



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

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**CHEMISTRY**

**5070/12**

Paper 1 Multiple Choice

**May/June 2011**

**1 hour**

Additional Materials:      Multiple Choice Answer Sheet  
   Soft clean eraser  
   Soft pencil (type B or HB recommended)



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**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

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

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

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

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This document consists of **13** printed pages and **3** blank pages.



- 1 A drop of liquid bromine is placed in the bottom of a gas jar. Brown fumes of bromine vapour slowly spread through the covered gas jar.

Why does this happen?

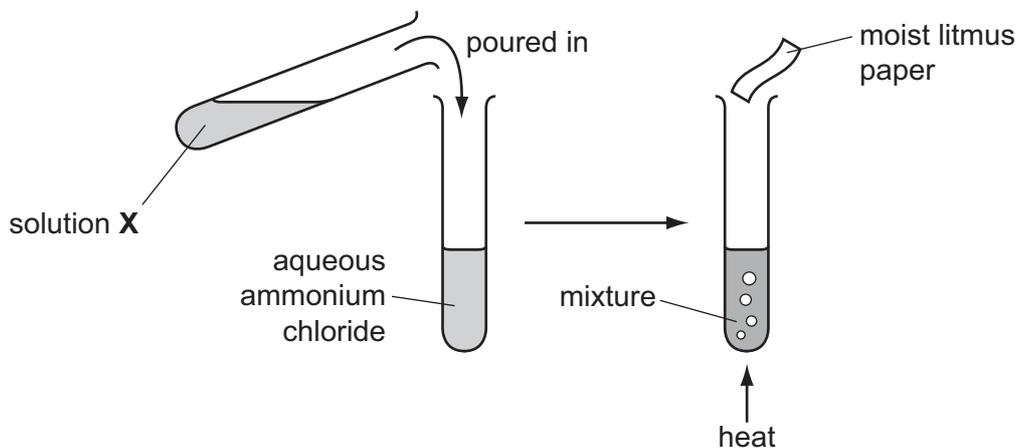
- A** Bromine vapour is less dense than air.  
**B** Bromine molecules and the molecules in air are always moving around.  
**C** Bromine molecules are smaller than the molecules in air.  
**D** Bromine molecules move faster than the molecules in air.

- 2 Copper(II) sulfate crystals are separated from sand using the four processes listed below.

In which order are these processes used?

	1st	2nd	3rd	4th
<b>A</b>	filtering	dissolving	crystallising	evaporating
<b>B</b>	filtering	dissolving	evaporating	crystallising
<b>C</b>	dissolving	evaporating	filtering	crystallising
<b>D</b>	dissolving	filtering	evaporating	crystallising

- 3 The diagrams show an experiment with aqueous ammonium chloride.



A gas, **Y**, is produced and the litmus paper changes colour.

What are solution **X** and gas **Y**?

	solution <b>X</b>	gas <b>Y</b>
<b>A</b>	aqueous sodium hydroxide	ammonia
<b>B</b>	aqueous sodium hydroxide	chlorine
<b>C</b>	dilute sulfuric acid	ammonia
<b>D</b>	dilute sulfuric acid	chlorine

- 4 A student tested a solution by adding aqueous sodium hydroxide. A precipitate was not seen because the reagent was added too quickly.

What could **not** have been present in the solution?

- A  $Al^{3+}$                       B  $Ca^{2+}$                       C  $NH_4^+$                       D  $Zn^{2+}$

- 5 In which of the following is there a lattice of positive ions in a 'sea of electrons'?

- A liquid potassium chloride  
B sand  
C solid graphite  
D solid magnesium

- 6 What is the mass of oxygen contained in 72 g of pure water?  
[Relative atomic masses: H = 1; O = 16]

- A 16 g                      B 32 g                      C 64 g                      D 70 g

- 7 A covalent bond is formed by

- A electron sharing between metals and non-metals.  
B electron sharing between non-metals.  
C electron transfer between non-metals.  
D electron transfer from metals to non-metals.

- 8 Which molecule has the **largest** number of electrons involved in covalent bonds?

- A  $C_2H_4$                       B  $CO_2$                       C  $CH_3OH$                       D  $N_2$

- 9 The equation for the reaction between calcium carbonate and hydrochloric acid is shown.



