

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY



Paper 3

0620/03

October/November 2004

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials required.

Candidate
Name

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Centre
Number

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Candidate
Number

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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 a pencil for any diagrams, graphs or rough working.

WRITE IN THE BOXES PROVIDED ON THE QUESTION PAPER

DO **NOT** WRITE IN THE BARCODE.

DO **NOT** WRITE IN THE GREY AREAS BETWEEN THE PAGES.

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

You may use a calculator.

Answer **all** questions.

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

A copy of the Periodic Table is printed on page 16.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
Total	

This document consists of **15** printed pages and **1** blank page.



- 1 (a) Two of the gases in air are nitrogen and oxygen. Name **two** other gases present in unpolluted air.

	[2]
--	-----

- (b) Two common pollutants present in air are sulphur dioxide and lead compounds. State the source and harmful effect of each.

sulphur dioxide

source	
harmful effect	
	[3]

lead compounds

source	
harmful effect	
	[2]

- (c) Respiration and photosynthesis are two of the processes that determine the percentage of oxygen and of carbon dioxide in the air.

- (i) Name another process that changes the percentages of these two gases in air.

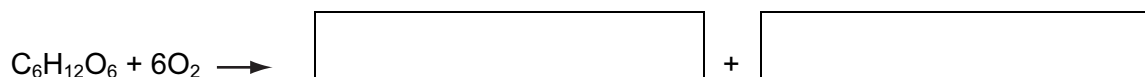
	[1]
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- (ii) The equation for photosynthesis is given below.



This is an endothermic reaction.

Complete the reaction for respiration.

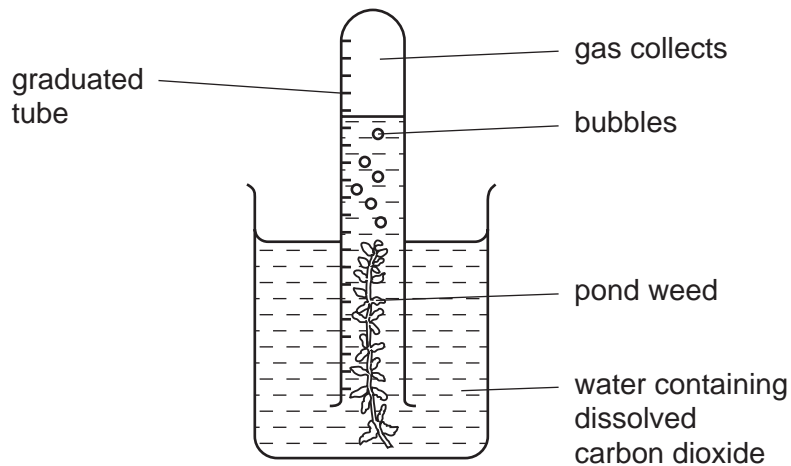


This is an reaction.

[2]

- (d) The rate of photosynthesis of pond weed can be measured using the following experiment.

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- (i) Describe how you could show that the gas collected in this experiment is oxygen.

	[1]
--	-----

- (ii) What measurements are needed to calculate the rate of this reaction?

	[2]
--	-----

- (iii) What would be the effect, and why, of moving the apparatus further away from the light?

<hr style="border-top: 1px dashed black;"/>	[2]
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- 2 The salt copper(II) sulphate can be prepared by reacting copper(II) oxide with sulphuric acid.

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Complete the list of instructions for making copper(II) sulphate using **six** of the words below.

blue cool dilute filter
saturated sulphate white oxide

Instructions

1 Add excess copper(II) oxide to sulphuric acid in a beaker and boil it.

2 to remove the unreacted copper(II) oxide.

3 Heat the solution until it is .

4 the solution to form

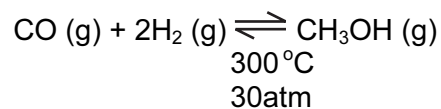
coloured crystals of copper (II)

.

[6]

3 The simplest alcohol is methanol.

(a) It is manufactured by the following reversible reaction.



(i) Reversible reactions can come to equilibrium. Explain the term *equilibrium*.

