



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

**CHEMISTRY**

**5070/11**

Paper 1 Multiple Choice

**October/November 2013**

**1 hour**

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



**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.

**DO NOT WRITE IN ANY BARCODES.**

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.

Electronic calculators may be used.

This document consists of **16** printed pages.



1 Which process provides the best evidence for the particle theory of matter?

- A dehydration
- B diffusion
- C filtration
- D neutralisation

2 The results of two tests on a solution **X** are shown.

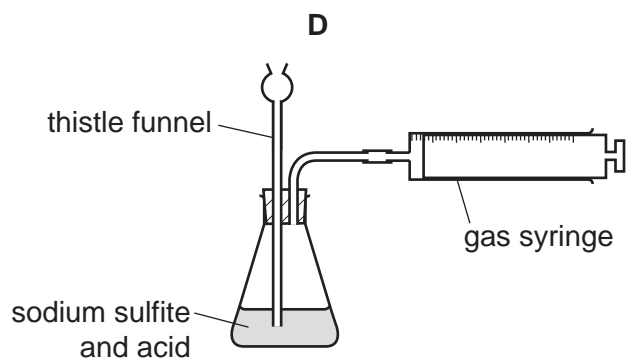
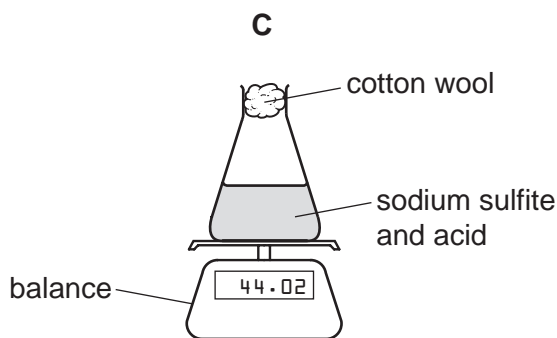
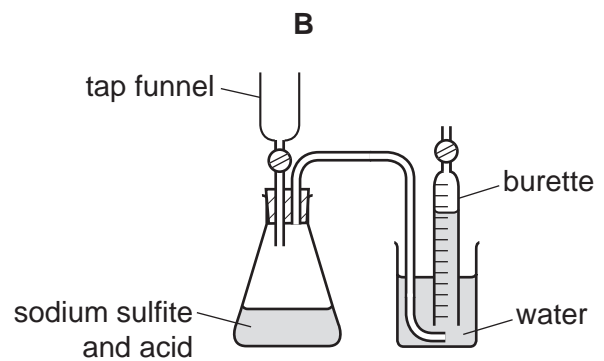
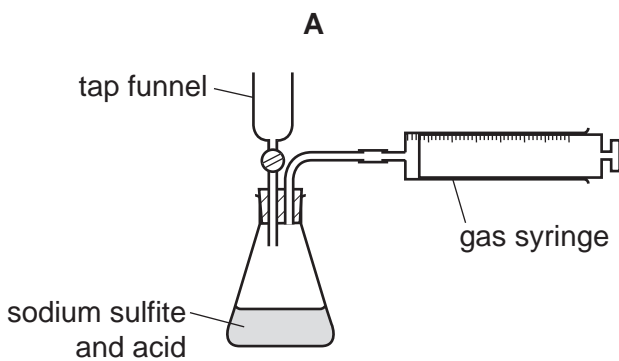
reagent added	few drops	an excess
aqueous sodium hydroxide	white precipitate	precipitate dissolves
aqueous ammonia	white precipitate	precipitate remains

Which ion is present in solution **X**?

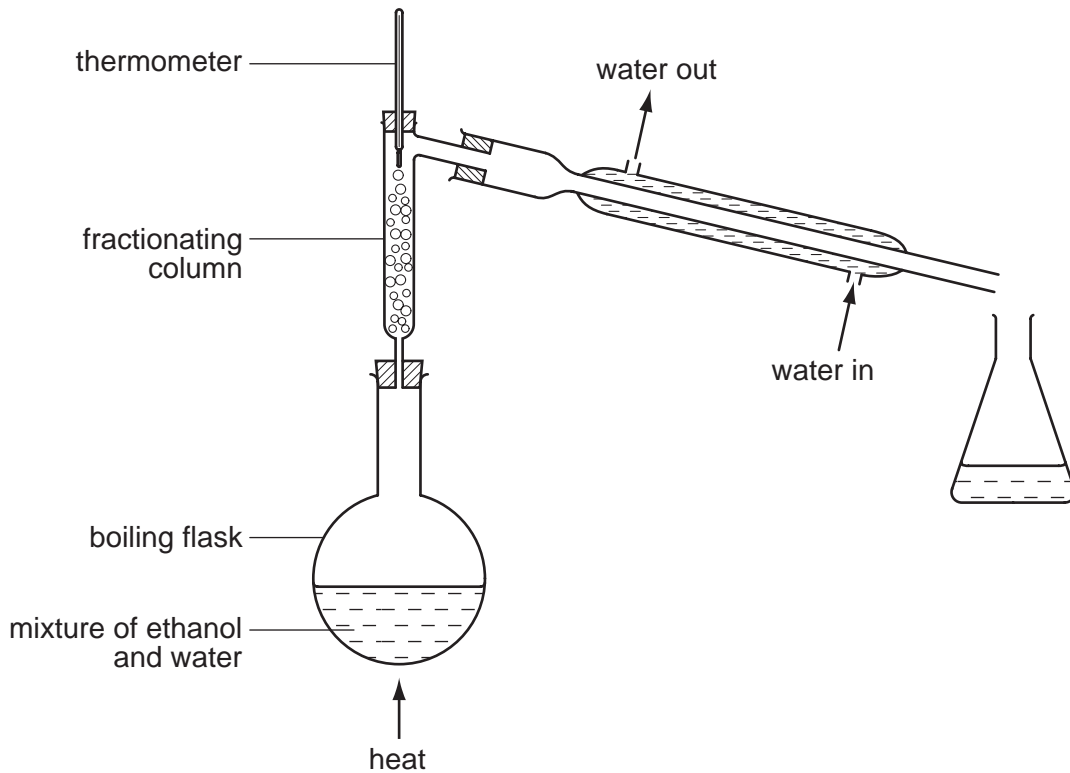
- A  $Al^{3+}$
- B  $Ca^{2+}$
- C  $Cu^{2+}$
- D  $Zn^{2+}$

3 A student wanted to follow how the rate of the reaction of sodium sulfite with acid varies with time. The reaction produces gaseous sulfur dioxide.

