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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.

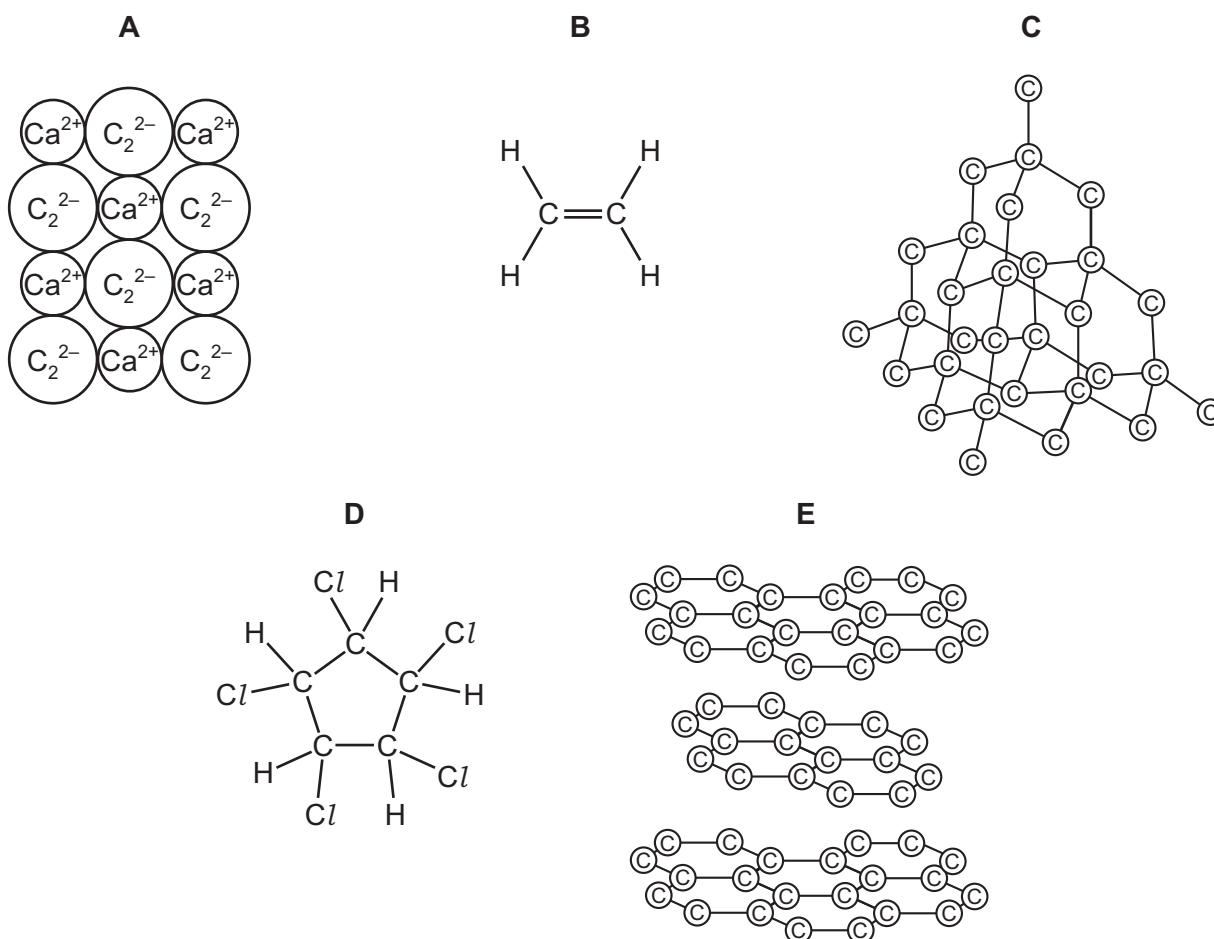
This document consists of **19** printed pages and **1** blank page.