[1]

(ii) At 400 °C, the percentage of methanol in the equilibrium mixture is lower than at 300 °C. Suggest an explanation.

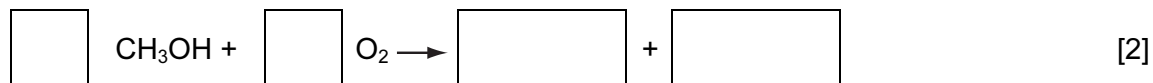
[2]

(iii) Suggest two advantages of using high pressure for this reaction. Give a reason for each advantage.

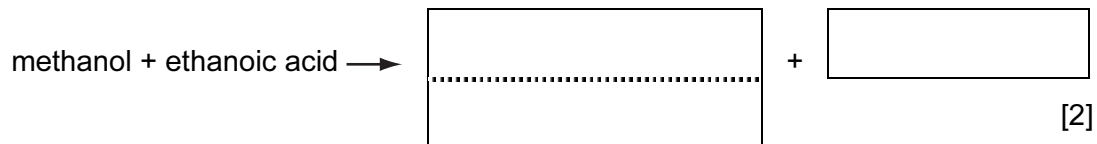
advantage	
reason	

advantage	
reason	
[5]	

(b) (i) Complete the equation for the combustion of methanol in an excess of oxygen.



(ii) Complete the word equation.

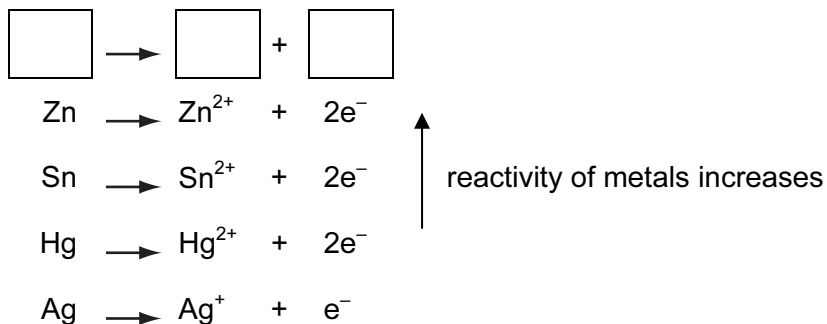


(iii) Methanol can be oxidised to an acid. Name this acid.

	[1]
--	-----

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- 4 In the following list of ionic equations, the metals are in order of reactivity.



- (a) (i) In the space at the top of the series, write an ionic equation that includes a more reactive metal. [1]

- (ii) Define *oxidation* in terms of electron transfer.

.....

[1]

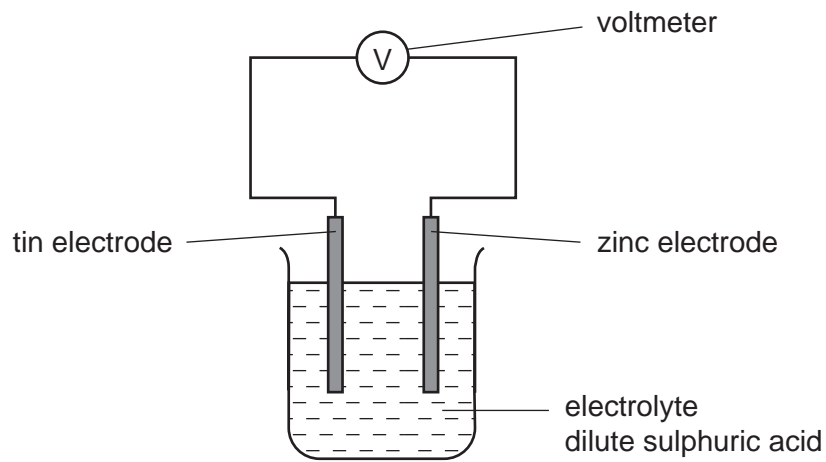
- (iii) Explain why the positive ions are likely to be oxidising agents.

[1]

- (iv) Which positive ion(s) can oxidise mercury metal (Hg)?

[1]

(b) The following diagram shows a simple cell.



- (i) Predict how the voltage of the cell would change if the tin electrode was replaced with a silver one.

