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This is the reaction used to inflate air bags

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Gases and Chemical Reactions

$$2\ NaN_3\ (s) \longrightarrow 2\ Na\ (s) + 3\ N_2\ (g)$$

Required to solve this problem”

- PV = nRT
- stoichiometry
- M = m/n

Work backwards: how many moles of N_2 are required?

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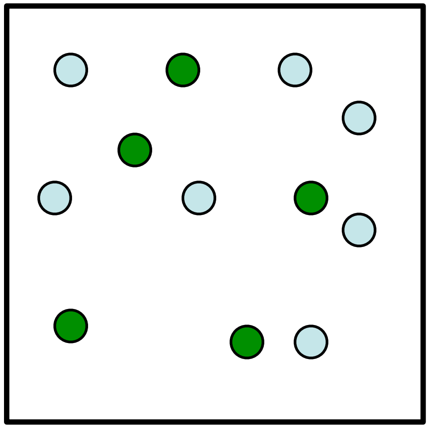
Mixture of gases – Partial pressures

Mixture of N_2 and O_2



$$P_{N_2} + P_{O_2}$$

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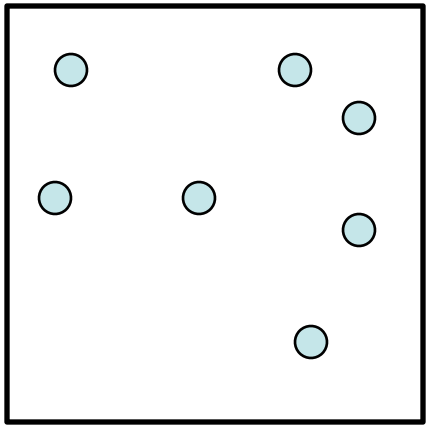
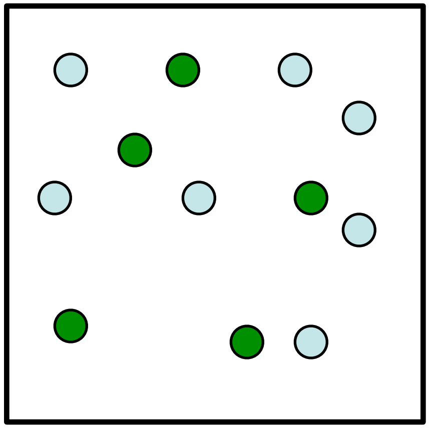


$$P_{N_2}$$



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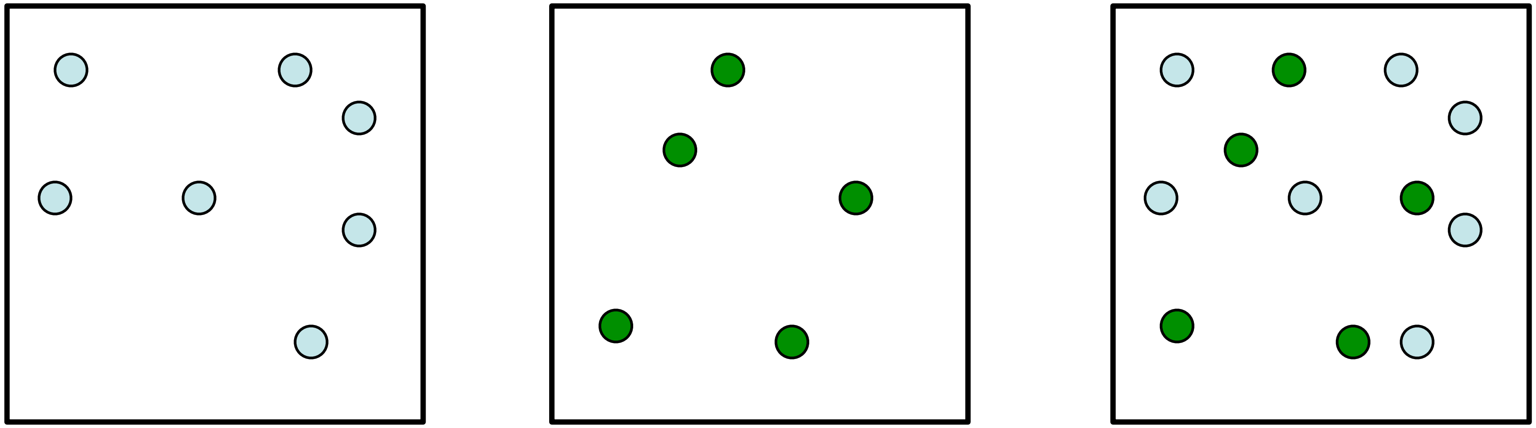

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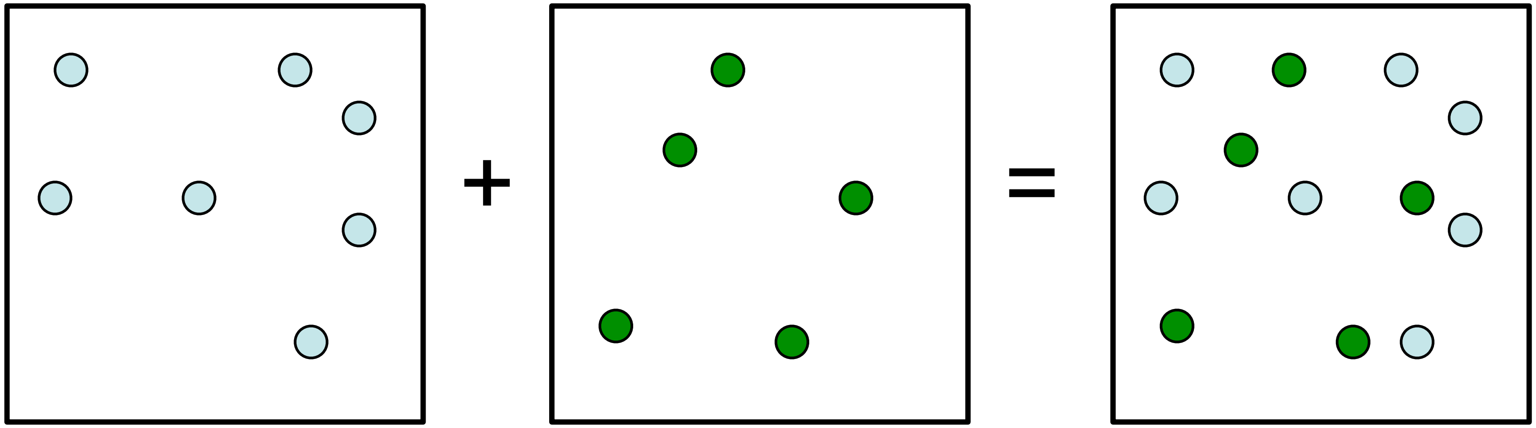