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 → +

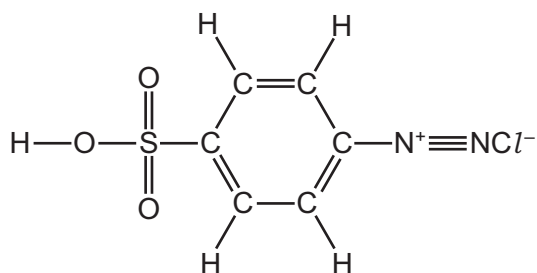
[2]

(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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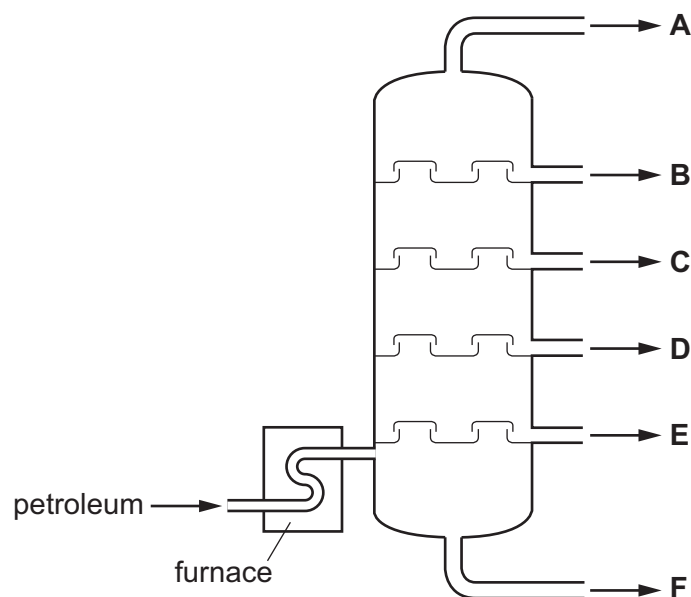
4 Petroleum is a mixture of hydrocarbons.

(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.

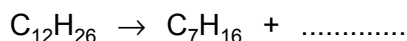
..... [1]

(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°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.

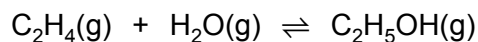
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[2]

[Total: 9]

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



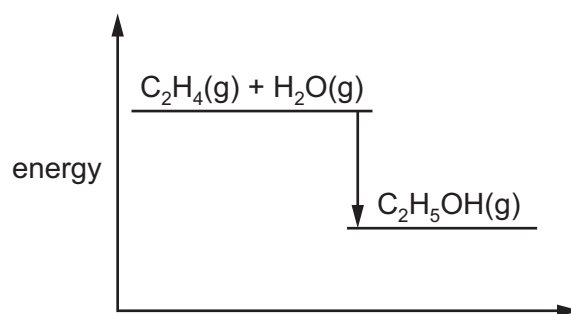
- (a) What is the meaning of the symbol $\rightleftharpoons$?

..... [1]

