

Cambridge
International
AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

* 9 6 2 9 0 3 2 1 1 1 *

CHEMISTRY

9701/34

Paper 3 Advanced Practical Skills 2

October/November 2015

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Give details of the practical session and laboratory where appropriate, in the boxes provided.
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.
You may lose marks if you do not show your working or if you do not use appropriate units.
Use of a Data Booklet is unnecessary.

Qualitative Analysis Notes are printed on pages 10 and 11.
A Periodic Table is printed on page 12.

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.

Session	
Laboratory	

For Examiner's Use	
1	
2	
3	
Total	

This document consists of **12** printed pages.

2

- 1 In this experiment you will determine the relative atomic mass, A_r , of magnesium by a titration method.

FB 1 is 2.00 mol dm^{-3} hydrochloric acid, HCl.

FB 3 is $0.120 \text{ mol dm}^{-3}$ sodium hydroxide, NaOH.

magnesium ribbon

bromophenol blue indicator

(a) Method

Reaction of magnesium with FB 1

- Pipette 25.0 cm^3 of **FB 1** into the 250 cm^3 beaker.
- Weigh the strip of magnesium ribbon and record its mass.

mass of magnesium = g

- Coil the strip of magnesium ribbon loosely and then add it to the **FB 1** in the beaker.
- Stir the mixture occasionally and wait until the reaction has finished.

Dilution of the excess acid

- Transfer all the solution from the beaker into the volumetric flask.
- Make the solution up to the mark using distilled water.
- Shake the flask to mix the solution before using it for your titrations.
- Label this solution of hydrochloric acid **FB 2**.

Titration

- Fill the burette with **FB 2**.
- Rinse the pipette out thoroughly. Then pipette 25.0 cm^3 of **FB 3** into a conical flask.
- Add several drops of bromophenol blue indicator.
- Perform a rough titration, by running the solution from the burette into the conical flask until the mixture just becomes yellow.
- Record your burette readings in the space below.

The rough titre is cm^3 .

- Carry out as many accurate titrations as you think necessary to obtain consistent results.
- Make sure any recorded results show the precision of your practical work.
- Record in a suitable form below all of your burette readings and the volume of **FB 2** added in each accurate titration.

I	
II	
III	
IV	
V	
VI	
VII	

[7]

3

- (b) From your accurate titration results, obtain a suitable value for the volume of **FB 2** to be used in your calculations.
Show clearly how you have obtained this value.

25.0 cm³ of **FB 3** required cm³ of **FB 2**. [1]

(c) Calculations

Show your working and appropriate significant figures in the final answer to **each** step of your calculations.

- (i) Calculate the number of moles of sodium hydroxide present in 25.0 cm³ of solution **FB 3**.

moles of NaOH = mol

- (ii) Give the equation for the reaction of hydrochloric acid, HCl, with sodium hydroxide, NaOH. State symbols are **not** required.

.....

Deduce the number of moles of hydrochloric acid in the volume of **FB 2** you calculated in (b).

moles of HCl = mol

- (iii) Calculate the number of moles of hydrochloric acid in 250 cm³ of **FB 2**.

moles of HCl in 250 cm³ of **FB 2** = mol

- (iv) Calculate the number of moles of hydrochloric acid in 25.0 cm³ of **FB 1**.

moles of HCl in 25.0 cm³ of **FB 1** = mol

4

- (v) In (a), you reacted 25.0 cm^3 of **FB 1** with your weighed piece of magnesium. After the reaction, the unreacted hydrochloric acid was used to prepare 250 cm^3 of **FB 2**.

Use your answers to (iii) and (iv) to calculate the number of moles of hydrochloric acid that reacted with the magnesium ribbon.

moles of HCl reacting with Mg = mol

- (vi) Complete the equation below, for the reaction of magnesium with hydrochloric acid. State symbols **are** required.



Use your answer to (v) to calculate the number of moles of magnesium used.

moles of Mg = mol

- (vii) Use your answer to (vi) to calculate the relative atomic mass, A_r , of magnesium.

A_r of Mg =
[6]

- (d) (i) State **one** observation that proves that the hydrochloric acid in **FB 1** was in excess for the reaction with the magnesium ribbon.

.....
.....

- (ii) A student carried out exactly the same experiment but used 1.00 g of magnesium ribbon. State and explain why the student's experiment could not be used to determine the value for the A_r of magnesium. Include a calculation in your answer.

