

Wednesday 18 January 2012 – Morning

**GCSE GATEWAY SCIENCE
CHEMISTRY B**

B741/02 Chemistry modules C1, C2, C3 (Higher Tier)

* B 7 3 6 7 0 0 1 1 2 *

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 15 minutes



Candidate forename					Candidate surname				
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Centre number						Candidate number			
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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

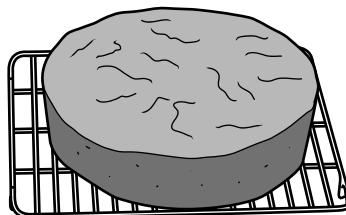
- Your quality of written communication is assessed in questions marked with a pencil (✍).
- The Periodic Table can be found on the back page.
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **75**.
- This document consists of **24** pages. Any blank pages are indicated.

Answer **all** the questions.

Section A – Module C1

- 1 This question is about chemical changes.

- (a) Amir is making a cake.



He adds baking powder to the cake mixture.

Baking powder contains sodium hydrogencarbonate.

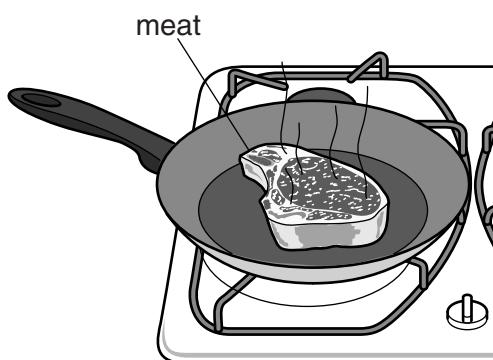
Sodium hydrogencarbonate breaks down when heated in an oven.

Sodium carbonate, water and a gas are the products made.

What gas is made?

..... [1]

- (b) Amir cooks some meat.



Meat contains protein.

What happens to the **protein molecules** when the meat is cooked?

..... [1]

[Total: 2]

2 This question is about the atmosphere.

- (a) The air we breathe is a mixture of gases.

Look at the table. It shows the percentage of gases in clean air.

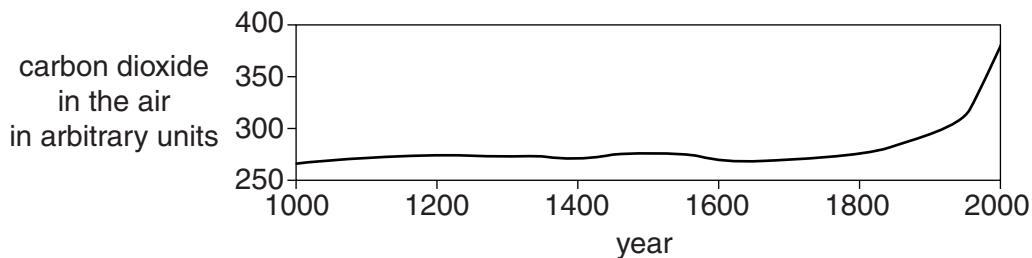
gas	percentage in clean air
nitrogen
oxygen	21
other gases	1
carbon dioxide	0.035

Complete the table.

[1]

- (b) Look at the graph.

The graph shows the carbon dioxide levels in the air from the year 1000 to the year 2000.



Look at the table.

It shows the population of the world in the year 1000, 1800 and 2000.

year	1000	1800	2000
world population in millions	275	1000	6000

Compare the data for population and carbon dioxide levels.

Does an increase in population **directly** cause an increase in carbon dioxide levels?

Explain your answer.

.....

.....

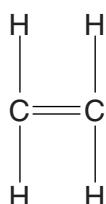
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[2]

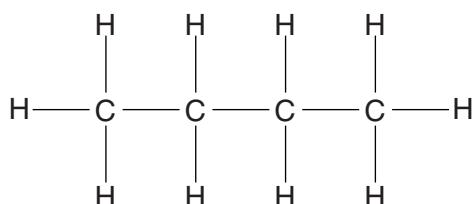
[Total: 3]

- 3 This question is about carbon compounds.

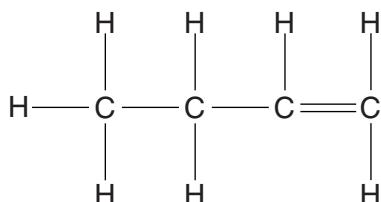
Compounds **A**, **B**, **C** and **D** are hydrocarbons.



