

Exercise walk-through

3.13

Beer-Lambert 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 Write the Beer-Lambert law and name each symbol. [2]

2.2 Find A for $\varepsilon = 500$, $b = 1.0$ cm, $c = 0.0010$ M. [2]

2.3 Absorbance is proportional to which quantity? [1]

Exercises 2.1-2.3

2.1 Write the Beer-Lambert law and name each symbol. [2]

2.1

- $A = \epsilon bc$: A absorbance, ϵ molar absorptivity, b path length, c concentration
-

2.2 Find A for $\epsilon = 500$, $b = 1.0$ cm, $c = 0.0010$ M. [2]

2.2

- $A = (500)(1.0)(0.0010) = 0.50$
-

2.3 Absorbance is proportional to which quantity? [1]

2.3

- Concentration

Exercise 3.1

3.1 In $A = \varepsilon bc$, doubling the concentration c (with ε , b fixed)

[1]

☐

A halves A

B doubles A

C leaves A unchanged

D squares A

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[1]

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3.1 B

- A is proportional to c , so doubling c doubles A

Exercise 3.2 (a)

3.2 A calibration line for a dye is $A = 250c$ (with c in mol/L).

(a) Find the absorbance of a 0.0016 M solution.

[2]

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(a) Find the absorbance of a 0.0016 M solution.

[2]

(a)

- $A = 250(0.0016) = 0.40$

Exercise 3.2 (b)

3.2 A calibration line for a dye is $A = 250c$ (with c in mol/L).

(b) A sample gives $A = 0.50$. Find its concentration.

[2]

Exercise 3.2 (b)

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(b) A sample gives $A = 0.50$. Find its concentration.

[2]

(b)

- $$c = \frac{0.50}{250} = 0.0020 \text{ M}$$

Exercise 3.3

3.3 A solution's absorbance is measured as 0.80 with $\varepsilon = 400 \text{ L mol}^{-1}\text{cm}^{-1}$ and $b = 1.0 \text{ cm}$. Find the concentration. [3]

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3.3

- $$c = \frac{A}{\varepsilon b} = \frac{0.80}{(400)(1.0)} = 0.0020 \text{ M}$$