

Exercise walk-through

3.6

Deviation from Ideal Gas Law

AP Chemistry

States of matter and the gas law

A balance of **kinetic energy** vs IMFs
sets the state:

Ideal gas law

$$PV = nRT \quad (T \text{ in kelvin})$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Dalton

$$: P_{tot} = \sum P_i, \text{ with}$$

$$P_i = x_i P_{tot}.$$



Gases fill volume; solids hold shape

Worked example – the ideal gas law

How many moles of gas fill a 2.0 L container at 300 K and 1.5 atm?

- $PV = nRT$, with
 $R = 0.0821 \text{ L atm}/(\text{mol K})$
- $n = \frac{PV}{RT} = \frac{(1.5)(2.0)}{(0.0821)(300)}$
- $= 0.12 \text{ mol}$

Check the units of R against the units you were given: with pressure in kPa you need a different R , and that mismatch is the commonest error in this calculation.

Exercises 2.1-2.3

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]

Exercises 2.1-2.3

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

2.1

- High temperature and low pressure
-

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

2.2

- The volume of the particles; the attractions between particles
-

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

2.3

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

Exercise 3.1

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

Exercise 3.1

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

3.1 B

- low temperature and high pressure

Exercise 3.2 (a)

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

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

[1]

Exercise 3.2 (a)

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

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

[1]

(a)

- Less ideally

Exercise 3.2 (b)

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

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

[2]

Exercise 3.2 (b)

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

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

(b)

- At low temperature the particles move slowly, so intermolecular attractions pull them together, reducing the pressure below the ideal prediction

Exercise 3.3

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

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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