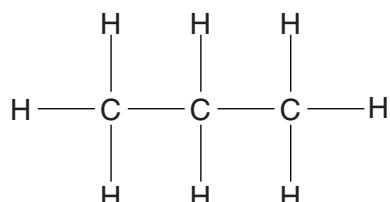
compound **A**



compound **B**



compound **C**



compound **D**

- (a) Look at the displayed formulas of these compounds.

Explain why they are all hydrocarbons.

.....
.....
.....

[2]

- (b) Write down the **molecular formula** of compound **B**.

answer

[1]

- (c) Look at the displayed formulas of compounds **A** and **C**.

Compounds **A** and **C** are **unsaturated**.

Explain why.

.....
.....

[1]

- (d) Compound A is ethene.

Ethene can be polymerised to make poly(ethene) in a process called addition polymerisation.

In polymerisation, small monomer molecules join together to make large polymer molecules.

Describe the addition polymerisation of ethene.

Your answer should include the displayed formula of poly(ethene).



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

[6]

. [6]

[Total: 10]

- 4 This question is about oil and the products from oil.

- (a) Crude oil is transported over long distances by sea and through pipelines.

The UK gets some of its crude oil from politically unstable countries.

Suggest one argument for, and one argument against, getting oil from such countries.

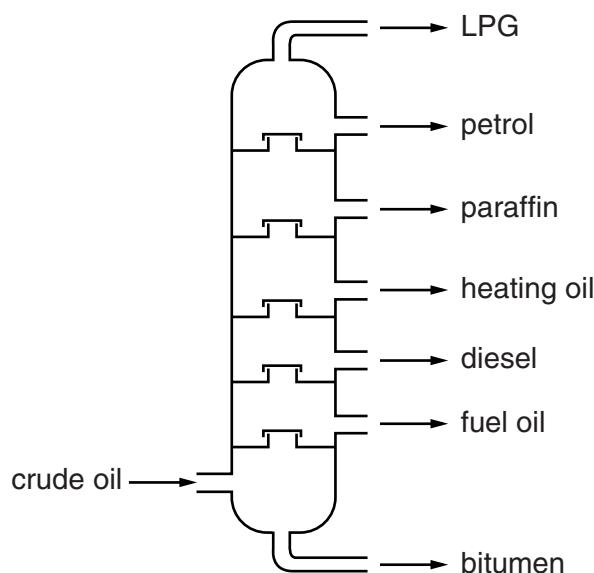
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[2]

- (b) Crude oil is separated into many fractions by fractional distillation.

Look at the diagram.

It shows a fractionating column.



LPG has a lower boiling point than petrol.

Explain why.

.....
.....
.....

[2]

(c) Look at the table.

It shows the percentage of each fraction in crude oil.

It also shows the percentage of each fraction needed for everyday use.

fraction	% in crude oil	% needed
LPG	4	4
petrol	5	22
heating oil	9	5
diesel	19	23
paraffin	13	8
fuel oil and bitumen	50	38

The table shows that fractional distillation cannot supply all the petrol that is needed.

Explain how an oil refinery uses **cracking** to make sure that enough petrol is made.

Use information from the table.

.....

.....

.....

[2]

(d) Look at the table.

It gives information about some fuels.

fuel	energy released by one gram of fuel in kJ	products of burning	availability
ethene	44.3	carbon dioxide and water	limited
hydrogen	143.0	water	limited
LPG	55.6	carbon dioxide and water	available
petrol	48.3	carbon dioxide, water and other gases	widely available

Petrol can be used to power a car.

Recommend one of these fuels as an alternative fuel to petrol.

fuel

Explain your answer using information from the table.

.....
.....
.....
.....

[2]

(e) Ethene, C_2H_4 , reacts with oxygen, O_2 .

Carbon dioxide and water are made.

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

.....

[Total: 10]

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Question 5 begins on page 10.

PLEASE DO NOT WRITE ON THIS PAGE

Section B – Module C2

- 5 George is researching information about construction materials on the internet.

Look at his results.

material	formula	density in g/cm ³	relative hardness (1=soft, 10=very hard)	relative strength (1=weak, 500=very strong)
brick	no information	2.0	6	3
steel	mainly Fe	7.7	6	400
limestone	CaCO ₃	2.4	3	7
granite	mainly SiO ₂	2.9	7	23
lead	Pb	11.4	1	12
marble	CaCO ₃	2.7	5	15
copper	Cu	8.9	3	200
wood	no information	0.9	0.8	1

- (a) Which material would be the **most** scratch resistant?

Choose from the table.

Explain your answer.

.....

.....

.....

