OCR
Oxford Cambridge and RSA

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Wednesday 22 June 2016 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE CHEMISTRY A / FURTHER ADDITIONAL SCIENCE A

A173/01 Module C7 (Foundation 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 quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- The Periodic Table is printed on the back page.
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

1 The Haber process uses nitrogen and hydrogen to make ammonia for fertilisers.

(a) The reaction between nitrogen and hydrogen is reversible.

Complete the equation for the process by drawing the symbol for a reversible reaction in the box.

$N_2 + 3H_2$ ☐ $2NH_3$ **[1]**

(b) The Haber process uses particular conditions to increase the rate of the reaction.

Which conditions increase the rate?

Put ticks (✓) in the boxes next to the **three** correct answers.

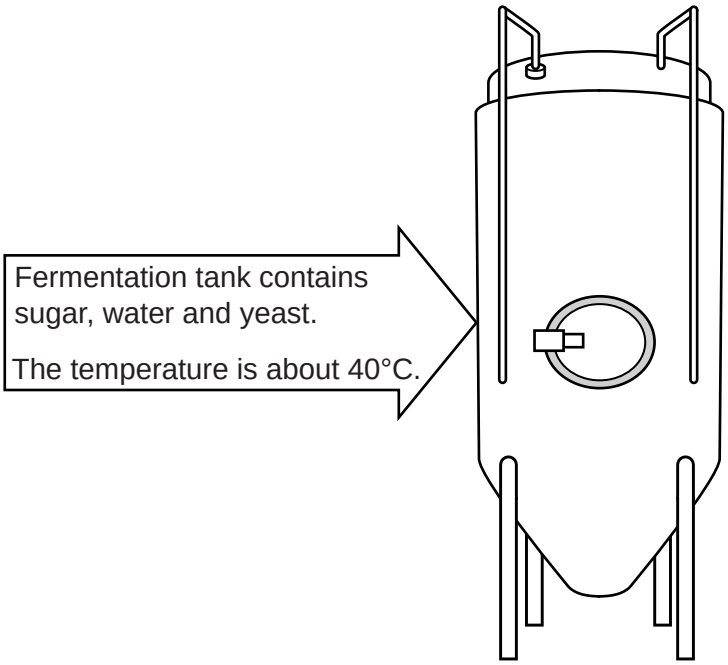
high temperature	☐
using a catalyst	☐
recycling unreacted hydrogen and nitrogen	☐
high pressure	☐
using nitrogen from the air as a feedstock	☐

[2]

[Total: 3]

2 Whisky is an alcoholic drink that contains ethanol.

The first stage in making whisky is fermentation.



(a) Which statements about fermentation are true?

Put ticks (✓) in the boxes next to the **two** correct answers.

The sugar is a waste product of the yeast.	☐
The conditions are optimum for yeast to grow.	☐
A very high temperature would make ethanol much faster.	☐
Yeast uses sugar as a source of food.	☐

[2]

(b) Fermentation can only be used to make solutions that contain about 12% ethanol.

Fermentation **cannot** be used to make the ethanol more concentrated.

Which statement explains why?

Put a tick (✓) in the box next to the correct answer.

The alcohol stops the yeast from working.	☐
There is no sugar left.	☐
The temperature is too low.	☐
The water boils and kills the yeast.	☐

[1]

(c) Whisky contains about 40% ethanol.

After fermentation, another process makes the ethanol solution more concentrated.

What process is used to make the ethanol more concentrated?

Put a (ring) around the correct answer.

desiccation **distillation** **filtration** **saturation** **[1]**

[Total: 4]

3 A company makes chemical compounds and uses them to make products such as fertilisers and drugs.

(a) The table gives information about these products.

Product	Type of process	Use
fertilisers	bulk	spread on soil to help crops grow
drugs	fine	used on people and animals

(i) What is the difference between the processes used to make bulk and fine chemicals?

