The Periodic Table

Group 1 Alkali Metals

Group 2 Alkaline Earth Metals

Group 3 **Group 4** **Group 5** **Group 6**

Group 7 Halogens

Group 8 Inert (Noble) Gases

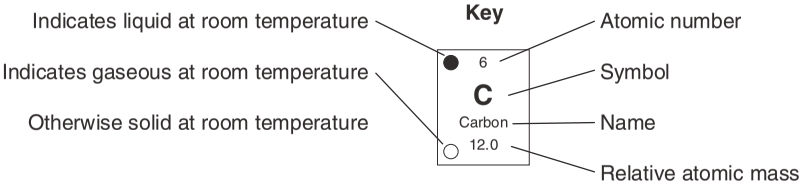
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Period 1								2 **He** Helium 4.0
Period 2	3 **Li** Lithium 6.9	4 **Be** Beryllium 9.0			5 B Boron 10.8	6 **C** Carbon 12.0	7 **N** Nitrogen 14.0	8 **O** Oxygen 16.0	9 **F** Fluorine 19.0	10 **Ne** Neon 20.2
Period 3	11 **Na** Sodium 23.0	12 **Mg** Magnesium 24.3			13 **Al** Aluminium 27.0	14 **Si** Silicon 28.1	15 **P** Phosphorus 31.0	16 **S** Sulphur 32.1	17 **Cl** Chlorine 35.5	18 **Ar** Argon 39.9
Period 4	19 **K** Potassium 39.1	20 **Ca** Calcium 40.1	21 Sc Scandium 45.0	22 Ti Titanium 47.9	23 V Vanadium 50.9	24 Cr Chromium 52.0	25 Mn Manganese 54.9	26 **Fe** Iron 55.9	27 **Co** Cobalt 58.9	28 **Ni** Nickel 58.7	29 **Cu** Copper 63.5	30 **Zn** Zinc 65.4	31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0	35 **Br** Bromine 79.9	36 **Kr** Krypton 83.8
Period 5	37 **Rb** Rubidium 85.5	38 **Sr** Strontium 87.6	39 Y Yttrium 88.9	40 Zr Zirconium 91.2	41 Nb Niobium 92.9	42 Mo Molybdenum 95.9	43 Tc Technetium (99)	44 Ru Ruthenium 101.1	45 Rh Rhodium 102.9	46 Pd Palladium 106.4	47 **Ag** Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 **Sn** Tin 118.7	51 Sb Antimony 121.8	52 Te Tellurium 127.6	53 **I** Iodine 126.9	54 **Xe** Xenon 131.3
Period 6	55 Cs Caesium 132.9	56 Ba Barium 137.3	57-71 Lathanides omitted	72 Hf Hafnium 178.5	73 Ta Tantalum 181.0	74 W Tungsten 183.9	75 Re Rhenium 186.2	76 Os Osmium 190.2	77 Ir Iridium 192.2	78 Pt Platinum 195.1	79 **Au** Gold 197.0	80 **Hg** Mercury 200.6	81 Tl Thallium 204.4	82 **Pb** Lead 207.2	83 Bi Bismuth 209.0	84 Po Polonium (210)	85 At Astatine (210)	86 Rn Radon (222)
Period 7	87 Fr Francium (223)	88 Ra Radium (226)	89-103 Actinides omitted	104 Unq Unnilquadium 261.1	105 Unp Unnilpentium 262.1	106 Unh Unnilhexium 263.1	107 Uns Unnilseptium 262.1	108 Uno Unniloctium 265.1	109 Une Unnilennium 266.1									

The 'staircase line' divides metals (on the left) from non-metals

The Transition Metals
Hard, strong, form coloured covalent compounds
Make good catalysts

Alkaline Earth Metals: form 2+ ions in ionic compounds

Alkali Metals: form 1+ ions in ionic compounds



$$\text{Number of moles of atoms} = \frac{\text{mass of element (g)}}{\text{relative atomic mass } (A_r)}$$

$$\text{Number of moles of substance} = \frac{\text{mass of substance (g)}}{\text{relative molecular mass } (M_r)}$$

The volume of 1 mole of any gas is 24 dm^3 at room temperature and pressure (rtp)

The Periodic Table is a chemical map. It arranges all the 109 known elements in order of their atomic numbers. Similar elements occur in vertical columns called **groups**.

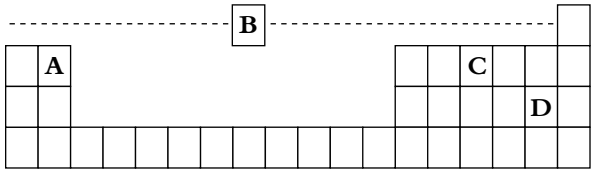
Questions

Tick the box next to the correct answer.

1 The elements in Group 8 (or Group 0) of the Periodic Table are called:

A halogens ☐
B reactive gases ☐
C alkanes ☐
D noble gases ☐

2 This incomplete Periodic Table shows the positions of four elements, A, B, C and D.



a Which of these is a metal?

A ☐ B ☐ C ☐ D ☐

b Which of these are liquids?

A all ☐
B none ☐
C B, C and D ☐
D B only ☐

c Which of these are gases?

