



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CHEMISTRY

0620/33

Paper 3 (Extended)

May/June 2013

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.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 12.

You may lose marks if you do not show your working or if you do not use appropriate units.

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.

This document consists of **11** printed pages and **1** blank page.



1 Substances can be classified as:

elements mixtures compounds

Elements can be divided into:

metals non-metals

(a) Define each of the following terms.

(i) *element*

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

(ii) *compound*

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

(iii) *mixture*

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

(b) Classify each of the following as either an element, compound or mixture.

(i) brass [1]

(ii) carbon dioxide [1]

(iii) copper [1]

(c) Which physical property is used to distinguish between metals and non-metals?

It is possessed by all metals but by only one non-metal.

..... [1]

[Total: 9]

2 One of the factors which determine the reaction rate of solids is particle size.

- (a) A mixture of finely powdered aluminium and air may explode when ignited. An explosion is a very fast exothermic reaction. This causes a large and sudden increase in temperature.

Explain each of the following in terms of collisions between reacting particles.

- (i) Why is the reaction between finely powdered aluminium and air very fast?

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

- (ii) Explain why for most reactions the rate of reaction decreases with time.

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

- (iii) Suggest an explanation why the rate of reaction in an explosion could increase rather than decrease with time.

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

- (b) (i) Give another example of a substance other than a metal which, when finely powdered, might explode when ignited in air.

..... [1]

- (ii) Describe a simple test-tube reaction which shows the effect of particle size on the rate at which a solid reacts with a solution.

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

[Total: 11]

- 3 Iron from the blast furnace is impure. It contains 5% of impurities, mainly carbon, sulfur, silicon and phosphorus. Almost all of this impure iron is converted into the alloy, mild steel.

(a) (i) State a use of mild steel.

..... [1]

(ii) Name and give a use of another iron-containing alloy.

name

use [2]

(b) The oxides of carbon and sulfur are gases. The oxides of silicon and phosphorus are not. Explain how these impurities are removed from the impure iron when it is converted into mild steel.

.....

 [5]

[Total: 8]

- 4 Germanium is an element in Group IV. The electron distribution of a germanium atom is 2 + 8 + 18 + 4. It has oxidation states of +2 and +4.

(a) Germanium forms a series of saturated hydrides similar to the alkanes.

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

[1]

(ii) Predict the general formula of the germanium hydrides.

..... [1]

- (b)** Draw a diagram showing the arrangement of the valency electrons in one molecule of the covalent compound germanium(IV) chloride, GeCl_4 .

Use o to represent an electron from a chlorine atom.
Use x to represent an electron from a germanium atom.

[2]

- (c)** Describe the structure of the giant covalent compound germanium(IV) oxide, GeO_2 . It has a similar structure to that of silicon(IV) oxide.

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

- (d)** Is the change GeCl_2 to GeCl_4 reduction, oxidation or neither? Give a reason for your choice.

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

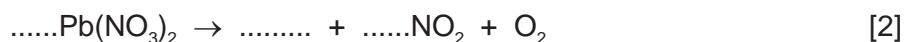
[Total: 9]

- 5** All metal nitrates decompose when heated. A few form a nitrite and oxygen. Most form the metal oxide, oxygen and a brown gas called nitrogen dioxide.

- (a) (i)** Name a metal whose nitrate decomposes to form the metal nitrite and oxygen.

..... [1]

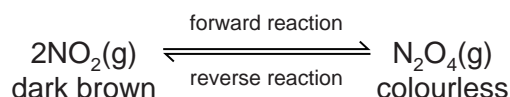
- (ii)** Complete the equation for the action of heat on lead(II) nitrate.



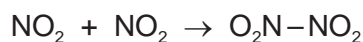
- (iii)** Suggest why the nitrate of the metal, named in **(a)(i)**, decomposes less readily than lead(II) nitrate.

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

- (b) Almost all samples of nitrogen dioxide are an equilibrium mixture of nitrogen dioxide, NO_2 , and dinitrogen tetroxide, N_2O_4 .



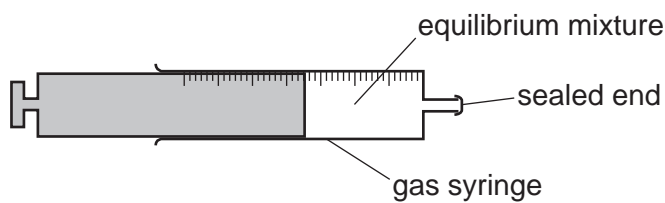
In the forward reaction, a bond forms between the two nitrogen dioxide molecules.



- (i) Explain the term *equilibrium mixture*.

.....
 [1]

- (ii) The syringe contains a sample of the equilibrium mixture. The plunger was pulled back reducing the pressure.
 How would the colour of the gas inside the syringe change? Give an explanation for your answer.



.....

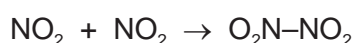
 [3]

- (iii) A sealed tube containing an equilibrium mixture of nitrogen dioxide and dinitrogen tetroxide was placed in a beaker of ice cold water.
 The colour of the mixture changed from brown to pale yellow.

Is the forward reaction exothermic or endothermic? Give an explanation for your choice.

.....
 [2]

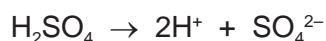
- (iv) What other piece of information given in the equation supports your answer to (iii)?



..... [1]

[Total: 12]

- 6 Sulfuric acid and malonic acid are both dibasic acids. One mole of a dibasic acid can form two moles of hydrogen ions.