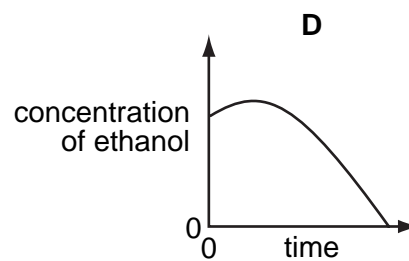
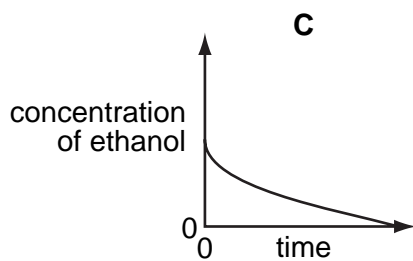
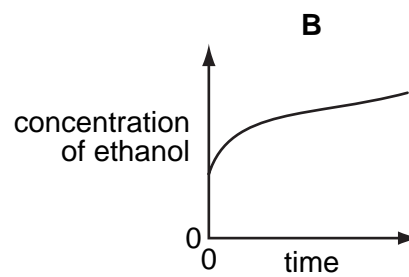
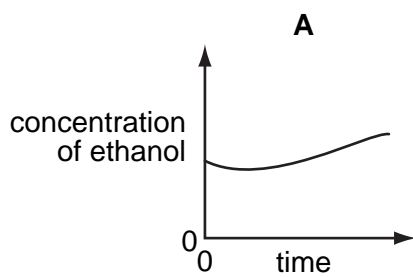
Which apparatus is **not** suitable?



- 4 The apparatus shown is used to distil a dilute solution of ethanol in water.  
[B.P.: ethanol, 78 °C; water 100 °C]



Which graph shows the change in concentration of the ethanol in the boiling flask as the distillation proceeds?



5 Aqueous silver nitrate is added to separate solutions of potassium chloride and sodium iodide.

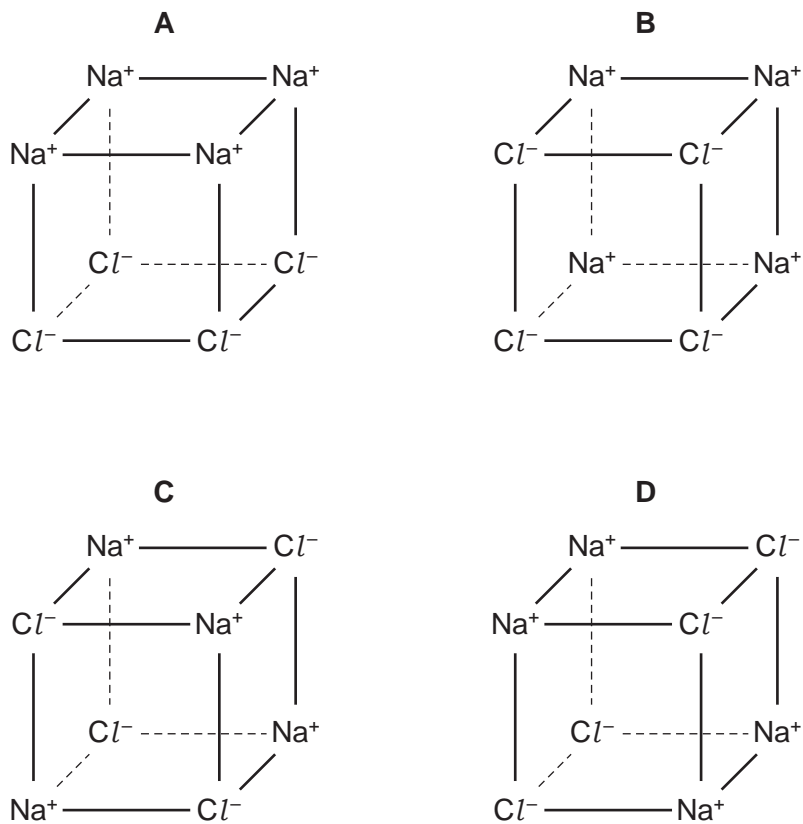
What are the colours of the precipitates formed?

	colour of precipitate formed with chloride	colour of precipitate formed with iodide
<b>A</b>	white	white
<b>B</b>	white	yellow
<b>C</b>	yellow	white
<b>D</b>	yellow	yellow