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

[Total: 17]

5

- 2 In this experiment you will determine the relative atomic mass of magnesium by thermal decomposition of hydrated magnesium sulfate.



FB 4 is hydrated magnesium sulfate, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$.

(a) Method

Record all your weighings in the space below.

- Weigh the crucible with its lid.
- Transfer all **FB 4** into the crucible.
- Weigh the crucible, lid and **FB 4**.
- Place the crucible on the pipe-clay triangle.
- Heat the crucible gently with the lid **on**, for about one minute.
- Then heat the crucible strongly, without the lid, for a further four minutes.
- Leave the crucible and its contents to cool with the lid on, for several minutes.
- **While the crucible is cooling, begin work on Question 3.**
- When the crucible has cooled, weigh it, with the lid and contents.
- Calculate and record the mass of anhydrous magnesium sulfate produced and the mass of water lost.

I	
II	
III	

[3]

(b) Calculations

- (i) Calculate the number of moles of water lost during heating.
(Use the data in the Periodic Table on page 12.)

moles of H_2O = mol

- (ii) Use the **equation above** and **your answer to (i)** to calculate the number of moles of anhydrous magnesium sulfate produced.

moles of MgSO_4 = mol

6

- (iii) Use your weighings and your answer to (ii) to calculate the relative formula mass, M_r , of anhydrous magnesium sulfate.

M_r of MgSO_4 =

- (iv) From your answer to (iii), calculate the relative atomic mass, A_r , of magnesium.

A_r of Mg =
[4]

- (c) (i) How could the experiment be improved to ensure that the magnesium sulfate had been completely dehydrated?

.....
.....

- (ii) Why is the lid put on the crucible during cooling?

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

[Total: 9]

3 Qualitative Analysis

At each stage of any test you are to record details of the following.

- colour changes seen
- the formation of any precipitate
- the solubility of such precipitates in an excess of the reagent added

Where gases are released they should be identified by a test, **described in the appropriate place in your observations.**

You should indicate clearly at what stage in a test a change occurs.

Marks are **not** given for chemical equations.

No additional tests for ions present should be attempted.

If any solution is warmed, a boiling tube MUST be used.

Rinse and reuse test-tubes and boiling tubes where possible.

Where reagents are selected for use in a test, the name or correct formula of the element or compound must be given.

(a) **FB 5** is a solution containing one cation and one anion.

Carry out test-tube tests to find out whether the cation in **FB 5** is magnesium and whether the anion is sulfate.

- State what reagents you used.
- Record the observations you made in a table.
- State your conclusions about which ions are present.

[4]

(b) **FB 6** is a salt containing one cation and one anion from those listed on pages 10 and 11.

- (i) Place a **few** crystals of **FB 6** in a hard-glass test-tube.
Heat gently at first and then strongly.
Leave the test-tube and its contents to cool.

Record **all** your observations below.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (ii) Dissolve the remainder of **FB 6** in about 20 cm³ of distilled water in a boiling tube for use in the following tests.

<i>test</i>	<i>observations</i>
To a 1 cm depth of the solution of FB 6 in a test-tube, add a few drops of aqueous silver nitrate.	
To a 1 cm depth of the solution of FB 6 in a test-tube, add a few drops of dilute sulfuric acid.	
To a 1 cm depth of the solution of FB 6 in a test-tube, add aqueous ammonia.	

<i>test</i>	<i>observations</i>
To a 1 cm depth of the solution of FB 6 in a boiling tube, add aqueous sodium hydroxide until in excess, then	
heat the mixture gently and carefully, and test any gas produced, then	
add a small piece of aluminium foil while the mixture is still warm. Test any gas produced.	

(iii) Deduce the formula of the salt in **FB 6**.