How many moles of calcium carbonate will give  $24 \text{ cm}^3$  of carbon dioxide when reacted with an excess of the acid?

(Assume one mole of carbon dioxide occupies  $24 \text{ dm}^3$ .)

- A 1 mol                      B 0.1 mol                      C 0.01 mol                      D 0.001 mol

- 10 Element X has the electronic structure 2,8,5. Element Y has the electronic structure 2,8,7.

What is the likely formula of a compound containing only X and Y?

- A  $XY_3$                       B  $X_2Y_3$                       C  $X_3Y$                       D  $X_3Y_2$

11 The empirical formula of a liquid compound is  $C_2H_4O$ .

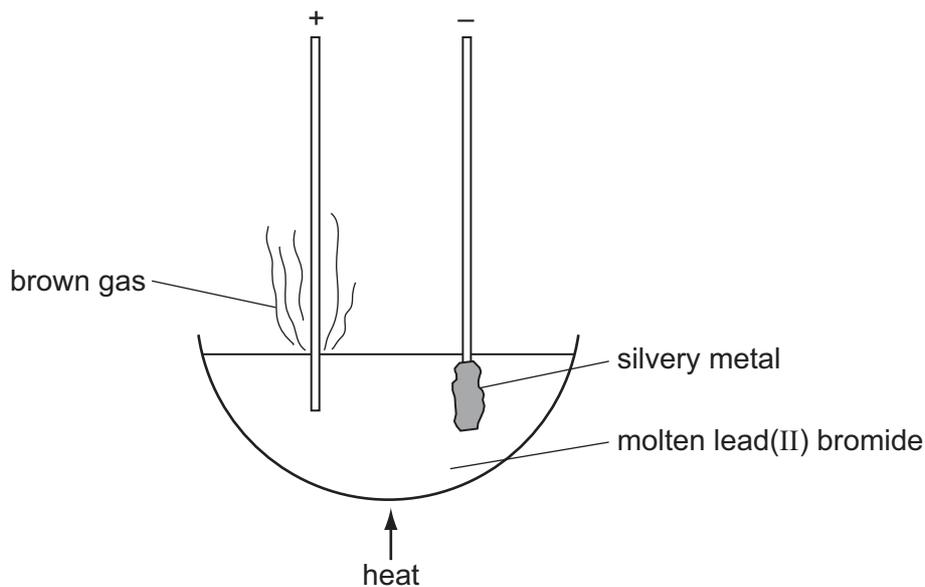
To find the empirical formula, it is necessary to know the

- A density of the compound.
- B percentage composition of the compound.
- C relative molecular mass of the compound.
- D volume occupied by 1 mole of the compound.

12 Which statement about both chlorine atoms and chloride ions is correct?

- A They are chemically identical.
- B They are isotopes of chlorine.
- C They have the same number of protons.
- D They have the same physical properties.

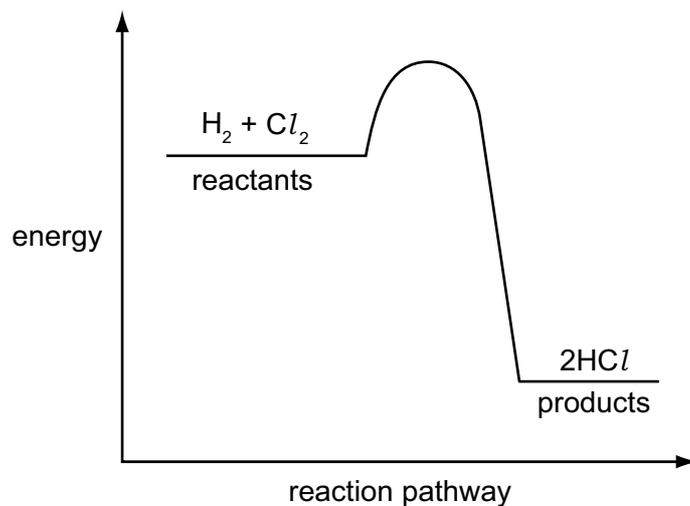
13 The diagram shows the electrolysis of molten lead(II) bromide using inert electrodes.



What happens during this electrolysis?

- A Atoms change to ions.
- B Covalent bonds are broken.
- C Ions change to atoms.
- D New compounds are formed.