$$P_{N_2} + P_{O_2} = P_{N_2} + P_{O_2}$$

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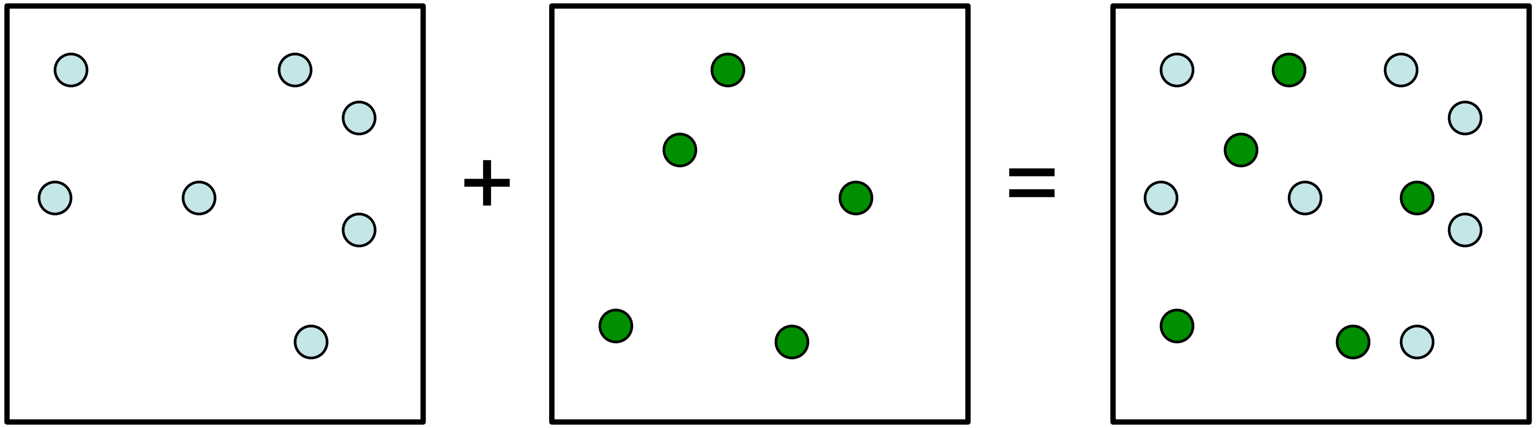

$$P_{N_2} \quad + \quad P_{O_2} \quad = \quad P_{N_2} + P_{O_2} = P_{Total}$$

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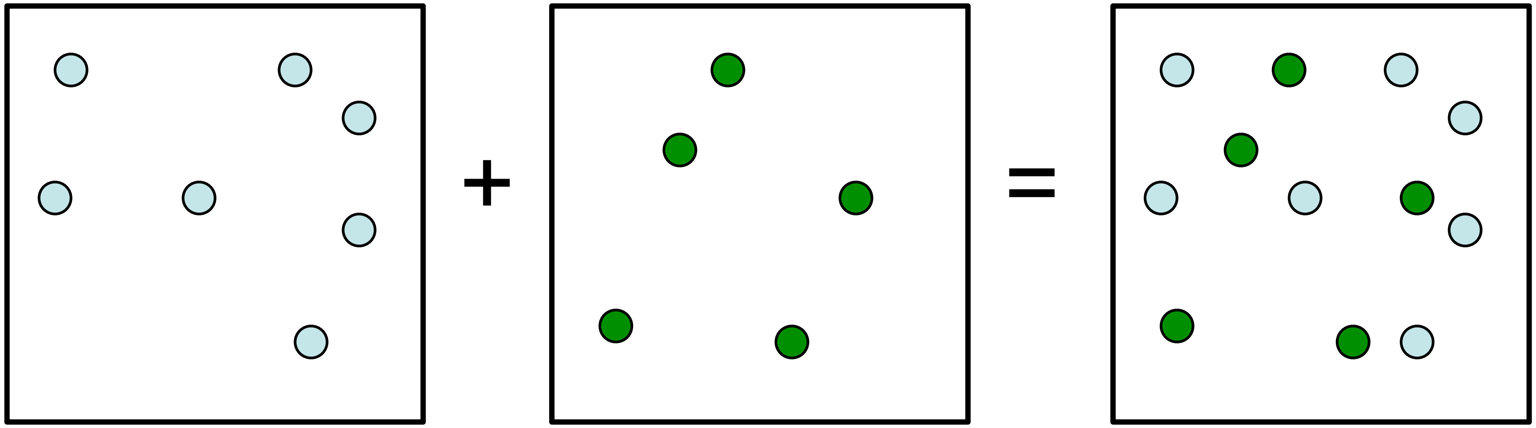
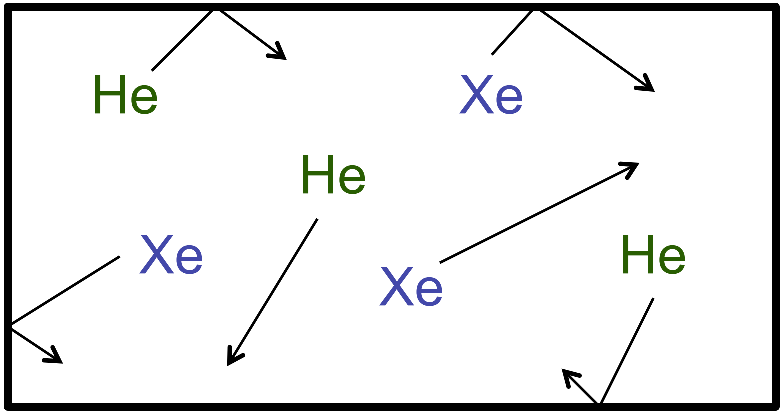


$$P_{N_2} \quad + \quad P_{O_2} \quad = \quad P_{N_2} + P_{O_2} = P_{Total}$$

$$P_{Tot} = \frac{n_{tot} \cdot R \cdot T}{V} = \frac{\left(n_{N_2} + n_{O_2}\right) \cdot R \cdot T}{V} = \frac{n_{N_2} \cdot R \cdot T}{V} + \frac{n_{O_2} \cdot R \cdot T}{V} = P_{N_2} + P_{O_2}$$

