



# Cambridge IGCSE™

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**CHEMISTRY**

**0620/32**

Paper 3 Theory (Core)

**May/June 2020**

**1 hour 15 minutes**

You must answer on the question paper.

No additional materials are needed.

## INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

## INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **20** pages. Blank pages are indicated.

1 (a) A list of symbols and formulae is shown.



Answer the following questions about these symbols and formulae.  
Each symbol or formula may be used once, more than once or not at all.

Which symbol or formula represents:

- (i) a compound produced by the thermal decomposition of calcium carbonate  
..... [1]
- (ii) an element which is used as a fuel  
..... [1]
- (iii) a gas which forms 78% of clean dry air  
..... [1]
- (iv) an ion which forms a blue precipitate when added to aqueous sodium hydroxide  
..... [1]
- (v) an ion formed when an atom gains an electron?  
..... [1]

- (b) Complete the table to show the relative charge and approximate relative mass of a proton, a neutron and an electron.

type of particle	relative charge	approximate relative mass
proton		1
neutron		
electron	-1	

[3]

- (c) Deduce the number of electrons and neutrons in an atom of the isotope of potassium shown.



number of electrons .....

number of neutrons .....

[2]

[Total: 10]

- 2 A solution is obtained by filtering a mixture of soil and water. The table shows the mass of some of the ions in  $1000\text{ cm}^3$  of this solution.

name of ion	formula of ion	mass of ion in $1000\text{ cm}^3$ of soil solution / mg
aluminium	$\text{Al}^{3+}$	0.2
	$\text{NH}_4^+$	22.0
calcium	$\text{Ca}^{2+}$	0.2
iron(II)	$\text{Fe}^{2+}$	79.0
magnesium	$\text{Mg}^{2+}$	0.1
nitrate	$\text{NO}_3^-$	28.0
phosphate	$\text{PO}_4^{3-}$	14.0
potassium	$\text{K}^+$	39.0
	$\text{SO}_4^{2-}$	5.1

- (a) Answer these questions using the information in the table.

(i) Which negative ion has the lowest concentration?

..... [1]

(ii) State the name of the  $\text{SO}_4^{2-}$  ion.

..... [1]

(iii) Calculate the mass of nitrate ions in  $200\text{ cm}^3$  of this solution.

mass = ..... mg [1]

(iv) Name the compound that contains  $\text{NH}_4^+$  ions and  $\text{NO}_3^-$  ions.

..... [1]

- (b) Describe a chemical test for calcium ions.

test .....

observations .....

[2]

(c) The names and formulae for some compounds are shown.

aluminium nitrate,  $\text{Al}(\text{NO}_3)_3$   
magnesium nitrate,  $\text{Mg}(\text{NO}_3)_2$   
sodium nitrate,  $\text{NaNO}_3$

Deduce the formula for calcium nitrate.

..... [1]

[Total: 7]

3 Many compounds have important uses.

(a) Complete the table to show the name, number of atoms in the formula and use.

name of compound	number of atoms in the formula	formula	use
water	hydrogen = 2 oxygen = 1	H <sub>2</sub> O	
	sulfur = 1 oxygen = 2	SO <sub>2</sub>	
calcium hydroxide (slaked lime)	calcium = ..... oxygen = ..... hydrogen = .....	Ca(OH) <sub>2</sub>	

[5]

(b) The table compares the reactions of four metals with steam.

metal	reaction with steam
copper	does not react
magnesium	reacts rapidly
sodium	reacts explosively
zinc	reacts slowly when warmed

Put the four metals in order of their reactivity.

Put the least reactive metal first.

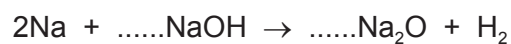
least reactive  $\longrightarrow$  most reactive

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[2]

(c) Sodium reacts with molten sodium hydroxide.

Complete the chemical equation for this reaction.



[2]

[Total: 9]

4 The properties of the first four Group I elements are shown in the table.

element	density in g/cm <sup>3</sup>	melting point /°C	boiling point /°C
lithium	0.53	181	1342
sodium	0.97	98	883
potassium	0.86	63	760
rubidium		39	686

(a) Answer these questions using only the information in the table.