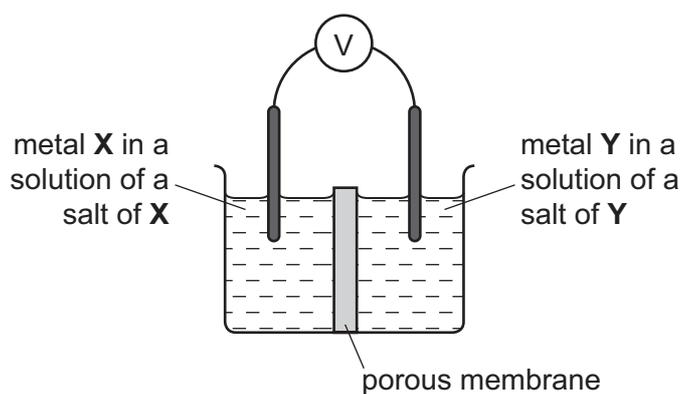
14 The energy profile diagram for the reaction between hydrogen and chlorine is shown.



What information about this reaction does the diagram show?

	type of reaction	sign of enthalpy change, $\Delta H$
<b>A</b>	endothermic	negative
<b>B</b>	endothermic	positive
<b>C</b>	exothermic	negative
<b>D</b>	exothermic	positive

15 Which pair of metals **X** and **Y** will produce the highest voltage when used as electrodes in a simple cell?



	metal X	metal Y
<b>A</b>	copper	silver
<b>B</b>	magnesium	silver
<b>C</b>	magnesium	zinc
<b>D</b>	zinc	copper

- 16 The equation shows what happens in a redox reaction between iron(II) chloride and chlorine gas.



Which equation describes the reduction process in this reaction?

- A  $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
  - B  $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$
  - C  $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$
  - D  $\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$
- 17 Which acid and base react together to produce an **insoluble** salt?
- A hydrochloric acid and sodium hydroxide
  - B nitric acid and calcium oxide
  - C sulfuric acid and barium hydroxide
  - D sulfuric acid and zinc oxide

- 18 Carbon and silicon are both in Group IV of the Periodic Table.

Which statement is correct for both carbon dioxide and silicon dioxide?

- A They are acidic oxides.
  - B They are readily soluble in water.
  - C They contain ionic bonds.
  - D They have giant molecular structures.
- 19 The following changes could be made to the conditions in the reaction between zinc and hydrochloric acid.
- 1 increase in concentration of the acid
  - 2 increase in particle size of the zinc
  - 3 increase in pressure on the system
  - 4 increase in temperature of the system

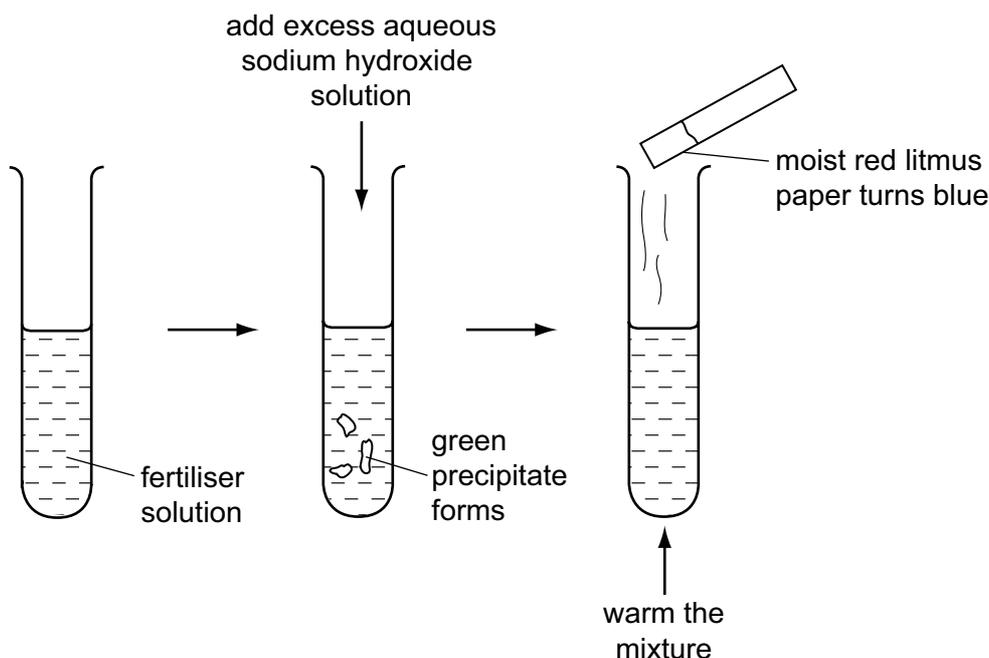
Which pair of changes will increase the rate of reaction?