Kinetic-Molecular Theory of Gases

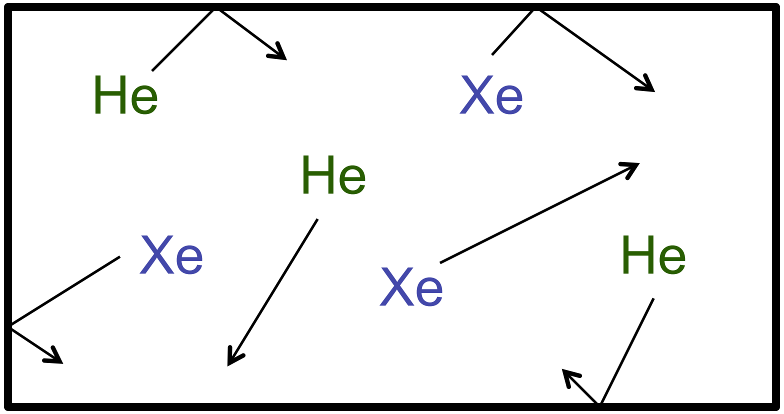


T=298 K

The He and Xe atoms have:

1) the same average velocities
2) the same average kinetic energies
3) (1) and (2)
4) neither

Kinetic-Molecular Theory of Gases



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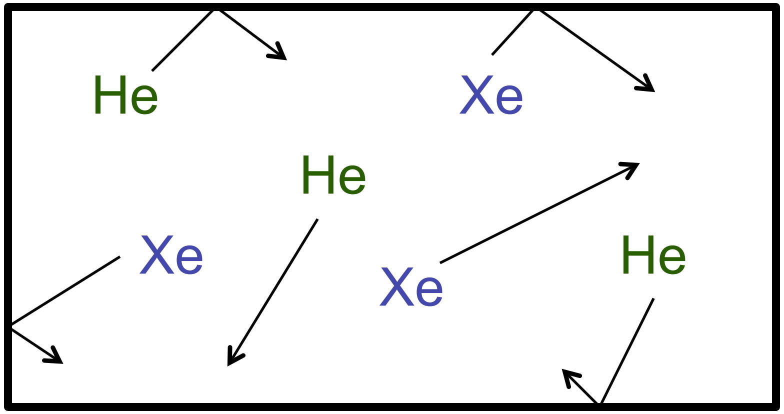

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Choose:

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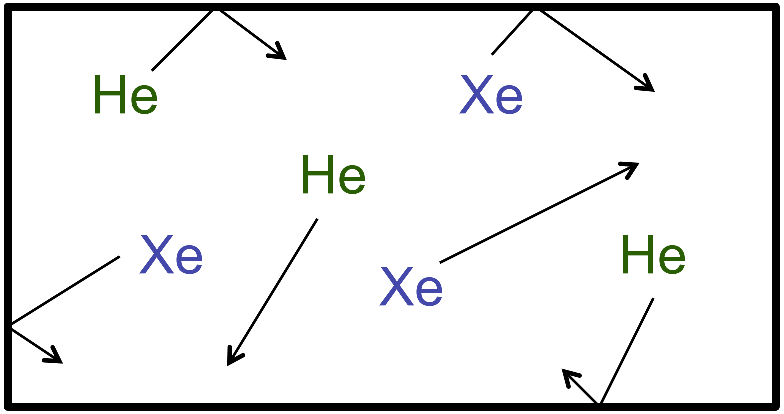
Kinetic-Molecular Theory of Gases

$$K.E. = \frac{1}{2}mv^2$$



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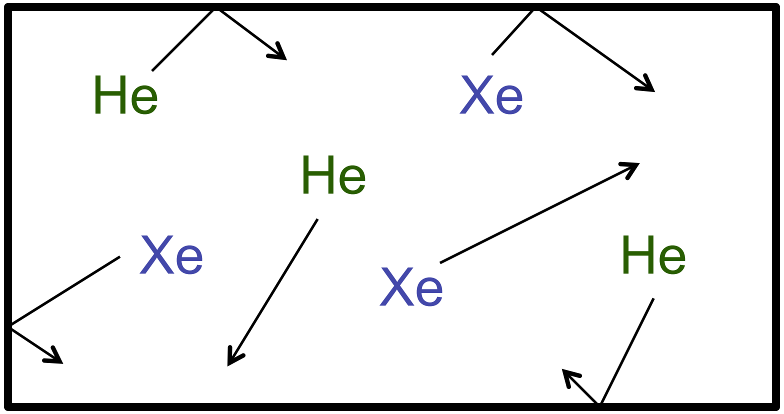

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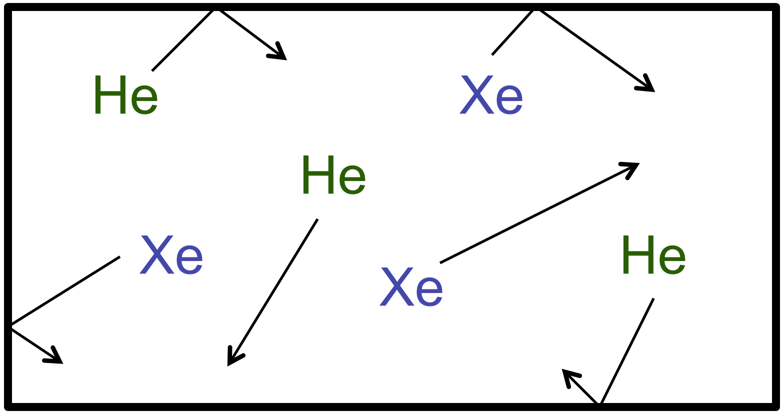