Dibasic acids can form salts of the type Na_2X and CaX .

- (a) Malonic acid is a white crystalline solid which is soluble in water. It melts at 135°C . The structural formula of malonic acid is given below. It forms salts called malonates.



- (i) How could you determine if a sample of malonic acid is pure?

technique used

result if pure [2]

- (ii) What is the molecular formula of malonic acid?

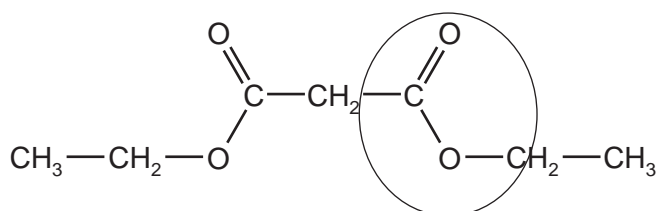
..... [1]

- (iii) When malonic acid is heated there are two products, carbon dioxide and a simpler carboxylic acid. Deduce the name and molecular formula of this acid.

.....

..... [2]

- (iv) Malonic acid reacts with ethanol to form a colourless liquid which has a 'fruity' smell. Its structural formula is given below.



What type of compound contains the group which is circled?

..... [1]

- (b) (i) Suggest why a solution of malonic acid, concentration 0.2 mol/dm^3 , has a higher pH than one of sulfuric acid of the same concentration.

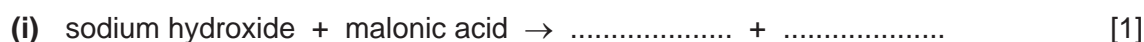
..... [1]

- (ii) Describe a test, other than measuring pH, which can be carried out on both acid solutions to confirm the explanation given in (b)(i) for the different pH values of the two acids.

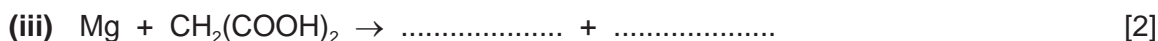
.....

..... [2]

- (c) Complete the following equations for reactions of these two acids.



.....



[Total: 16]

- 7 Alkanes and alkenes are both series of hydrocarbons.

- (a) (i) Explain the term *hydrocarbon*.

.....

..... [1]

- (ii) What is the difference between these two series of hydrocarbons?

.....

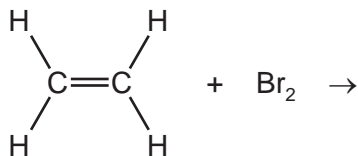
..... [2]

- (b) Alkenes and simpler alkanes are made from long-chain alkanes by cracking. Complete the following equation for the cracking of the alkane $\text{C}_{20}\text{H}_{42}$.



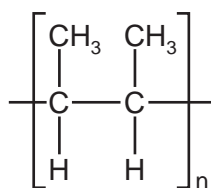
- (c) Alkenes such as butene and ethene are more reactive than alkanes. Alkenes are used in the petrochemical industry to make a range of products, which includes polymers and alcohols.

- (i) Dibromoethane is used as a pesticide. Complete the equation for its preparation from ethene.



[1]

- (ii) The structural formula of a poly(alkene) is given below.



Deduce the structural formula of its monomer.

[2]

- (iii) How is butanol made from butene, $\text{CH}_3-\text{CH}_2-\text{CH}=\text{CH}_2$? Include an equation in your answer.

.....

..... [2]

- (iv) Cracking changes alkanes into alkenes. How could an alkene be converted into an alkane? Include an equation in your answer.

.....

..... [2]

(d) 20 cm³ of a hydrocarbon was burnt in 175 cm³ of oxygen. After cooling, the volume of the remaining gases was 125 cm³. The addition of aqueous sodium hydroxide removed carbon dioxide leaving 25 cm³ of unreacted oxygen.

(i) volume of oxygen used = cm³ [1]

(ii) volume of carbon dioxide formed = cm³ [1]

(iii) Deduce the formula of the hydrocarbon and the balanced equation for the reaction.

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

[Total: 15]

DATA SHEET
The Periodic Table of the Elements

Group		I	II	III	IV	V	VI	VII	0							
		1 H Hydrogen 1							2 He Helium 2							
3	4	7 Li Lithium	9 Be Beryllium		11 B Boron	12 C Carbon	13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon				
11	12	23 Na Sodium	24 Mg Magnesium		27 Fe Iron	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		
19	20	39 K Potassium	40 Ca Calcium		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	
37	38	85 Rb Rubidium	88 Sr Strontium		101 Ru Ruthenium	102 Rh Rhodium	103 Pd Palladium	104 Ag Silver	105 Cd Cadmium	106 In Indium	107 Sn Tin	108 Sb Antimony	109 Te Tellurium	110 I Iodine	111 Xe Xenon	
55	56	133 Cs Caesium	137 Ba Barium		186 Re Rhenium	187 Rh Rhodium	188 Pt Platinum	189 Au Gold	190 Hg Mercury	191 Tl Thallium	192 Pb Lead	193 Bi Bismuth	194 Po Polonium	195 At Astatine	196 Rn Radon	
87	88	226 Fr Francium	226 Ra Radium		227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium

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
232 Th Thorium	238 U Uranium	238 U Uranium	238 U Uranium	238 U Uranium	238 U Uranium	238 U Uranium	238 U Uranium	238 U Uranium	238 U Uranium	238 U Uranium	238 U Uranium

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

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

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

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