

Wednesday 1 February 2012 – Afternoon

**GCSE GATEWAY SCIENCE
CHEMISTRY B**

B642/02 Unit 2 Modules C4 C5 C6 (Higher Tier)

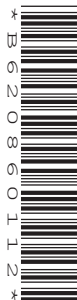
Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: 1 hour



Candidate forename		Candidate surname	
Centre number		Candidate number	

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The Periodic Table is printed on the back page.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.

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3

Answer **all** the questions.**Section A – Module C4**

- 1 This question is about acids, bases and salts.

Look at this list of compounds.

ammonia, NH_3

ammonium nitrate, NH_4NO_3

calcium carbonate, CaCO_3

hydrochloric acid, HCl

sodium chloride, NaCl

sodium hydroxide, NaOH

sulfuric acid, H_2SO_4

Choose compounds only from this list to answer the questions.

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

- (a) Write down the name of a compound that reacts with magnesium carbonate to make carbon dioxide.

..... [1]

- (b) Which **two** compounds react together to make sodium chloride?

..... and [1]

- (c) Write down the name of a compound that has a high concentration of hydrogen ions when in solution.

..... [1]

[Total: 3]

- 2 Ammonium phosphate is a fertiliser.

The formula for ammonium phosphate is $(\text{NH}_4)_3\text{PO}_4$.



- (a) (i) Calculate the relative formula mass, M_r , for ammonium phosphate.

The relative atomic mass of H = 1, of N = 14, of O = 16 and of P = 31.

.....

.....

.....

.....

relative formula mass = [1]

- (ii) Calculate the percentage by mass of nitrogen in ammonium phosphate.

.....

.....

.....

% by mass = [1]

- (b) A factory makes ammonium phosphate.

Ian predicts the factory should make 25 tonnes of ammonium phosphate.

The factory actually makes 17.5 tonnes of ammonium phosphate.

What is the percentage yield?

.....

.....

.....

percentage yield = % [2]

5

- (c) A farmer accidentally uses too much ammonium phosphate fertiliser.

Some of the ammonium phosphate gets washed into a river.

This causes **eutrophication**.

Eventually organisms living in the river will die.

Describe how eutrophication leads to the death of these organisms.

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..... [3]