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

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

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

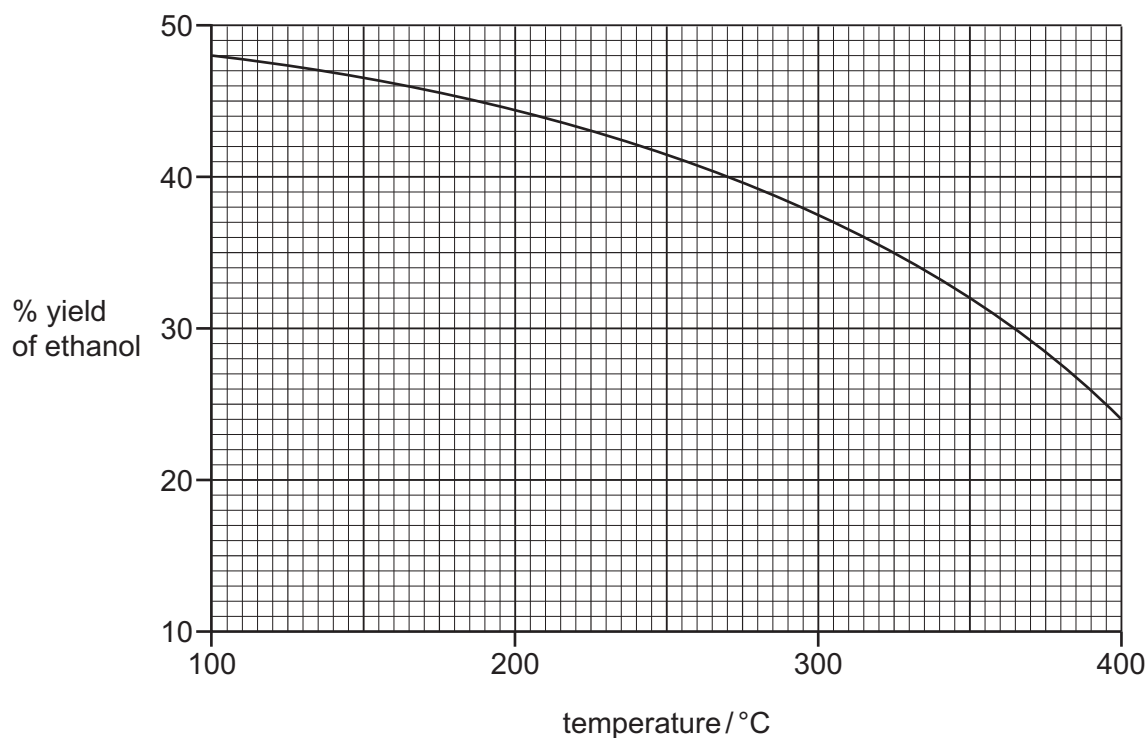


Is this reaction exothermic or endothermic?

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.



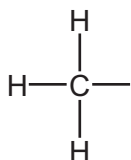
- (i) Describe how the percentage yield changes with temperature.

.....
 [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.

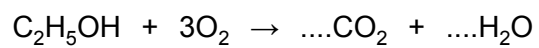


[1]

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

..... [1]

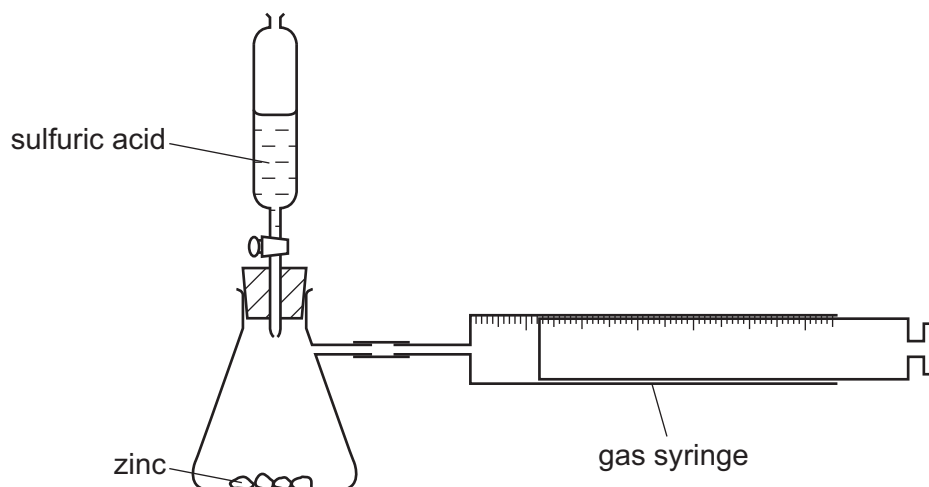
(iii) Complete the chemical equation for the complete combustion of ethanol.



