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0620/33

May/June 2016

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 20.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

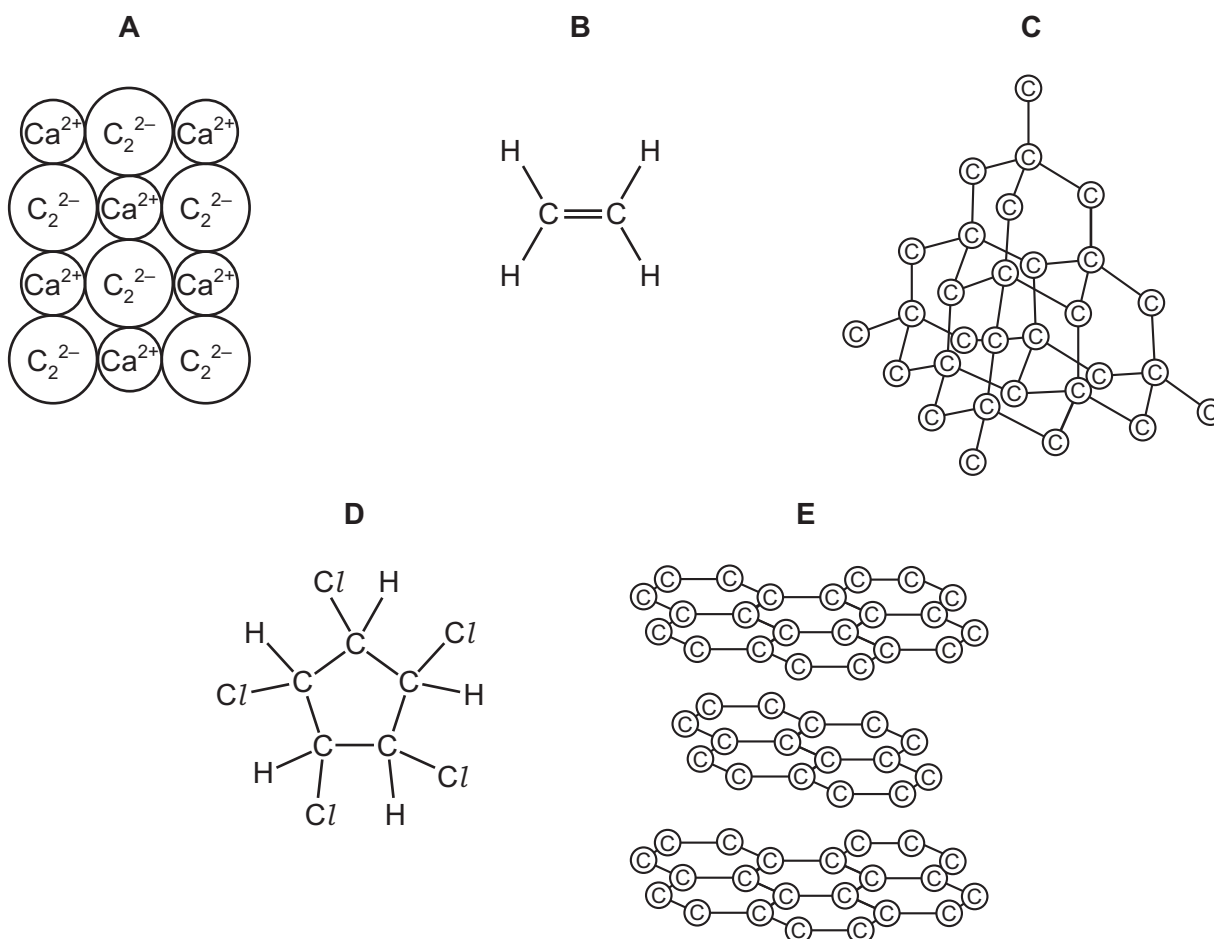
The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **19** printed pages and **1** blank page.



CAMBRIDGE
International Examinations

1 The structures of some substances containing carbon are shown.



Answer the following questions about these substances.

(a) (i) Which **two** substances have giant covalent structures?

..... and [1]

(ii) Which substance decolourises aqueous bromine?

..... [1]

(iii) Which substance is most likely to be a gas at room temperature and pressure?

..... [1]

(iv) Which substance is a hydrocarbon?

..... [1]

(v) Determine the simplest formula for substance **D**.