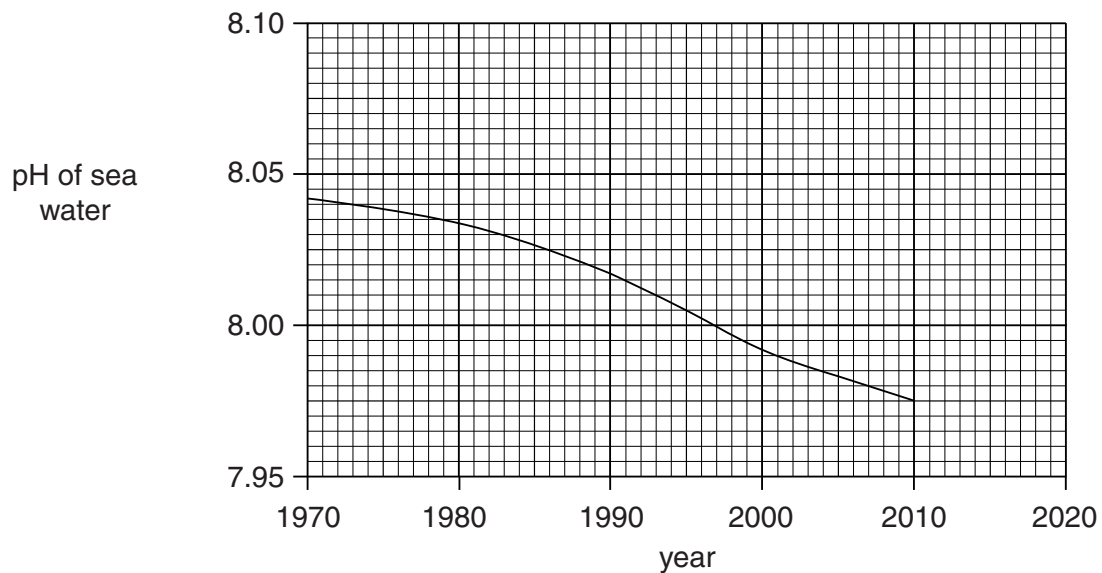
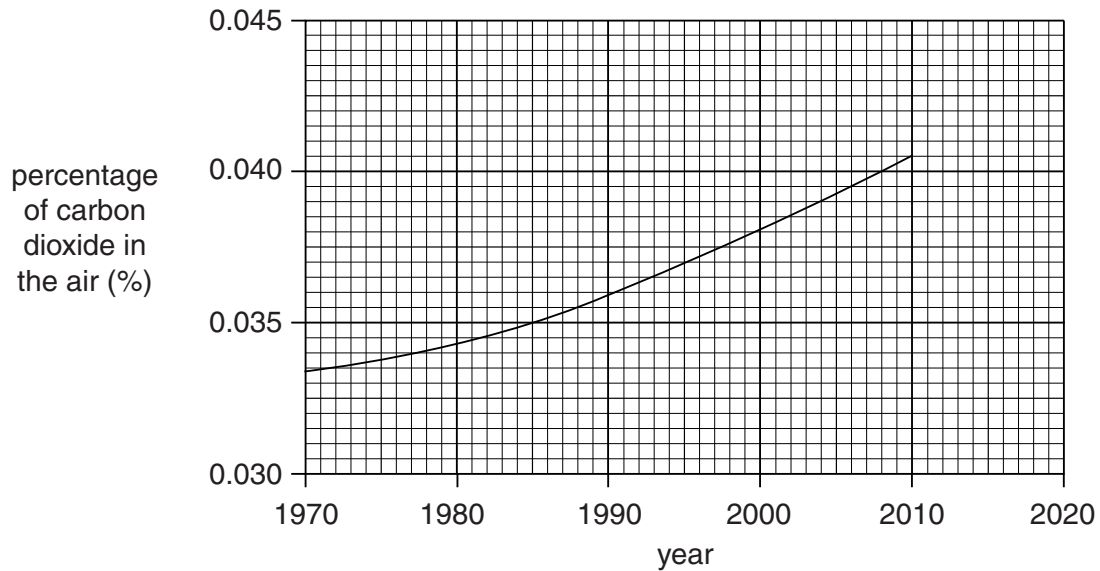
[Total: 7]

- 3 Some scientists think there is a connection between the pH of sea water and the percentage of carbon dioxide in the air.

Look at the two graphs.

One graph shows how the percentage of carbon dioxide in the air has changed since 1970.

The other graph shows how the pH of sea water has changed since 1970.



7

- (a) Describe the relationship between the percentage of carbon dioxide in the air and the pH of sea water.

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

- (b) Scientists do not use universal indicator to measure the changes in pH of sea water.
Suggest why.

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

- (c) Scientists know that carbon dioxide, CO_2 , reacts with water, H_2O , to make an acid.

The acid is called carbonic acid, H_2CO_3 .

Construct a **balanced symbol** equation for this reaction.

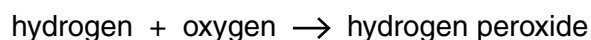
..... [1]

[Total: 3]

- 4 Hydrogen peroxide solution is used to sterilise contact lenses.

Look at the word equation.

It shows the overall process used to make hydrogen peroxide.



This continuous process uses a catalyst and a temperature of 45 °C.

One factor that affects the cost of making hydrogen peroxide is the availability of oxygen.

The oxygen is obtained cheaply from the air.

- (a) Using a catalyst makes the reaction faster.

Explain how this reduces the cost of making hydrogen peroxide.