[2]

[Total: 11]

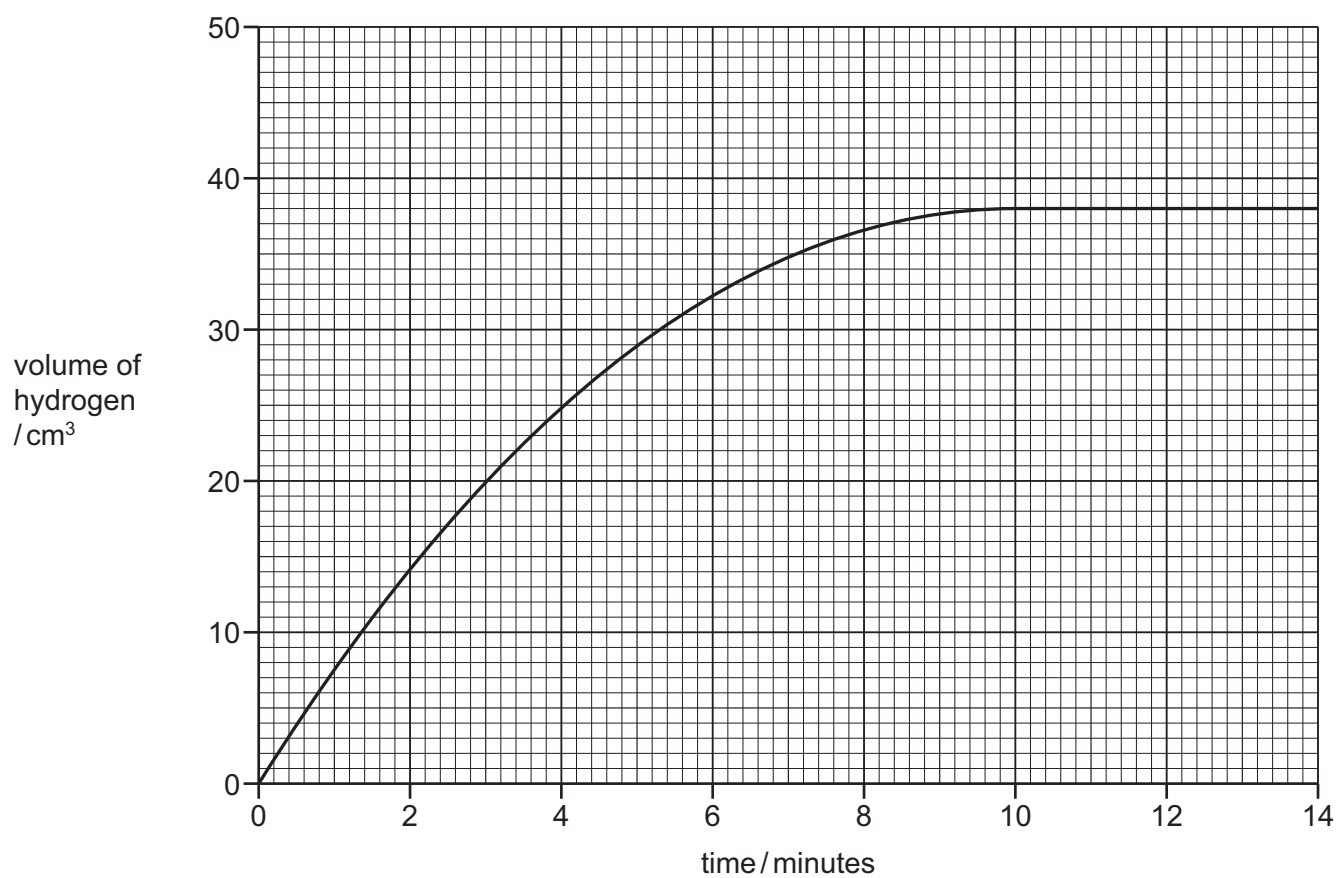
- 7 A student investigated the reaction between zinc and sulfuric acid at 20 °C using the apparatus shown. The zinc was in excess.



- (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.

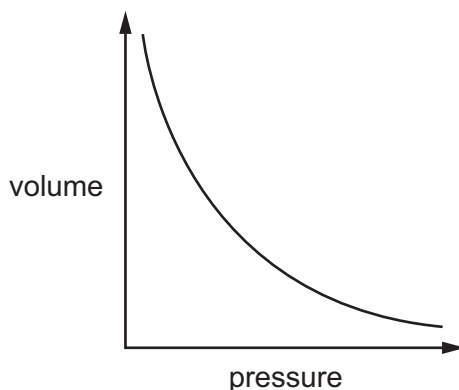
Give **one** use of sulfur dioxide.