..... [1]

(b) Two isotopes of carbon are $^{13}_6\text{C}$ and $^{14}_6\text{C}$.

(i) How do these two isotopes differ in their atomic structure?

..... [1]

(ii) Determine the number of neutrons present in one atom of the isotope $^{14}_6\text{C}$.

..... [1]

[Total: 7]

2 This question is about metals.

(a) The table shows some properties of the metals, **R**, **S**, **T** and **U**.

metal	relative electrical conductivity	relative heat conductivity	density in g/cm^3	melting point / $^{\circ}\text{C}$
R	4.3	11.8	2.7	660
S	1.2	4.2	7.9	1535
T	6.2	22.3	8.9	1083
U	4.1	12.4	7.1	420

Which metal would be best to make the base of a pan for cooking food?

Use the information in the table to explain your answer.

.....

.....

.....

..... [3]

(b) Zinc chloride can be made by reacting excess zinc with hydrochloric acid.

Suggest how the excess zinc can be removed from the reaction mixture.

..... [1]

(c) Zinc can be obtained from molten zinc chloride by electrolysis.

(i) What is meant by the term *electrolysis*?

.....

..... [2]

- (ii) Draw a labelled diagram of the apparatus that could be used to electrolyse molten zinc chloride.

[3]

- (d) Give **one** advantage of recycling metals.

..... [1]

[Total: 10]

3 The table gives some information about the halogens.

element	colour	melting point/°C	boiling point/°C
chlorine	light green	−101	−35
bromine	red-brown	−7	+59
iodine	grey-black	+114	+184
astatine		+302	+337

(a) (i) Predict the colour of astatine.

..... [1]

(ii) Describe the trend in the boiling points of the halogens.

..... [1]

(iii) Deduce the state of chlorine at −50 °C.

Explain your answer.

.....
 [2]

(b) (i) Complete the word equation for the reaction of bromine with aqueous potassium astatide.

bromine + potassium astatide → +

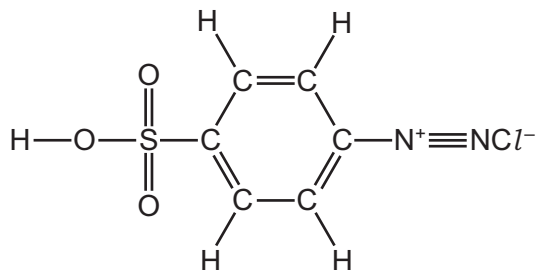
[2]

(ii) Suggest why bromine does **not** react with aqueous potassium chloride.

.....
 [1]

- (c) Compound **X** is used to prepare the dye methyl orange.

The structure of compound **X** is shown.



Complete the table and calculate the relative molecular mass of compound **X**.

type of atom	number of atoms	atomic mass	
carbon	6	12	$6 \times 12 = 72$
hydrogen	5	1	$5 \times 1 = 5$
nitrogen	2	14	$2 \times 14 = 28$
sulfur	1	32	$1 \times 32 = 32$
oxygen			
chlorine			

relative molecular mass = [2]

- (d) Describe how you could use methyl orange to distinguish between solutions of hydrochloric acid and sodium hydroxide.

.....

..... [2]

- (e) Methyl orange and Congo red are dyes. A mixture of methyl orange and Congo red can be separated by chromatography.

Draw a labelled diagram to show how the apparatus is arranged to carry out chromatography.

[3]

[Total: 14]

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TURN OVER TO CONTINUE

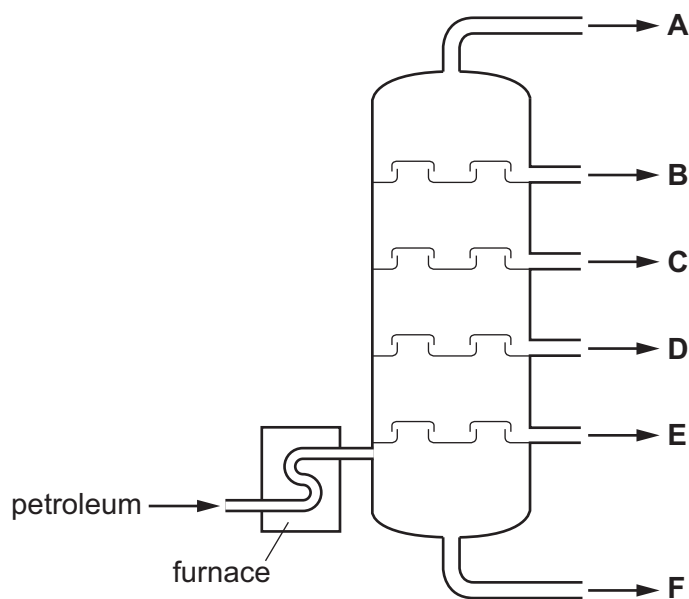
4 Petroleum is a mixture of hydrocarbons.