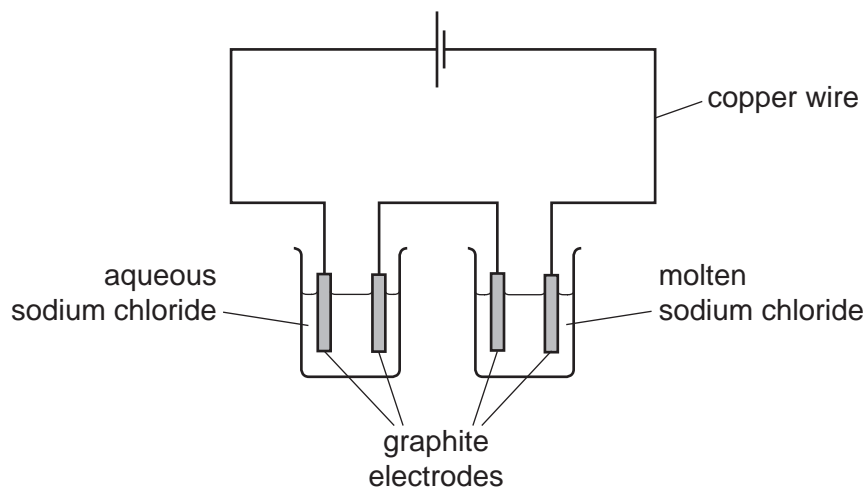
6 Which substance will **not** conduct electricity at room temperature and pressure?

- A** dilute nitric acid
- B** graphite
- C** mercury
- D** sodium chloride

7 Which diagram correctly shows the arrangement of the ions in solid sodium chloride?



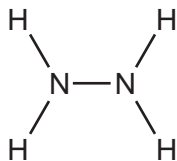
- 8 The diagram shows the electrolysis of aqueous sodium chloride and of molten sodium chloride.



Which substance in the diagram has both positive ions and mobile electrons?

- A aqueous sodium chloride
  - B copper wire
  - C graphite electrodes
  - D molten sodium chloride
- 9 Which statement describes the conversion of magnesium atoms to magnesium ions?
- A The change is reduction, because there has been a gain of electrons.
  - B The change is oxidation, because there has been a loss of electrons.
  - C The change is reduction, because there has been a loss of electrons.
  - D The change is oxidation, because there has been a gain of electrons.

- 10 The diagram shows the structural formula of the covalent molecule hydrazine, N<sub>2</sub>H<sub>4</sub>.

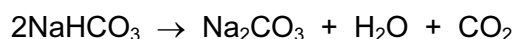


Consider **all** the electrons in a molecule of hydrazine.

Which description fits the arrangement of these electrons in the molecule?

	total number of electrons involved in bonding	total number of electrons not involved in bonding
<b>A</b>	5	4
<b>B</b>	5	8
<b>C</b>	10	4
<b>D</b>	10	8

- 11 Sodium hydrogencarbonate decomposes on heating.

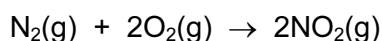


In an experiment, a 5.0 mol sample of sodium hydrogencarbonate is heated.

Which volume of carbon dioxide, measured at room temperature and pressure, is evolved?

- A** 24 dm<sup>3</sup>      **B** 36 dm<sup>3</sup>      **C** 48 dm<sup>3</sup>      **D** 60 dm<sup>3</sup>

- 12 Nitrogen and oxygen react according to the equation.



The enthalpy change for the reaction shown is +66 kJ.

If two moles of nitrogen and two moles of oxygen are used, what will be the enthalpy change?

- A** +16.5 kJ      **B** +33 kJ      **C** +66 kJ      **D** +132 kJ

- 13 Which statement about the four gases carbon dioxide, CO<sub>2</sub>, hydrogen, H<sub>2</sub>, oxygen, O<sub>2</sub> and ozone, O<sub>3</sub> is correct?

- A** One mole of each gas occupies the same volume at a given temperature and pressure.  
**B** Ozone has the fastest rate of diffusion at a given temperature and pressure.  
**C** They are all denser than air.  
**D** They are all elements.

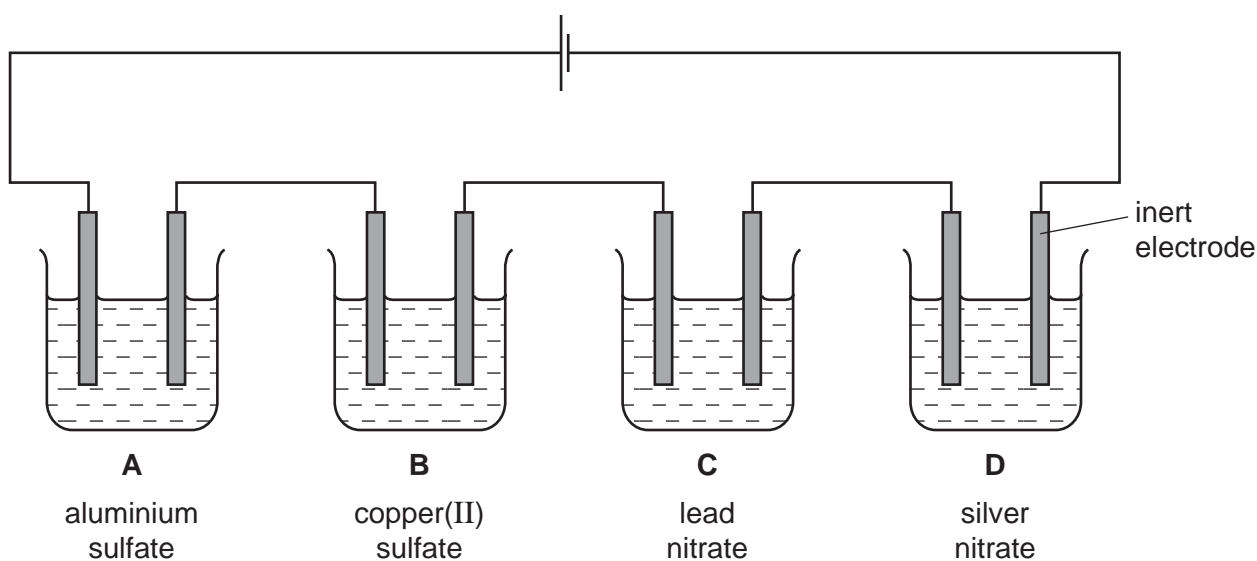
14 When dilute sulfuric acid is electrolysed between inert electrodes, which statements are correct?