- A 1 and 2      B 1 and 4      C 2 and 3      D 3 and 4

20 Which calcium compound does **not** increase the pH of acidic soils?

- A calcium carbonate
- B calcium hydroxide
- C calcium oxide
- D calcium sulfate

21 A solution of fertiliser was tested as shown.



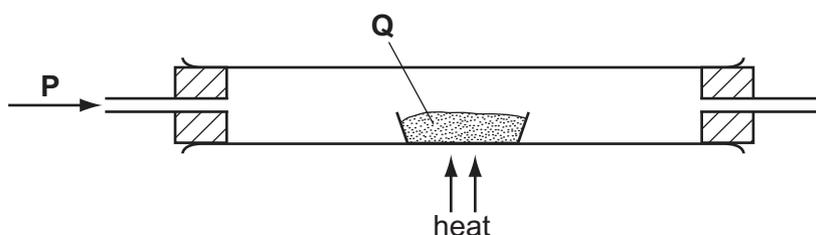
Which ions must be present in the fertiliser?

- A  $\text{Fe}^{2+}$  and  $\text{SO}_4^{2-}$
- B  $\text{Fe}^{3+}$  and  $\text{NO}_3^-$
- C  $\text{NH}_4^+$  and  $\text{Fe}^{2+}$
- D  $\text{NH}_4^+$  and  $\text{NO}_3^-$

22 Which pair of properties are **both** correct for a typical transition element?

	property 1	property 2
A	forms coloured compounds	soluble in water
B	high density	has variable oxidation states
C	low density	high melting point
D	low melting point	can act as a catalyst

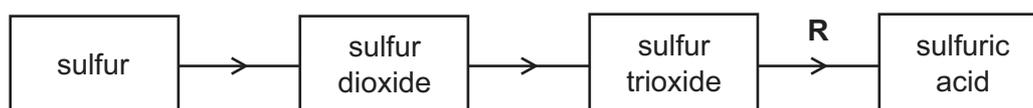
- 23 What happens when zinc foil is placed in an aqueous solution of copper(II) sulfate?
- A Copper(II) ions are oxidised.  
 B There is no reaction.  
 C Zinc atoms are oxidised.  
 D Zinc sulfate is precipitated.
- 24 Which deduction about the element astatine, At, can be made from its position in Group VII?
- A It forms covalent compounds with sodium.  
 B It is a gas.  
 C It is displaced from aqueous potassium astatide, KAt, by chlorine.  
 D It is more reactive than iodine.
- 25 In the apparatus shown, gas **P** is passed over solid **Q**.



No reaction occurs if **P** and **Q** are

	<b>P</b>	<b>Q</b>
<b>A</b>	hydrogen	lead(II) oxide
<b>B</b>	hydrogen	magnesium oxide
<b>C</b>	oxygen	carbon
<b>D</b>	oxygen	sulfur

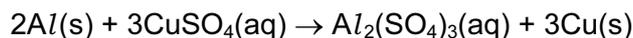
- 26 The diagram represents the manufacture of sulfuric acid by the Contact process.



What is used in step **R**?

- A concentrated sulfuric acid followed by water  
 B vanadium(V) oxide  
 C water followed by concentrated sulfuric acid  
 D water only

- 27 Aluminium is higher than copper in the reactivity series so the following displacement reaction should be feasible.