Formula is

[10]

[Total: 14]

Qualitative Analysis Notes

Key: [ppt. = precipitate]

1 Reactions of aqueous cations

ion	reaction with	
	NaOH(aq)	NH ₃ (aq)
aluminium, Al ³⁺ (aq)	white ppt. soluble in excess	white ppt. insoluble in excess
ammonium, NH ₄ ⁺ (aq)	no ppt. ammonia produced on heating	–
barium, Ba ²⁺ (aq)	no ppt. (if reagents are pure)	no ppt.
calcium, Ca ²⁺ (aq)	white ppt. with high [Ca ²⁺ (aq)]	no ppt.
chromium(III), Cr ³⁺ (aq)	grey-green ppt. soluble in excess giving dark green solution	grey-green ppt. insoluble in excess
copper(II), Cu ²⁺ (aq)	pale blue ppt. insoluble in excess	blue ppt. soluble in excess giving dark blue solution
iron(II), Fe ²⁺ (aq)	green ppt. turning brown on contact with air insoluble in excess	green ppt. turning brown on contact with air insoluble in excess
iron(III), Fe ³⁺ (aq)	red-brown ppt. insoluble in excess	red-brown ppt. insoluble in excess
magnesium, Mg ²⁺ (aq)	white ppt. insoluble in excess	white ppt. insoluble in excess
manganese(II), Mn ²⁺ (aq)	off-white ppt. rapidly turning brown on contact with air insoluble in excess	off-white ppt. rapidly turning brown on contact with air insoluble in excess
zinc, Zn ²⁺ (aq)	white ppt. soluble in excess	white ppt. soluble in excess

2 Reactions of anions

<i>ion</i>	<i>reaction</i>
carbonate, CO_3^{2-}	CO_2 liberated by dilute acids
chloride, $\text{Cl}^-(\text{aq})$	gives white ppt. with $\text{Ag}^+(\text{aq})$ (soluble in $\text{NH}_3(\text{aq})$)
bromide, $\text{Br}^-(\text{aq})$	gives cream ppt. with $\text{Ag}^+(\text{aq})$ (partially soluble in $\text{NH}_3(\text{aq})$)
iodide, $\text{I}^-(\text{aq})$	gives yellow ppt. with $\text{Ag}^+(\text{aq})$ (insoluble in $\text{NH}_3(\text{aq})$)
nitrate, $\text{NO}_3^-(\text{aq})$	NH_3 liberated on heating with $\text{OH}^-(\text{aq})$ and Al foil
nitrite, $\text{NO}_2^-(\text{aq})$	NH_3 liberated on heating with $\text{OH}^-(\text{aq})$ and Al foil; NO liberated by dilute acids (colourless $\text{NO} \rightarrow$ (pale) brown NO_2 in air)
sulfate, $\text{SO}_4^{2-}(\text{aq})$	gives white ppt. with $\text{Ba}^{2+}(\text{aq})$ (insoluble in excess dilute strong acids)
sulfite, $\text{SO}_3^{2-}(\text{aq})$	SO_2 liberated with dilute acids; gives white ppt. with $\text{Ba}^{2+}(\text{aq})$ (soluble in excess dilute strong acids)

3 Tests for gases

<i>gas</i>	<i>test and test result</i>
ammonia, NH_3	turns damp red litmus paper blue
carbon dioxide, CO_2	gives a white ppt. with limewater (ppt. dissolves with excess CO_2)
chlorine, Cl_2	bleaches damp litmus paper
hydrogen, H_2	“pops” with a lighted splint
oxygen, O_2	relights a glowing splint
sulfur dioxide, SO_2	turns acidified aqueous potassium manganate(VII) from purple to colourless