.....

[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.

.....

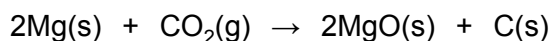
.....

..... [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	Key										III	IV	V	VI	VII	VIII	
		atomic number atomic symbol name relative atomic mass										1 H hydrogen 1						
3 Li lithium 7	4 Be beryllium 9																	
11 Na sodium 23	12 Mg magnesium 24																	
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84	
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131	
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —	
87 Fr francium —	88 Ra radium —	89–103 actinoids	104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	114 Fl flerovium —	116 Lv livermorium —	118 Ts tennessine —	119 Og oganesson —	120 Nh nihonium —	121 Lr lawrencium —	

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	ununium	—	120	Uuq	ununquadium	—	121	Uuh	ununhexium	—	122	Uub
123	Uut	ununtrium	—	124	Uuq	ununquadium	—	125	Uuh	ununhexium	—	126	Uub	ununheptium	—	127	Uub
132	Uub	ununbium	—	133	Uuh	ununhexium	—	134	Uub	ununheptium	—	135	Uut	ununoctium	—	136	Uuq
143	Uut	ununtrium	—	144	Uuq	ununquadium	—	145	Uuh	ununhexium	—	146	Uub	ununheptium	—	147	Uut
153	Uuh	ununhexium	—	154	Uub	ununheptium	—	155	Uut	ununoctium	—	156	Uuq	ununnonium	—	157	Uuh
163	Uub	ununbium	—	164	Uuh	ununhexium	—	165	Uub	ununheptium	—	166	Uut	ununoctium	—	167	Uuq
173	Uut	ununtrium	—	174	Uuq	ununquadium	—	175	Uuh	ununhexium	—	176	Uub	ununheptium	—	177	Uut
183	Uuh	ununhexium	—	184	Uub	ununheptium	—	185	Uut	ununoctium	—	186	Uuq	ununnonium	—	187	Uuh
193	Uub	ununbium	—	194	Uuh	ununhexium	—	195	Uub	ununheptium	—	196	Uut	ununoctium	—	197	Uuq
203	Uuh	ununhexium	—	204	Uub	ununheptium	—	205	Uut	ununoctium	—	206	Uuq	ununnonium	—	207	Uuh
213	Uut	ununtrium	—	214	Uuq	ununquadium	—	215	Uuh	ununhexium	—	216	Uub	ununheptium	—	217	Uut
223	Uuq	ununquadium	—	224	Uuh	ununhexium	—	225	Uub	ununheptium	—	226	Uut	ununoctium	—	227	Uuq
233	Uuh	ununhexium	—	234	Uub	ununheptium	—	235	Uut	ununoctium	—	236	Uuq	ununnonium	—	237	Uuh
243	Uub	ununbium	—	244	Uuh	ununhexium	—	245	Uub	ununheptium	—	246	Uut	ununoctium	—	247	Uuq
253	Uut	ununtrium	—	254	Uuq	ununquadium	—	255	Uuh	ununhexium	—	256	Uub	ununheptium	—	257	Uut
263	Uuq	ununquadium	—	264	Uuh	ununhexium	—	265	Uub	ununheptium	—	266	Uut	ununoctium	—	267	Uuh
273	Uub	ununbium	—	274	Uuh	ununhexium	—	275	Uub	ununheptium	—	276	Uut	ununoctium	—	277	Uuq
283	Uuh	ununhexium	—	284	Uub	ununheptium	—	285	Uut	ununoctium	—	286	Uuq	ununnonium	—	287	Uuh
293	Uut	ununtrium	—	294	Uuq	ununquadium	—	295	Uuh	ununhexium	—	296	Uub	ununheptium	—	297	Uut