[1]

- (ii) Which electrode would go into the solution as positive ions? Give a reason for your choice.

[1]

- (iii) State how you can predict the direction of the electron flow in cells of this type.

[1]

- 5 Strontium and sulphur chlorides both have a formula of the type XCl_2 but they have different properties.

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property	strontium chloride	sulphur chloride
appearance	white crystalline solid	red liquid
melting point / °C	873	-80
particles present	ions	molecules
electrical conductivity of solid	poor	poor
electrical conductivity of liquid	good	poor

- (a) The formulae of the chlorides are similar because both elements have a valency of 2. Explain why Group II and Group VI elements both have a valency of 2.

[2]

- (b) Draw a diagram showing the arrangement of the valency electrons in one covalent molecule of sulphur chloride.
Use x to represent an electron from a sulphur atom.
Use o to represent an electron from a chlorine atom.

[3]

- (c) Explain the difference in electrical conductivity between the following.

- (i) solid and liquid strontium chloride

[1]

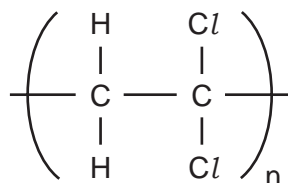
- (ii) liquid strontium chloride and liquid sulphur chloride

[1]

- 6 Polymers are extensively used in food packaging. Poly(dichloroethene) is used because gases can only diffuse through it very slowly. Polyesters have a high thermal stability and food can be cooked in a polyester bag.

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- (a) (i) The structure of poly(dichloroethene) is given below.



Draw the structural formula of the monomer.

[1]

- (ii) Explain why oxygen can diffuse faster through the polymer bag than carbon dioxide can.

[2]

- (b) (i) A polyester can be formed from the monomers HO-CH₂CH₂-OH and HOOC-C₆H₄-COOH. Draw the structure of this polyester.

[2]

- (ii) Name a naturally occurring class of compounds that contains the ester linkage.

	[1]
--	-----

- (iii) Suggest what is meant by the term *thermal stability*.

	[1]
--	-----

- (c) (i) Describe **two** environmental problems caused by the disposal of plastic (polymer) waste.

	[2]
--	-----

- (ii) The best way of disposing of plastic waste is recycling to form new plastics. What is another advantage of recycling plastics made from petroleum?

	[1]
--	-----

- 7 (a) (i) Write a symbol equation for the action of heat on zinc hydroxide.

[2]

- (ii) Describe what happens when solid **sodium** hydroxide is heated strongly.

[1]

- (b) What would be **observed** when copper(II) nitrate is heated?

[3]

- (c) Iron(III) sulphate decomposes when heated. Calculate the mass of iron(III) oxide formed and the volume of sulphur trioxide produced when 10.0 g of iron(III) sulphate was heated.

Mass of one mole of $\text{Fe}_2(\text{SO}_4)_3$ is 400 g.



Number of moles of $\text{Fe}_2(\text{SO}_4)_3$ =	
Number of moles of Fe_2O_3 formed =	
Mass of iron(III) oxide formed =	g
Number of moles of SO_3 produced =	
Volume of sulphur trioxide at r.t.p. =	dm^3

[5]

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8 The alkenes are a homologous series of unsaturated hydrocarbons.

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(a) The table below gives the names, formulae and boiling points of the first members of the series.

name	formula	boiling point/°C
ethene	C ₂ H ₄	-102
propene	C ₃ H ₆	-48
butene	C ₄ H ₈	-7
pentene	C ₅ H ₁₀	30
hexene		

(i) Complete the table by giving the formula of hexene and by predicting its boiling point.

[2]

(ii) Deduce the formula of the alkene which has a relative molecular mass of 168. Show your working.

[2]

(b) Describe a test that will distinguish between the two isomers, but-2-ene and cyclobutane.

test	
result with but-2-ene	
result with cyclobutane	[3]

(c) Alkenes undergo addition reactions.

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(i) What class of organic compound is formed when an alkene reacts with water?

	[1]
--	-----

(ii) Predict the structural formula of the compound formed when hydrogen chloride reacts with but-2-ene.