The Periodic Table of the Elements

		Group																																																																																																																																																																																																																																																																																																																																																																																																																																																								
I	II	III	IV	V	VI	VII	0																																																																																																																																																																																																																																																																																																																																																																																																																																																			
6.9 Li Lithium 3	9.0 Be Beryllium 4	1.0 H Hydrogen 1	10.8 B Boron 5	12.0 C Carbon 6	14.0 N Nitrogen 7	16.0 O Oxygen 8	19.0 F Fluorine 9	20.2 Ne Neon 10																																																																																																																																																																																																																																																																																																																																																																																																																																																		
23.0 Na Sodium 11	24.3 Mg Magnesium 12	27.0 Al Aluminium 13	28.1 Si Silicon 14	31.0 P Phosphorus 15	32.1 S Sulfur 16	35.5 Cl Chlorine 17	39.9 Ar Argon 18																																																																																																																																																																																																																																																																																																																																																																																																																																																			
39.1 K Potassium 19	40.1 Ca Calcium 20	69.7 Ga Gallium 31	72.6 Ge Germanium 32	74.9 As Arsenic 33	79.0 Se Selenium 34	79.9 Br Bromine 35	83.8 Kr Krypton 36																																																																																																																																																																																																																																																																																																																																																																																																																																																			
85.5 Rb Rubidium 37	87.6 Sr Strontium 38	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	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	208 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86																																																																																																																																																																																																																																																																																																																																																																																																																																																			
87 Fr Francium	88 Ra Radium	112 Uub Ununbium	111 Uuu Unununium	110 Uun Ununium	109 Mt Meitnerium	108 Hs Hassium	107 Bh Bohrium	106 Sg Seaborgium	105 Db Dubnium	104 Rf Rutherfordium	103 Ac Actinium	102 Th Thorium	101 Pa Protactinium	100 U Uranium	99 Np Neptunium	98 Pu Plutonium	97 Bk Berkelium	96 Cm Curium	95 Am Americium	94 Pm Promethium	93 Np Neptunium	92 U Uranium	91 Pa Protactinium	90 Th Thorium	89 Ac Actinium																																																																																																																																																																																																																																																																																																																																																																																																																																	
