

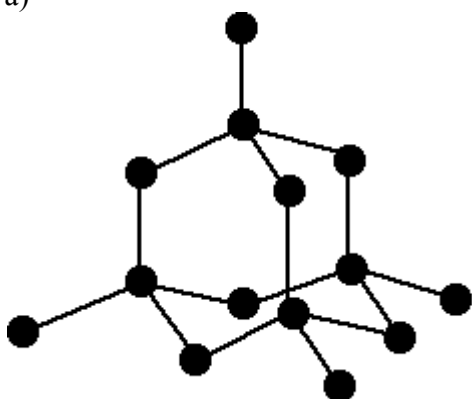
Chemguide – answers

GIANT COVALENT STRUCTURES

You shouldn't have found this very difficult. You probably came across most of it in chemistry that you did up to the age of 16.

1. Giant doesn't just mean very large. It applies to a structure which has a huge, but variable number of atoms (or ions) depending on the size of the crystal. This is different from a large molecule where the number of atoms is fixed for a particular molecule.

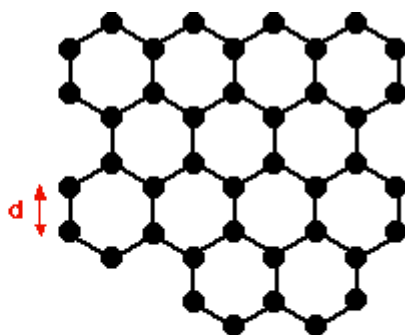
2. a)



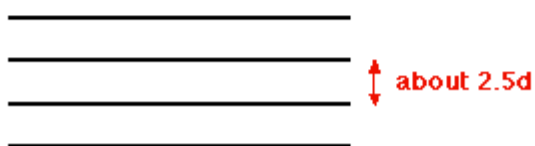
This is probably the bare minimum that you should draw, but don't try to be too clever and draw any more than this. Any other lines which you have included to join up any other atoms make your diagram wrong.

b)

atoms in one layer:



a stack of layers:



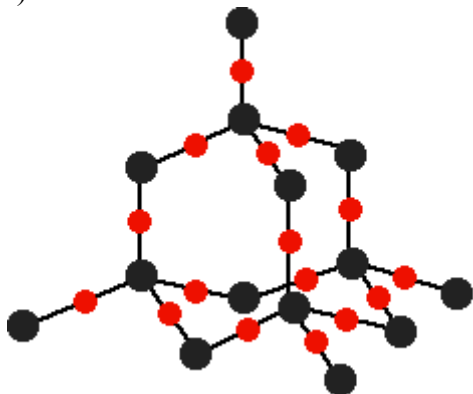
Check your diagram carefully. Students often get the pattern wrong by including other shapes (like diamonds). It should consist purely of hexagons. If you have included any other shapes, it is wrong.

If you are going to use this two-part diagram (and it makes sense unless mark schemes from your examiners suggest otherwise), make sure you include at least the amount of labelling as there is on this diagram.

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3. a) In diamond, you have to break very strong C-C covalent bonds in 3-dimensions in order to split the crystal. In graphite, although there are very strong C-C bonds within the sheets, the sheets can slide over each other.
- b) There is a large amount of empty space between the sheets in graphite, whereas the atoms are all close together in diamond.
- c) To melt both substances you have to break C-C bonds – it isn't enough just to separate the sheets in graphite. This takes lots of energy.
- d) In graphite, an electron from each carbon atom is delocalised and is free to move around in the sheet. In diamond, all the electrons are tied to particular bonds and aren't free to move.
- e) In both diamond and graphite the structure involves strong C-C bonds. Breaking these structures up could only happen if there were strong interactions between solvent molecules and carbon atoms. There are no interactions which are strong enough.

4. a)



Draw a diamond structure and then draw an oxygen atom half-way along each bond. In chemistry at this level, a diagram like this should be perfectly acceptable.

- b) (i) To destroy the structure, you have to break strong Si-O bonds in 3-dimensions.
- (ii) It needs a lot of energy to break these strong covalent bonds.
- (iii) There are no mobile delocalised electrons. All the electrons are tied to particular bonds.
- (iv) There are no possible attractions which could occur between solvent molecules and the silicon or oxygen atoms which could overcome the covalent bonds in the giant structure.