[2]

- (b) Look at the picture of a girder bridge.



Which material would be best to use to make the girders of this bridge?

Choose from the table.

Explain your answer.

.....
.....
.....

[2]

- (c) Marble, granite and wood are materials that can be used to make a kitchen worktop.

Describe the **advantages** and **disadvantages** of marble, granite and wood for making a kitchen worktop.

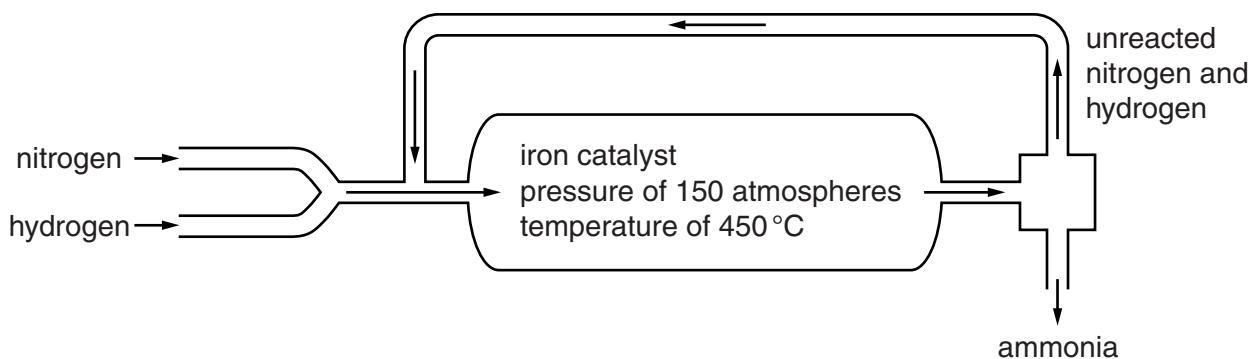
Use information from the table.

.....
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[3]

[Total: 7]

- 6 Look at the diagram. It shows how ammonia is made in the Haber process.



- (a) Unreacted nitrogen and hydrogen are recycled.

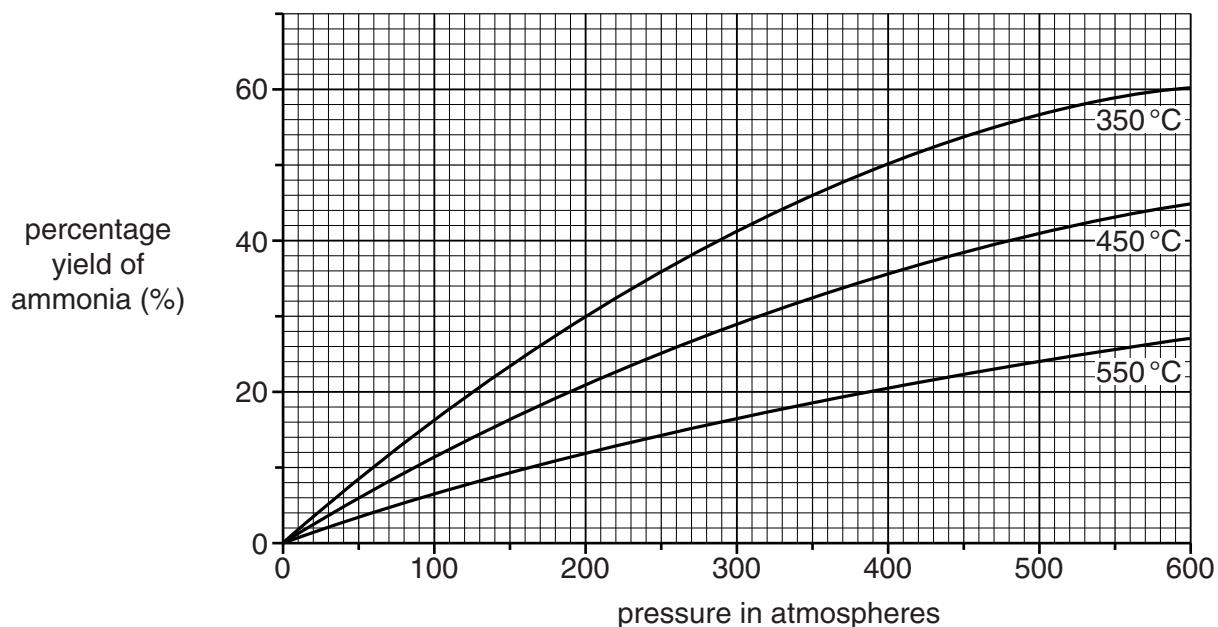
Explain why.