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

(ii) Monitoring of purity is much more important for compounds used in drugs than for compounds used in fertilisers.

Use the information in the table to help you to explain why.

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

(iii) Each manufacturing process has many stages.

Chemists work in the stages that involve making the chemical compounds.

Which stages involve making the chemical compounds?

Put ticks (✓) in the boxes next to the **two** correct answers.

choosing feedstocks ☐

designing labels ☐

choosing the best reaction conditions ☐

deciding on how the products are advertised ☐

transporting the products ☐

[2]

(b) Millions of tonnes of hydrogen are made every year. In industry, most hydrogen is made by a reaction between methane gas and steam.

methane + steam → hydrogen + carbon dioxide

$CH_4 + 2H_2O \rightarrow 4H_2 + CO_2$

The table shows some information about the process.

Feedstocks	methane (natural gas) and water
Number of stages in process	2
Temperature needed	700–1100 °C
Energy source	burning some of the methane gas
By-products	none
Waste product	carbon dioxide gas
Atom economy	15%

Use the information to help you to explain why this process is **not** sustainable.

The quality of written communication will be assessed in your answer.

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..... **[6]**

(c) Scientists are working on a new process to produce hydrogen.

The new process splits water to make hydrogen. A catalyst is used in the process.

$$2H_2O \rightarrow 2H_2 + O_2$$

(i) What is the name of the by-product of this reaction?

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

(ii) Using a catalyst reduces the energy needed to break up the water.

How does the catalyst work?

Put ticks (✓) in the boxes next to the **two** correct answers.

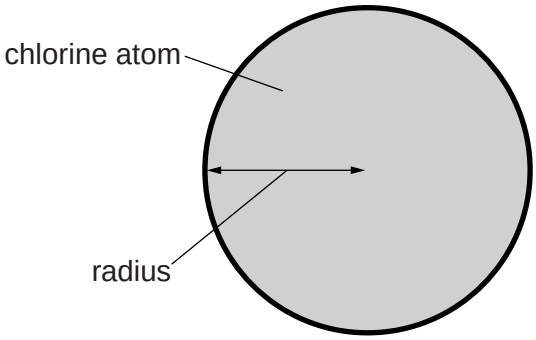
The catalyst increases the time taken for the reaction.	☐
The catalyst lowers the activation energy.	☐
The catalyst provides a different route for the reaction	☐
The catalyst is used up instead of the water.	☐

[2]

[Total: 15]

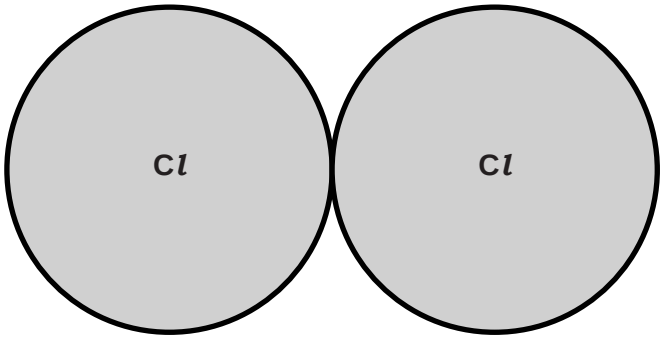
4 Len looks up data about the sizes of atoms of chlorine and some other Group 7 elements.

(a) The size of an atom is measured by measuring its **radius**.