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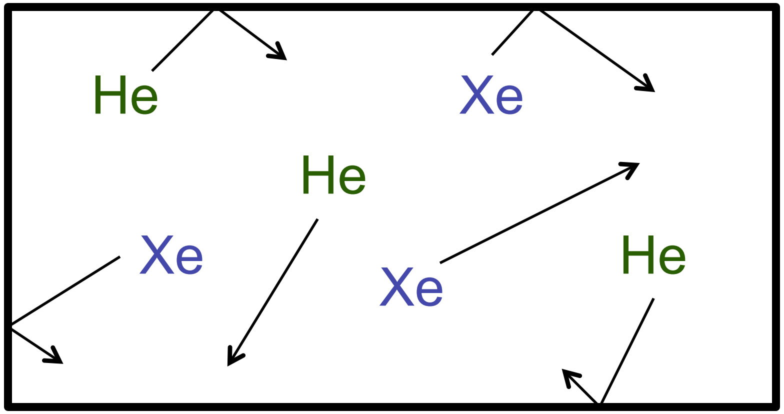

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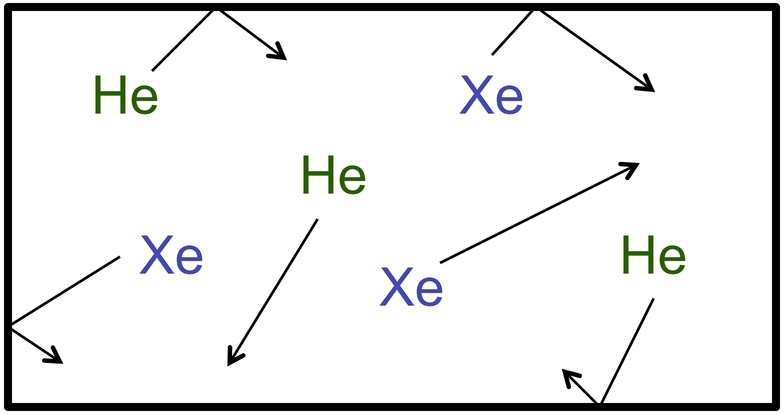

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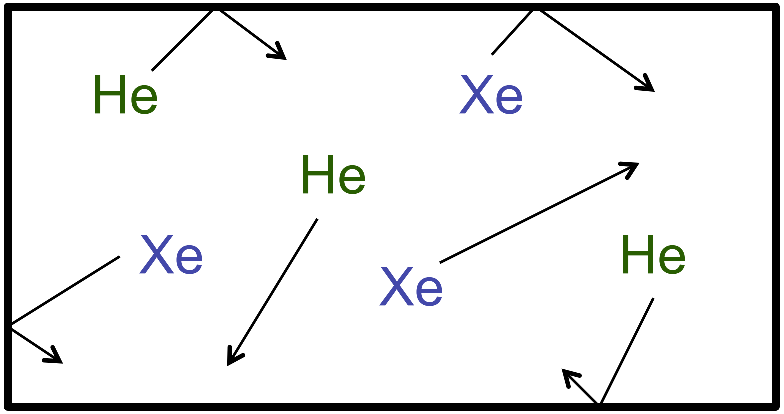

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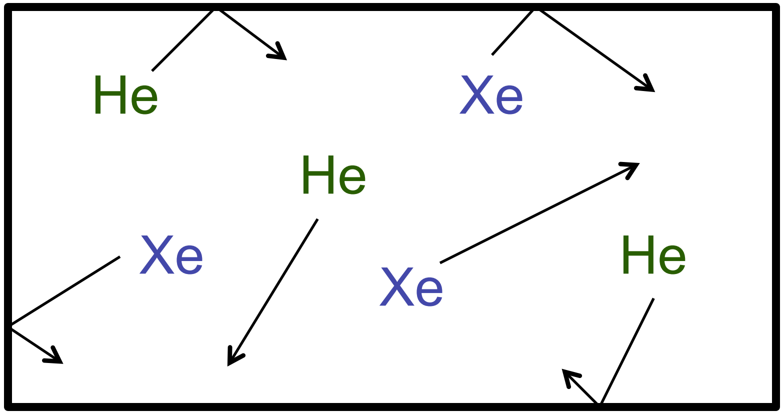

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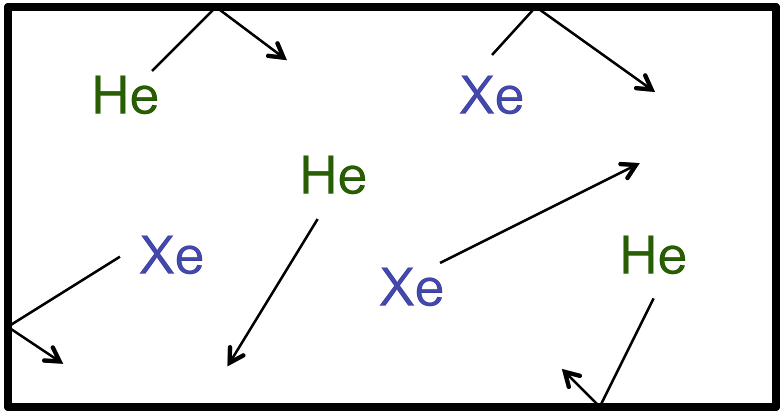

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The *average* of the square of the velocities

Kinetic-Molecular Theory of Gases

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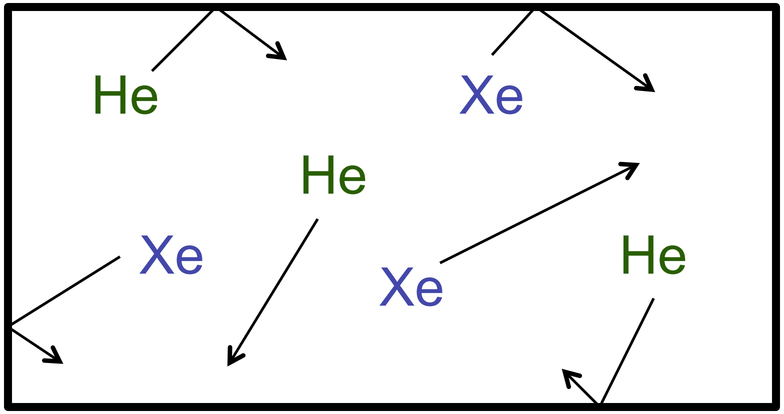