(a) What is the meaning of the term *hydrocarbon*?

..... [1]

(b) Petroleum can be separated into different fractions by fractional distillation.

The diagram shows a fractionating column. The fractions are shown by letters.



Describe how fractional distillation is used to separate the petroleum into fractions.

In your answer refer to

- changes of state,
- differences in boiling points.

.....

 [5]

(c) The properties of the fractions are shown in the table.

fraction	number of carbon atoms	percentage by mass of the fraction	boiling range / °C
A	1 – 4	3	less than 40
B	4 – 10	14	40 – 160
C	10 – 16	13	160 – 250
D	16 – 20	9	250 – 300
E	20 – 25	9	300 – 350
F	more than 25		more than 350
		total = 100	

(i) Describe how the number of carbon atoms affects the boiling range.

.....
 [1]

(ii) Determine the percentage by mass of fraction **F** in this sample of petroleum.

..... [1]

(iii) Which **one** of the fractions is mainly gaseous at 25 °C?

..... [1]

(iv) Fraction **F** is the residue. It contains bitumen.

Give **one** use of bitumen.

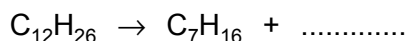
..... [1]

(d) Fraction **C** can be cracked to form alkenes.

(i) Describe **one** condition required for cracking.

..... [1]

- (ii) Complete the chemical equation for the cracking of dodecane, $C_{12}H_{26}$, to form heptane, C_7H_{16} , and one other hydrocarbon.



[1]

[Total: 12]

5 Iron is a transition element.

- (a) Describe the physical and chemical properties of iron.

.....

.....

.....

.....

.....

[5]

- (b) Iron carbonyl, $Fe(CO)_5$, is a covalent liquid.

- (i) Suggest **two** physical properties of iron carbonyl.

.....

.....

[2]

- (ii) When heated above $200^\circ C$, iron carbonyl undergoes thermal decomposition.



Explain why this reaction could have an adverse effect on health if not carried out in a fume cupboard.

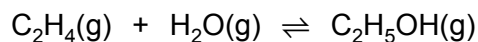
.....

.....

[2]

[Total: 9]

- 6 Ethanol can be manufactured by reacting ethene with steam.



- (a) What is the meaning of the symbol $\rightleftharpoons$?

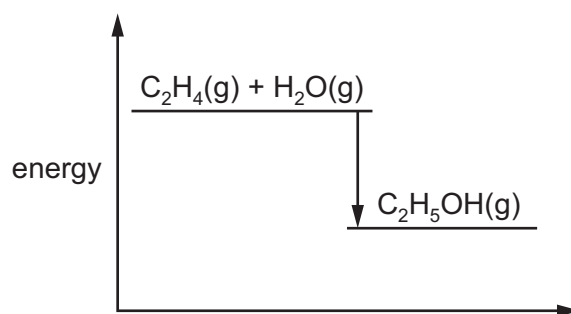
..... [1]

- (b) State **two** conditions needed for this reaction.

.....

..... [2]

- (c) The energy level diagram for this reaction is shown.



