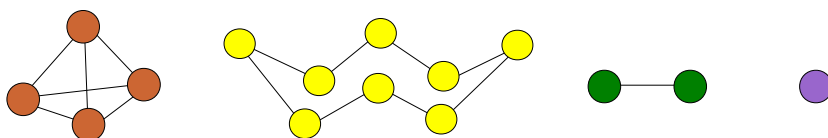


Chemguide – answers

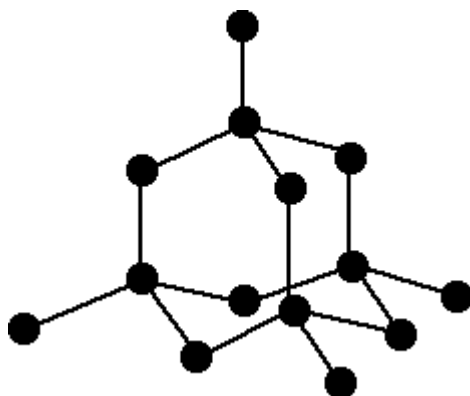
STRUCTURES OF THE PERIOD 3 ELEMENTS

1. a) You should have picked out phosphorus, sulphur, chlorine and argon.

You could use the diagrams on the Chemguide page you have just read, but you need to be quite good to draw these convincingly without a computer. Instead, use diagrams like these:



- b) Silicon is the only one with a giant covalent structure – the same as diamond:



2. a) Each of these is an example of metallic bonding. This involves the attraction between a delocalised sea of electrons and the nuclei of the atoms.

From sodium to aluminium, the number of electrons delocalised per atom rises from 1 to 3, and so the “sea” is getting more negatively charged. The number of protons in the nucleus is increasing – so more positively charged. The atoms are getting smaller – so the distance between the nuclei and the “sea” is falling.

All of these things make the attraction between the nuclei and the “sea” stronger, and more difficult to break. So more heat is needed to turn the metal into a gas.

b) All of these molecules are attracted to each other by van der Waals dispersion forces which rely on the number of electrons moving around, and the distance over which they can move. On the whole, bigger molecules have bigger temporary dipoles, and so stronger intermolecular attractions. The biggest molecule is sulphur, S_8 ; next biggest is phosphorus, P_4 ; next is chlorine, Cl_2 ; and the smallest is the single argon atom in the argon molecule.

So sulphur has the highest melting and boiling points, phosphorus next, then chlorine and argon.

- c) You have to break strong Si-Si bonds in three dimensions in order to melt or boil it.

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d) Sodium, magnesium and aluminium are ordinary conductors of electricity, silicon is a semiconductor, and the rest are non-conductors of electricity. You wouldn't be expected to comment on how conductivity differs between the three metals.

(Notice that the question just says “How does . . .” - it doesn't ask you to explain it, just to give a statement of fact.)