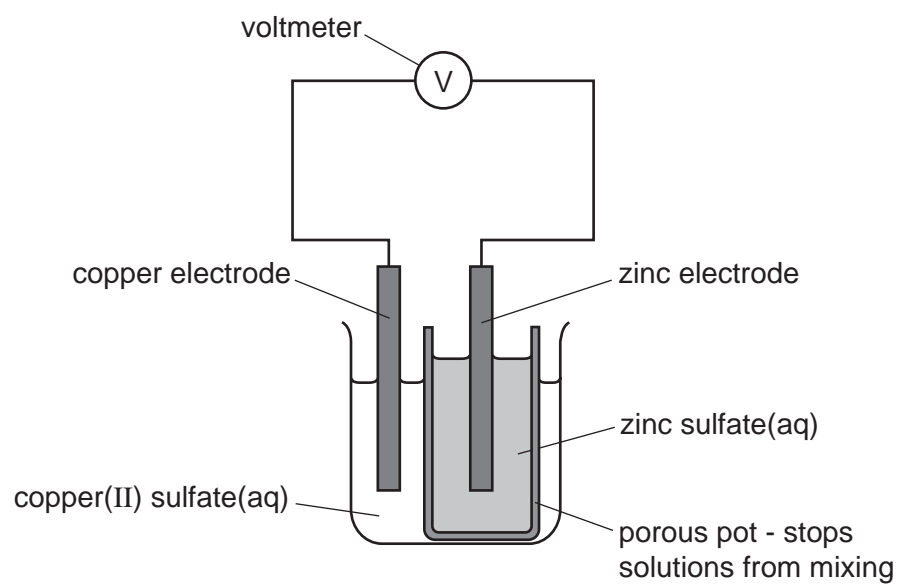


Explain, by mentioning ions and electrons, why the exposed steel does not rust.

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

(c) Zinc electrodes have been used in cells for many years, one of the first was the cell in 1831.

For
iner's



(i) Give an explanation for the following in terms of atoms and ions.

observation at zinc electrode – *the electrode becomes smaller*

explanation
..... [1]

observation at copper electrode – *the electrode becomes bigger*

explanation
..... [1]

(ii) When a current flows, charged particles move around the circuit.

What type of particle moves through the electrolytes?

..... [1]

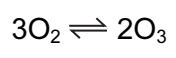
Which particle moves through the wires and the voltmeter?

..... [1]

[Total: 10]

4 The distinctive smell of the seaside was thought to be caused by ozone, O₃.
Ozone is a form of the element oxygen.

(a) A mixture of oxygen and ozone is formed by passing electric sparks through oxygen.



Suggest a technique that might separate this mixture. Explain why this method separates the two forms of oxygen.

technique

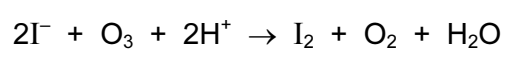
explanation

.....

.....

..... [2]

(b) Ozone is an oxidant. It can oxidise an iodide to iodine.



(i) What would you see when ozone is bubbled through aqueous acidified potassium iodide?

.....

.....

.....

..... [2]

(ii) Explain in terms of electron transfer why the change from iodide ions to iodine molecules is oxidation.

.....

..... [1]

(iii) Explain, using your answer to **b(ii)**, why ozone is the oxidant in this reaction.

.....

..... [1]

(c) It is now known that the smell of the seaside is due to the chemical dimethyl sulfide, $(\text{CH}_3)_2\text{S}$.

- (i) Draw a diagram that shows the arrangement of the valency electrons in one molecule of this covalent compound.
Use x to represent an electron from a carbon atom.
Use o to represent an electron from a hydrogen atom.
Use • to represent an electron from a sulfur atom.

[3]

(ii) Name the **three** compounds formed when dimethyl sulfide is burnt in excess oxygen.

.....

.....

..... [2]

[Total: 11]

5 The first three elements in Group IV are carbon, silicon and germanium. The elements and their compounds have similar properties.

(a) The compound, silicon carbide, has a macromolecular structure similar to that of diamond.

(i) A major use of silicon carbide is to reinforce aluminium alloys which are used in the construction of spacecraft. Suggest **three** of its physical properties.

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

(ii) Draw a diagram to show the arrangement of silicon atoms around one carbon atom in silicon carbide. Label this diagram 1.

Draw a diagram to show the arrangement of carbon atoms around one silicon atom in silicon carbide. Label this diagram 2.

[3]

(b) Germanium(IV) oxide, GeO_2 , has the same macromolecular structure as silicon(IV) oxide. Draw the structural formula of germanium(IV) oxide.