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

- (b) Describe and explain two **other** ways of reducing the cost of making hydrogen peroxide.

factor 1

explanation
.....

factor 2

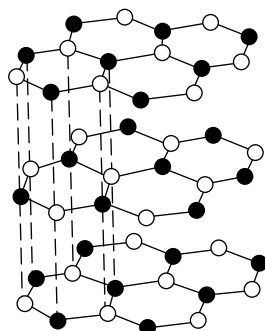
explanation
..... [2]

[Total: 3]

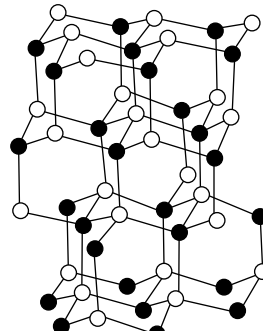
- 5 Boron nitride, BN, exists in two different forms.

The forms have structures that are similar to graphite and diamond.

Look at the structures of these two forms of boron nitride.



structure **A**



structure **B**

- (a) Structure **A** has a structure similar to graphite.

Explain why boron nitride with structure **A** is slippery.

.....

 [1]

- (b) Structure **B** has a structure similar to diamond.

- (i) Boron nitride with structure **B** does not conduct electricity.

Explain why.

.....
 [1]

- (ii) Boron nitride with structure **B** has a very high melting point.

Explain why.

.....

 [2]

[Total: 4]

10

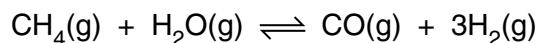
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Section B – Module C5

- 6 Hydrogen is manufactured from methane and water.

Look at the balanced symbol equation for this reaction.



- (a) Kate calculates that 6 tonnes of hydrogen, H_2 , can be made from 16 tonnes of methane, CH_4 .

What mass of hydrogen can be made from 320 tonnes of methane?

.....

.....

.....

mass of hydrogen = tonnes [1]

- (b) The reaction between methane and water is reversible.

The reaction reaches an equilibrium.

Put ticks (✓) next to the **two** sentences that are correct.

At equilibrium the forward and backward reactions have stopped.

☐

At equilibrium the rate of the forward reaction is greater than the backward reaction.

☐

At equilibrium the rate of the forward reaction is the same as the backward reaction.

☐

At equilibrium the concentrations of the reactants are the same as the concentrations of the products.

☐

At equilibrium the concentrations of the reactants and of the products do not change.

☐

[2]

- (c) The conditions for the reaction are 700 °C and 30 atmospheres pressure.

At these conditions the **position of equilibrium is on the right**.

What is meant by 'the position of equilibrium is on the right'?

.....

..... [1]

[Total: 4]

- 7 Ali uses the internet to find out about sea water.

Look at the table of information he finds.

It shows the concentration of ions in sea water.

name of ion	formula of ion	concentration in g/dm ³
calcium	Ca ²⁺	0.40
chloride	Cl ⁻	19.00
hydrogencarbonate	HCO ₃ ⁻	0.14
magnesium	Mg ²⁺	1.26
potassium	K ⁺	0.38
sodium	Na ⁺	10.56
sulfate	SO ₄ ²⁻	2.65

- (a) One of the substances dissolved in sea water is sodium sulfate.

What is the formula for sodium sulfate?

..... [1]

- (b) Ali measures out a 3000 cm³ sample of sea water.

What is the mass, in grams, of calcium ions in the sample?

.....

mass =g [1]

- (c) What is the concentration, in mol/dm³, of chloride ions in sea water?

The relative atomic mass, A_r , of Cl = 35.5.

.....

concentration =mol/dm³ [1]

13

- (d) Ali tests a sample of sea water with barium chloride solution.

Barium chloride solution contains barium ions, Ba^{2+} .

The sulfate ions, SO_4^{2-} , in the sea water react with the barium ions.

A white precipitate of barium sulfate, BaSO_4 , is made.