Two atoms bond together to make a molecule.

chlorine molecule
Cl_2

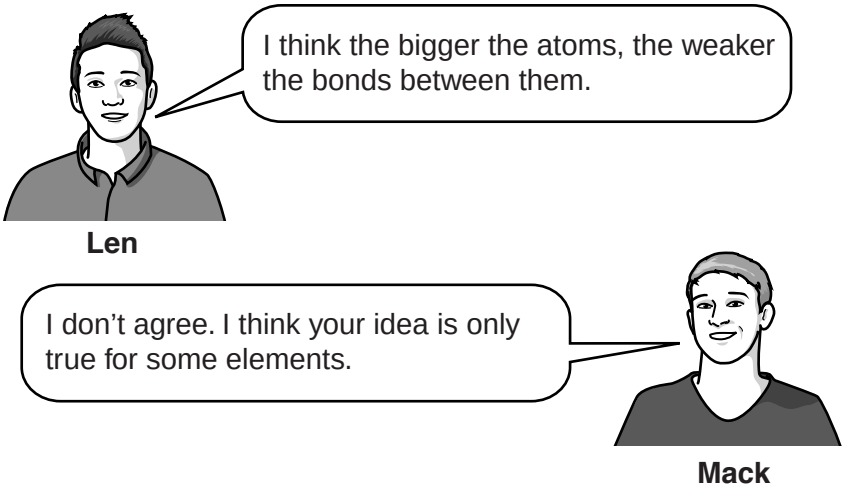


Len also finds out the **energy needed to break the bond** that holds the atoms together in a molecule.

This is his data.

Element	**Radius of an atom (pm)**	**Energy needed to break bond (kJ/mol)**
Fluorine F_2	42	155
Chlorine Cl_2	79	242
Bromine Br_2	94	193
Iodine I_2	115	151

He talks about the data with Mack.



Use examples and data from the table to explain why Len's idea is only true for some elements.

The quality of written communication will be assessed in your answer.

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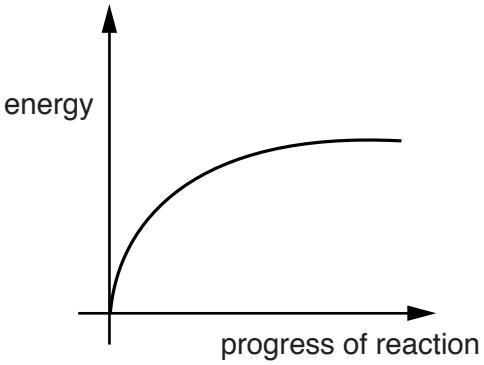
..... **[6]**

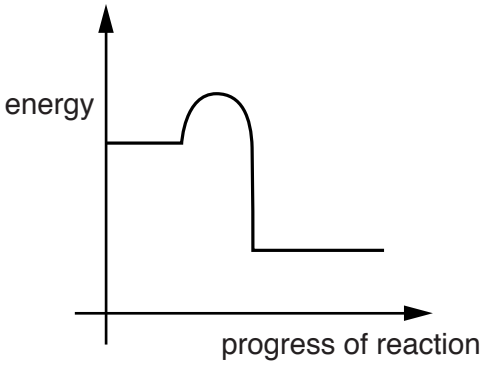
(b) Shining a bright light on a mixture of chlorine gas and hydrogen gas makes it explode.

The reaction is very exothermic.

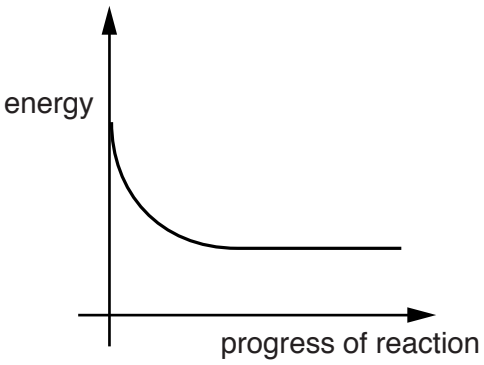
(i) Which energy level diagram, **A**, **B**, **C** or **D**, is correct for the reaction between chlorine and hydrogen?