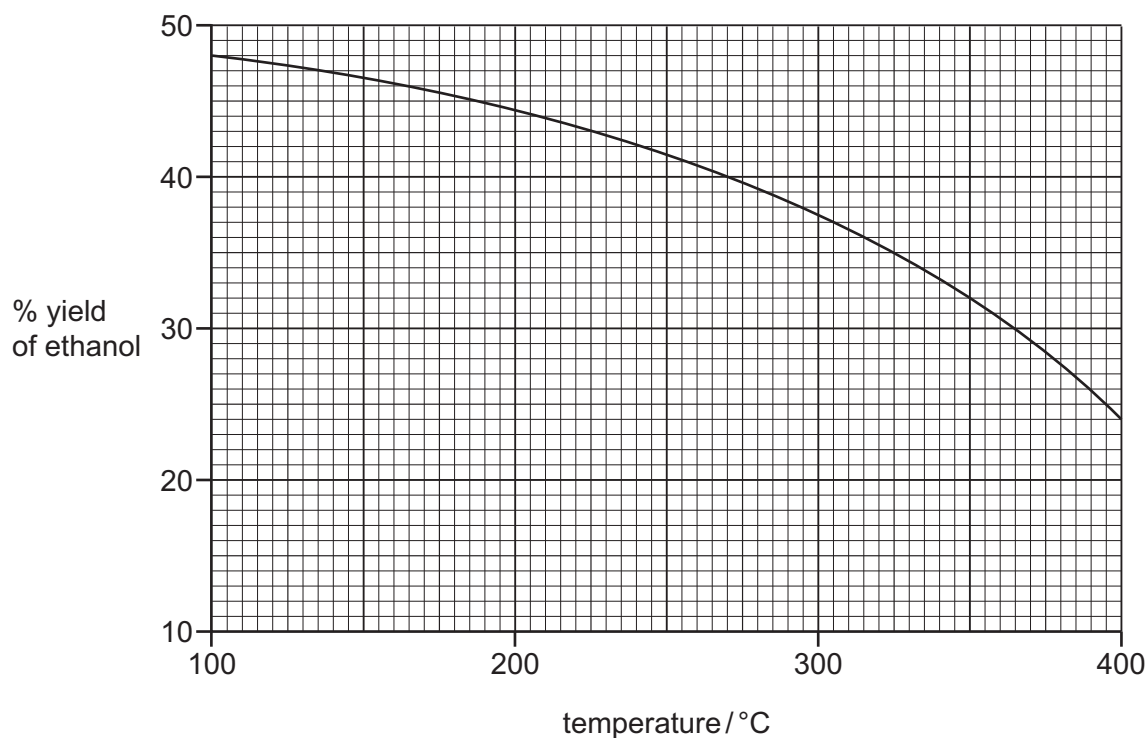
Is this reaction exothermic or endothermic?

Give a reason for your answer.

.....

..... [2]

- (d) The graph below shows how the percentage yield of ethanol changes with temperature when the pressure is kept constant.



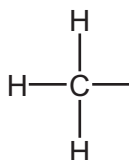
- (i) Describe how the percentage yield changes with temperature.

.....
 [1]

- (ii) Determine the percentage yield when the temperature is 350 °C.

..... [1]

- (e) (i) Complete the structure of ethanol, C_2H_5OH , to show all atoms and all bonds.

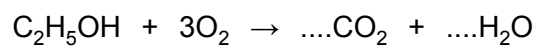


[1]

- (ii) Give **one** use of ethanol.

..... [1]

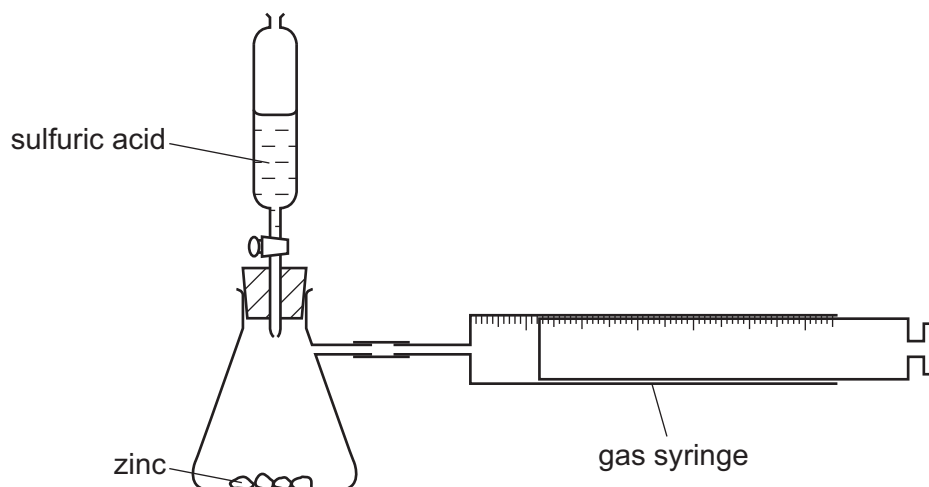
(iii) Complete the chemical equation for the complete combustion of ethanol.



