

## The structure of ice and water



Iceberg drifting in open ocean

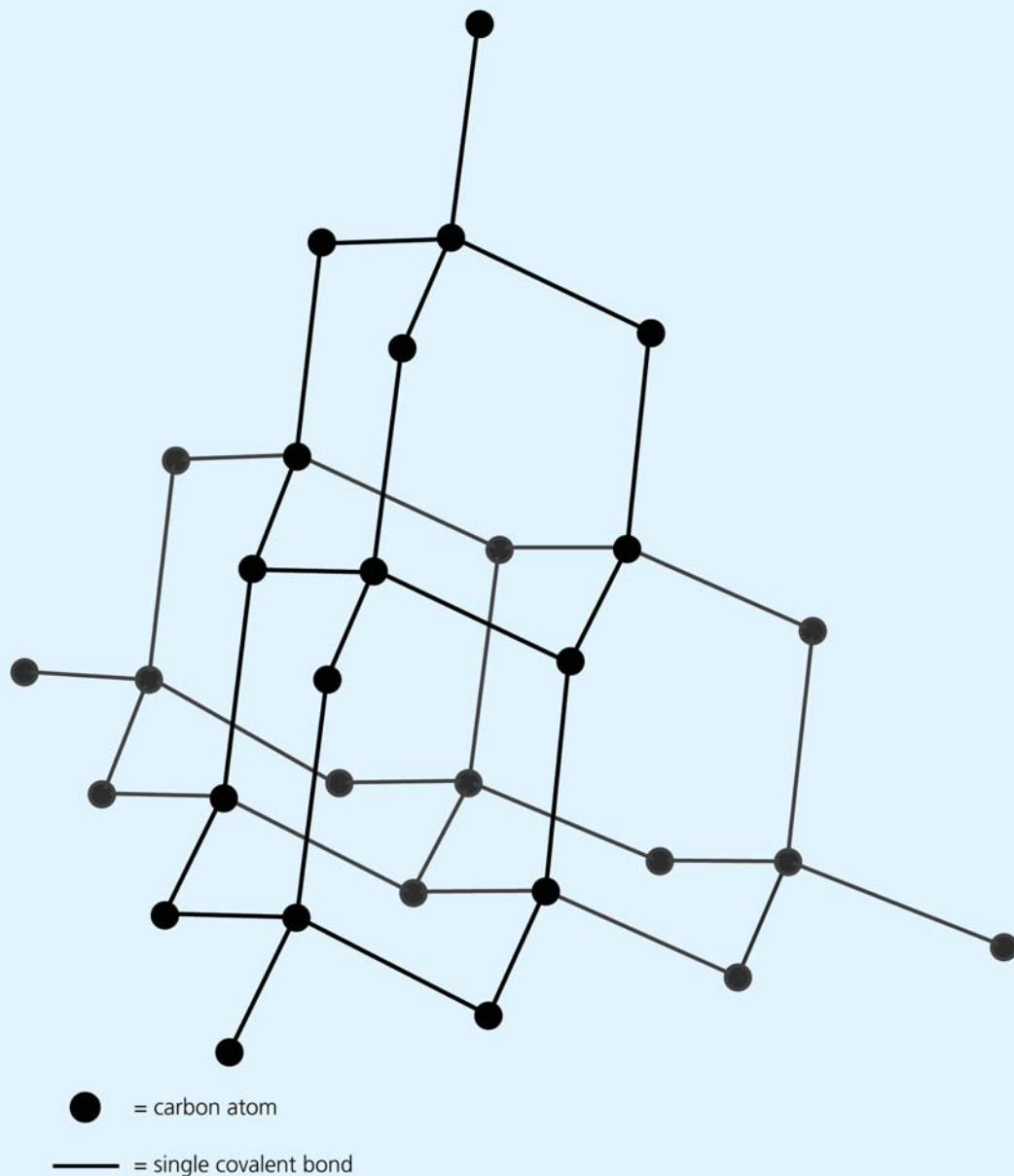
### Questions

1. Draw a dot and cross diagram for a water molecule and use it to explain why water is a V-shaped molecule with the H-O-H angle of approximately  $105^\circ$ .
2. Draw a hydrogen bond formed between two water molecules. Draw the  $\delta+$  and  $\delta-$  partial charges on the appropriate atoms.
3. Explain how a hydrogen bond forms. Why can it only form via an atom of hydrogen (in other words, what is special about the hydrogen atom)?
4. The figure shows two sets of electrically charged plates with an electric field between them. Draw a water molecule in each to show how it lines up with the electric field.