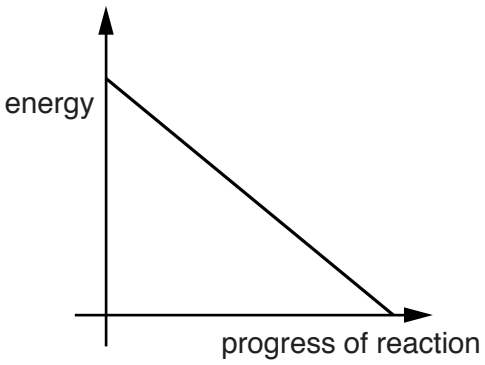
A



B



C



D

Put a ring around the correct answer.

A **B** **C** **D**

[1]

(ii) Complete the sentences about this reaction between chlorine and hydrogen by putting a ring around the correct words in each sentence.

To start the reaction bonds need to **break** / **form**.

To start the reaction, energy is **taken in** / **given out**.

The reaction is exothermic and so overall energy is **taken in** / **given out**.

During the reaction **more** / **less** energy is taken in than given out. **[3]**

[Total: 10]

5 A scientist works in a quality control laboratory for a chemical company.

The company makes acids for use in cleaning products.

(a) The scientist tests two acids, **acid A** and **acid B**.

He does a series of titrations for each acid.

He does a rough titration. He then repeats the titration three times taking more care.

These are his results.

Acid	Volume of sodium hydroxide solution used in cm^3				
	Rough	**Repeat 1**	**Repeat 2**	**Repeat 3**	
A	25.0	24.5	24.4	24.6	
B	28.0	27.7	26.1	25.0	

(i) What is the range of volumes of sodium hydroxide used for the **repeats** for each acid?

range for **acid A**: from ..... to .....cm^3

range for **acid B**: from ..... to .....cm^3

[2]

(ii) The scientist looks at the ranges to decide whether he needs to do more repeats.

Do you think he needs to do more repeats for **acid A**?

Do you think he needs to do more repeats for **acid B**?

Explain your reasons.

acid A .....

.....

acid B .....

.....

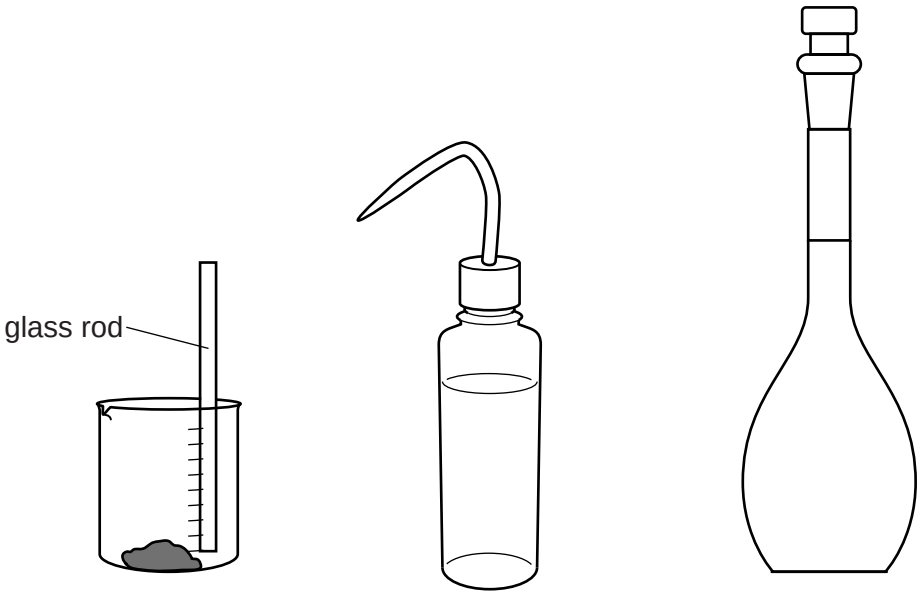
[2]

(b) The scientist tests the quality of one of the cleaning products.

He makes up a standard solution of a cleaning product.

He starts by weighing some of the solid cleaning product into a beaker.

He uses this apparatus to make up his standard solution.



beaker and weighed cleaning product

water

flask

Write down how he should use this apparatus to make a standard solution of cleaning product.

