



# The Periodic Table of the Elements

1	2	3	4	5	6	7	0											
7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>Mg</b> magnesium 12	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									
19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	21 <b>Sc</b> scandium 21	22 <b>Ti</b> titanium 22	23 <b>V</b> vanadium 23	24 <b>Cr</b> chromium 24	25 <b>Mn</b> manganese 25	26 <b>Fe</b> iron 26	27 <b>Co</b> cobalt 27	28 <b>Ni</b> nickel 28	29 <b>Cu</b> copper 29	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	
37 <b>Rb</b> rubidium 37	38 <b>Sr</b> strontium 38	39 <b>Y</b> yttrium 39	40 <b>Zr</b> zirconium 40	41 <b>Nb</b> niobium 41	42 <b>Mo</b> molybdenum 42	43 <b>Tc</b> technetium [98]	44 <b>Ru</b> ruthenium 44	45 <b>Rh</b> rhodium 45	46 <b>Pd</b> palladium 46	47 <b>Ag</b> silver 47	48 <b>Cd</b> cadmium 48	49 <b>In</b> indium 49	50 <b>Sn</b> tin 50	51 <b>Sb</b> antimony 51	52 <b>Te</b> tellurium 52	53 <b>I</b> iodine 53	54 <b>Xe</b> xenon 54	
55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	72 <b>Hf</b> hafnium 72	73 <b>Ta</b> tantalum 73	74 <b>W</b> tungsten 74	75 <b>Re</b> rhenium 75	76 <b>Os</b> osmium 76	77 <b>Ir</b> iridium 77	78 <b>Pt</b> platinum 78	79 <b>Au</b> gold 79	80 <b>Hg</b> mercury 80	81 <b>Tl</b> thallium 81	82 <b>Pb</b> lead 82	83 <b>Bi</b> bismuth 83	84 <b>Po</b> polonium 84	85 <b>At</b> astatine 85	86 <b>Rn</b> radon 86	
[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	[261] <b>Rf</b> rutherfordium 104	[262] <b>Db</b> dubnium 105	[266] <b>Sg</b> seaborgium 106	[268] <b>Mt</b> meitnerium 109	[277] <b>Hs</b> hassium 108	[271] <b>Ds</b> darmstadtium 110	[272] <b>Rg</b> roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated								

1  
**H**  
hydrogen  
1

**Key**  
relative atomic mass  
atomic symbol  
name  
atomic (proton) number

\* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

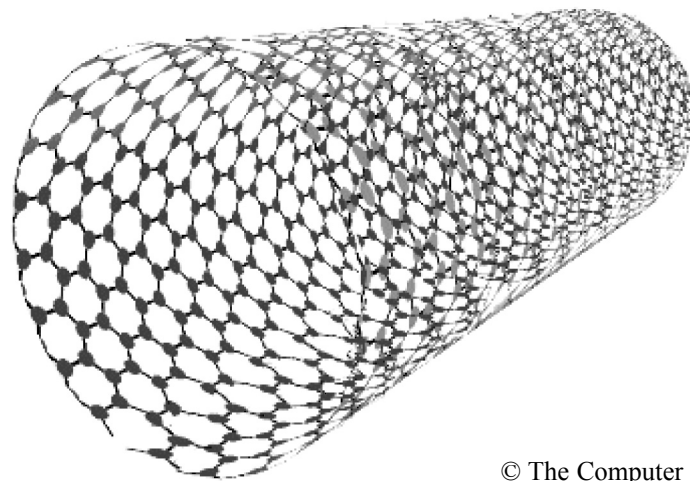
The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.





- (d) In the past 30 years, carbon has been found to form other types of structures: carbon nanotubes and fullerenes.  
The structure of a carbon nanotube resembles a graphite layer rolled round to form a cylinder.

The structure of a carbon nanotube is shown in the diagram below.



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Carbon nanotubes form fibres that are very strong, tough and lightweight.

Suggest a use for materials made from carbon nanotubes.

..... (1)

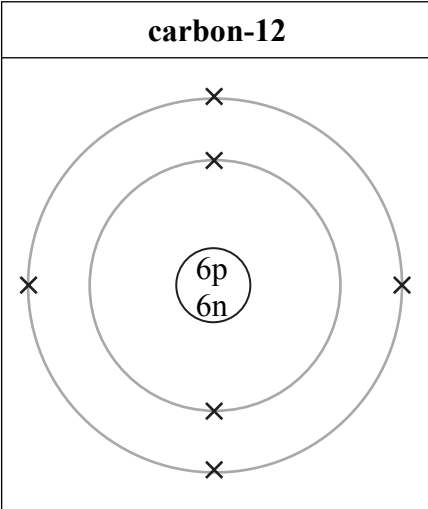
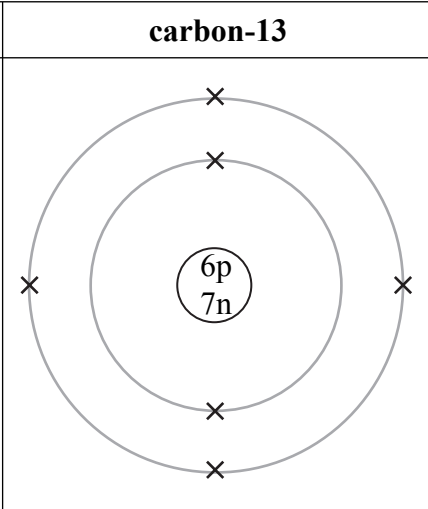


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(e) Carbon atoms exist as two stable isotopes. These are shown in the table.

