

Write your name here

Surname

Other names

**Edexcel GCSE**

Centre Number

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Candidate Number

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**Chemistry**

**Unit C3: Chemistry in Action**

**Higher Tier**

Thursday 23 May 2013 – Morning

**Time: 1 hour**

Paper Reference

**5CH3H/01**

**You must have:**

Calculator, ruler

Total Marks

### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*

### Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (\*) are ones where the quality of your written communication will be assessed  
– *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

### Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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**PEARSON**

# The Periodic Table of the Elements

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

1	<b>H</b>	1
	hydrogen	

relative atomic mass
atomic symbol
name
atomic (proton) number

\* 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.



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**Questions begin on next page.**



**Answer ALL questions**

**Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ~~☒~~ and then mark your new answer with a cross ☒.**

**Electrolysis**

**1** (a) The ions in sodium chloride solution are

- sodium ions, Na<sup>+</sup>
- chloride ions, Cl<sup>-</sup>
- hydrogen ions, H<sup>+</sup>
- hydroxide ions, OH<sup>-</sup>

Sodium chloride solution is electrolysed using a direct electric current.

(i) Which of these ions will be attracted to the cathode during the electrolysis of sodium chloride solution?

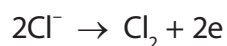
Put a cross (☒) in the box next to your answer.

(1)

- A** H<sup>+</sup> ions only
- B** H<sup>+</sup> and Na<sup>+</sup> ions
- C** Cl<sup>-</sup> ions only
- D** Cl<sup>-</sup> and OH<sup>-</sup> ions

(ii) Chlorine is one of the products of the electrolysis.

The half-equation for the production of chlorine is



Explain how the half-equation shows that chloride ions are oxidised.

(2)

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(iii) Suggest why the solution remaining at the end of the electrolysis is alkaline.

(1)

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(iv) The electrolysis of sodium chloride solution does not produce metallic sodium.

State what change you would make to the electrolyte to obtain metallic sodium.

(1)

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(b) (i) When copper sulfate solution is electrolysed using inert electrodes, oxygen is formed at the positively charged anode.

Explain how the oxygen is formed from ions in the solution.

(2)

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(ii) The other product is copper.

1.27 g of copper were produced in an experiment.

Calculate the number of moles of copper, Cu, produced in this experiment.

(Relative atomic mass: Cu = 63.5)

(1)

.....

amount of copper produced = ..... mol

**(Total for Question 1 = 8 marks)**

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### Organic chemistry

2 (a) (i) Which of the following is the formula for a molecule of butane?

Put a cross (☒) in the box next to your answer.

(1)

- A**  $C_3H_6$
- B**  $C_3H_8$
- C**  $C_4H_8$
- D**  $C_4H_{10}$

(ii) Draw the structure of a molecule of propene, showing all covalent bonds.

(2)

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

Ethanol,  $C_2H_5OH$ , can be converted into ethanoic acid,  $CH_3COOH$ .

In this reaction, ethanol is

(1)

- A** dehydrated
- B** neutralised
- C** oxidised
- D** reduced



(c) (i) Describe what you would **see** when solid sodium carbonate is added to dilute ethanoic acid.

(2)

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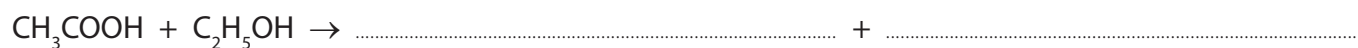
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(ii) When ethanoic acid reacts with ethanol, one of the products is the ester, ethyl ethanoate.

Complete the balanced equation for this reaction.

(2)



**(Total for Question 2 = 8 marks)**



## Ethanol

- 3 (a) Ethanol can be produced by reacting ethene with steam.

Write the balanced equation for this reaction.

(2)

- (b) Ethanol can also be produced by fermentation.

Describe how ethanol can be produced from sugar by fermentation.

(2)

- (c) A country has large amounts of available fertile land.

It has no reserves of crude oil.

It is not a wealthy country.

Explain why this country produces the ethanol it needs by fermentation rather than from ethene.

(3)





(d) Ethanol is a member of the homologous series of alcohols.  
The first three members of the series are

methanol     $\text{CH}_3\text{OH}$

ethanol      $\text{C}_2\text{H}_5\text{OH}$

propanol     $\text{C}_3\text{H}_7\text{OH}$

Use the formulae of these molecules to explain why these alcohols are members of the same homologous series.