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The *average* of the square of the velocities

$$\sqrt{m_{He}}\sqrt{\overline{v_{He}^2}} = \sqrt{m_{Xe}}\sqrt{\overline{v_{Xe}^2}}$$

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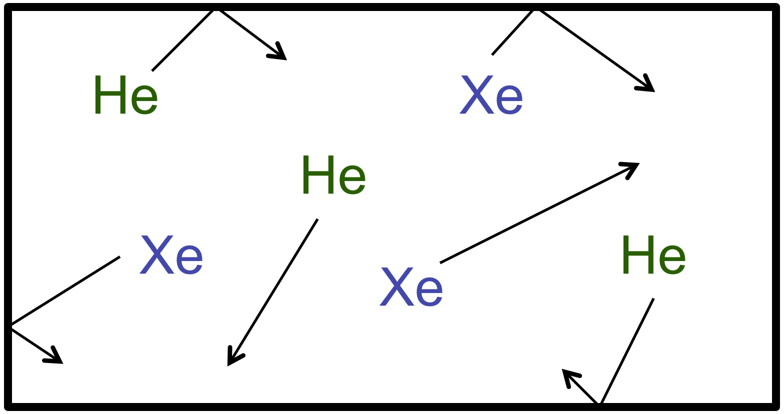

$$m_{He}\overline{v^2}_{He} = m_{Xe}\overline{v^2}_{Xe}$$

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$$\sqrt{m_{He}}\sqrt{\overline{v^2}_{He}} = \sqrt{m_{Xe}}\sqrt{\overline{v^2}_{Xe}}$$

$$\frac{\sqrt{\overline{v^2}_{Xe}}}{\sqrt{\overline{v^2}_{He}}} = \frac{\sqrt{m_{He}}}{\sqrt{m_{Xe}}}$$

Kinetic-Molecular Theory of Gases

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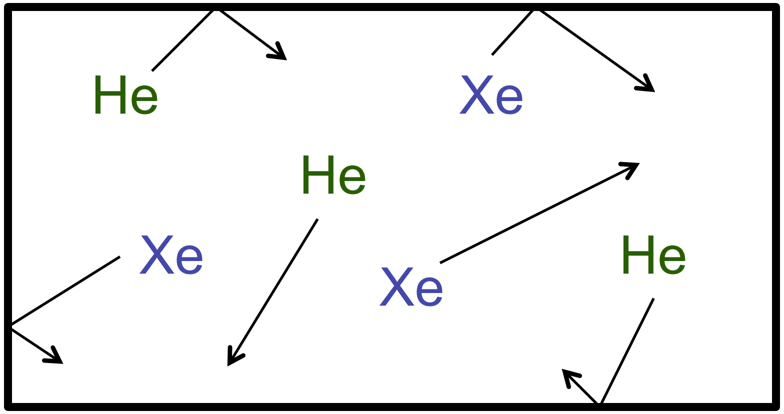

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The *average* of the square of the velocities

$$\sqrt{m_{He}}\sqrt{\overline{v^2_{He}}} = \sqrt{m_{Xe}}\sqrt{\overline{v^2_{Xe}}}$$

The square root of the *average* of the square of the velocities

$$\frac{\sqrt{\overline{v^2_{Xe}}}}{\sqrt{\overline{v^2_{He}}}} = \frac{\sqrt{m_{He}}}{\sqrt{m_{Xe}}}$$

Kinetic-Molecular Theory of Gases

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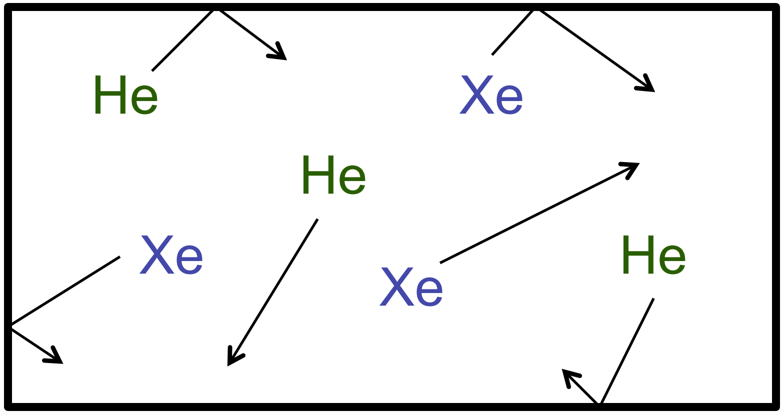

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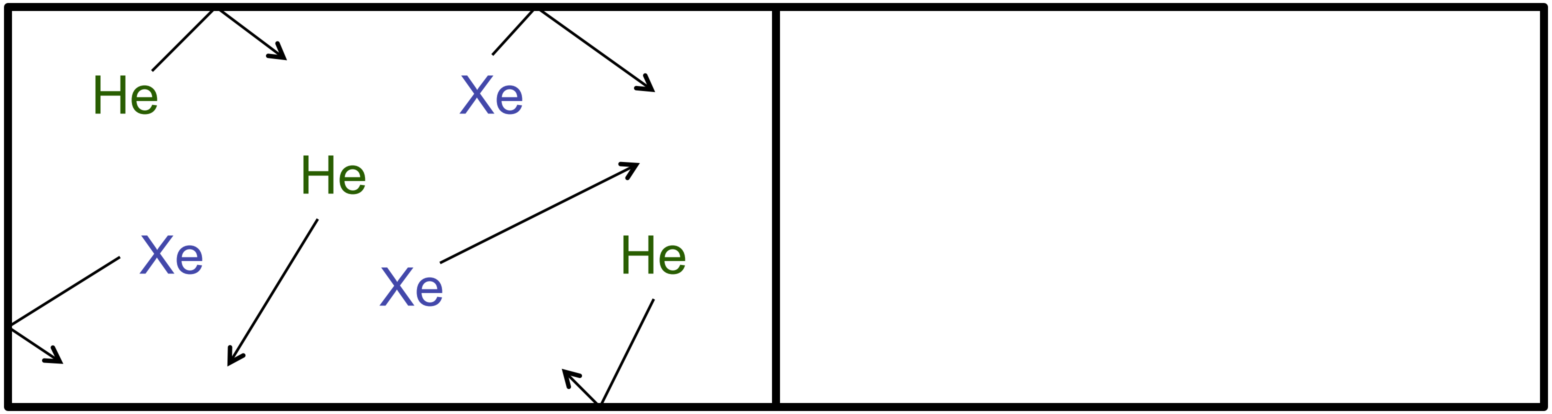
The square root of the *average* of the square of the velocities

$$\frac{\sqrt{\overline{v^2_{Xe}}}}{\sqrt{\overline{v^2_{He}}}} = \frac{\sqrt{m_{He}}}{\sqrt{m_{Xe}}}$$