[2]

[Total: 11]

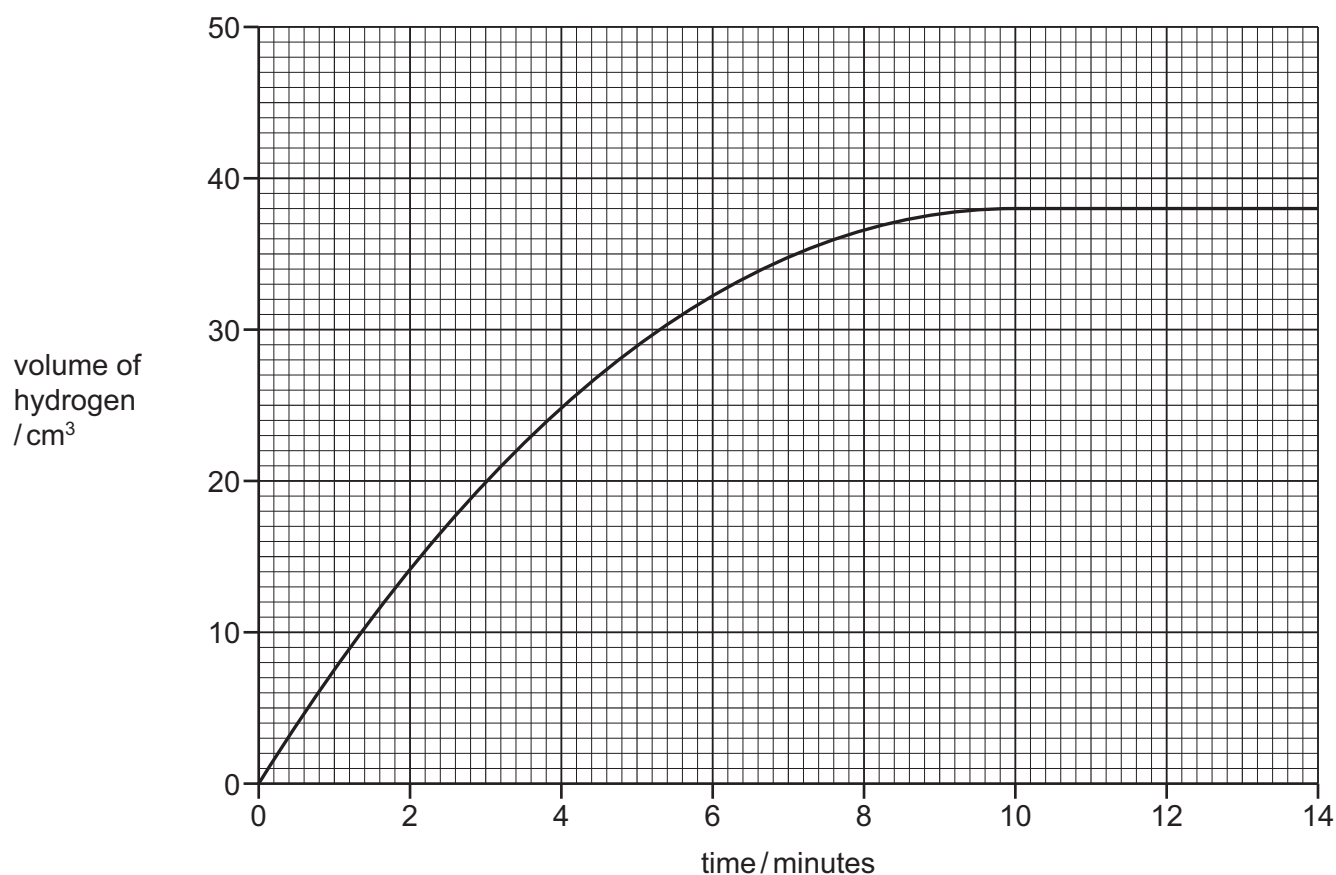
- 7 A student investigated the reaction between zinc and sulfuric acid at 20 °C using the apparatus shown. The zinc was in excess.



- (a) What should the student do to start the reaction?

..... [1]

- (b) The graph shows the volume of hydrogen released as the reaction proceeds.



- (i) Explain why the volume of gas stays the same after 10 minutes.

..... [1]

- (ii) How long did it take for the first 20 cm³ of gas to be collected?

..... [1]

- (iii) The student repeated the experiment at 30 °C. All other conditions remained the same.