- 1 Hydrogen is released at the negative electrode.
- 2 Oxygen is released at the positive electrode.
- 3 Sulfur dioxide is released at the positive electrode.
- 4 The acid becomes more concentrated.

**A** 1, 2 and 4      **B** 1 and 2 only      **C** 2 and 3      **D** 3 and 4

15 When electrolysed using inert electrodes, which dilute solution would produce the greatest increase in mass of the cathode?

[ $A_r$ : Al, 27; Cu, 64; Pb, 207; Ag, 108]



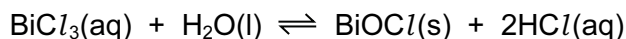
16 The formation of liquid water from hydrogen and oxygen is thought to occur in three stages.

- 1  $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 4\text{H}(\text{g}) + 2\text{O}(\text{g})$
- 2  $4\text{H}(\text{g}) + 2\text{O}(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$
- 3  $2\text{H}_2\text{O}(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$

Which stages would be exothermic?

**A** 1, 2 and 3      **B** 1 and 2 only      **C** 1 only      **D** 2 and 3 only

- 17 When bismuth(III) chloride,  $\text{BiCl}_3$ , is added to water, a white precipitate of  $\text{BiOCl}$  is formed.



If this reversible reaction is at equilibrium and hydrochloric acid is added, what will happen?

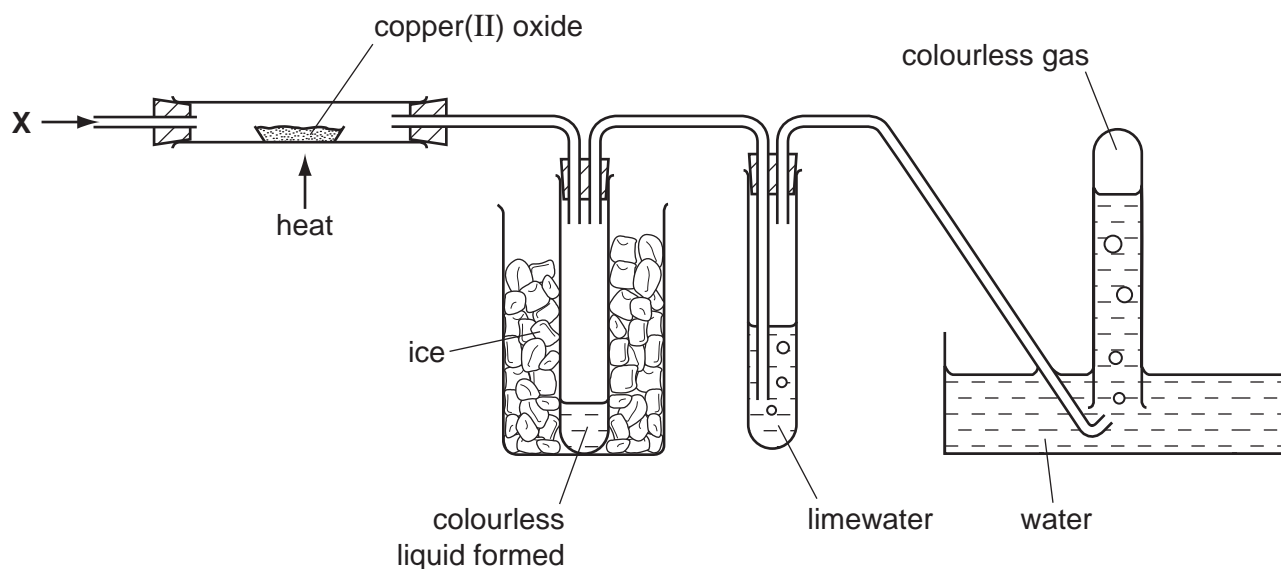
- A The position of equilibrium moves to the left and more white precipitate is formed.
  - B The position of equilibrium moves to the left and the white precipitate disappears.
  - C The position of equilibrium moves to the right and more white precipitate is formed.
  - D The position of equilibrium moves to the right and the white precipitate disappears.
- 18 Which colour change occurs when ethanol is added to a small quantity of warm, acidified potassium dichromate(VI)?
- A orange to colourless
  - B orange to green
  - C purple to colourless
  - D purple to green
- 19 Sulfur and selenium, Se, are in the same group of the Periodic Table.
- From this, we would expect selenium to form compounds having the formulae
- A  $\text{Se}_2\text{O}$ ,  $\text{Na}_2\text{Se}$  and  $\text{NaSeO}_4$ .
  - B  $\text{SeO}_2$ ,  $\text{Na}_2\text{Se}$  and  $\text{NaSeO}_4$ .
  - C  $\text{SeO}_2$ ,  $\text{Na}_2\text{Se}$  and  $\text{Na}_2\text{SeO}_4$ .
  - D  $\text{SeO}_3$ ,  $\text{NaSe}$  and  $\text{NaSeO}_4$ .
- 20 When the product of a reaction between two gases is added to water, a solution of pH7 is formed.

Which could be these gases?

- A hydrogen and chlorine
- B hydrogen and nitrogen
- C hydrogen and oxygen
- D oxygen and carbon monoxide



- 21 When pure gas **X** was passed through the apparatus shown, the copper(II) oxide turned pink and the limewater stayed colourless.



What is gas **X**?