.....
.....

[1]

- (b) Look at the graph.

It shows the percentage yield of ammonia at different temperatures and pressures.



What is the percentage yield of ammonia at **450 °C** and **400 atmospheres**?

answer %

[1]

(c) Look at the graph.

- (i) What conditions, shown on the graph, give the **highest** yield of ammonia?

pressure = atmospheres

temperature = °C

[1]

- (ii) Ammonia is manufactured at 450 °C and 150 atmospheres using an iron catalyst.

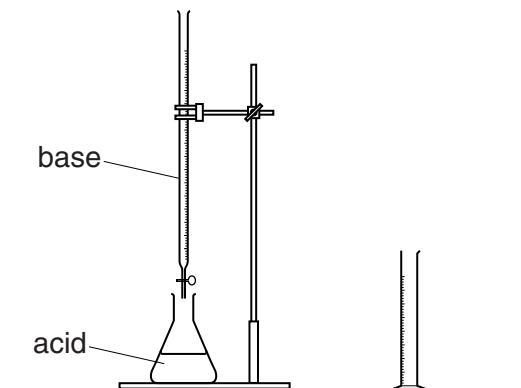
Explain why these conditions are used.

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[3]

[Total: 6]

- 7 Jade and Philip are making fertilisers by neutralisation.



- (a) Complete the **word** equation for neutralisation.



[1]

- (b) Jade and Philip want to make potassium nitrate.

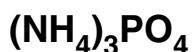
Which **acid** and which **base** should they use?

.....
.....

[2]

- (c) Jade and Philip also make ammonium phosphate.

The formula of ammonium phosphate is



What is the total number of **atoms** in this formula?

.....

[1]

[Total: 4]

- 8** Scientists accept that the surface of the Earth is made up of **tectonic plates**.

(a) Describe the theory of plate tectonics and use this theory to explain subduction.



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

[6]

[6]

(b) Geologists study the structure of the Earth.

This is not an easy thing to do.

Explain why.

[2]

[2]

[Total: 8]

Section C – Module C3

- 9 Pharmaceutical drugs or medicines are speciality chemicals.



- (a) Pharmaceutical drugs are often made by batch processes rather than continuous processes.

Explain why.

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.....
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[1]

- (b) Pharmaceutical drugs often cost a lot of money to make and develop.

One reason is that it takes many years to research and test a new drug.

Explain **two** other reasons why it is expensive to make and develop a new drug.

.....
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.....
.....

[2]

- (c) Pharmaceutical drugs need to be tested to make sure they are safe to use.

The research and testing of pharmaceutical drugs may include

- animal testing
- testing on human volunteers.

The ideas and views of people in society affect the work of scientists.

Suggest how the ideas and views of people in society have changed the way scientists research and test pharmaceutical drugs.

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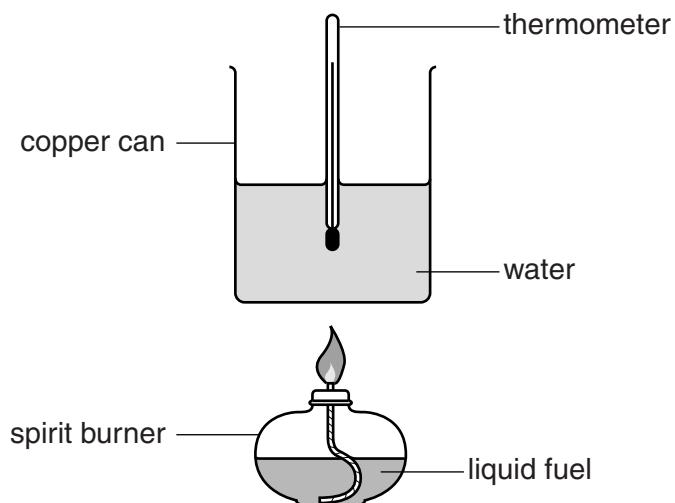
[2]

[Total: 5]

- 10 Petrol is a mixture of hydrocarbons.

David investigates the energy released when five of these hydrocarbons are burned.

Look at the apparatus he uses.



Each time, he burns 0.5 g of hydrocarbon and heats 100 g of water.

David measures the temperature of the water before heating.

He measures the temperature again when the hydrocarbon has finished burning.