A all ☐
B none ☐
C B, C and D ☐
D B only ☐

3 The metals in Group 1 are called the:

A transition metals ☐
B alkali metals ☐
C acid metals ☐
D reactive metals ☐

4 In which Group of the Periodic Table will you find an element with the electronic structure: 2, 3?

A 1 ☐
B 2 ☐
C 3 ☐
D 4 ☐

5 The elements in Group 7 of the Table all have similar chemical properties. This is because they:

A are all in the same Period ☐
B are all metals which form positive ions ☐
C all gain one electron to form ions ☐
D all lose one electron to form ions ☐

6 The elements in Group 2 are called the:

A alkaline earth metals ☐
B semi-metals ☐
C noble metals ☐
D unreactive metals ☐

7 The elements in the same Group in the Periodic Table have:

A the same atomic numbers ☐
B similar chemical properties ☐
C regularly decreasing atomic diameters ☐
D the same number of electrons in their electron clouds ☐

8 A metal M reacts with chlorine to form the compound MCl_2. In which Group of the Periodic Table is the metal M to be found?

A Group 1 ☐
B Group 2 ☐
C Group 7 ☐
D Group 8 ☐

9 As you move across the Periodic Table, from left to right in any one Period, the elements show the trend of going from:

A more reactive to less reactive ☐
B metallic to non-metallic elements ☐
C smaller atomic size to larger atomic size ☐
D non-metallic to metallic character ☐

10 Which of the following shows the electronic structures of three elements in the same Group of the Periodic Table?

A	2, 8	2, 8, 1	2, 8, 2 ☐
B	2, 7	2, 8	2, 8, 1 ☐
C	2	2, 8	2, 8, 8 ☐
D	2, 8, 2	2, 8, 3	2, 8, 4 ☐

Answer the following questions in the space provided.

11 A neutral atom has an equal number of positive charges to the total number of electrons in the outer shells. The alkali metals of Group 1 all have **one** electron in their outer shell. When one of these metals reacts with another element, it loses its single outer electron to form an ion. Since it now has one less electron, the ion is positive; any positive ion is called a cation.

a Write the cation symbols for the:
potassium ion _____
sodium ion _____
lithium ion _____

Alkaline earth metals lose two electrons when they react with other elements

b Write the cation symbols for:
magnesium _____
calcium _____
strontium _____

Halogen atoms gain one electron when they react and are called anions.

c Write the anion symbols for:
bromine _____
chlorine _____
fluorine _____

12 Metal cations react with halogen anions to give compounds which are called **salts**. For example, the salt formed when sodium reacts with chlorine is called sodium chloride. The name of the metal is always put first.

Write the names of all the salts which could possibly be produced from reactions between lithium, sodium and potassium, **each one** reacting with fluorine, chlorine and bromine. (Remember to put the name of the metal **first**.)

i _____
ii _____
iii _____
iv _____
v _____
vi _____
vii _____
viii _____
ix _____

Answers

1 (**D**) Although the name 'inert gases' is chemically more informative, students should know the alternate and more 'historical' name. (1)

2 a (**A**), b (**B**) and c (**C**) It is perhaps an interesting fact that only **two** elements occur naturally in the liquid state (at room temperature). Knowledge of this and the fact that the only elements which are gases are the six noble gases, two halogens, the two gases which make up the (major part of) air, nitrogen and oxygen, plus hydrogen, making a total of 11 in all. Although not necessarily valuable information, this could be very helpful basic information when dealing with reactions dependent on the chemical states of the elements. (1)

3 (**B**) Again, not a terribly useful bit of information on its own, but by learning names of Groups of the elements, students will be able to apply their knowledge relating to one element to the chemical behaviour of other less common elements. (1)

4 (**C**) This is certainly not a question of recall or knowledge, but it is important for students to understand the basic construction of the Table and how progression across the Groups is closely related to the electron content of the outer shell. (1)

5 (**C**) This is an important fact for students to learn since it applies without exception throughout this Group. (1)

6 (**A**) As with Question 3 above, the generalities of chemical behaviour can be extended to unfamiliar elements if their Group identity is known. (1)

7 (**B**) The last option, D, is a good distractor. If the word 'outer' had been placed before 'electron clouds' then this too would have been correct. When discussing the other 'distractors' the instructor might 'open the door' to the idea of atomic sizes (volumes), by pointing out that each step down in a Group means an additional 'onion skin layer' or shell of electrons. Hence, the opposite of C is correct, in that atomic diameters increase as you go down a Group. (1)

8 (**B**) This question provides a precursor for **Units 5** and **6**, which deal in part with combining of metallic with non-metallic ions. (1)

9 (**B**) This is a fairly straightforward question which should be answered correctly by most students. The option C here offers an opportunity to emphasise, again, that there is a regular and gradual change in the physical size of atoms as you move, either vertically in a Group (Question 7) or horizontally in a Period (this question). These graduated changes of size are due to the changes in the number of shells (vertical movement in Groups) and 'tightness of hold', or force of attraction on the electrons (horizontal Period movement) by the forces of the positive nucleus. (1)

10 (**C**) All but C show changes of electron shell populations across Periods. The Group in C are the inert gases. (1)

11 Students should begin to have a fluency in writing and understanding the identities of cations and anions and to use the terminology comfortably.

a	K^+	Na^+	Li^+	(3)
b	Mg^{2+}	Ca^{2+}	Sr^{2+}	(3)
c	Br^-	Cl^-	F^-	(3)

12 This is more of a combination game than a test of chemical knowledge. It does, however, offer the opportunity for students to familiarise themselves, and become comfortable with, the proper nomenclature of simple compounds. It is an opportunity too for the teacher to point out and show the application of the simple rule that a compound composed of two elements has its name ending in -ide. (This is also an opportunity to stress the correct spellings of fluoride and chloride, both of which are notorious for being incorrectly spelled!)

In any order:

lithium fluoride
lithium chloride
lithium bromide

sodium fluoride
sodium chloride
sodium bromide

potassium fluoride
potassium chloride
potassium bromide

(1 each, total = 9 marks)

Total for unit = 28 marks