- A carbon dioxide
  - B carbon monoxide
  - C hydrogen
  - D nitrogen
- 22 Which reagent is added to aqueous potassium chloride to prepare lead chloride?
- A aqueous lead nitrate
  - B lead
  - C lead carbonate
  - D lead sulfate
- 23 Which change in the properties of the halogens is **not** correct?

	chlorine → bromine → iodine
A	darker in colour
B	decrease in melting point
C	decrease in rate of diffusion
D	increase in density

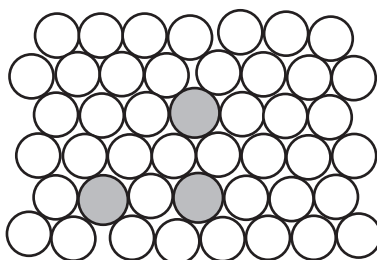
24 *W*, *X* and *Y* are elements in the same period of the Periodic Table.

- *X* forms compounds of formulae  $XCl_2$  and  $XCl_3$ .
- *Y* forms a solution of pH12 when it reacts with water.
- The reaction of *W* with water is similar to the reaction of *Y* with water but is less vigorous.

In which order are the elements in the Periodic Table?

	left to right along a period
<b>A</b>	$W \rightarrow Y \rightarrow X$
<b>B</b>	$X \rightarrow W \rightarrow Y$
<b>C</b>	$X \rightarrow Y \rightarrow W$
<b>D</b>	$Y \rightarrow W \rightarrow X$

25 The diagram shows the structure of an alloy.



Which statement about alloys is correct?

- A** Alloys can only be formed by mixing copper or iron with other metals.
- B** High carbon steel alloys are soft and easily shaped.
- C** In an alloy there is attraction between positive ions and delocalised electrons.
- D** The alloy brass has a chemical formula.

26 The metals iron, lead and zinc can be manufactured by the reduction of their oxides with coke.

What is the correct order of the ease of reduction of the metal oxides?

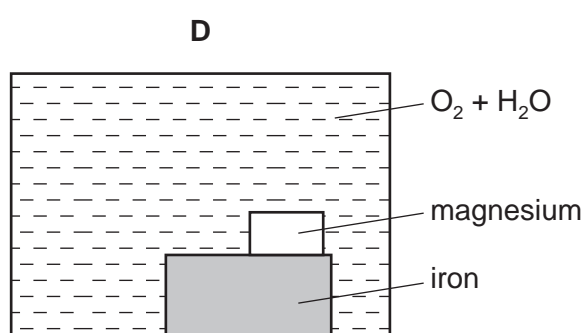
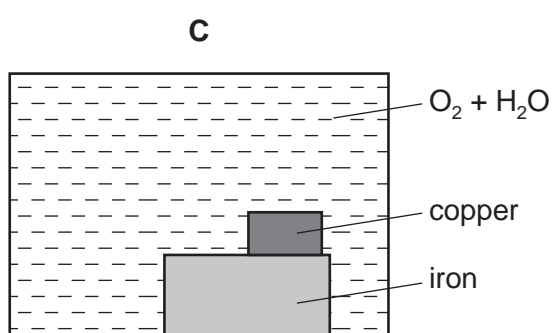
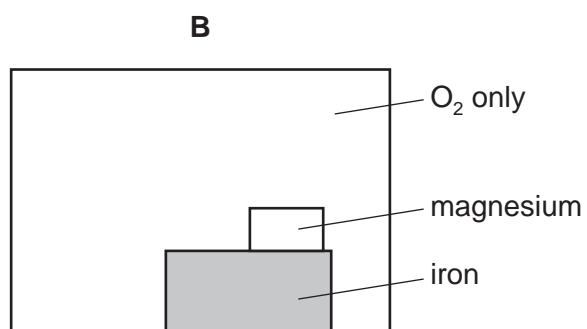
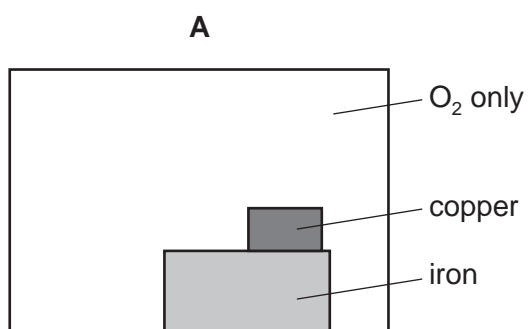
	oxides become more difficult to reduce →
<b>A</b>	iron → lead → zinc
<b>B</b>	iron → zinc → lead
<b>C</b>	lead → iron → zinc
<b>D</b>	zinc → iron → lead

27 Aluminium is manufactured by the electrolysis of molten aluminium oxide.

Which gas is **not** formed during this process?

- A carbon dioxide
- B carbon monoxide
- C oxygen
- D sulfur dioxide

28 Which diagram correctly illustrates the conditions necessary for the rusting of iron and also the metal that can be used to prevent rusting by sacrificial protection?



29 Metals usually occur in their ore combined with another element.

Which metal is least likely to occur combined with another element?

- A aluminium
- B calcium
- C magnesium
- D silver

30 The noble gases, argon, helium, krypton and xenon, are present in air.

Which noble gas is present in the largest proportion?

- A argon
- B helium
- C krypton
- D xenon

31 The following stages happen during eutrophication.

- 1 increase in growth of algae
- 2 increase in nitrate concentration
- 3 death of aquatic plants
- 4 decrease in dissolved oxygen

In which order do these stages occur?