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..... **[4]**

[Total: 8]

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Question 6 begins on page 14

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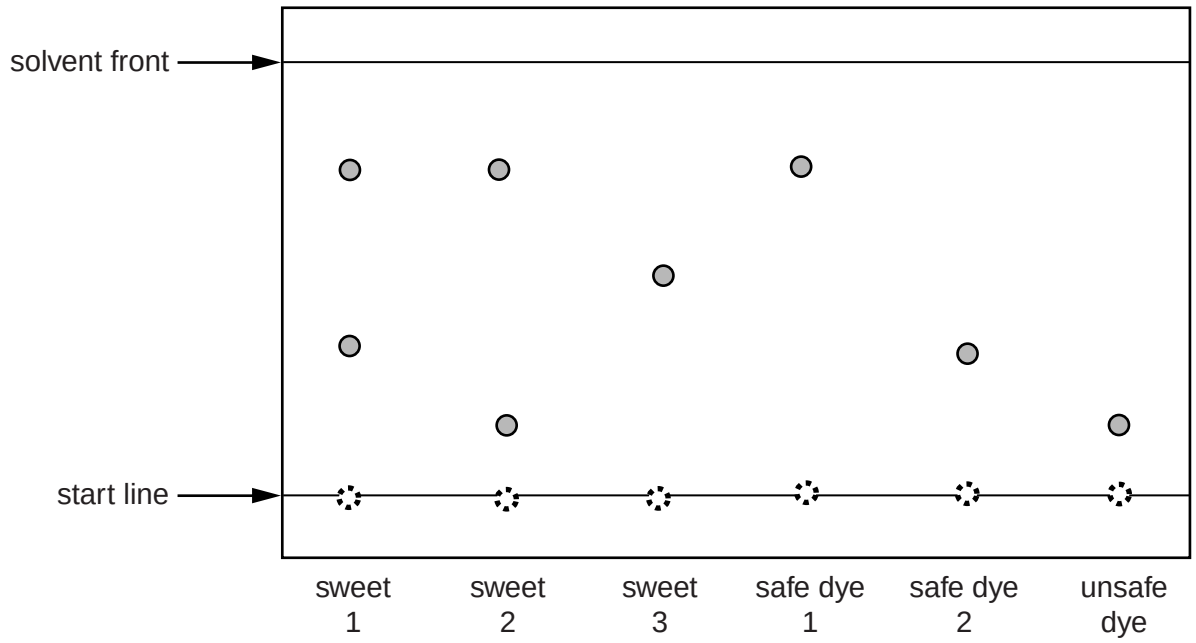
6 Alex uses chromatography to check that the food dyes used in some sweets are safe.

He tests three sweets against three known reference dyes.

Two of the references are known safe dyes.

One reference is a known unsafe dye.

Here is the chromatogram showing his results.



(a) Alex's job is to decide whether or not the sweets contain only safe dyes or if they might contain any unsafe dyes.

What conclusions can you make about the safety of the sweets and the dyes that the sweets contain?

Use the results of the chromatogram to explain your answer.

The quality of written communication will be assessed in your answer.

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..... **[6]**

(b) Alex decides to calculate the *Rf* of safe dye 1.

What measurements does he need to make from the chromatogram to use in his calculation?

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

(c) Alex also uses chromatography to identify the **flavourings** used in sweets.

At the end of his experiment he sprays his chromatogram with a locating agent.

Why does he need to do this?