58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon	87 Fr Francium	88 Ra Radium	89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium	104 Uuo Ununoctium	105 Uuq Ununquadium	106 Uuh Ununhexium	107 Uub Ununbium	108 Uut Ununtrium	109 Uuq Ununquadium	110 Uun Ununium	111 Uuu Unununium	112 Uub Ununbium	113 Uut Ununtrium	114 Uuq Ununquadium	115 Uuh Ununhexium	116 Uuo Ununoctium	117 Uue Ununseptium	118 Uuo Ununoctium	119 Uuq Ununquadium	120 Uun Ununium	121 Uuu Unununium	122 Uub Ununbium	123 Uut Ununtrium	124 Uuq Ununquadium	125 Uuh Ununhexium	126 Uuo Ununoctium	127 Uue Ununseptium	128 Uuq Ununquadium	129 Uun Ununium	130 Uuu Unununium	131 Uub Ununbium	132 Uut Ununtrium	133 Uuq Ununquadium	134 Uuh Ununhexium	135 Uuo Ununoctium	136 Uue Ununseptium	137 Uuq Ununquadium	138 Uun Ununium	139 Uuu Unununium	140 Uub Ununbium	141 Uut Ununtrium	142 Uuq Ununquadium	143 Uuh Ununhexium	144 Uuo Ununoctium	145 Uue Ununseptium	146 Uuq Ununquadium	147 Uun Ununium	148 Uuu Unununium	149 Uub Ununbium	150 Uut Ununtrium	151 Uuq Ununquadium	152 Uuh Ununhexium	153 Uuo Ununoctium	154 Uue Ununseptium	155 Uuq Ununquadium	156 Uun Ununium	157 Uuu Unununium	158 Uub Ununbium	159 Uut Ununtrium	160 Uuq Ununquadium	161 Uuh Ununhexium	162 Uuo Ununoctium	163 Uue Ununseptium	164 Uuq Ununquadium	165 Uun Ununium	166 Uuu Unununium	167 Uub Ununbium	168 Uut Ununtrium	169 Uuq Ununquadium	170 Uuh Ununhexium	171 Uuo Ununoctium	172 Uue Ununseptium	173 Uuq Ununquadium	174 Uun Ununium	175 Uuu Unununium	176 Uub Ununbium	177 Uut Ununtrium	178 Uuq Ununquadium	179 Uuh Ununhexium	180 Uuo Ununoctium	181 Uue Ununseptium	182 Uuq Ununquadium	183 Uun Ununium	184 Uuu Unununium	185 Uub Ununbium	186 Uut Ununtrium	187 Uuq Ununquadium	188 Uuh Ununhexium	189 Uuo Ununoctium	190 Uue Ununseptium	191 Uuq Ununquadium	192 Uun Ununium	193 Uuu Unununium	194 Uub Ununbium	195 Uut Ununtrium	196 Uuq Ununquadium	197 Uuh Ununhexium	198 Uuo Ununoctium	199 Uue Ununseptium	200 Uuq Ununquadium	201 Uun Ununium	202 Uuu Unununium	203 Uub Ununbium	204 Uut Ununtrium	205 Uuq Ununquadium	206 Uuh Ununhexium	207 Uuo Ununoctium	208 Uue Ununseptium	209 Uuq Ununquadium	210 Uun Ununium	211 Uuu Unununium	212 Uub Ununbium	213 Uut Ununtrium	214 Uuq Ununquadium	215 Uuh Ununhexium	216 Uuo Ununoctium	217 Uue Ununseptium	218 Uuq Ununquadium	219 Uun Ununium	220 Uuu Unununium	221 Uub Ununbium	222 Uut Ununtrium	223 Uuq Ununquadium	224 Uuh Ununhexium	225 Uuo Ununoctium	226 Uue Ununseptium	227 Uuq Ununquadium	228 Uun Ununium	229 Uuu Unununium	230 Uub Ununbium	231 Uut Ununtrium	232 Uuq Ununquadium	233 Uuh Ununhexium	234 Uuo Ununoctium	235 Uue Ununseptium	236 Uuq Ununquadium	237 Uun Ununium	238 Uuu Unununium	239 Uub Ununbium	240 Uut Ununtrium	241 Uuq Ununquadium	242 Uuh Ununhexium	243 Uuo Ununoctium	244 Uue Ununseptium	245 Uuq Ununquadium	246 Uun Ununium	247 Uuu Unununium	248 Uub Ununbium	249 Uut Ununtrium	250 Uuq Ununquadium	251 Uuh Ununhexium	252 Uuo Ununoctium	253 Uue Ununseptium	254 Uuq Ununquadium	255 Uun Ununium	256 Uuu Unununium	257 Uub Ununbium	258 Uut Ununtrium	259 Uuq Ununquadium	260 Uuh Ununhexium	261 Uuo Ununoctium	262 Uue Ununseptium	263 Uuq Ununquadium	264 Uun Ununium	265 Uuu Unununium	266 Uub Ununbium	267 Uut Ununtrium	268 Uuq Ununquadium	269 Uuh Ununhexium	270 Uuo Ununoctium	271 Uue Ununseptium	272 Uuq Ununquadium	273 Uun Ununium	274 Uuu Unununium	275 Uub Ununbium	276 Uut Ununtrium	277 Uuq Ununquadium	278 Uuh Ununhexium	279 Uuo Ununoctium	280 Uue Ununseptium	281 Uuq Ununquadium	282 Uun Ununium	283 Uuu Unununium	284 Uub Ununbium	285 Uut Ununtrium	286 Uuq Ununquadium	287 Uuh Ununhexium	288 Uuo Ununoctium	289 Uue Ununseptium	290 Uuq