These are his results.

hydrocarbon	molecular formula	temperature of water in °C	
		at start	at end
hexane	C ₆ H ₁₄	20	40
heptane	C ₇ H ₁₆	19	41
octane	C ₈ H ₁₈	15	39
nonane	C ₉ H ₂₀	18	45
decane	C ₁₀ H ₂₂	20	46

- (a) Calculate the energy released per gram by **hexane**.

Use the equation

$$\text{energy} = \text{mass} \times \text{specific heat capacity} \times \text{temperature change}$$

The specific heat capacity of water is 4.2 J/g°C.

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energy released per gram = J/g

[2]

- (b) David knows that the bigger the hydrocarbon molecule, the more carbon atoms it has.

David concludes that the bigger the hydrocarbon molecule, the more energy per gram is released.

Explain whether David's results fully support this conclusion.

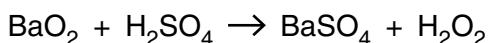
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[2]

[Total: 4]

- 11 Hydrogen peroxide has the molecular formula H_2O_2 .

Hydrogen peroxide can be manufactured by reacting barium peroxide, BaO_2 , with sulfuric acid, H_2SO_4 .



Barium sulfate, BaSO_4 , is a waste product.

Look at the table of relative formula masses, M_r .

formula	relative formula mass, M_r
BaO_2	169
H_2SO_4	98
BaSO_4	233
H_2O_2	34

- (a) Show that the **atom economy** for the reaction is 12.7%.

.....
.....
.....

[1]

- (b) A factory makes 18 tonnes of hydrogen peroxide.

Phil predicts the factory should make 20 tonnes of hydrogen peroxide.

Calculate the **percentage yield** of hydrogen peroxide.

.....
.....
.....

percentage yield = %

[2]

- (c) The manufacture of hydrogen peroxide from barium peroxide is **not sustainable**.

Explain why.

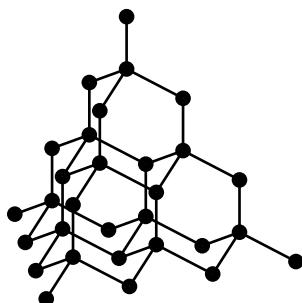
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[1]

[Total: 4]

- 12 Diamond is a form of carbon.

Look at the structure of diamond.



Scientists use the structure **and** bonding of a substance to explain its properties.

- (a) Diamond has a very high melting point.

Explain why.

.....
.....
.....
.....

[2]

- (b) Diamond does not conduct electricity.

Explain why.

.....
.....

[1]

[Total: 3]

- 13 Magnesium reacts with dilute hydrochloric acid, HCl .

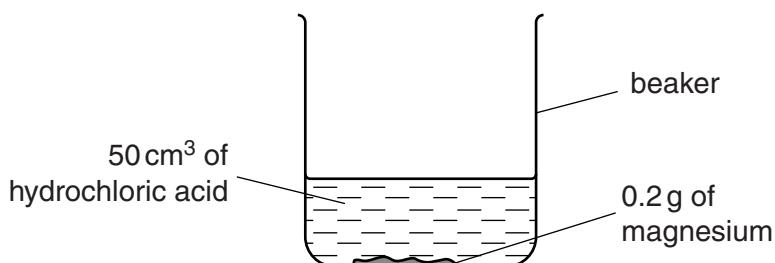
Magnesium chloride and hydrogen, H_2 , are made.

- (a) Write down the **balanced symbol** equation for this reaction.

..... [2]

- (b) Peter and Rachel investigate the reaction between magnesium and hydrochloric acid.

Look at the apparatus they use.



They time how long it takes for all of the magnesium to react (the reaction time).

Look at their results.

experiment	temperature of acid	concentration of acid	magnesium ribbon or powder	reaction time in seconds	mean rate of reaction in g/s
A	cold	dilute	ribbon	240	8.33×10^{-4}
B	cold	concentrated	ribbon	120	
C	warm	dilute	ribbon	100	2.00×10^{-3}
D	cold	dilute	powder	50	4.00×10^{-3}

- (i) Look at the results for experiment B.

Calculate the mean rate of reaction in experiment B.

Give your answer to **three** significant figures.

.....
.....

rate of reaction = g/s

[1]

- (ii) Peter and Rachel can use a model called **collision theory** to explain how factors affect the rate of a reaction.

They know the rate of reaction increases when

- the temperature of the acid increases
- magnesium powder is used instead of magnesium ribbon.

Explain why, using collision theory.