In the diagrams

p = proton  
n = neutron  
× = electron

	carbon-12	carbon-13
		
mass number	12	13
atomic number	6	6

(i) Explain the meaning of the term **isotope**.

.....  
.....  
.....

(2)

(ii) The electronic configuration of a carbon atom is 2.4.  
What does this tell you about the position of carbon in the periodic table?

.....  
.....  
.....

(1)

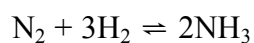
Q1

(Total 8 marks)



2. (a) A German scientist, Fritz Haber, developed a process to react nitrogen and hydrogen together to make ammonia.

The equation for the reaction is



- (i) Explain how you know that this equation is balanced.

.....  
 .....  
 .....

(1)

- (ii) State the conditions used in the Haber process.

.....  
 .....

(2)

- (b) Most of the ammonia is used to make artificial fertilisers. Natural fertilisers, such as manure, are also used.

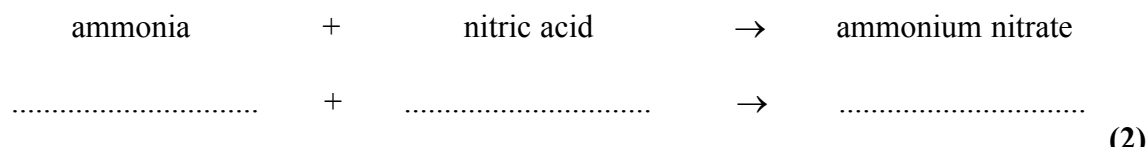
Give one advantage of using artificial fertilisers rather than natural fertilisers.

.....  
 .....

(1)

- (c) Ammonium nitrate is an artificial fertiliser. Ammonia reacts with nitric acid to make ammonium nitrate.

Write the balanced equation for this reaction.



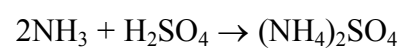
(2)



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(d) Another fertiliser, ammonium sulphate, is made by reacting ammonia with sulphuric acid.

The equation for this reaction is



What is the atom economy for the formation of ammonium sulphate in this reaction?

$$\text{atom economy} = \frac{\text{mass of useful product}}{\text{total mass of product}} \times 100\%$$

.....  
.....

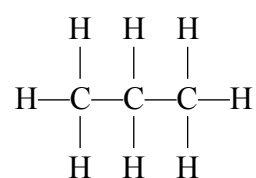
atom economy = .....%  
**(1)**

**Q2**

**(Total 7 marks)**



3. Propane is an alkane.  
The diagram shows the structure of a molecule of propane.



- (a) Propene, C<sub>3</sub>H<sub>6</sub>, is an alkene.  
Draw the structure of a molecule of propene, showing all covalent bonds.

(2)

- (b) Describe a test to distinguish between propane and propene.

test.....

.....

result with propane .....

.....

result with propene .....

.....

(3)



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(c) The polymer poly(propene) is made from propene.  
Poly(propene) softens at 160 °C.  
It forms tough fibres and has high resistance to attack by acids and alkalis.  
Different dyes can be added to poly(propene) to make products with different colours.

(i) Describe how propene molecules react with each other to form poly(propene) molecules.

.....  
.....  
.....

(2)

(ii) Suggest an item that could be made from poly(propene) and state which property of poly(propene) makes it suitable for this use.

.....

(1)

Q3

(Total 8 marks)



4. Calcium fluoride is an ionic compound.  
It can be made by reacting calcium with fluorine.

(a) Calcium fluoride consists of calcium ions,  $\text{Ca}^{2+}$ , and fluoride ions,  $\text{F}^-$ .

(i) Explain how a calcium atom, Ca, forms a calcium ion,  $\text{Ca}^{2+}$ .

.....  
.....  
(1)

(ii) Write the formula of calcium fluoride.

.....  
(1)

(b) Explain why calcium fluoride has a high melting point.

.....  
.....  
(1)

(c) When molten calcium fluoride is electrolysed, fluorine gas is formed at the positive electrode.

Name the element formed at the negative electrode.

.....  
(1)

(d) The element fluorine exists as fluorine molecules,  $\text{F}_2$ .

(i) Draw a dot and cross diagram to show the arrangement of electrons in one molecule of fluorine.  
Show outer electrons only.

(2)



(ii) Fluorine can be made into a solid by cooling it.  
Solid fluorine melts at  $-220^{\circ}\text{C}$ .

Explain why fluorine has such a low melting point.

.....

.....

(1)

(Total 7 marks)

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Q4

**TOTAL FOR PAPER: 30 MARKS**

**END**



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