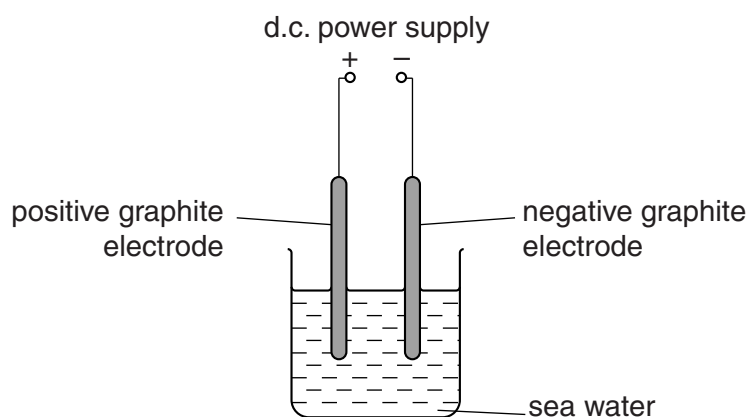
Write the **balanced ionic** equation for this reaction.

Include **state symbols** in your equation.

..... [2]

- (e) Ali decides to investigate the electrolysis of sea water.

Look at the apparatus he uses.



Ali turns on the d.c. power supply.

Bubbles are seen at both electrodes.

This shows that electrolysis is happening.

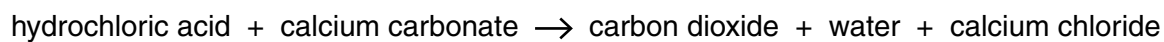
Suggest why it is possible to electrolyse sea water.

Use ideas about particles.

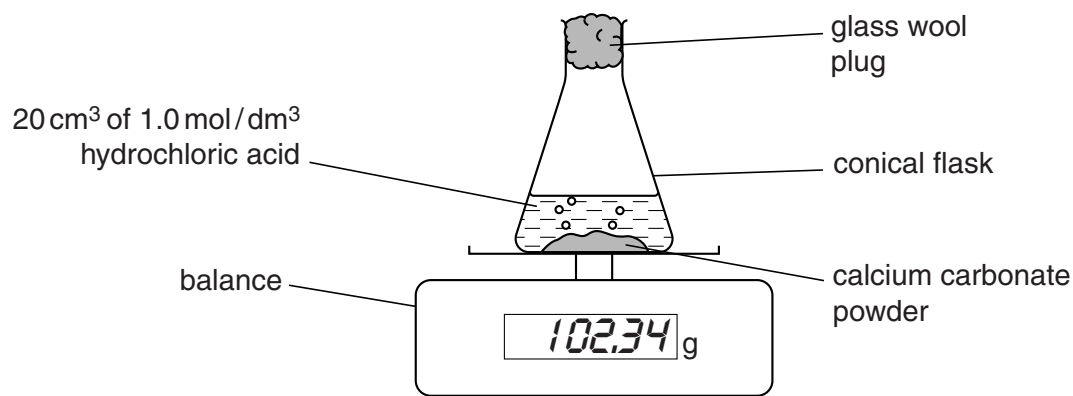
.....
 [2]

[Total: 7]

- 8 Hazel investigates the reaction between hydrochloric acid and calcium carbonate.



Look at the apparatus she uses.



Every minute she records the mass on the balance.

Look at the table of her results.

time in minutes	mass in grams
0	102.34
1	102.29
2	102.24
3	102.19
4	102.14
5	102.09
6	102.04
7	101.99
8	101.95
9	101.92
10	101.91
11	101.90
12	101.90
13	101.90

15

- (a) The reaction finishes after 11 minutes.

Calculate

- the total mass of carbon dioxide, CO_2 , made
- the amount, in moles, of carbon dioxide made
- the volume, in dm^3 , of carbon dioxide made.

The relative atomic mass of C = 12 and of O = 16.