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

[6]

[Total: 9]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2	3	4	5	6	7	0
Li lithium 3	Be beryllium 4	Ca calcium 20	Sc scandium 21	Ti titanium 22	V vanadium 23	Cr chromium 24	Mn manganese 25
K potassium 19	Ca strontium 38	Y yttrium 39	Nb niobium 41	Zr zirconium 40	Y yttrium 39	Mo molybdenum 42	Tc technetium 43
Rb rubidium 37	Sr strontium 38	La* lanthanum 57	Ba barium 56	Ta tantalum 73	Hf hafnium 72	W tungsten 74	Ru rhodium 45
Cs caesium 55	Fr francium 87	Ac* actinium 89	Ra radium 88	Db dubnium 105	Rf rutherfordium 104	Sg seaborgium 106	Mt meitnerium 108
[223]	[226]	[227]	[261]	[262]	[264]	[266]	[277]
Key	relative atomic mass atomic symbol name atomic (proton) number	atomic symbol name atomic (proton) number					
1 H hydrogen 1	2 He helium 2	3 Li lithium 3	4 Be beryllium 4	5 B boron 5	6 C carbon 6	7 N nitrogen 7	8 O oxygen 8
9 Be beryllium 4	10 Mg magnesium 12	11 B boron 5	12 C carbon 6	13 Al aluminum 13	14 Si silicon 14	15 P phosphorus 15	16 S sulfur 16
17 Cl chlorine 17	18 Ar argon 18	19 F fluorine 9	20 Ne neon 10	21 Br bromine 35	22 Se selenium 34	23 Te tellurium 52	24 Kr krypton 36
25 Cu copper 29	26 Fe iron 26	27 Ga gallium 31	28 Ge germanium 32	29 Zn zinc 30	30 As arsenic 33	31 Sb antimony 51	32 I iodine 53
33 Ni nickel 28	34 Co cobalt 27	35 In indium 49	36 Sn tin 50	37 Cd cadmium 48	38 Ge germanium 32	39 Sb antimony 51	40 Po polonium 84
41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Sc scandium 21	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48
49 Zr zirconium 40	50 Nb niobium 41	51 V vanadium 23	52 Cr chromium 24	53 Mn manganese 25	54 Fe iron 26	55 Co cobalt 27	56 Mn manganese 25
57 Ta tantalum 73	58 Tc technetium 43	59 Co cobalt 27	60 Rh rhodium 45	61 Ru ruthenium 44	62 Pd palladium 46	63 Ag silver 47	64 Cd cadmium 48
59 Ni nickel 28	60 Rh rhodium 45	61 Ru ruthenium 44	62 Pd palladium 46	63 Ag silver 47	64 Cd cadmium 48	65 Zn zinc 30	66 Ge germanium 32
67 Ir iridium 77	68 Os osmium 76	69 Pt platinum 78	70 Ga gallium 31	71 Ge germanium 32	72 Sb antimony 51	73 Se selenium 34	74 Br bromine 35
75 W tungsten 74	76 Os osmium 76	77 Tl thallium 81	78 Sn tin 50	79 Au gold 79	80 Po polonium 84	81 Bi bismuth 83	82 At astatine 85
77 Hs hassium 108	78 Mt meitnerium 109	79 Ds darmstadtium 110	80 Rg roentgenium 111	81 Rg roentgenium 111	82 At astatine 85	83 Rn radon 86	84 Kr krypton 36
85 Fr francium 87	86 Ra radium 88	87 Ac* actinium 89	88 Rf rutherfordium 104	89 Db dubnium 105	90 Bh bohrium 107	91 Hs hassium 108	92 Mt meitnerium 109
93 Nb niobium 41	94 Tc technetium 43	95 Ru ruthenium 44	96 Os osmium 76	97 Pt platinum 78	98 Ir iridium 77	99 Hs hassium 108	100 Mt meitnerium 109
99 Ru ruthenium 44	100 Os osmium 76	101 Rh rhodium 45	102 Pd palladium 46	103 Ru ruthenium 44	104 Ir iridium 77	105 Pt platinum 78	106 Hs hassium 108
103 Rh rhodium 45	104 Pd palladium 46	105 Ru ruthenium 44	106 Ir iridium 77	107 Pt platinum 78	108 Hs hassium 108	109 Mt meitnerium 109	110 Ds darmstadtium 110
107 Ir iridium 77	108 Pt platinum 78	109 Hs hassium 108	110 Mt meitnerium 109	111 Rg roentgenium 111	112 Rg roentgenium 111	113 Xe xenon 54	114 Rn radon 86