(i) Describe the general trend in the boiling points of the Group I elements.

..... [1]

(ii) Explain why it is difficult to predict the density of rubidium.

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

(iii) Deduce the state of rubidium at 45°C. Explain your answer.

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

(b) When sodium reacts with carboxylic acids, hydrogen is produced.

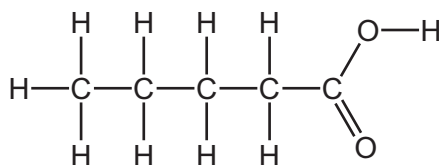
(i) Describe a test for hydrogen.

test .....

observations .....

[2]

(ii) The structure of a carboxylic acid is shown.



Deduce the formula of this carboxylic acid to show the number of atoms of carbon, hydrogen and oxygen.

..... [1]

(c) Universal indicator is added to an aqueous solution of sodium oxide.

- What colour change is observed?

from green to .....

- Give a reason for your answer.

.....  
.....

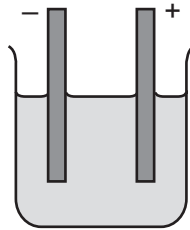
[2]

[Total: 9]



5 Molten magnesium bromide is electrolysed.

The incomplete apparatus is shown.



(a) (i) Complete the diagram by:

- labelling the anode and cathode
- adding the power supply and connecting wires.

[2]

(ii) Predict the products of this electrolysis at the:

positive electrode .....

negative electrode. ....

[2]

(b) The electrodes must be able to conduct electricity.

(i) Give **one** other property that the electrodes must have.

..... [1]

(ii) Name a suitable element that can be used as an electrode.

..... [1]

(c) Aqueous chlorine reacts with aqueous magnesium bromide.



(i) How does this reaction show that chlorine is more reactive than bromine?

..... [1]

(ii) What colour is bromine in aqueous solution?

..... [1]

(d) Complete the chemical equation for the reaction of chlorine with phosphorus.



[Total: 10]

6 Acids have characteristic properties.

(a) Hydrochloric acid reacts with magnesium carbonate.

Name the products of this reaction and give the observations.

.....

.....

.....

.....

..... [4]

(b) The rate of reaction of iron with sulfuric acid can be determined by measuring the time taken to produce 20 cm<sup>3</sup> of hydrogen.

A student measured the time taken to produce 20 cm<sup>3</sup> of hydrogen using three different concentrations of sulfuric acid.

In each experiment the student used:

- 1 g of iron powder
- the same temperature
- the same volume of sulfuric acid.

The results are shown in the table.

concentration of acid in mol/dm <sup>3</sup>	time /s
0.1	33
0.2	17
0.5	8

(i) Use the information in the table to describe how the rate of reaction changes with the concentration of sulfuric acid.

..... [1]

(ii) Describe the effect of each of the following on the rate of this reaction with 0.5 mol/dm<sup>3</sup> of sulfuric acid.

- Larger pieces of iron are used.

All other conditions stay the same.

.....

- The temperature is increased.

All other conditions stay the same.

.....

[2]

(c) Heat is given out when iron reacts with sulfuric acid.

What term describes a reaction which gives out heat?

..... [1]

(d) The reaction of iron with steam is shown.



How does this equation show that iron gets oxidised?

.....

..... [1]

(e) Rust contains hydrated iron(III) oxide.

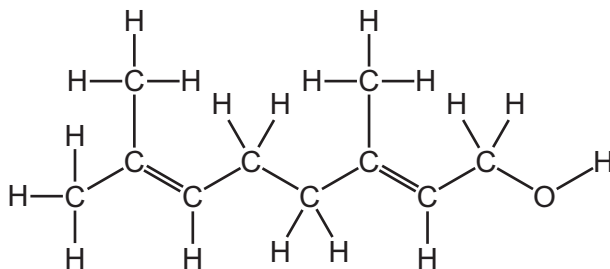
Describe and explain **one** method of preventing iron from rusting.

.....

..... [2]

[Total: 11]

7 The structure of nerol is shown.



(a) Draw a circle around the alcohol functional group on the structure of nerol. [1]

(b) What feature of the nerol molecule shows that it is an unsaturated compound?  
 ..... [1]

(c) Nerol can be extracted from some plants.