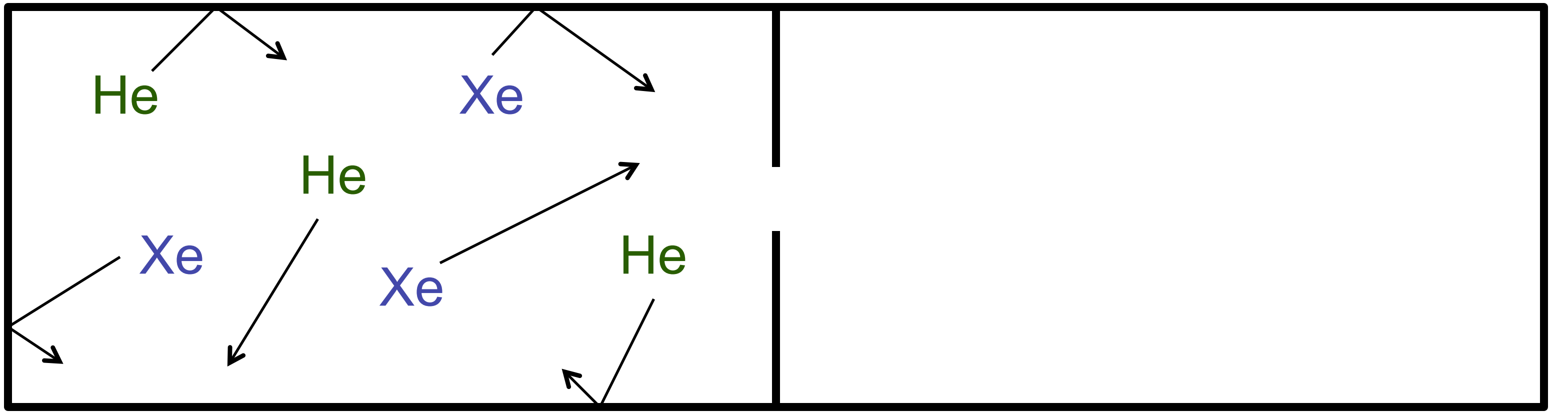
"Root mean squared velocity
(rms velocity)

Kinetic-Molecular Theory of Gases



$$\frac{\sqrt{\overline{v_{Xe}^{2}}}}{\sqrt{\overline{v_{He}^{2}}}} = \frac{\sqrt{m_{He}}}{\sqrt{m_{Xe}}}$$

Kinetic-Molecular Theory of Gases



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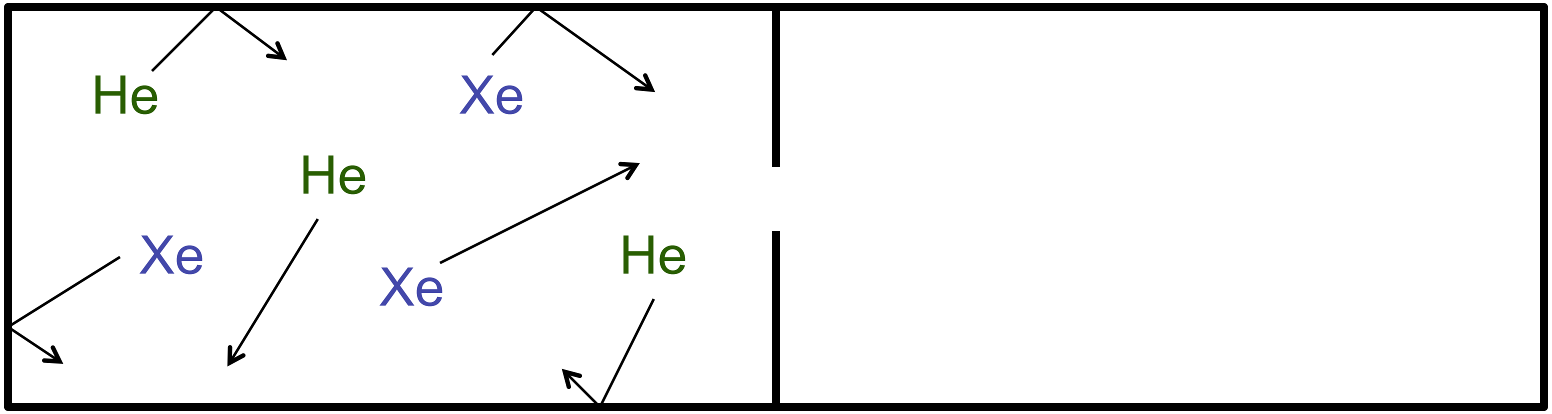
Kinetic-Molecular Theory of Gases