115 In indium 49	116 Sn tin 50	117 Tl thallium 81	118 Po polonium 84	119 Sb antimony 51	120 Te tellurium 52	121 I iodine 53	122 Br bromine 35
116 Sn tin 50	117 Tl thallium 81	118 Po polonium 84	119 Sb antimony 51	120 Te tellurium 52	121 I iodine 53	122 Br bromine 35	123 Kr krypton 36
119 Sn tin 50	120 Te tellurium 52	121 I iodine 53	122 Br bromine 35	123 Kr krypton 36	124 Xe xenon 54	125 Rn radon 86	126 Rn radon 86
125 Xe xenon 54	126 Rn radon 86	127 At astatine 85	128 Te tellurium 52	129 I iodine 53	130 Br bromine 35	131 Kr krypton 36	132 Rn radon 86
133 Cs caesium 55	134 Fr francium 87	135 Ac* actinium 89	136 Rf rutherfordium 104	137 Db dubnium 105	138 Bh bohrium 107	139 Hs hassium 108	140 Mt meitnerium 109
134 Fr francium 87	135 Ac* actinium 89	136 Rf rutherfordium 104	137 Db dubnium 105	138 Bh bohrium 107	139 Hs hassium 108	140 Mt meitnerium 109	141 Rg roentgenium 111
141 Hs hassium 108	142 Mt meitnerium 109	143 Ds darmstadtium 110	144 Rg roentgenium 111	145 Rg roentgenium 111	146 Rg roentgenium 111	147 Rg roentgenium 111	148 Rg roentgenium 111
142 Mt meitnerium 109	143 Ds darmstadtium 110	144 Rg roentgenium 111	145 Rg roentgenium 111	146 Rg roentgenium 111	147 Rg roentgenium 111	148 Rg roentgenium 111	149 Rg roentgenium 111
143 Ds darmstadtium 110	144 Rg roentgenium 111	145 Rg roentgenium 111	146 Rg roentgenium 111	147 Rg roentgenium 111	148 Rg roentgenium 111	149 Rg roentgenium 111	150 Rg roentgenium 111
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155 Rg roentgenium 111	156 Rg roentgenium 111	157 Rg roentgenium 111	158 Rg roentgenium 111	159 Rg roentgenium 111	160 Rg roentgenium 111	161 Rg roentgenium 111	162 Rg roentgenium 111
156 Rg roentgenium 111	157 Rg roentgenium 111	158 Rg roentgenium 111	159 Rg roentgenium 111	160 Rg roentgenium 111	161 Rg roentgenium 111	162 Rg roentgenium 111	163 Rg roentgenium 111
157 Rg roentgenium 111	158 Rg roentgenium 111	159 Rg roentgenium 111	160 Rg roentgenium 111	161 Rg roentgenium 111	162 Rg roentgenium 111	163 Rg roentgenium 111	164 Rg roentgenium 111
158 Rg roentgenium 111	159 Rg roentgenium 111	160 Rg roentgenium 111	161 Rg roentgenium 111	162 Rg roentgenium 111	163 Rg roentgenium 111	164 Rg roentgenium 111	165 Rg roentgenium 111
159 Rg roentgenium 111	160 Rg roentgenium 111	161 Rg roentgenium 111	162 Rg roentgenium 111	163 Rg roentgenium 111	164 Rg roentgenium 111	165 Rg roentgenium 111	166 Rg roentgenium 111
160 Rg roentgenium 111	161 Rg roentgenium 111	162 Rg roentgenium 111	163 Rg roentgenium 111	164 Rg roentgenium 111	165 Rg roentgenium 111	166 Rg roentgenium 111	167 Rg roentgenium 111
161 Rg roentgenium 111	162 Rg roentgenium 111	163 Rg roentgenium 111	164 Rg roentgenium 111	165 Rg roentgenium 111	166 Rg roentgenium 111	167 Rg roentgenium 111	168 Rg roentgenium 111
162 Rg roentgenium 111	163 Rg roentgenium 111	164 Rg roentgenium 111	165 Rg roentgenium 111	166 Rg roentgenium 111	167 Rg roentgenium 111	168 Rg roentgenium 111	169 Rg roentgenium 111
163 Rg roentgenium 111	164 Rg roentgenium 111	165 Rg roentgenium 111	166 Rg roentgenium 111	167 Rg roentgenium 111	168 Rg roentgenium 111	169 Rg roentgenium 111	170 Rg roentgenium 111
164 Rg roentgenium 111	165 Rg roentgenium 111	166 Rg roentgenium 111	167 Rg roentgenium 111	168 Rg roentgenium 111	169 Rg roentgenium 111	170 Rg roentgenium 111	171 Rg roentgenium 111