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

32 Which gas will react with ozone in the upper atmosphere of the Earth?

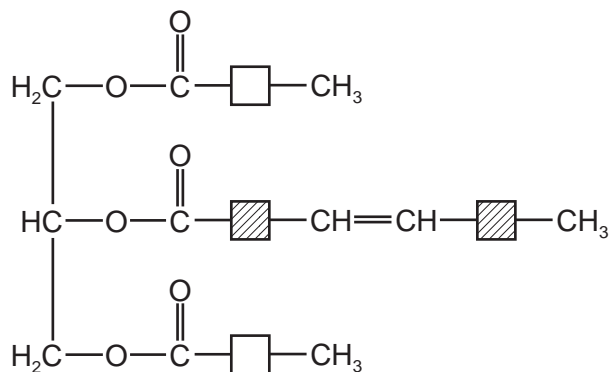
- A  $\text{CF}_2\text{Cl}_2$       B  $\text{CH}_4$       C  $\text{CO}_2$       D  $\text{SO}_2$

33 Iron is extracted from iron ore in a blast furnace.

Which solid substances are fed into the top of the blast furnace?

- 1 coke
  - 2 cryolite
  - 3 limestone
- A 1, 2 and 3      B 1 and 2 only      C 1 and 3 only      D 2 and 3 only

34 The diagram shows a simplified structure of a fat.



Which compounds in the table have linkages that can be found in this fat? (Do **not** consider C–H or C–C bonds as linkages.)

	ethene	nylon	<i>Terylene</i>
<b>A</b>	✓	✓	✓
<b>B</b>	✓	✓	x
<b>C</b>	✓	x	✓
<b>D</b>	x	✓	✓

35 The solubility of the carboxylic acids in water decreases as the size of the carboxylic acid molecules increases.

Which carboxylic acid is the least soluble in water?

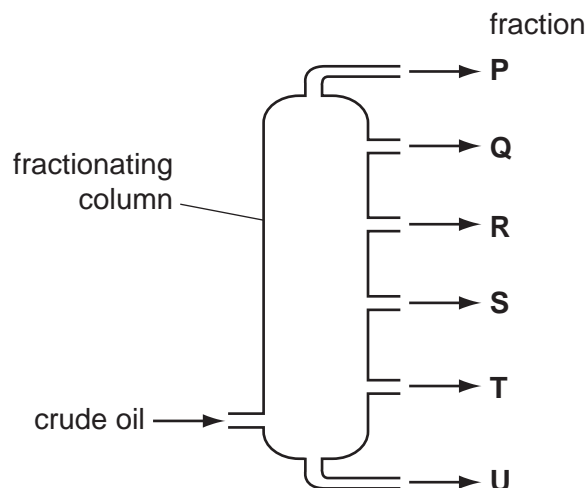
- A** butanoic acid
- B** ethanoic acid
- C** methanoic acid
- D** propanoic acid

36 Poly(ethene) is the addition polymer formed from the monomer ethene.

Which statement is correct?

- A** Poly(ethene) can be disposed of by burning – this produces carbon dioxide and water.
- B** Poly(ethene) decolourises bromine water.
- C** Poly(ethene) has the empirical formula  $\text{C}_2\text{H}_4$ .
- D** Poly(ethene) is acted upon by bacteria so that it decomposes quickly when in a landfill site.

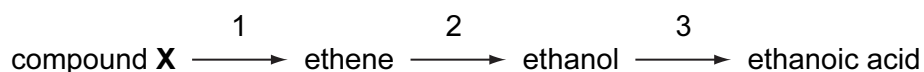
37 The diagram shows the fractionation of crude oil.



Which row explains why fraction **R** is collected above fraction **S**?

	boiling point of <b>R</b>	average molecular mass of <b>R</b>
<b>A</b>	higher than <b>S</b>	greater than <b>S</b>
<b>B</b>	higher than <b>S</b>	smaller than <b>S</b>
<b>C</b>	lower than <b>S</b>	greater than <b>S</b>
<b>D</b>	lower than <b>S</b>	smaller than <b>S</b>

38 In the manufacture of ethanoic acid, the chemical industry uses the following sequence of reactions.

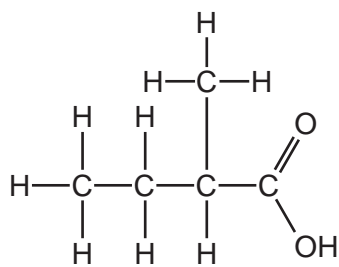


What are the three processes?

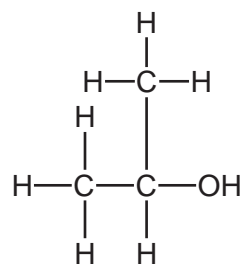
	1	2	3
<b>A</b>	cracking	hydration	oxidation
<b>B</b>	cracking	polymerisation	hydration
<b>C</b>	hydration	polymerisation	oxidation
<b>D</b>	polymerisation	oxidation	hydration

39 Esters are formed when an alcohol reacts with a carboxylic acid.

Which ester would be formed using the carboxylic acid and alcohol shown?