Draw the shape of the line **on the grid on page 16** when the reaction was carried out at 30 °C.

[2]

- (c) The student repeated the experiment using zinc powder instead of small pieces of zinc.

Describe and explain how the rate of reaction differs when zinc powder is used.

.....

..... [2]

- (d) Sulfuric acid is a compound.

- (i) What is the meaning of the term *compound*?

.....

..... [1]

- (ii) Sulfur is used to make sulfuric acid.

Give **one** source of sulfur.

.....

[1]

- (iii) Sulfur is oxidised by air to form sulfur dioxide.

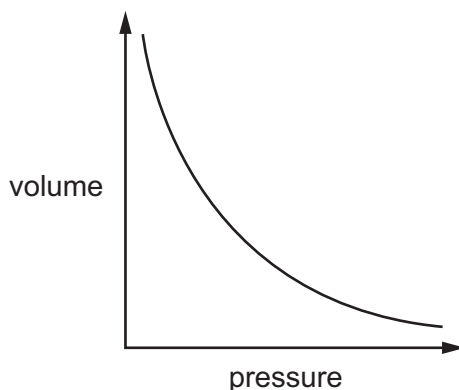
Give **one** use of sulfur dioxide.

.....

[1]

[Total: 10]

- 8 The graph shows how increasing the pressure at constant temperature changes the volume of a fixed mass of carbon dioxide gas.



- (a) Describe how the volume of gas changes with pressure.

.....

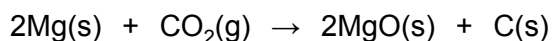
.....

..... [2]

- (b) What happens to the average distance of the molecules from each other when the pressure is decreased?

..... [1]

- (c) Carbon dioxide can be reduced by magnesium.



- (i) Use the information in the equation to show that carbon dioxide gets reduced.

..... [1]

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

Tick **one** box.

respiration	☐
reaction of an acid with a metal oxide	☐
reaction of an acid with a carbonate	☐
thermal decomposition of limestone	☐

[1]

- (iii) Give **two** problems caused by increasing the amount of carbon dioxide in the atmosphere.

.....

.....

..... [2]

[Total: 7]

The Periodic Table of Elements

Group																									
I	II											III	IV	V	VI	VII	VIII								
		<div>Key</div> <div>atomic number atomic symbol name relative atomic mass</div>											<div>1</div> <div>H</div> <div>hydrogen</div> <div>1</div>												
3	4																							5	6
Li lithium 7	Be beryllium 9												B boron 11	C carbon 12	N nitrogen 14	O oxygen 16	F fluorine 19	He helium 4							
11	12												13	14	15	16	17	18							
Na sodium 23	Mg magnesium 24												Al aluminium 27	Si silicon 28	P phosphorus 31	S sulfur 32	Cl chlorine 35.5	Ar argon 40							
19	20												31	32	33	34	35	36							
K potassium 39	Ca calcium 40												Ga gallium 70	Ge germanium 73	As arsenic 75	Se selenium 79	Br bromine 80	Kr krypton 84							
37	38												49	50	51	52	53	54							
Rb rubidium 85	Sr strontium 88												In indium 115	Sn tin 119	Sb antimony 122	Te tellurium 128	I iodine 127	Xe xenon 131							
55	56												81	82	83	84	85	86							
Cs caesium 133	Ba barium 137												Tl thallium 204	Pb lead 207	Bi bismuth 209	Po polonium —	At astatine —	Rn radon —							
87	88												114		116										
Fr francium —	Ra radium —												Fl flerovium —		Lv livermorium —										
													112		118										
													Cn copernicium —	Rg roentgenium —	Ds darmstadtium —	Mt meitnerium —	Hs hassium —								
													29	28	27	26	25	24	23	22	21				
													Cu copper 64	Ni nickel 59	Co cobalt 59	Fe iron 56	Mn manganese 55	Cr chromium 52	V vanadium 51	Ti titanium 48	Sc scandium 45				
													47	46	45	44	43	42	41	40	39				
													Ag silver 108	Pd palladium 106	Rh rhodium 103	Ru ruthenium 101	Tc technetium —	Mo molybdenum 96	Nb niobium 93	Zr zirconium 91	Y yttrium 89				
													79	78	77	76	75	74	73	72	57–71				
													Au gold 197	Pt platinum 195	Ir iridium 192	Os osmium 190	Re rhenium 186	W tungsten 184	Ta tantalum 181	Hf hafnium 178	lanthanoids				
													111	110	109	108	107	106	105	104	89–103				
													Rg roentgenium —	Ds darmstadtium —	Mt meitnerium —	Hs hassium —	Bh bohrium —	Sg seaborgium —	Db dubnium —	Rf rutherfordium —	actinoids				