Ununquadium	291 Uun Ununium	292 Uuu Unununium	293 Uub Ununbium	294 Uut Ununtrium	295 Uuq Ununquadium	296 Uuh Ununhexium	297 Uuo Ununoctium	298 Uue Ununseptium	299 Uuq Ununquadium	300 Uun Ununium	301 Uuu Unununium	302 Uub Ununbium	303 Uut Ununtrium	304 Uuq Ununquadium	305 Uuh Ununhexium	306 Uuo Ununoctium	307 Uue Ununseptium	308 Uuq Ununquadium	309 Uun Ununium	310 Uuu Unununium	311 Uub Ununbium	312 Uut Ununtrium	313 Uuq Ununquadium	314 Uuh Ununhexium	315 Uuo Ununoctium	316 Uue Ununseptium	317 Uuq Ununquadium	318 Uun Ununium	319 Uuu Unununium	320 Uub Ununbium	321 Uut Ununtrium	322 Uuq Ununquadium	323 Uuh Ununhexium	324 Uuo Ununoctium	325 Uue Ununseptium	326 Uuq Ununquadium	327 Uun Ununium	328 Uuu Unununium	329 Uub Ununbium	330 Uut Ununtrium	331 Uuq Ununquadium	332 Uuh Ununhexium	333 Uuo Ununoctium	334 Uue Ununseptium	335 Uuq Ununquadium	336 Uun Ununium	337 Uuu Unununium	338 Uub Ununbium	339 Uut Ununtrium	340 Uuq Ununquadium	341 Uuh Ununhexium	342 Uuo Ununoctium	343 Uue Ununseptium	344 Uuq Ununquadium	345 Uun Ununium	346 Uuu Unununium	347 Uub Ununbium	348 Uut Ununtrium	349 Uuq Ununquadium	350 Uuh Ununhexium	351 Uuo Ununoctium	352 Uue Ununseptium	353 Uuq Ununquadium	354 Uun Ununium	355 Uuu Unununium	356 Uub Ununbium	357 Uut Ununtrium	358 Uuq Ununquadium	359 Uuh Ununhexium	360 Uuo Ununoctium	361 Uue Ununseptium	362 Uuq Ununquadium	363 Uun Ununium	364 Uuu Unununium	365 Uub Ununbium	366 Uut Ununtrium	367 Uuq Ununquadium	368 Uuh Ununhexium	369 Uuo Ununoctium	370 Uue Ununseptium	371 Uuq Ununquadium	372 Uun Ununium	373 Uuu Unununium	374 Uub Ununbium	375 Uut Ununtrium	376 Uuq Ununquadium	377 Uuh Ununhexium	378 Uuo Ununoctium	379 Uue Ununseptium	380 Uuq Ununquadium	381 Uun Ununium	382 Uuu Unununium	383 Uub Ununbium	384 Uut Ununtrium	385 Uuq Ununquadium	386 Uuh Ununhexium	387 Uuo Ununoctium	388 Uue Ununseptium	389 Uuq Ununquadium	390 Uun Ununium	391 Uuu Unununium	392 Uub Ununbium	393 Uut Ununtrium	394 Uuq Ununquadium	395 Uuh Ununhexium	396 Uuo Ununoctium	397 Uue Ununseptium	398 Uuq Ununquadium	399 Uun Ununium	400 Uuu Unununium	401 Uub Ununbium	402 Uut Ununtrium	403 Uuq Ununquadium	404 Uuh Ununhexium	405 Uuo Ununoctium	406 Uue Ununseptium	407 Uuq Ununquadium	408 Uun Ununium	409 Uuu Unununium	410 Uub Ununbium	411 Uut Ununtrium	412 Uuq Ununquadium	413 Uuh Ununhexium	414 Uuo Ununoctium	415 Uue Ununseptium	416 Uuq Ununquadium	417 Uun Ununium	418 Uuu Unununium	419 Uub Ununbium	420 Uut Ununtrium	421 Uuq Ununquadium	422 Uuh Ununhexium	423 Uuo Ununoctium	424 Uue Ununseptium	425 Uuq Ununquadium	426 Uun Ununium	427 Uuu Unununium	428 Uub Ununbium	429 Uut Ununtrium	430 Uuq Ununquadium	431 Uuh Ununhexium	432 Uuo Ununoctium	433 Uue Ununseptium	434 Uuq Ununquadium	435 Uun Ununium	436 Uuu Unununium	437 Uub Ununbium	438 Uut Ununtrium	439 Uuq Ununquadium	440 Uuh Ununhexium	441 Uuo Ununoctium	442 Uue Ununseptium	443 Uuq Ununquadium	444 Uun Ununium	445 Uuu Unununium	446 Uub Ununbium	447 Uut Ununtrium	448 Uuq Ununquadium	449 Uuh Ununhexium	450 Uuo Ununoctium	451 Uue Ununseptium	452 Uuq Ununquadium	453 Uun Ununium	454 Uuu Unununium	455 Uub Ununbium	456 Uut Ununtrium	457 Uuq Ununquadium	458 Uuh Ununhexium	459 Uuo Ununoctium	460 Uue Ununseptium	461 Uuq Ununquadium	462 Uun Ununium	463 Uuu Unununium	464 Uub Ununbium	465 Uut Ununtrium	466 Uuq Ununquadium	467 Uuh Ununhexium	468 Uuo Ununoctium	469 Uue Ununseptium	470 Uuq Ununquadium	471 Uun Ununium	472 Uuu Unununium	473 Uub Ununbium	474 Uut Ununtrium	475 Uuq Ununquadium	476 Uuh Ununhexium	477 Uuo Ununoctium	478 Uue Ununseptium	479 Uuq Ununquadium	480 Uun Ununium	481 Uuu Unununium	482 Uub Ununbium	483 Uut Ununtrium	484 Uuq Ununquadium	485 Uuh Ununhexium	486 Uuo Ununoctium	487 Uue Ununseptium	488 Uuq Ununquadium	489 Uun Ununium	490 Uuu Unununium	491 Uub Ununbium	492 Uut Ununtrium	493 Uuq Ununquadium	494 Uuh Ununhexium	495 Uuo Ununoctium	496 Uue Ununseptium	497 Uuq Ununquadium	498 Uun Ununium	499 Uuu Unununium	500 Uub