	[1]
--	-----

(iii) Draw the structure of the polymer formed from but-2-ene.

	[2]
--	-----

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DATA SHEET
The Periodic Table of the Elements

		Group																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	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 Fe Iron 26	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Ca Calcium 20	41 Zr Zirconium 40	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	58-71 Lanthanoid series	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	90-103 Actinoid series	91 Th Thorium 90	92 Pa Protactinium 91	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	104-118 Other elements	109 Co Cobalt 27	110 Ni Nickel 28	111 Cu Copper 29	112 Zn Zinc 30	113 In Indium 49	114 Sn Tin 50	115 Sb Antimony 51	116 Te Tellurium 52	117 At Astatine 85	118 Xe Xenon 54	119 Fr Francium 87	120 Ra Radium 88	121-132 Other elements	133 Cs Caesium 55	134 Ba Barium 56	135 La Lanthanum 57	136-147 Other elements	148 Fr Francium 87	149 Ra Radium 88	150-161 Other elements	162 Dy Dysprosium 66	163 Ho Holmium 67	164 Er Erbium 68	165 Tm Thulium 69	166 Yb Ytterbium 70	167 Lu Lutetium 71	168-179 Other elements	180 Fr Francium 87	181 Ra Radium 88	182-193 Other elements	194 Th Thorium 90	195 Pa Protactinium 91	196 U Uranium 92	197 Np Neptunium 93	198 Pu Plutonium 94	199 Am Americium 95	200 Cm Curium 96	201 Bk Berkelium 97	202 Cf Californium 98	203 Es Einsteinium 99	204 Fm Fermium 100	205 Md Mendelevium 101	206 No Nobelium 102	207 Lr Lawrencium 103	208-218 Other elements	219 Fr Francium 87	220 Ra Radium 88	221-232 Other elements	233 Th Thorium 90	234 Pa Protactinium 91	235 U Uranium 92	236 Np Neptunium 93	237 Pu Plutonium 94	238 Am Americium 95	239 Cm Curium 96	240 Bk Berkelium 97	241 Cf Californium 98	242 Es Einsteinium 99	243 Fm Fermium 100	244 Md Mendelevium 101	245 No Nobelium 102	246 Lr Lawrencium 103	247-288 Other elements	289 Fr Francium 87	290 Ra Radium 88	291-302 Other elements	303 Th Thorium 90	304 Pa Protactinium 91	305 U Uranium 92	306 Np Neptunium 93	307 Pu Plutonium 94	308 Am Americium 95	309 Cm Curium 96	310 Bk Berkelium 97	311 Cf Californium 98	312 Es Einsteinium 99	313 Fm Fermium 100	314 Md Mendelevium 101	315 No Nobelium 102	316 Lr Lawrencium 103	317-382 Other elements	383 Fr Francium 87	384 Ra Radium 88	385-396 Other elements	397 Th Thorium 90	398 Pa Protactinium 91	399 U Uranium 92	400 Np Neptunium 93	401 Pu Plutonium 94	402 Am Americium 95	403 Cm Curium 96	404 Bk Berkelium 97	405 Cf Californium 98	406 Es Einsteinium 99	407 Fm Fermium 100	408 Md Mendelevium 101	409 No Nobelium 102	410 Lr Lawrencium 103	411-486 Other elements	487 Fr Francium 87	488 Ra Radium 88	489-490 Other elements	491 Th Thorium 90	492 Pa Protactinium 91	493 U Uranium 92	494 Np Neptunium 93	495 Pu Plutonium 94	496 Am Americium 95	497 Cm Curium 96	498 Bk Berkelium 97	499 Cf Californium 98	500 Es Einsteinium 99	501 Fm Fermium 100	502 Md Mendelevium 101	503 No