lanthanoids																	
57	La	lanthanum	139	58	Ce	cerium	140	59	Pr	praseodymium	141	60	Nd	neodymium	144	61	Pm
—																	
89	Ac	actinium	—	90	Th	thorium	232	91	Pa	protactinium	231	92	U	uranium	238	93	Np
actinoids																	
62	Sm	samarium	150	63	Eu	europlum	152	64	Gd	gadolinium	157	65	Tb	terbium	159	66	Dy
94	Pu	plutonium	—	95	Am	americium	—	96	Cm	curium	—	97	Bk	berkelium	—	98	Cf
103	Lr	lawrencium	—	104	Rf	rutherfordium	—	105	Db	dubnium	—	106	Sg	seaborgium	—	107	Bh
108	Hs	hassium	—	109	Mt	meitnerium	—	110	Ds	darmstadtium	—	111	Rg	roentgenium	—	112	Cn
113	Nh	nihonium	—	114	Fl	flerovium	—	115	Mc	moscovium	—	116	Lv	livermorium	—	117	Uue
118	Og	oganeson	—	119	Uut	unbinilium	—	120	Uub	unbihunium	—	121	Uuh	unbiunium	—	122	Uuq
123	Uuq	unbiquadium	—	124	Uub	unbihunium	—	125	Uut	unbinilium	—	126	Uuq	unbiunium	—	127	Uuh
132	Uuh	unbihunium	—	133	Uub	unbihunium	—	134	Uut	unbinilium	—	135	Uuq	unbiunium	—	136	Uuh
143	Uuh	unbihunium	—	144	Uub	unbihunium	—	145	Uut	unbinilium	—	146	Uuq	unbiunium	—	147	Uuh
153	Uuh	unbihunium	—	154	Uub	unbihunium	—	155	Uut	unbinilium	—	156	Uuq	unbiunium	—	157	Uuh
163	Uuh	unbihunium	—	164	Uub	unbihunium	—	165	Uut	unbinilium	—	166	Uuq	unbiunium	—	167	Uuh
173	Uuh	unbihunium	—	174	Uub	unbihunium	—	175	Uut	unbinilium	—	176	Uuq	unbiunium	—	177	Uuh
183	Uuh	unbihunium	—	184	Uub	unbihunium	—	185	Uut	unbinilium	—	186	Uuq	unbiunium	—	187	Uuh
193	Uuh	unbihunium	—	194	Uub	unbihunium	—	195	Uut	unbinilium	—	196	Uuq	unbiunium	—	197	Uuh
203	Uuh	unbihunium	—	204	Uub	unbihunium	—	205	Uut	unbinilium	—	206	Uuq	unbiunium	—	207	Uuh
213	Uuh	unbihunium	—	214	Uub	unbihunium	—	215	Uut	unbinilium	—	216	Uuq	unbiunium	—	217	Uuh
223	Uuh	unbihunium	—	224	Uub	unbihunium	—	225	Uut	unbinilium	—	226	Uuq	unbiunium	—	227	Uuh
233	Uuh	unbihunium	—	234	Uub	unbihunium	—	235	Uut	unbinilium	—	236	Uuq	unbiunium	—	237	Uuh
243	Uuh	unbihunium	—	244	Uub	unbihunium	—	245	Uut	unbinilium	—	246	Uuq	unbiunium	—	247	Uuh
253	Uuh	unbihunium	—	254	Uub	unbihunium	—	255	Uut	unbinilium	—	256	Uuq	unbiunium	—	257	Uuh
263	Uuh	unbihunium	—	264	Uub	unbihunium	—	265	Uut	unbinilium	—	266	Uuq	unbiunium	—	267	Uuh
273	Uuh	unbihunium	—	274	Uub	unbihunium	—	275	Uut	unbinilium	—	276	Uuq	unbiunium	—	277	Uuh
283	Uuh	unbihunium	—	284	Uub	unbihunium	—	285	Uut	unbinilium	—	286	Uuq	unbiunium	—	287	Uuh
293	Uuh	unbihunium	—	294	Uub	unbihunium	—	295	Uut	unbinilium	—	296	Uuq	unbiunium	—	297	Uuh