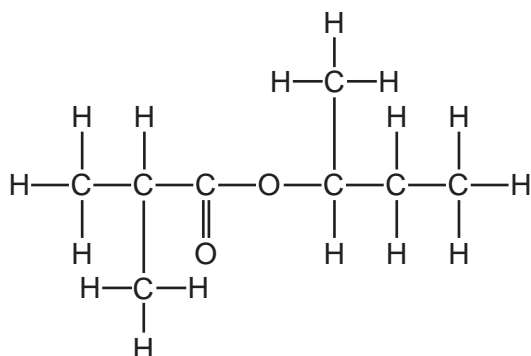


carboxylic acid

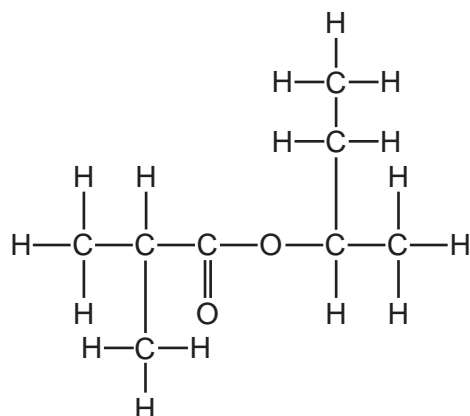


alcohol

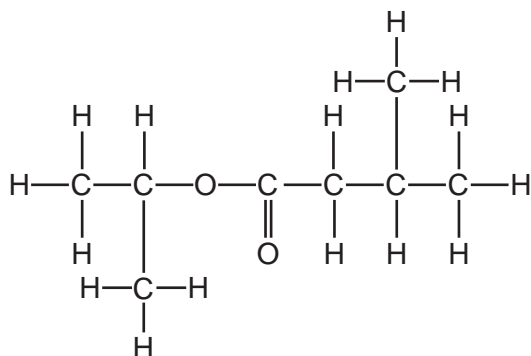
A



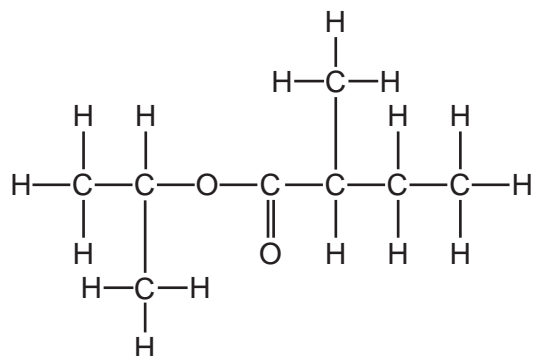
B



C



D



40 Which equation represents a combustion reaction?

- A  $\text{C}_2\text{H}_4 + \text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_5\text{OH}$
- B  $\text{C}_2\text{H}_5\text{OH} + \text{O}_2 \rightarrow \text{CH}_3\text{CO}_2\text{H} + \text{H}_2\text{O}$
- C  $\text{CH}_3\text{CO}_2\text{H} + 2\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}$
- D  $\text{CH}_3\text{CO}_2\text{H} + \text{CH}_3\text{OH} \rightarrow \text{CH}_3\text{CO}_2\text{CH}_3 + \text{H}_2\text{O}$

