

Solutions

Original marking guidance: M1 method, A1 accuracy, B1 explanation.

2.1 London forces: instantaneous dipoles induce dipoles in neighbouring particles.

2.2 Methanol can: it has an O–H donor and oxygen lone pairs. The ether lacks H bonded to N/O/F, so its pure molecules cannot form this hydrogen-bond network; it can accept hydrogen bonds from water.

2.3 Larger, more polarisable electron clouds/more electrons give stronger London attractions requiring more energy to overcome.

3.1 2,2-dimethylpropane is more compact and has less effective intermolecular contact, so London attractions between molecules are weaker.

3.2 An open hydrogen-bonded arrangement keeps ice molecules further apart, giving lower density than liquid water. Halogenoalkane molecules cannot replace the water hydrogen-bond network effectively; bond polarity alone does not guarantee sufficiently favourable new attractions.