[2]

(c) Germanium forms a series of hydrides comparable to the alkanes.

(i) Draw the structural formula of the hydride which contains three germanium atoms per molecule.

[1]

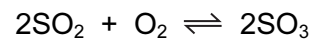
(ii) Predict the products of the complete combustion of this hydride.

[2]

.....

[Total: 11]

6 (a) Sulfuric acid is made by the Contact process.



This is carried out in the presence of a catalyst at 450 °C and 2 atmospheres pressure.

(i) Sulfur dioxide is made by burning sulfur. Name a source of sulfur.

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

(ii) Give another use of sulfur dioxide.

..... [1]

(iii) Name the catalyst used.

..... [1]

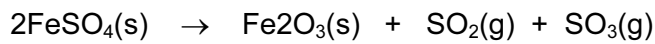
(iv) If the temperature is decreased to 300 °C, the yield of sulfur trioxide increases. Explain why this lower temperature is not used.

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

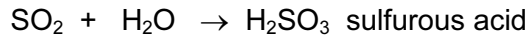
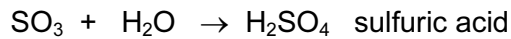
(v) Sulfur trioxide is dissolved in concentrated sulfuric acid. This is added to water to make more sulfuric acid. Why is sulfur trioxide not added directly to water?

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

- (b) Sulfuric acid was first made in the Middle East by heating the mineral, green vitriol, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$. The gases formed were cooled.



On cooling



- (i) How could you show that the first reaction is reversible?

.....
 [2]

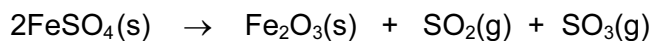
- (ii) Sulfurous acid is a reductant. What would you see when acidified potassium manganate(VII) is added to a solution containing this acid?

.....
 [2]

- (iii) Suggest an explanation why sulfurous acid in contact with air changes into sulfuric acid.

..... [1]

- (c) 12.16 g of anhydrous iron(II) sulfate was heated. Calculate the mass of iron(III) oxide formed and the volume of gases, at r.t.p., formed.



mass of one mole of $\text{FeSO}_4 = 152 \text{ g}$

number of moles of FeSO_4 used =

number of moles of Fe_2O_3 formed =

mass of one mole of $\text{Fe}_2\text{O}_3 = \dots\dots\dots \text{g}$

mass of iron(III) oxide formed =

total number of moles of gases formed =

total volume of gases formed = dm^3

[6]

[Total: 16]

7 Butan-1-ol is used as a solvent for paints and varnishes, to make esters and as a fuel. Butan-1-ol can be manufactured from but-1-ene, which is made from petroleum.

Biobutanol is a fuel of the future. It can be made by the fermentation of almost any form of biomass - grain, straw, leaves etc.

(a) But-1-ene can be obtained from alkanes such as nonane, C₉H₂₀, by cracking.

(i) Give the reaction conditions.

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

(ii) Complete an equation for the cracking of nonane, C₉H₂₀, to give but-1-ene.

C₉H₂₀ → [2]

(iii) Name the reagent that reacts with but-1-ene to form butan-1-ol.

..... [1]

(b) (i) Balance the equation for the complete combustion of butan-1-ol.

..... C₄H₉OH + O₂ → CO₂ + H₂O [2]

(ii) Write a word equation for the preparation of the ester butyl propanoate.

..... [2]

(c) The fermentation of biomass by bacteria produces a mixture of products which include biobutanol, propanol, hydrogen and propanoic acid.

(i) Draw the structural formula of propanol and of propanoic acid. Show all the bonds.

propanol

propanoic acid

[2]

(ii) Why is it important to develop these fuels, such as biobutanol, as alternatives to petroleum?

..... [1]

(d) How could you show that butanol made from petroleum and biobutanol are the same chemical?

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

[Total: 13]

DATA SHEET
The Periodic Table of the Elements

		Group															
I	II	III	IV	V	VI	VII	0					0					
1 H Hydrogen											2 He Helium						
3 Li Lithium	4 Be Beryllium	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon	11 B Boron	12 C Carbon	13 Al Aluminium	14 N Nitrogen	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon		
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Caesium	56 Ba Barium	57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89 Ac Actinium											103 Lr Lawrencium				

140 Ce Cerium	141 Pr Praseodymium	144 Nd Neodymium	150 Sm Samarium	152 Eu Europium	157 Gd Gadolinium	162 Dy Dysprosium	165 Ho Holmium	167 Er Erbium	169 Tm Thulium	173 Yb Ytterbium	175 Lu Lutetium
58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
90 Th Thorium	91 Pa Protactinium	92 U Uranium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

*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.).