(2)

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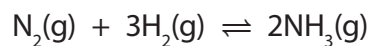
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**(Total for Question 3 = 9 marks)**



### Ammonia

- 4 When nitrogen and hydrogen react to form ammonia, the reaction can reach a dynamic equilibrium.



- (a) Explain what is meant by a **dynamic equilibrium**.

(2)

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- (b) In industry, the reaction between nitrogen and hydrogen is affected by the conditions used.

- (i) The pressure used is 250 atmospheres.

Explain how the use of a higher pressure would affect the equilibrium yield of ammonia.

(2)

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- (ii) The reaction between nitrogen and hydrogen to form ammonia is exothermic. The temperature used is 450 °C.

Explain how the use of a lower temperature would affect the equilibrium yield of ammonia.

(2)

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(iii) Even at 450°C, the reaction is very slow.

State what is used in industry to overcome this problem.

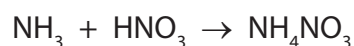
(1)

(c) (i) Calculate the minimum volume of hydrogen required to completely convert 1000 dm<sup>3</sup> of nitrogen into ammonia.

(1)

volume of hydrogen = ..... dm<sup>3</sup>

(ii) Ammonia is reacted with excess nitric acid, HNO<sub>3</sub>, to make ammonium nitrate, NH<sub>4</sub>NO<sub>3</sub>.



Calculate the mass of ammonium nitrate produced by the complete reaction of 34 g of ammonia.

(Relative atomic masses H = 1.0, N = 14, O = 16)

(3)

mass of ammonium nitrate produced = ..... g

**(Total for Question 4 = 11 marks)**



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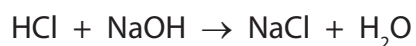
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### Using titration

- 5 Titration can be used to determine the exact amount of hydrochloric acid that reacts with a given amount of sodium hydroxide solution.



- (a) What type of reaction takes place when hydrochloric acid reacts with sodium hydroxide solution?

(1)

Put a cross (☒) in the box next to your answer.

- A** neutralisation
- B** oxidation
- C** precipitation
- D** reduction

- (b) Suggest why universal indicator must not be used in titration experiments.

(1)





(d) Sodium hydroxide solution is titrated with dilute hydrochloric acid.

The results of the experiment are

volume of sodium hydroxide solution = 25.0 cm<sup>3</sup>

volume of 0.100 mol dm<sup>-3</sup> hydrochloric acid used

rough titration = 23.1 cm<sup>3</sup>

1<sup>st</sup> titration = 22.6 cm<sup>3</sup>

2<sup>nd</sup> titration = 22.8 cm<sup>3</sup>

(i) State the volume of hydrochloric acid that must be used to calculate the concentration of sodium hydroxide solution.

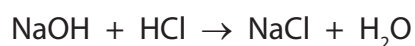
(1)

volume of hydrochloric acid = ..... cm<sup>3</sup>

(ii) In a different experiment, 25.0 cm<sup>3</sup> of sodium hydroxide solution reacted with 23.2 cm<sup>3</sup> of 0.100 mol dm<sup>-3</sup> hydrochloric acid, HCl.

Calculate the concentration of this sodium hydroxide solution, NaOH, in mol dm<sup>-3</sup>.

(3)



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concentration of sodium hydroxide solution = ..... mol dm<sup>-3</sup>

**(Total for Question 5 = 12 marks)**



### Identifying salts

6 (a) Substance **X** is an ammonium salt.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

A test was carried out to find which anion is present in substance **X**.  
Dilute hydrochloric acid was added to a sample of substance **X**.  
There was effervescence and the gas given off turned limewater milky.

The anion present in substance **X** is

(1)

- A** carbonate ion,  $\text{CO}_3^{2-}$
- B** chloride ion,  $\text{Cl}^-$
- C** nitrate ion,  $\text{NO}_3^-$
- D** sulfate ion,  $\text{SO}_4^{2-}$

(ii) Describe how sodium hydroxide solution can be used to show that ammonium ions are present in substance **X**.

(2)

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(b) Aluminium ions,  $\text{Al}^{3+}$ , react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

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