

Intermolecular Forces

Practice Worksheet

Part A — Knowledge and Understanding

1. Identify the strongest intermolecular force present in each substance:

- a) CH_4
- b) NH_3
- c) HCl
- d) CO_2

2. Which of the following molecules are polar?

- a) H_2O
- b) CO_2
- c) CH_4
- d) SO_2

3. State whether each molecule exhibits hydrogen bonding:

- a) HF
- b) CH_3OH
- c) H_2S
- d) NH_3

4. Which type of intermolecular force is present between:

- a) Two non-polar molecules
- b) Two polar molecules
- c) Molecules containing H–O bonds

Part B — Application

5. Order the following elements from the lowest to the highest boiling point:

Ne, Ar, Kr

Explain your reasoning.

6. Which has the higher boiling point? Explain.

a) CH₄ or C₃H₈

b) HCl or HF

7. Which substance has stronger intermolecular forces?

a) CO₂ or SO₂

b) H₂O or H₂S

8. Order the following in increasing strength of intermolecular forces:

London dispersion, hydrogen bonding, dipole–dipole

Explain your reasoning

9. Which molecule has the highest viscosity? Explain.

a) Pentane

b) Hexane

c) Octane

Part C — Thinking

10. Explain why iodine (I₂) is a solid at room temperature while bromine (Br₂) is a liquid.

11. Explain why water has a much higher boiling point than H₂S.

12. Two substances have similar molar mass: CO and N₂

Which has stronger intermolecular forces? Explain.

13. Explain why linear molecules generally have stronger dispersion forces than branched or cyclic molecules.

14. Why does increasing molecular mass generally increase boiling point?

Part D — Extension

15. Compare ethanol (C_2H_5OH) and dimethyl ether (CH_3OCH_3). Which has the higher boiling point? Explain in detail.

16. Explain why intermolecular hydrogen bonding leads to unusually high boiling points compared to other intermolecular forces.

17. A substance has very weak intermolecular forces. Predict its physical properties (boiling point, viscosity, and state).

18. Explain how bond polarity and molecular geometry determine molecular polarity. Then explain how molecular polarity determines the type of intermolecular forces present.

19. Two hydrocarbons have the same molecular formula but different shapes (isomers). Explain how their boiling points may differ.

20. Explain why noble gases can exist as liquids at very low temperatures.

Success Criteria — Practice

I can:

- ✓ identify intermolecular forces correctly
- ✓ compare molecules using structure and polarity
- ✓ explain trends using particle reasoning
- ✓ justify answers clearly using scientific vocabulary

Answer Keys

1. CH₄: LDF | NH₃: H-bond | HCl: dipole | CO₂: LDF
2. Polar: H₂O, SO₂
3. Yes: HF, CH₃OH, NH₃
4. Non-polar → LDF | Polar → dipole | H–O → H-bond
5. Ne < Ar < Kr (↑ electrons → ↑ LDF)
6. a) C₃H₈ > CH₄ (size)
b) HF > HCl (H-bond)
7. a) SO₂ > CO₂ (polar vs non-polar)
b) H₂O > H₂S (H-bond)
8. LDF < Dipole < H-bond
9. Octane (largest → strongest LDF)
10. I₂ > Br₂ (more electrons → stronger LDF → solid)
11. H₂O forms H-bonds; H₂S does not
12. CO > N₂ (polar vs non-polar)
13. Linear → greater surface → stronger LDF
14. ↑ mass → ↑ electrons → ↑ polarizability → ↑ BP
15. Ethanol > ether (H-bonding)
16. Strong polarity (H–N/O/F) → strong attraction
17. Low BP, low viscosity, gas/volatile
18. Shape determines polarity → determines IMF
19. Linear > branched (surface area)
20. Low temp → low KE → weak LDF can hold atoms