One mole of gas at room temperature and pressure has a volume of 24 dm^3 .

.....

.....

.....

.....

.....

..... [3]

- (b) Hazel uses 20.0 cm^3 of 1.00 mol/dm^3 hydrochloric acid.

Calculate the amount, in moles, of hydrochloric acid Hazel uses.

.....

..... [1]

- (c) Hazel repeats the experiment.

This time she uses 20.0 cm^3 of 1.00 mol/dm^3 ethanoic acid and excess calcium carbonate.

- (i) The same volume of carbon dioxide is made.

Explain why.

.....

..... [1]

- (ii) The reaction is slower than with hydrochloric acid.

Explain why.

Use ideas about hydrogen ions.

.....

.....

..... [2]

[Total: 7]

Turn over

16

- 9 The molecular formula of butane is C_4H_{10} .

The molar mass of butane is 58 g/mol.

- (a) The empirical formula for butane is C_2H_5 .

What is meant by the words **empirical formula**?

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

- (b) The molar mass of butane can be calculated from relative atomic masses.

Complete the following sentence about relative atomic mass.

The relative atomic mass of an element is the average mass of an atom of an element

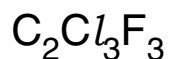
compared to the mass of
..... [1]

[Total: 2]

Section C – Module C6

10 Freon is a CFC.

The formula of freon is



(a) CFCs can be used as refrigerants and aerosol propellants.

The use of CFCs has been banned in the UK.

Explain why.

.....

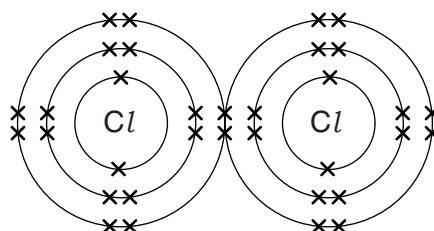
.....

.....

.....

..... [2]

(b) Look at the diagram. It shows the electron arrangement of a chlorine molecule.



The two chlorine atoms are joined by the shared pair of electrons in the covalent bond.

The covalent bond can be broken to make two free radicals.

Explain what happens to the shared pair of electrons when free radicals are made.

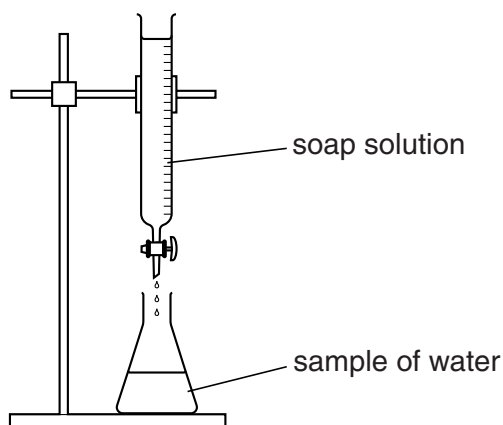
.....

..... [1]

[Total: 3]

11 Judi and Phil are investigating samples of water.

Look at the diagram. It shows the apparatus they use.



They add soap solution to samples of water and shake them.

They add more soap solution until a permanent lather is made.

Look at the table of their results.

sample	burette reading at start in cm ³	burette reading at end in cm ³	volume of soap solution added in cm ³
distilled water	0.0	1.0	1.0
tap water	1.0	11.0	10.0
boiled tap water	11.0	12.0	1.0
pond water	12.0	17.2	5.2
boiled pond water	17.2	22.4	5.2

(a) (i) The tap water contains only **temporary** hardness.

Explain how you can tell from Judi and Phil's results.

.....

 [2]

(ii) Why is distilled water used as one of the water samples?

..... [1]

19

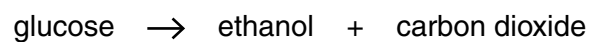
- (b) Temporary hard water contains calcium hydrogencarbonate, $\text{Ca}(\text{HCO}_3)_2$.