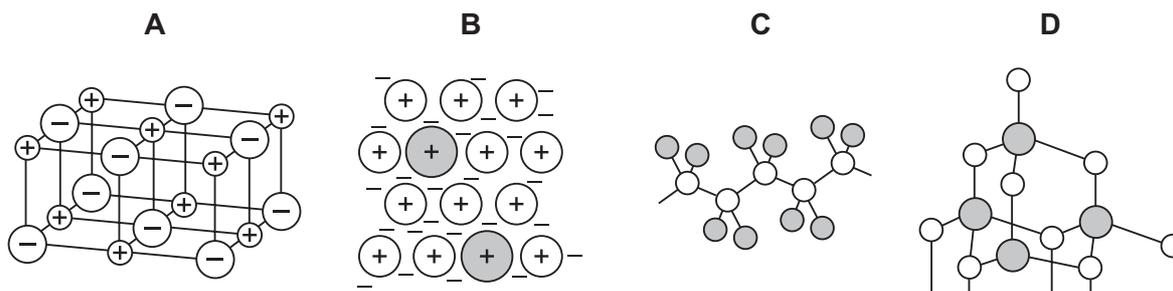


The reaction does not take place at room temperature.

What is the reason for this?

- A Aluminium has an inert coating all over it.
  - B The compound aluminium sulfate does not exist.
  - C The reaction is exothermic.
  - D The reaction needs to be warmed to take place.
- 28 Scrap iron is often recycled.
- Which reason for recycling is **not** correct?
- A It reduces the amount of pollution at the site of the ore extraction.
  - B It reduces the amount of waste taken to landfill sites.
  - C It reduces the need to collect the scrap iron.
  - D It saves natural resources.
- 29 The gases coming from a car's exhaust contain oxides of nitrogen.
- How are these oxides formed?
- A Nitrogen reacts with carbon dioxide.
  - B Nitrogen reacts with carbon monoxide.
  - C Nitrogen reacts with oxygen.
  - D Nitrogen reacts with petrol.
- 30 Which element can only be extracted from its ore using electrolysis?
- A calcium
  - B copper
  - C lead
  - D silver

31 Which diagram represents the structure of an alloy?



32 When a volcano erupts, which gas is produced in significant amounts?

- A** carbon monoxide
- B** chlorofluorocarbons
- C** methane
- D** sulfur dioxide

33 Useful fractions are obtained by the fractional distillation of petroleum.

Which fraction is matched by its use?

	fraction	use
<b>A</b>	bitumen	fuel in cars
<b>B</b>	lubricating oils	for making waxes and polishes
<b>C</b>	paraffin (kerosene)	for making roads
<b>D</b>	petrol (gasolene)	aircraft fuel

34 Compounds X and Y are both alkanes. Compound X has a higher boiling point than compound Y.

What could be the formulae of compounds X and Y?

	compound X	compound Y
<b>A</b>	$C_8H_{16}$	$C_9H_{18}$
<b>B</b>	$C_8H_{18}$	$C_9H_{20}$
<b>C</b>	$C_9H_{18}$	$C_8H_{16}$
<b>D</b>	$C_9H_{20}$	$C_8H_{18}$

35 Compound X is a hydrocarbon. It reacts with steam to form an alcohol.

Which type of compound is X and what would be its effect on bromine water?

	type of compound	effect on bromine water
<b>A</b>	alkane	turns from brown to colourless
<b>B</b>	alkane	turns from colourless to brown
<b>C</b>	alkene	turns from brown to colourless
<b>D</b>	alkene	turns from colourless to brown

36 Which bond is present in both nylon and *Terylene*?

**A** C – O      **B** C = O      **C** N – C      **D** N – H

37 With which substance will ethene react to form more than one product?

- A** bromine
- B** hydrogen
- C** oxygen
- D** steam









**DATA SHEET**  
**The Periodic Table of the Elements**

		Group																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10	23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulfur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18	39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36	85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	106 <b>Pd</b> Palladium 46	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54	133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	210 <b>At</b> Astatine 85	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	226 <b>Fr</b> Francium 87	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	232 <b>Th</b> Thorium 90	232 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> 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91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103	238 <b>Lu</b> Lutetium 71	238 <b>Yb</b> Ytterbium 70	238 <b>Er</b> Erbium 68	238 <b>Tm</b> Thulium 69	238 <b>Dy</b> Dysprosium 66	238 <b>Ho</b> Holmium 67	238 <b>Er</b> Erbium 68	238 <b>Ho</b> Holmium 67	238 <b>Dy</b> Dysprosium 66	238 <b>Sm</b> Samarium 62	238 <b>Pm</b> Promethium 61	238 <b>Nd</b> Neodymium 60	238 <b>Pr</b> Praseodymium 59	238 <b>Ce</b> Cerium 58	238 <b>Th</b> Thorium 90	238 <b>Pa</b> Protactinium