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

		Group																													
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII																		
		1 <b>H</b> Hydrogen 1											4 <b>He</b> Helium 2																		
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4												19 <b>F</b> Fluorine 9																		
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	5 <b>B</b> Boron 5	6 <b>C</b> Carbon 6	7 <b>N</b> Nitrogen 7	8 <b>O</b> Oxygen 8	9 <b>Ne</b> Neon 10	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>Si</b> Silicon 14	15 <b>P</b> Phosphorus 15	16 <b>S</b> Sulfur 16	17 <b>Cl</b> Chlorine 17	18 <b>Ar</b> Argon 18																	
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	29 <b>Sc</b> Scandium 21	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	54 <b>Xe</b> Xenon 54																
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	45 <b>Sc</b> Scandium 21	46 <b>Ti</b> Titanium 22	47 <b>V</b> Vanadium 23	48 <b>Cr</b> Chromium 24	49 <b>Mn</b> Manganese 25	50 <b>Fe</b> Iron 26	51 <b>Co</b> Cobalt 27	52 <b>Ni</b> Nickel 28	53 <b>Cu</b> Copper 29	54 <b>Zn</b> Zinc 30	65 <b>Ga</b> Gallium 31	66 <b>Ge</b> Germanium 32	67 <b>As</b> Arsenic 33	68 <b>Se</b> Selenium 34	79 <b>Br</b> Bromine 35	80 <b>Kr</b> Krypton 36														
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	89 <b>Y</b> Yttrium 39	90 <b>Zr</b> Zirconium 40	91 <b>Nb</b> Niobium 41	92 <b>Mo</b> Molybdenum 42	93 <b>Tc</b> Technetium 43	94 <b>Ru</b> Ruthenium 44	95 <b>Rh</b> Rhodium 45	96 <b>Pd</b> Palladium 46	97 <b>Ag</b> Silver 47	98 <b>Cd</b> Cadmium 48	101 <b>Ru</b> Ruthenium 44	102 <b>Rh</b> Rhodium 45	103 <b>Pd</b> Palladium 46	104 <b>Ag</b> Silver 47	105 <b>Cu</b> Copper 29	106 <b>Zn</b> Zinc 30	107 <b>Ga</b> Gallium 31	108 <b>Ge</b> Germanium 32	109 <b>As</b> Arsenic 33	110 <b>Se</b> Selenium 34	111 <b>Br</b> Bromine 35	112 <b>Kr</b> Krypton 36	121 <b>Sb</b> Antimony 51	122 <b>Te</b> Tellurium 52	123 <b>I</b> Iodine 53	124 <b>Xe</b> Xenon 54				
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	139 <b>La</b> Lanthanum 57	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70	153 <b>Lu</b> Lutetium 71	154 <b>Hf</b> Hafnium 72	155 <b>Ta</b> Tantalum 73	156 <b>W</b> Tungsten 74	157 <b>Re</b> Rhenium 75	158 <b>Os</b> Osmium 76	159 <b>Ir</b> Iridium 77	160 <b>Pt</b> Platinum 78	161 <b>Au</b> Gold 79	162 <b>Hg</b> Mercury 80	163 <b>Tl</b> Thallium 81	164 <b>Pb</b> Lead 82	165 <b>Bi</b> Bismuth 83	166 <b>Po</b> Polonium 84	167 <b>At</b> Astatine 85	168 <b>Rn</b> Radon 86
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70	153 <b>Lu</b> Lutetium 71	154 <b>Hf</b> Hafnium 72	155 <b>Ta</b> Tantalum 73	156 <b>W</b> Tungsten 74	157 <b>Re</b> Rhenium 75	158 <b>Os</b> Osmium 76	159 <b>Ir</b> Iridium 77	160 <b>Pt</b> Platinum 78	161 <b>Au</b> Gold 79	162 <b>Hg</b> Mercury 80	163 <b>Tl</b> Thallium 81	164 <b>Pb</b> Lead 82	165 <b>Bi</b> Bismuth 83	166 <b>Po</b> Polonium 84	167 <b>At</b> Astatine 85	168 <b>Rn</b> Radon 86	
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70	153 <b>Lu</b> Lutetium 71	154 <b>Hf</b> Hafnium 72	155 <b>Ta</b> Tantalum 73	156 <b>W</b> Tungsten 74	157 <b>Re</b> Rhenium 75	158 <b>Os</b> Osmium 76	159 <b>Ir</b> Iridium 77	160 <b>Pt</b> Platinum 78	161 <b>Au</b> Gold 79	162 <b>Hg</b> Mercury 80	163 <b>Tl</b> Thallium 81	164 <b>Pb</b> Lead 82	165 <b>Bi</b> Bismuth 83	166 <b>Po</b> Polonium 84	167 <b>At</b> Astatine 85	168 <b>Rn</b> Radon 86	
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70	153 <b>Lu</b> Lutetium 71	154 <b>Hf</b> Hafnium 72	155 <b>Ta</b> Tantalum 73	156 <b>W</b> Tungsten 74	157 <b>Re</b> Rhenium 75	158 <b>Os</b> Osmium 76	159 <b>Ir</b> Iridium 77	160 <b>Pt</b> Platinum 78	161 <b>Au</b> Gold 79	162 <b>Hg</b> Mercury 80	163 <b>Tl</b> Thallium 81	164 <b>Pb</b> Lead 82	165 <b>Bi</b> Bismuth 83	166 <b>Po</b> Polonium 84	167 <b>At</b> Astatine 85	168 <b>Rn</b> Radon 86	
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70	153 <b>Lu</b> Lutetium 71	154 <b>Hf</b> Hafnium 72	155 <b>Ta</b> Tantalum 73	156 <b>W</b> Tungsten 74	157 <b>Re</b> Rhenium 75	158 <b>Os</b> Osmium 76	159 <b>Ir</b> Iridium 77	160 <b>Pt</b> Platinum 78	161 <b>Au</b> Gold 79	162 <b>Hg</b> Mercury 80	163 <b>Tl</b> Thallium 81	164 <b>Pb</b> Lead 82	165 <b>Bi</b> Bismuth 83	166 <b>Po</b> Polonium 84	167 <b>At</b> Astatine 85	168 <b>Rn</b> Radon 86	
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70	153 <b>Lu</b> Lutetium 71	154 <b>Hf</b> Hafnium 72	155 <b>Ta</b> Tantalum 73	156 <b>W</b> Tungsten 74	157 <b>Re</b> Rhenium 75	158 <b>Os</b> Osmium 76	159 <b>Ir</b> Iridium 77	160 <b>Pt</b> Platinum 78	161 <b>Au</b> Gold 79	162 <b>Hg</b> Mercury 80	163 <b>Tl</b> Thallium 81	164 <b>Pb</b> Lead 82	165 <b>Bi</b> Bismuth 83	166 <b>Po</b> Polonium 84	167 <b>At</b> Astatine 85	168 <b>Rn</b> Radon 86	
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70	153 <b>Lu</b> Lutetium 71	154 <b>Hf</b> Hafnium 72	155 <b>Ta</b> Tantalum 73	156 <b>W</b> Tungsten 74	157 <b>Re</b> Rhenium 75	158 <b>Os</b> Osmium 76	159 <b>Ir</b> Iridium 77	160 <b>Pt</b> Platinum 78	161 <b>Au</b> Gold 79	162 <b>Hg</b> Mercury 80	163 <b>Tl</b> Thallium 81	164 <b>Pb</b> Lead 82	165 <b>Bi</b> Bismuth 83	166 <b>Po</b> Polonium 84	167 <b>At</b> Astatine 85	168 <b>Rn</b> Radon 86	
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70	153 <b>Lu</b> Lutetium 71	154 <b>Hf</b> Hafnium 72	155 <b>Ta</b> Tantalum 73	156 <b>W</b> Tungsten 74	157 <b>Re</b> Rhenium 75	158 <b>Os</b> Osmium 76	159 <b>Ir</b> Iridium 77	160 <b>Pt</b> Platinum 78	161 <b>Au</b> Gold 79	162 <b>Hg</b> Mercury 80	163 <b>Tl</b> Thallium 81	164 <b>Pb</b> Lead 82	165 <b>Bi</b> Bismuth 83	166 <b>Po</b> Polonium 84	167 <b>At</b> Astatine 85	168 <b>Rn</b> Radon 86	
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70	153 <b>Lu</b> Lutetium 71	154 <b>Hf</b> Hafnium 72	155 <b>Ta</b> Tantalum 73	156 <b>W</b> Tungsten 74	157 <b>Re</b> Rhenium 75	158 <b>Os</b> Osmium 76	159 <b>Ir</b> Iridium 77	160 <b>Pt</b> Platinum 78	161 <b>Au</b> Gold 79	162 <b>Hg</b> Mercury 80	163 <b>Tl</b> Thallium 81	164 <b>Pb</b> Lead 82	165 <b>Bi</b> Bismuth 83	166 <b>Po</b> Polonium 84	167 <b>At</b> Astatine 85	168 <b>Rn</b> Radon 86	
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67	150 <b>Er</b> Erbium 68	151 <b>Tm</b> Thulium 69	152 <b>Yb</b> Ytterbium 70																	