Temporary hard water is made when water containing dissolved carbon dioxide reacts with calcium carbonate, CaCO_3 .

Write a **balanced symbol** equation for this reaction.

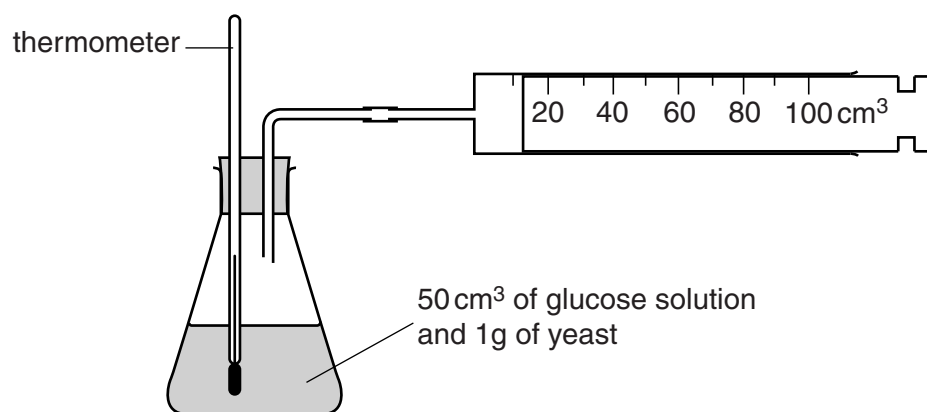
..... [2]

[Total: 5]

12 Ethanol is made by fermentation.

Clive and Gill investigate the fermentation of glucose.

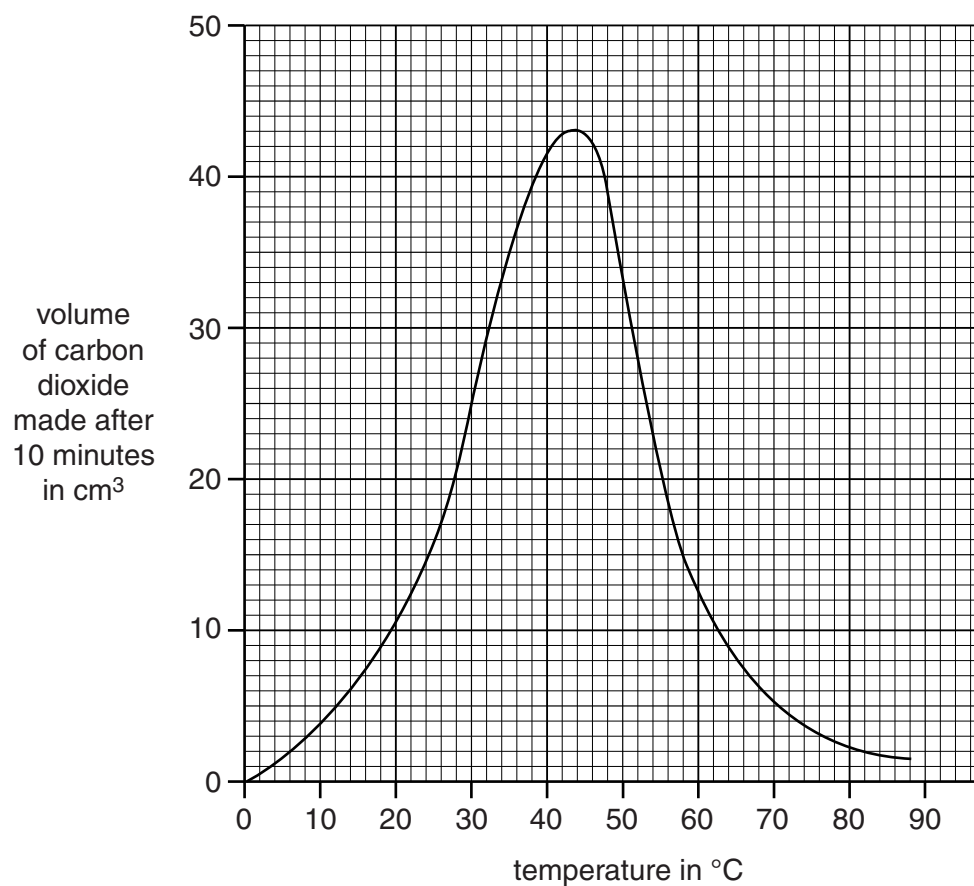
Look at the diagram. It shows the apparatus they use.