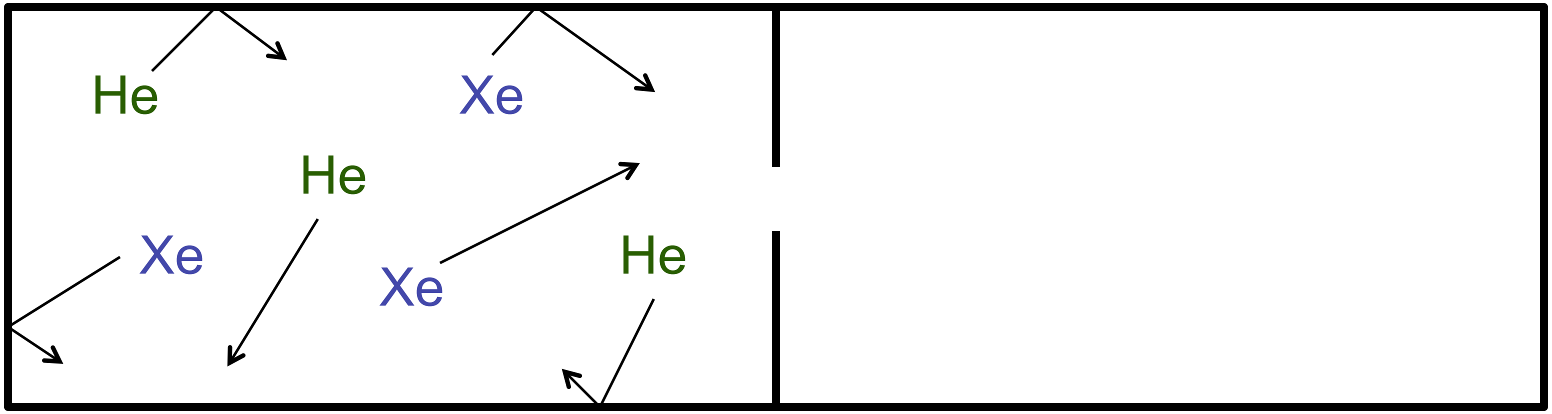


A short time after the hole opens, the right side will contain

1) More Xe atoms than He
2) More He atoms than Xe
3) The same amount of each

$$\frac{\sqrt{\overline{v^2_{Xe}}}}{\sqrt{\overline{v^2_{He}}}} = \frac{\sqrt{m_{He}}}{\sqrt{m_{Xe}}}$$

Kinetic-Molecular Theory of Gases



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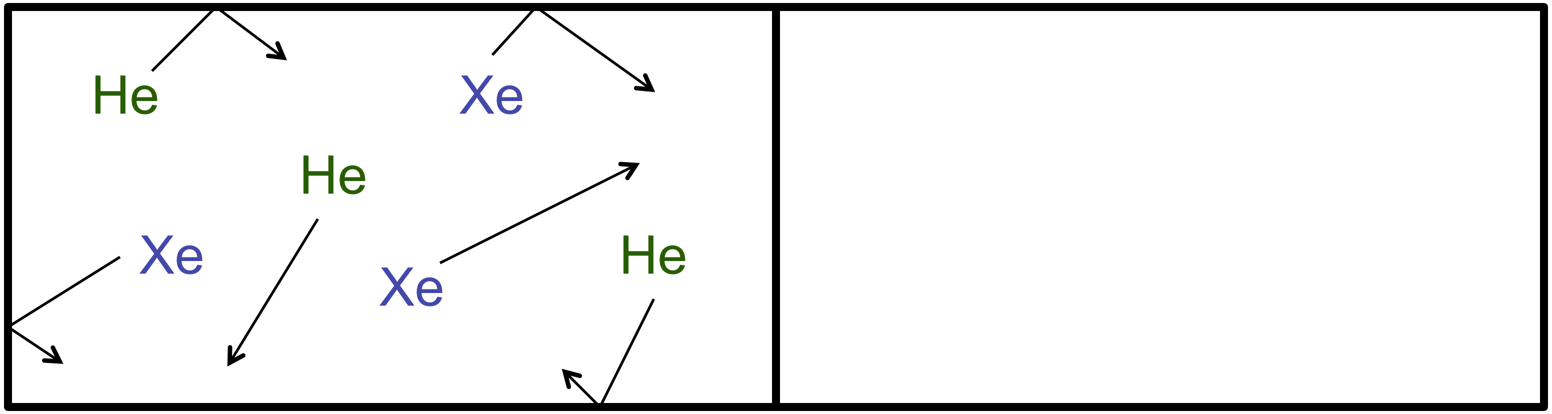
$$\frac{\sqrt{\overline{v^2_{Xe}}}}{\sqrt{\overline{v^2_{He}}}} = \frac{\sqrt{m_{He}}}{\sqrt{m_{Xe}}} < 1$$

$$\sqrt{\overline{v^2_{He}}} > \sqrt{\overline{v^2_{Xe}}}$$

Kinetic-Molecular Theory of Gases



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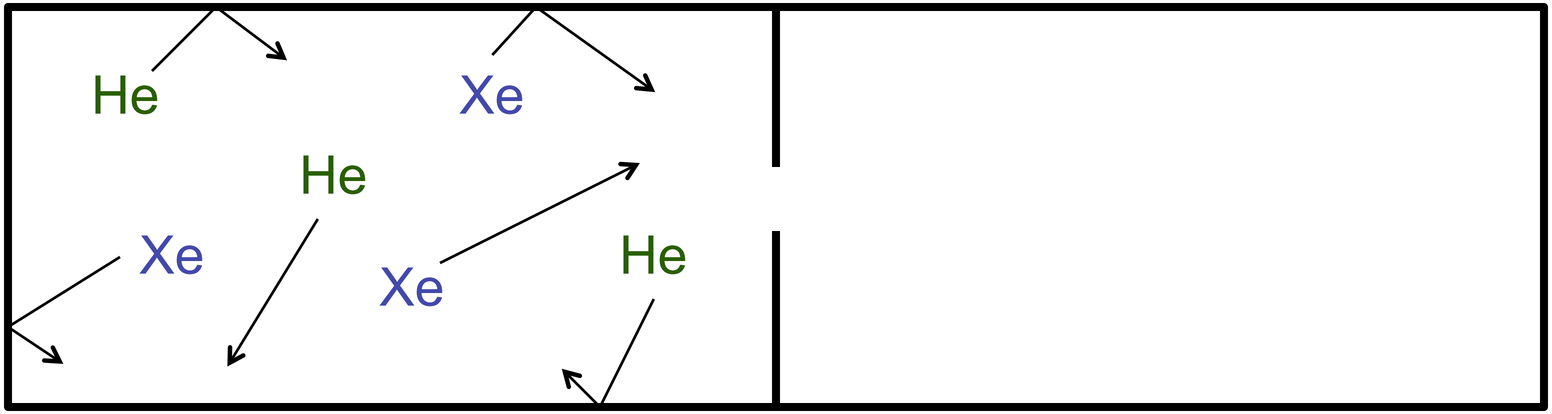
Kinetic-Molecular Theory of Gases