Nobelium 102	504 Lr Lawrencium 103	505-580 Other elements	581 Fr Francium 87	582 Ra Radium 88	583-594 Other elements	595 Th Thorium 90	596 Pa Protactinium 91	597 U Uranium 92	598 Np Neptunium 93	599 Pu Plutonium 94	600 Am Americium 95	601 Cm Curium 96	602 Bk Berkelium 97	603 Cf Californium 98	604 Es Einsteinium 99	605 Fm Fermium 100	606 Md Mendelevium 101	607 No Nobelium 102	608 Lr Lawrencium 103	609-684 Other elements	685 Fr Francium 87	686 Ra Radium 88	687-698 Other elements	699 Th Thorium 90	700 Pa Protactinium 91	701 U Uranium 92	702 Np Neptunium 93	703 Pu Plutonium 94	704 Am Americium 95	705 Cm Curium 96	706 Bk Berkelium 97	707 Cf Californium 98	708 Es Einsteinium 99	709 Fm Fermium 100	710 Md Mendelevium 101	711 No Nobelium 102	712 Lr Lawrencium 103	713-788 Other elements	789 Fr Francium 87	790 Ra Radium 88	791-802 Other elements	803 Th Thorium 90	804 Pa Protactinium 91	805 U Uranium 92	806 Np Neptunium 93	807 Pu Plutonium 94	808 Am Americium 95	809 Cm Curium 96	810 Bk Berkelium 97	811 Cf Californium 98	812 Es Einsteinium 99	813 Fm Fermium 100	814 Md Mendelevium 101	815 No Nobelium 102	816 Lr Lawrencium 103	817-892 Other elements	893 Fr Francium 87	894 Ra Radium 88	895-906 Other elements	907 Th Thorium 90	908 Pa Protactinium 91	909 U Uranium 92	910 Np Neptunium 93	911 Pu Plutonium 94	912 Am Americium 95	913 Cm Curium 96	914 Bk Berkelium 97	915 Cf Californium 98	916 Es Einsteinium 99	917 Fm Fermium 100	918 Md Mendelevium 101	919 No Nobelium 102	920 Lr Lawrencium 103	921-996 Other elements	997 Fr Francium 87	998 Ra Radium 88	999-1010 Other elements	1011 Th Thorium 90	1012 Pa Protactinium 91	1013 U Uranium 92	1014 Np Neptunium 93	1015 Pu Plutonium 94	1016 Am Americium 95	1017 Cm Curium 96	1018 Bk Berkelium 97	1019 Cf Californium 98	1020 Es Einsteinium 99	1021 Fm Fermium 100	1022 Md Mendelevium 101	1023 No Nobelium 102	1024 Lr Lawrencium 103	1025-1100 Other elements	1101 Fr Francium 87	1102 Ra Radium 88	1103-1114 Other elements	1115 Th Thorium 90	1116 Pa Protactinium 91	1117 U Uranium 92	1118 Np Neptunium 93	1119 Pu Plutonium 94	1120 Am Americium 95	1121 Cm Curium 96	1122 Bk Berkelium 97	1123 Cf Californium 98	1124 Es Einsteinium 99	1125 Fm Fermium 100	1126 Md Mendelevium 101	1127 No Nobelium 102	1128 Lr Lawrencium 103	1129-1204 Other elements	1205 Fr Francium 87	1206 Ra Radium 88	1207-1218 Other elements	1219 Th Thorium 90	1220 Pa Protactinium 91	1221 U Uranium 92	1222 Np Neptunium 93	1223 Pu Plutonium 94	1224 Am Americium 95	1225 Cm Curium 96	1226 Bk Berkelium 97	1227 Cf Californium 98	1228 Es Einsteinium 99	1229 Fm Fermium 100	1230 Md Mendelevium 101	1231 No Nobelium 102	1232 Lr Lawrencium 103	1233-1308 Other elements	1309 Fr Francium 87	1310 Ra Radium 88	1311-1322 Other elements	1323 Th Thorium 90	1324 Pa Protactinium 91	1325 U Uranium 92	1326 Np Neptunium 93	1327 Pu Plutonium 94	1328 Am Americium 95	1329 Cm Curium 96	1330 Bk Berkelium 97	1331 Cf Californium 98	1332 Es Einsteinium 99	1333 Fm Fermium 100	