AP CHEMISTRY • EXERCISE SHEET

3.6 Deviation from the Ideal Gas Law

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

Objective

Build the skills to answer exam questions on **deviations from the ideal gas law**.

You must be able to:

- state when real gases deviate (**high pressure, low temperature**)
- explain the two causes (particle **volume** and **attractions**)
- predict which gas is more ideal

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

When deviations matter

Real gases behave most **ideally** at **high temperature** and **low pressure**. They deviate most at **low temperature** and **high pressure**, where the ideal assumptions break down.

The two causes

The ideal law assumes zero particle volume and no attractions. In reality:

- particles **do** take up volume —matters at high pressure (crowded);
- particles **do** attract —matters at low temperature (slow-moving, so attractions pull them together).

Effect on pressure

Attractions make real particles hit the walls a little **less** hard, so the real pressure is slightly **lower** than ideal. Particle volume makes the available space smaller, raising pressure at very high compression.

Which gas is more ideal

Small, nonpolar gases with weak IMFs (like He, H_2) behave most ideally. Large or polar gases (with strong attractions) deviate more.

2 Practice

Now apply the methods above.

2.1 Under what conditions do real gases behave most ideally? [1]

2.2 Name the two properties of real particles that the ideal law ignores. [2]

2.3 Which behaves more ideally: He or NH_3? Give a reason. [2]

3 Exam-style questions

3.1 Real gases deviate most from ideal behavior at [1]

- **A** high temperature and low pressure
- **B** low temperature and high pressure
- **C** standard conditions
- **D** any temperature

3.2 A gas is cooled to near its boiling point at high pressure.

(a) State whether it behaves more or less ideally. [1]

(b) Explain the role of intermolecular attractions at low temperature. [2]

3.3 Explain why He behaves more ideally than H_2O vapor, in terms of intermolecular forces. [2]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **3.6 Deviation from the Ideal Gas Law** lesson on the **Learn** page;
- read the **Deviation from the Ideal Gas Law** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 High temperature and low pressure.

2.2 The volume of the particles; the attractions between particles.

2.3 He —it is small and nonpolar with only weak dispersion forces, so it deviates less than the polar, hydrogen-bonding NH_3.

3.1 B —low temperature and high pressure.

3.2 (a) Less ideally. (b) At low temperature the particles move slowly, so intermolecular attractions pull them together, reducing the pressure below the ideal prediction.

3.3 He has only weak dispersion forces, while H_2O has strong hydrogen bonding; stronger attractions cause larger deviations, so He is more ideal.