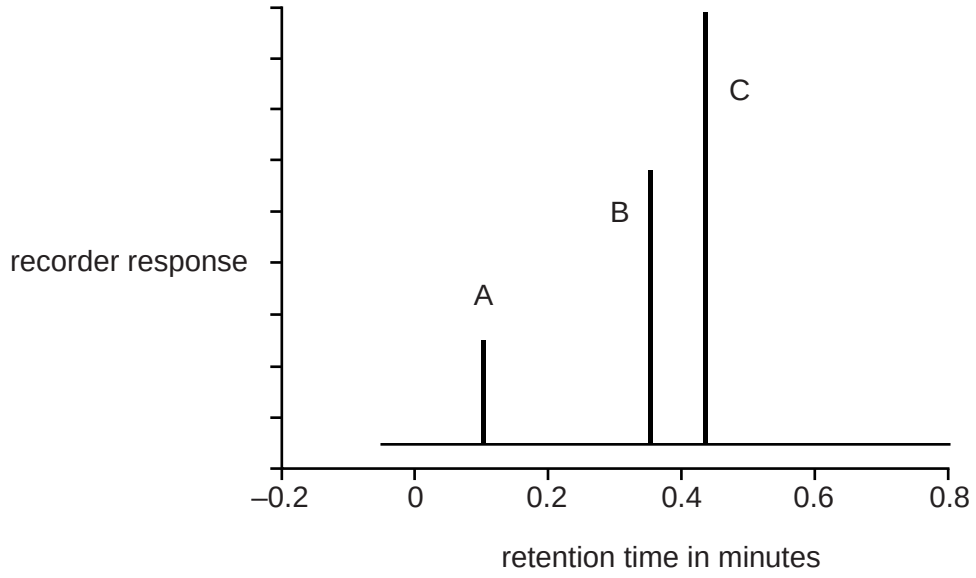
Put a tick (✓) in the box next to the correct answer.

To separate the spots.	☐
To remove the solvent.	☐
To see the spots.	☐
To speed up the movement of the solvent.	☐

[1]

(d) Alex decides to use a chromatography machine to analyse the dyes from a different type of sweet.

This is the printout he gets.



(i) The printout shows that three dyes have been used in the sweet.

Alex thinks that there is more of dye C in the sweet than either dye A or dye B.

How does the printout show that he is right?

Put a tick (✓) in the box next to the correct answer.

Dye C has the highest peak.	☐
Dye C has the longest retention time.	☐
There is more than 0.4 g of dye C in the sweet.	☐
Dyes A and B both have retention times below 0.4 minutes.	☐

[1]

(ii) Alex says that the chromatography printout gives both **qualitative** and **quantitative** information about the dyes used in the sweet.

Explain why this is true.

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

[Total: 12]

7 The table shows some information about the first four alkanes.

Name	Formula
methane	.....
.....	C_2H_6
.....	C_3H_8
butane	.....

(a) Complete the table by filling in the missing boxes. Use names and formulae from these lists.

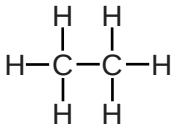
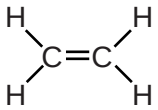
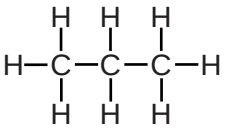
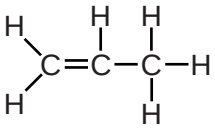
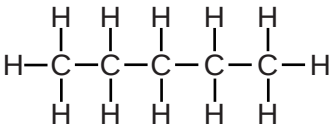
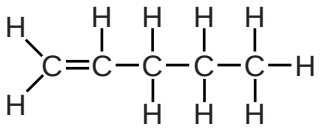
ethanol **propane** **butanol** **ethane** **methanol**

C_2H_4 **CH_4** **C_2H_5OH** **CH_3COOH** **C_4H_{10}**

[3]

(b) Alkenes are another family of hydrocarbons.

The table shows the structures of some alkanes and alkenes that have the same number of carbon atoms.

Number of carbon atoms	Structure of alkane	Structure of alkene
2		
3		
5		

(i) What are the **similarities** and **differences** between the structures of alkanes and alkenes?

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

(ii) Draw the structure of an alkane and an alkene that contain 6 carbon atoms.

alkane	**alkene**

[2]

[Total: 8]

END OF QUESTION PAPER

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							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						

Key

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.