165 Rg roentgenium 111	166 Rg roentgenium 111	167 Rg roentgenium 111	168 Rg roentgenium 111	169 Rg roentgenium 111	170 Rg roentgenium 111	171 Rg roentgenium 111	172 Rg roentgenium 111
166 Rg roentgenium 111	167 Rg roentgenium 111	168 Rg roentgenium 111	169 Rg roentgenium 111	170 Rg roentgenium 111	171 Rg roentgenium 111	172 Rg roentgenium 111	173 Rg roentgenium 111
167 Rg roentgenium 111	168 Rg roentgenium 111	169 Rg roentgenium 111	170 Rg roentgenium 111	171 Rg roentgenium 111	172 Rg roentgenium 111	173 Rg roentgenium 111	174 Rg roentgenium 111
168 Rg roentgenium 111	169 Rg roentgenium 111	170 Rg roentgenium 111	171 Rg roentgenium 111	172 Rg roentgenium 111	173 Rg roentgenium 111	174 Rg roentgenium 111	175 Rg roentgenium 111
169 Rg roentgenium 111	170 Rg roentgenium 111	171 Rg roentgenium 111	172 Rg roentgenium 111	173 Rg roentgenium 111	174 Rg roentgenium 111	175 Rg roentgenium 111	176 Rg roentgenium 111
170 Rg roentgenium 111	171 Rg roentgenium 111	172 Rg roentgenium 111	173 Rg roentgenium 111	174 Rg roentgenium 111	175 Rg roentgenium 111	176 Rg roentgenium 111	177 Rg roentgenium 111
171 Rg roentgenium 111	172 Rg roentgenium 111	173 Rg roentgenium 111	174 Rg roentgenium 111	175 Rg roentgenium 111	176 Rg roentgenium 111	177 Rg roentgenium 111	178 Rg roentgenium 111
172 Rg roentgenium 111	173 Rg roentgenium 111	174 Rg roentgenium 111	175 Rg roentgenium 111	176 Rg roentgenium 111	177 Rg roentgenium 111	178 Rg roentgenium 111	179 Rg roentgenium 111
173 Rg roentgenium 111	174 Rg roentgenium 111	175 Rg roentgenium 111	176 Rg roentgenium 111	177 Rg roentgenium 111	178 Rg roentgenium 111	179 Rg roentgenium 111	180 Rg roentgenium 111
174 Rg roentgenium 111	175 Rg roentgenium 111	176 Rg roentgenium 111	177 Rg roentgenium 111	178 Rg roentgenium 111	179 Rg roentgenium 111	180 Rg roentgenium 111	181 Rg roentgenium 111
175 Rg roentgenium 111	176 Rg roentgenium 111	177 Rg roentgenium 111	178 Rg roentgenium 111	179 Rg roentgenium 111	180 Rg roentgenium 111	181 Rg roentgenium 111	182 Rg roentgenium 111
176 Rg roentgenium 111	177 Rg roentgenium 111	178 Rg roentgenium 111	179 Rg roentgenium 111	180 Rg roentgenium 111	181 Rg roentgenium 111	182 Rg roentgenium 111	183 Rg roentgenium 111
177 Rg roentgenium 111	178 Rg roentgenium 111	179 Rg roentgenium 111	180 Rg roentgenium 111	181 Rg roentgenium 111	182 Rg roentgenium 111	183 Rg roentgenium 111	184 Rg roentgenium 111
178 Rg roentgenium 111	179 Rg roentgenium 111	180 Rg roentgenium 111	181 Rg roentgenium 111	182 Rg roentgenium 111	183 Rg roentgenium 111	184 Rg roentgenium 111	185 Rg roentgenium 111
179 Rg roentgenium 111	180 Rg roentgenium 111	181 Rg roentgenium 111	182 Rg roentgenium 111	183 Rg roentgenium 111	184 Rg roentgenium 111	185 Rg roentgenium 111	186 Rg roentgenium 111
180 Rg roentgenium 111	181 Rg roentgenium 111	182 Rg roentgenium 111	183 Rg roentgenium 111	184 Rg roentgenium 111	185 Rg roentgenium 111	186 Rg roentgenium 111	187 Rg roentgenium 111
181 Rg roentgenium 111	182 Rg roentgenium 111	183 Rg roentgenium 111	184 Rg roentgenium 111	185 Rg roentgenium 111	186 Rg roentgenium 111	187 Rg roentgenium 111	188 Rg roentgenium 111
182 Rg<br							

* 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.