

Exercise walk-through

3.4

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 Convert 27°C to kelvin.

[1]

2.2 Find n for a gas with $P = 2.0 \text{ atm}$, $V = 10.0 \text{ L}$, $T = 300 \text{ K}$.

[3]

2.3 A gas at 1.0 atm and 2.0 L is compressed to 0.5 L at constant T . Find the new pressure.

[2]

Exercises 2.1-2.3

2.1 Convert 27°C to kelvin.

[1]

2.1

- $27 + 273 = 300 \text{ K}$
-

2.2 Find n for a gas with $P = 2.0 \text{ atm}$, $V = 10.0 \text{ L}$, $T = 300 \text{ K}$.

[3]

2.2

- $n = \frac{PV}{RT} = \frac{(2.0)(10.0)}{(0.08206)(300)} = 0.81 \text{ mol}$
-

2.3 A gas at 1.0 atm and 2.0 L is compressed to 0.5 L at constant T . Find the new pressure.

[2]

2.3

- $P_2 = \frac{P_1 V_1}{V_2} = \frac{(1.0)(2.0)}{0.5} = 4.0 \text{ atm}$

Exercise 3.1

3.1 In $PV = nRT$, the temperature must be in

[1]

☐

A °C

B kelvin

C °F

D any unit

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3.1 B

- kelvin

Exercise 3.2 (a)

3.2 A 5.0 L container holds 0.25 mol of gas at 350 K.

(a) Find the pressure in atm.

[3]

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[3]

(a)

- $$P = \frac{nRT}{V} = \frac{(0.25)(0.08206)(350)}{5.0} = 1.44 \text{ atm}$$

Exercise 3.2 (b)

3.2 A 5.0 L container holds 0.25 mol of gas at 350 K.

(b) State what happens to the pressure if the temperature is doubled at constant volume. [1]

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(b)

- The pressure doubles

Exercise 3.3

3.3 A balloon has volume 2.0 L at 300 K. Find its volume at 360 K if the pressure is unchanged. [3]

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3.3

- $\frac{V_1}{T_1} = \frac{V_2}{T_2}; V_2 = 2.0 \times \frac{360}{300} = 2.4 \text{ L}$