Clive and Gill measure the volume of carbon dioxide made after 10 minutes.

They do the investigation 8 times at different temperatures.

Look at the graph. It shows their results.



21

- (a) (i) What is the volume of carbon dioxide made at **25 °C**?

answercm³ [1]

- (ii) What is the **optimum temperature** for fermentation in their investigation?

answer°C [1]

- (b) Ethanol can also be made by hydration.

Ethene and steam are passed over a heated catalyst of phosphoric acid.



Write about the **advantages** and **disadvantages** of making ethanol by

- fermentation
- hydration.

.....

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.....

.....

.....

.....

.....

..... [3]

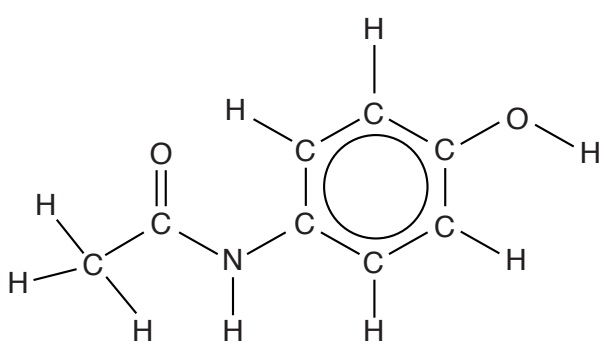
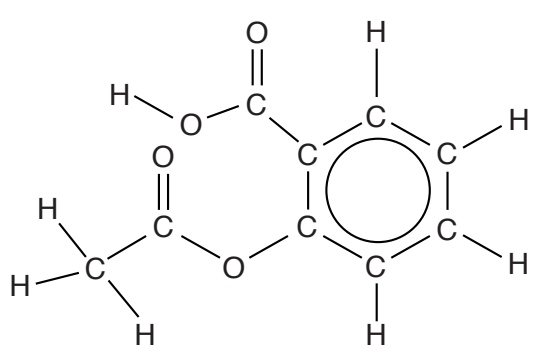
[Total: 5]

13 This question is about medicines.

One type of medicine is an **analgesic**.

Aspirin and paracetamol are analgesics.

Look at the displayed formulas of paracetamol and aspirin.

name	displayed formula
paracetamol	
aspirin	

The molecular formula of paracetamol is $C_8H_9O_2N$.

(a) Write down the molecular formula of aspirin.

..... [1]

(b) Write about one similarity and one difference between the structures of paracetamol and aspirin.

similarity

.....

difference

..... [2]

[Total: 3]

14 This question is about rusting.

John wants to stop his bicycle chain rusting.



(a) John puts oil onto his bicycle chain.

Explain why this stops the chain rusting.

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

(b) Iron can have a piece of magnesium attached to it.

This also stops iron rusting.

Explain how.

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

(c) Write the **word equation** for the rusting of iron.

..... [2]

[Total: 4]

END OF QUESTION PAPER

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The Periodic Table of the Elements

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1	2	Key										3	4	5	6	7	0							
		relative atomic mass atomic symbol name atomic (proton) number																1 H hydrogen 1		4 He helium 2				
7 Li lithium 3	9 Be beryllium 4																	11 B boron 5		12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12																	27 Al aluminium 13		28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36							
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54							
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86							
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated													

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.