303	Uuq	ununquadium	—	304	Uuh	ununhexium	—	305	Uub	ununheptium	—	306	Uut	ununoctium	—	307	Uuq
313	Uuh	ununhexium	—	314	Uub	ununheptium	—	315	Uut	ununoctium	—	316	Uuq	ununnonium	—	317	Uuh
323	Uub	ununbium	—	324	Uuh	ununhexium	—	325	Uub	ununheptium	—	326	Uut	ununoctium	—	327	Uuq
333	Uut	ununtrium	—	334	Uuq	ununquadium	—	335	Uuh	ununhexium	—	336	Uub	ununheptium	—	337	Uut
343	Uuh	ununhexium	—	344	Uub	ununheptium	—	345	Uut	ununoctium	—	346	Uuq	ununnonium	—	347	Uuh
353	Uub	ununbium	—	354	Uuh	ununhexium	—	355	Uub	ununheptium	—	356	Uut	ununoctium	—	357	Uuq
363	Uuh	ununhexium	—	364	Uub	ununheptium	—	365	Uut	ununoctium	—	366	Uuq	ununnonium	—	367	Uuh
373	Uut	ununtrium	—	374	Uuq	ununquadium	—	375	Uuh	ununhexium	—	376	Uub	ununheptium	—	377	Uut
383	Uuq	ununquadium	—	384	Uuh	ununhexium	—	385	Uub	ununheptium	—	386	Uut	ununoctium	—	387	Uuq
393	Uuh	ununhexium	—	394	Uub	ununheptium	—	395	Uut	ununoctium	—	396	Uuq	ununnonium	—	397	Uuh
403	Uub	ununbium	—	404	Uuh	ununhexium	—	405	Uub	ununheptium	—	406	Uut	ununoctium	—	407	Uuq
413	Uut	ununtrium	—	414	Uuq	ununquadium	—	415	Uuh	ununhexium	—	416	Uub	ununheptium	—	417	Uut
423	Uuh	ununhexium	—	424	Uub	ununheptium	—	425	Uut	ununoctium	—	426	Uuq	ununnonium	—	427	Uuh
433	Uub	ununbium	—	434	Uuh	ununhexium	—	435	Uub	ununheptium	—	436	Uut	ununoctium	—	437	Uuq
443	Uuh	ununhexium	—	444	Uub	ununheptium	—	445	Uut	ununoctium	—	446	Uuq	ununnonium	—	447	Uuh
453	Uut	ununtrium	—	454	Uuq	ununquadium	—	455	Uuh	ununhexium	—	456	Uub	ununheptium	—	457	Uut
463	Uuq	ununquadium	—	464	Uuh	ununhexium	—	465	Uub	ununheptium	—	466	Uut	ununoctium	—	467	Uuq
473	Uuh	ununhexium	—	474	Uub	ununheptium	—	475	Uut	ununoctium	—	476	Uuq	ununnonium	—	477	Uuh
483	Uub	ununbium	—	484	Uuh	ununhexium	—	485	Uub	ununheptium	—	486	Uut	ununoctium	—	487	Uuq
493	Uuh	ununhexium	—	494	Uub	ununheptium	—	495	Uut	ununoctium	—	496	Uuq	ununnonium	—	497	Uuh
503	Uut	ununtrium	—	504	Uuq	ununquadium	—	505	Uuh	ununhexium	—	506	Uub	ununheptium	—	507	Uut
513	Uuq	ununquadium	—	514	Uuh	ununhexium	—	515	Uub	ununheptium	—	516	Uut	ununoctium	—	517	Uuq
523	Uuh	ununhexium	—	524	Uub	ununheptium	—	525	Uut	ununoctium	—	526	Uuq	ununnonium	—	527	Uuh
533	Uub	ununbium	—	534	Uuh	ununhexium	—	535	Uub	ununheptium	—	536	Uut	ununoctium	—	537	Uuq
543	Uuh	ununhexium	—	544	Uub	ununheptium	—	545	Uut	ununoctium	—	546	Uuq	ununnonium	—	547	Uuh
553	Uut	ununtrium	—	554	Uuq	ununquadium	—	555	Uuh	ununhexium	—	556	Uub	ununheptium	—	557	Uut
563	Uuq	ununquadium	—	564	Uuh	ununhexium	—	565	Uub	ununheptium	—	566	Uut	ununoctium	—	567	Uuh