1334 Md Mendelevium 101	1335 No Nobelium 102	1336 Lr Lawrencium 103	1337-1412 Other elements	1413 Fr Francium 87	1414 Ra Radium 88	1415-1426 Other elements	1427 Th Thorium 90	1428 Pa Protactinium 91	1429 U Uranium 92	1430 Np Neptunium 93	1431 Pu Plutonium 94	1432 Am Americium 95	1433 Cm Curium 96	1434 Bk Berkelium 97	1435 Cf Californium 98	1436 Es Einsteinium 99	1437 Fm Fermium 100	1438 Md Mendelevium 101	1439 No Nobelium 102	1440 Lr Lawrencium 103	1441-1516 Other elements	1517 Fr Francium 87	1518 Ra Radium 88	1519-1530 Other elements	1531 Th Thorium 90	1532 Pa Protactinium 91	1533 U Uranium 92	1534 Np Neptunium 93	1535 Pu Plutonium 94	1536 Am Americium 95	1537 Cm Curium 96	1538 Bk Berkelium 97	1539 Cf Californium 98	1540 Es Einsteinium 99	1541 Fm Fermium 100	1542 Md Mendelevium 101	1543 No Nobelium 102	1544 Lr Lawrencium 103	1545-1620 Other elements	1621 Fr Francium 87	1622 Ra Radium 88	1623-1634 Other elements	1635 Th Thorium 90	1636 Pa Protactinium 91	1637 U Uranium 92	1638 Np Neptunium 93	1639 Pu Plutonium 94	1640 Am Americium 95	1641 Cm Curium 96	1642 Bk Berkelium 97	1643 Cf Californium 98	1644 Es Einsteinium 99	1645 Fm Fermium 100	1646 Md Mendelevium 101	1647 No Nobelium 102	1648 Lr Lawrencium 103	1649-1724 Other elements	1725 Fr Francium 87	1726 Ra Radium 88	1727-1738 Other elements	1739 Th Thorium 90	1740 Pa Protactinium 91	1741 U Uranium 92	1742 Np Neptunium 93	1743 Pu Plutonium 94	1744 Am Americium 95	1745 Cm Curium 96	1746 Bk Berkelium 97	1747 Cf Californium 98	1748 Es Einsteinium 99	1749 Fm Fermium 100	1750 Md Mendelevium 101	1751 No Nobelium 102	1752 Lr Lawrencium 103	1753-1828 Other elements	1829 Fr Francium 87	1830 Ra Radium 88	1831-1842 Other elements	1843 Th Thorium 90	1844 Pa Protactinium 91	1845 U Uranium 92	1846 Np Neptunium 93	1847 Pu Plutonium 94	1848 Am Americium 95	1849 Cm Curium 96	1850 Bk Berkelium 97	1851 Cf Californium 98	1852 Es Einsteinium 99	1853 Fm Fermium 100	1854 Md Mendelevium 101	1855 No Nobelium 102	1856 Lr Lawrencium 103	1857-1932 Other elements	1933 Fr Francium 87	1934 Ra Radium 88	1935-1946 Other elements	1947 Th Thorium 90	1948 Pa Protactinium 91	1949 U Uranium 92	1950 Np Neptunium 93	1951 Pu Plutonium 94	1952 Am Americium 95	1953 Cm Curium 96	1954 Bk Berkelium 97	1955 Cf Californium 98	1956 Es Einsteinium 99	1957 Fm Fermium 100	1958 Md Mendelevium 101	1959 No Nobelium 102	1960 Lr Lawrencium 103	1961-2036 Other elements	2037 Fr Francium 87	2038 Ra Radium 88	2039-2050 Other elements	2051 Th Thorium 90	2052 Pa Protactinium 91	2053 U Uranium 92	2054 Np Neptunium 93	2055 Pu Plutonium 94	2056 Am Americium 95	2057 Cm Curium 96	2058 Bk Berkelium 97	2059 Cf Californium 98	2060 Es Einsteinium 99	2061 Fm Fermium 100	2062 Md Mendelevium 101	2063 No Nobelium 102	2064 Lr Lawrencium 103	2065-2140 Other elements	2141 Fr Francium 87	2142 Ra Radium 88	2143-2154 Other elements	2155 Th Thorium 90	2156 Pa Protactinium 91	2157 U Uranium 92	2158 Np Neptunium 93	2159 Pu Plutonium 94	2160 Am