303	Uuh	unbihunium	—	304	Uub	unbihunium	—	305	Uut	unbinilium	—	306	Uuq	unbiunium	—	307	Uuh
313	Uuh	unbihunium	—	314	Uub	unbihunium	—	315	Uut	unbinilium	—	316	Uuq	unbiunium	—	317	Uuh
323	Uuh	unbihunium	—	324	Uub	unbihunium	—	325	Uut	unbinilium	—	326	Uuq	unbiunium	—	327	Uuh
333	Uuh	unbihunium	—	334	Uub	unbihunium	—	335	Uut	unbinilium	—	336	Uuq	unbiunium	—	337	Uuh
343	Uuh	unbihunium	—	344	Uub	unbihunium	—	345	Uut	unbinilium	—	346	Uuq	unbiunium	—	347	Uuh
353	Uuh	unbihunium	—	354	Uub	unbihunium	—	355	Uut	unbinilium	—	356	Uuq	unbiunium	—	357	Uuh
363	Uuh	unbihunium	—	364	Uub	unbihunium	—	365	Uut	unbinilium	—	366	Uuq	unbiunium	—	367	Uuh
373	Uuh	unbihunium	—	374	Uub	unbihunium	—	375	Uut	unbinilium	—	376	Uuq	unbiunium	—	377	Uuh
383	Uuh	unbihunium	—	384	Uub	unbihunium	—	385	Uut	unbinilium	—	386	Uuq	unbiunium	—	387	Uuh
393	Uuh	unbihunium	—	394	Uub	unbihunium	—	395	Uut	unbinilium	—	396	Uuq	unbiunium	—	397	Uuh
403	Uuh	unbihunium	—	404	Uub	unbihunium	—	405	Uut	unbinilium	—	406	Uuq	unbiunium	—	407	Uuh
413	Uuh	unbihunium	—	414	Uub	unbihunium	—	415	Uut	unbinilium	—	416	Uuq	unbiunium	—	417	Uuh
423	Uuh	unbihunium	—	424	Uub	unbihunium	—	425	Uut	unbinilium	—	426	Uuq	unbiunium	—	427	Uuh
433	Uuh	unbihunium	—	434	Uub	unbihunium	—	435	Uut	unbinilium	—	436	Uuq	unbiunium	—	437	Uuh
443	Uuh	unbihunium	—	444	Uub	unbihunium	—	445	Uut	unbinilium	—	446	Uuq	unbiunium	—	447	Uuh
453	Uuh	unbihunium	—	454	Uub	unbihunium	—	455	Uut	unbinilium	—	456	Uuq	unbiunium	—	457	Uuh
463	Uuh	unbihunium	—	464	Uub	unbihunium	—	465	Uut	unbinilium	—	466	Uuq	unbiunium	—	467	Uuh
473	Uuh	unbihunium	—	474	Uub	unbihunium	—	475	Uut	unbinilium	—	476	Uuq	unbiunium	—	477	Uuh
483	Uuh	unbihunium	—	484	Uub	unbihunium	—	485	Uut	unbinilium	—	486	Uuq	unbiunium	—	487	Uuh
493	Uuh	unbihunium	—	494	Uub	unbihunium	—	495	Uut	unbinilium	—	496	Uuq	unbiunium	—	497	Uuh
503	Uuh	unbihunium	—	504	Uub	unbihunium	—	505	Uut	unbinilium	—	506	Uuq	unbiunium	—	507	Uuh
513	Uuh	unbihunium	—	514	Uub	unbihunium	—	515	Uut	unbinilium	—	516	Uuq	unbiunium	—	517	Uuh
523	Uuh	unbihunium	—	524	Uub	unbihunium	—	525	Uut	unbinilium	—	526	Uuq	unbiunium	—	527	Uuh
533	Uuh	unbihunium	—	534	Uub	unbihunium	—	535	Uut	unbinilium	—	536	Uuq	unbiunium	—	537	Uuh
543	Uuh	unbihunium	—	544	Uub	unbihunium	—	545	Uut	unbinilium	—	546	Uuq	unbiunium	—	547	Uuh
553	Uuh	unbihunium	—	554	Uub	unbihunium	—	555	Uut	unbinilium	—	556	U				