Crushed plant leaves containing nerol are mixed with an organic solvent called octane.

Nerol dissolves in octane.

(i) Describe how you would separate the crushed plant leaves from the solution of nerol in octane.  
 ..... [1]

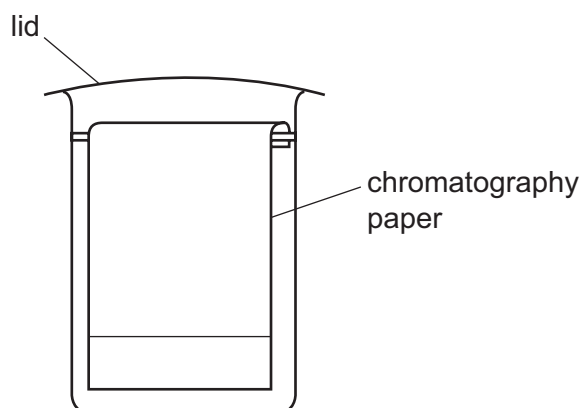
(ii) The boiling point of nerol is 224 °C.  
 The boiling point of octane is 126 °C.

Explain how distillation separates nerol from the octane.

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

(d) The mixture of coloured compounds in plant leaves can be separated by chromatography.

The apparatus is shown.



On the diagram:

- draw an 'X' to show where the mixture of coloured compounds is placed at the start of the experiment
- draw a line to show the level of the solvent at the start of the experiment.

[2]

(e) Ethanol is a solvent.

(i) Draw the structure of ethanol to show all of the atoms and all of the bonds.

[2]

(ii) Complete the sentences about the manufacture of ethanol using words from the list.

**catalyst      hydrocarbon      hydrogen**  
**oxygen      plastic      steam**

Ethanol is manufactured by the reaction of ethene with ..... The rate of this reaction is increased by the use of a .....

[2]

(f) Ethene and propene are in the same homologous series of organic compounds.

Which **two** statements about ethene and propene are correct.

Tick **two** boxes.

They have the same physical properties.

They have the same number of carbon atoms.

They have similar chemical properties.

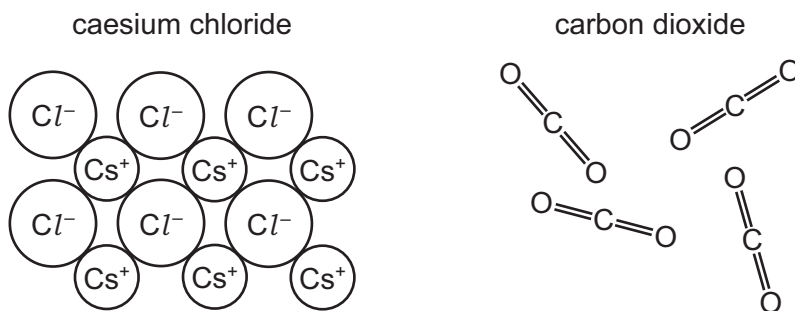
They have the same number of hydrogen atoms.

They have the same functional group.

[2]

[Total: 13]

- 8 The diagram shows part of the structures of caesium chloride and carbon dioxide.



- (a) Describe both caesium chloride and carbon dioxide in terms of:

- bonding

.....

.....

.....

.....

- solubility in water

.....

.....

- arrangement of particles.

.....

.....

[5]

- (b) Caesium oxide is a compound.

What is meant by the term *compound*?

.....

..... [1]

- (c) Explain why caesium is **not** extracted from caesium oxide by heating with carbon.

..... [1]



(d) Caesium is a metal.

Describe **two** properties that are characteristic of most metals.

1 .....

2 .....

[2]

(e) Carbon dioxide is a gas.

(i) Which **one** of these processes does **not** produce carbon dioxide?

Tick **one** box.

the reaction of hydrochloric acid with calcium carbonate

respiration in animals and plants

the reaction of hydrochloric acid with magnesium

the thermal decomposition of calcium carbonate

[1]

(ii) Carbon dioxide is a greenhouse gas.

Give **one** effect of an increase in the concentration of greenhouse gases in the atmosphere.

..... [1]

[Total: 11]



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