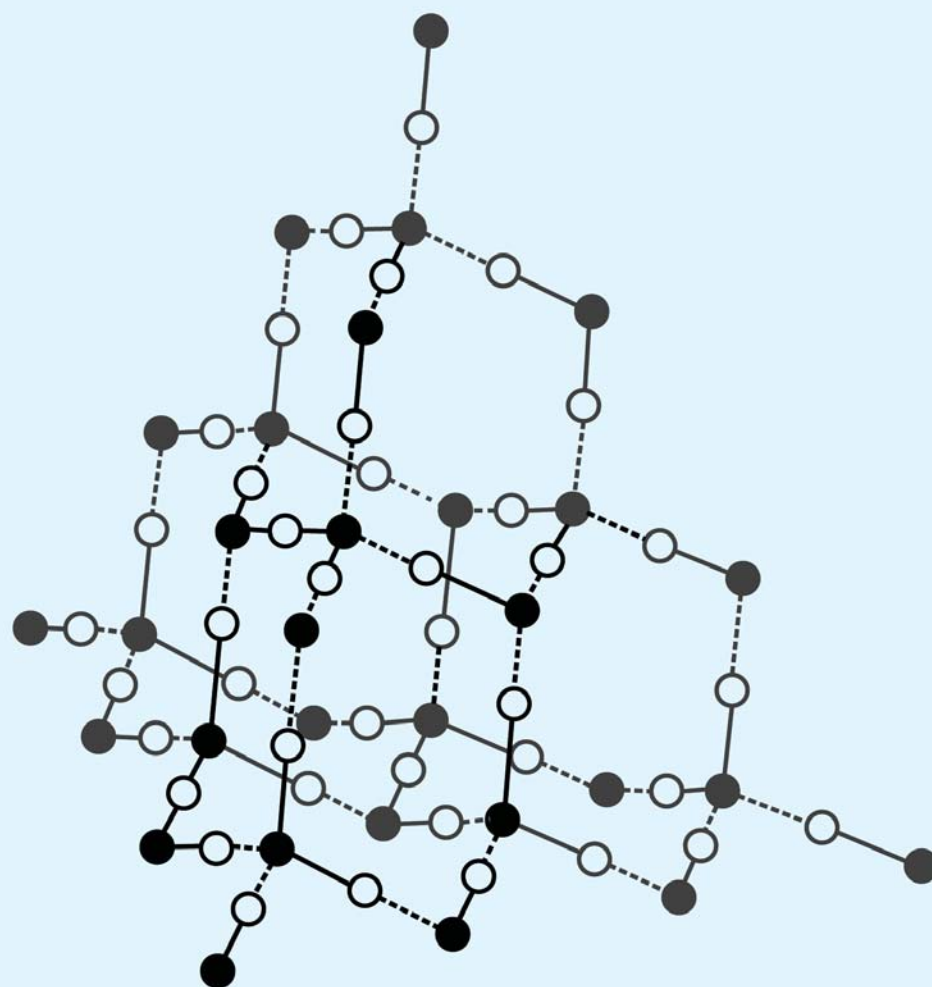


Electrically charged plates

5. The figure below shows the structure of diamond. Compare it with that of ice (shown overleaf) and point out the similarities and differences. Explain why the melting point of ice is so much lower than that of diamond.



*The structure of diamond*



- = oxygen atom
- = hydrogen atom
- = single covalent bond
- - - - = hydrogen bond

*The structure of ice*

6. Suggest which of the following molecules: methane,  $\text{CH}_4$  and ammonia,  $\text{NH}_3$ , will respond to microwave radiation in the same way as water. You will need to draw dot and cross diagrams and dipoles for a complete answer.
7. Rubbing a plastic ruler on fleece clothing gives the ruler an electrical charge, which is probably positive (although this will depend on the actual materials of the ruler and the fleece). Explain why holding a charged ruler close to a gentle stream of water from a tap attracts the water even though water molecules are electrically neutral. What difference (if any) would it make if the ruler were negatively charged? Explain your answer. You might like to try this simple experiment if you have never done it.