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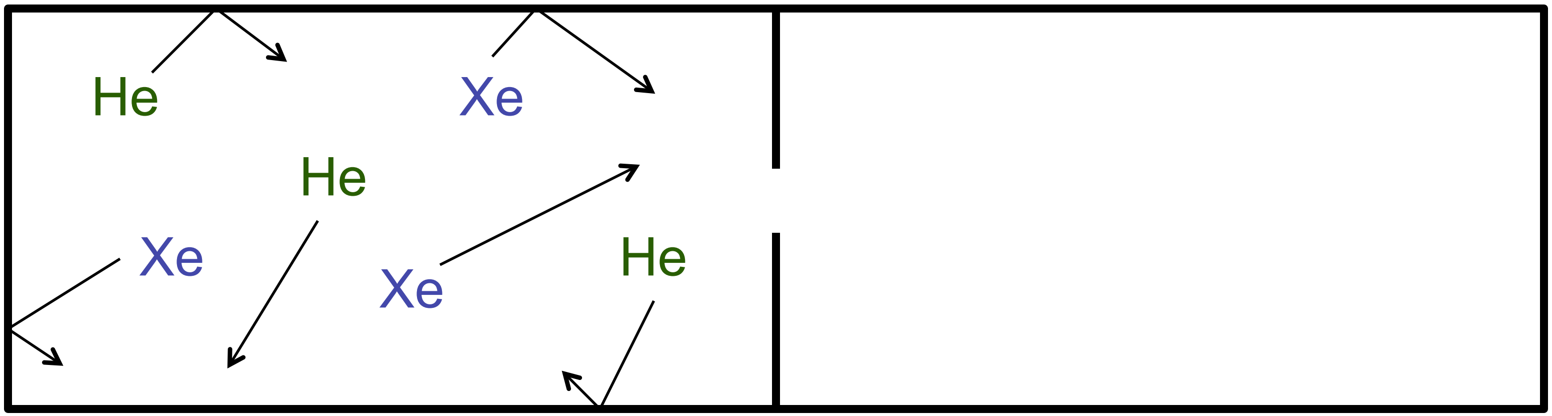
Kinetic-Molecular Theory of Gases



A *long* time after the hole opens, the right side will contain

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2) More He atoms than Xe
[✓ 3) The same amount of each]

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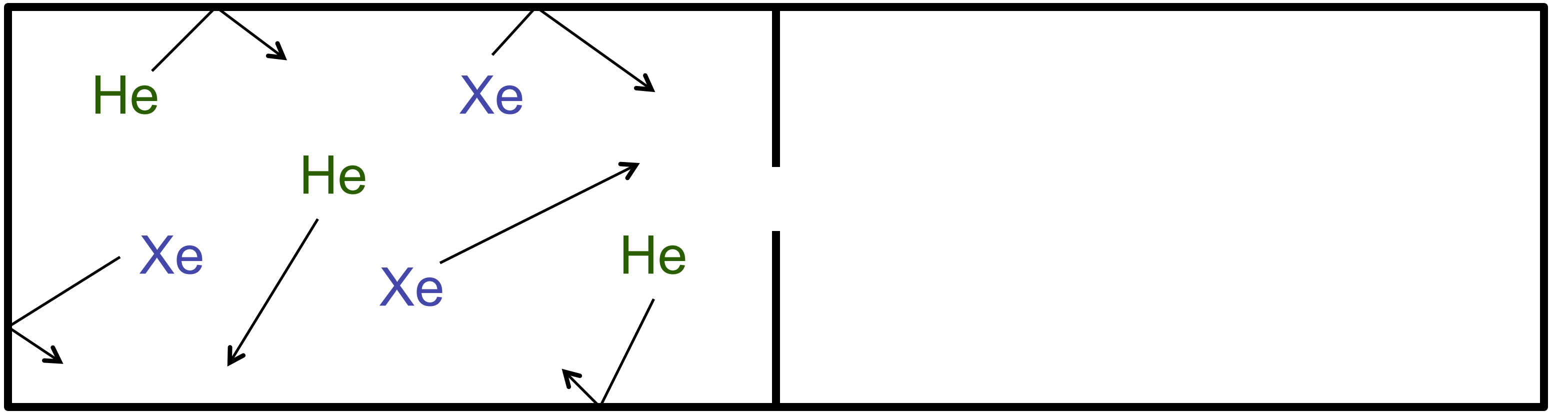
Kinetic-Molecular Theory of Gases



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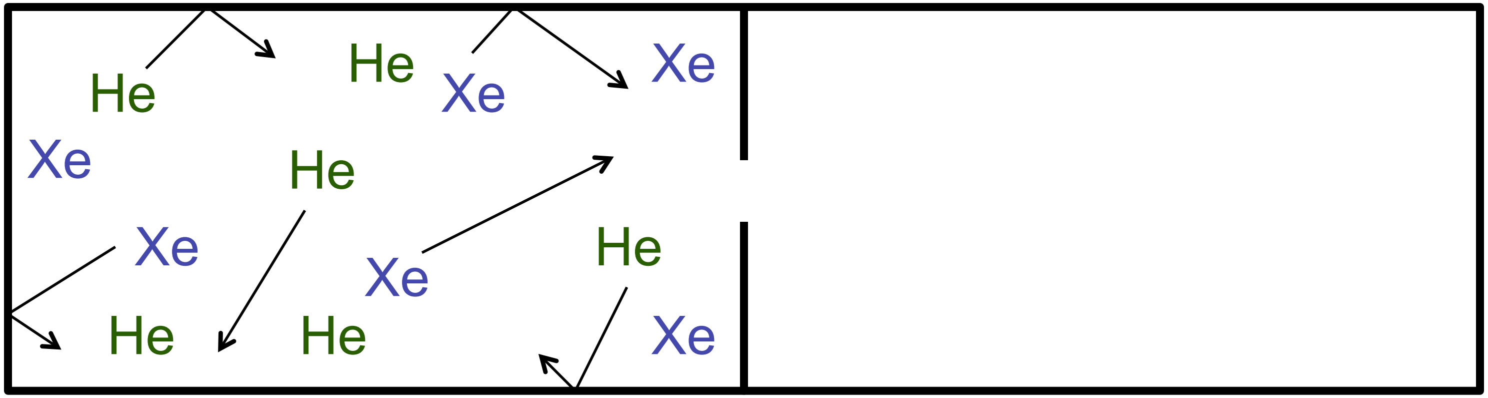
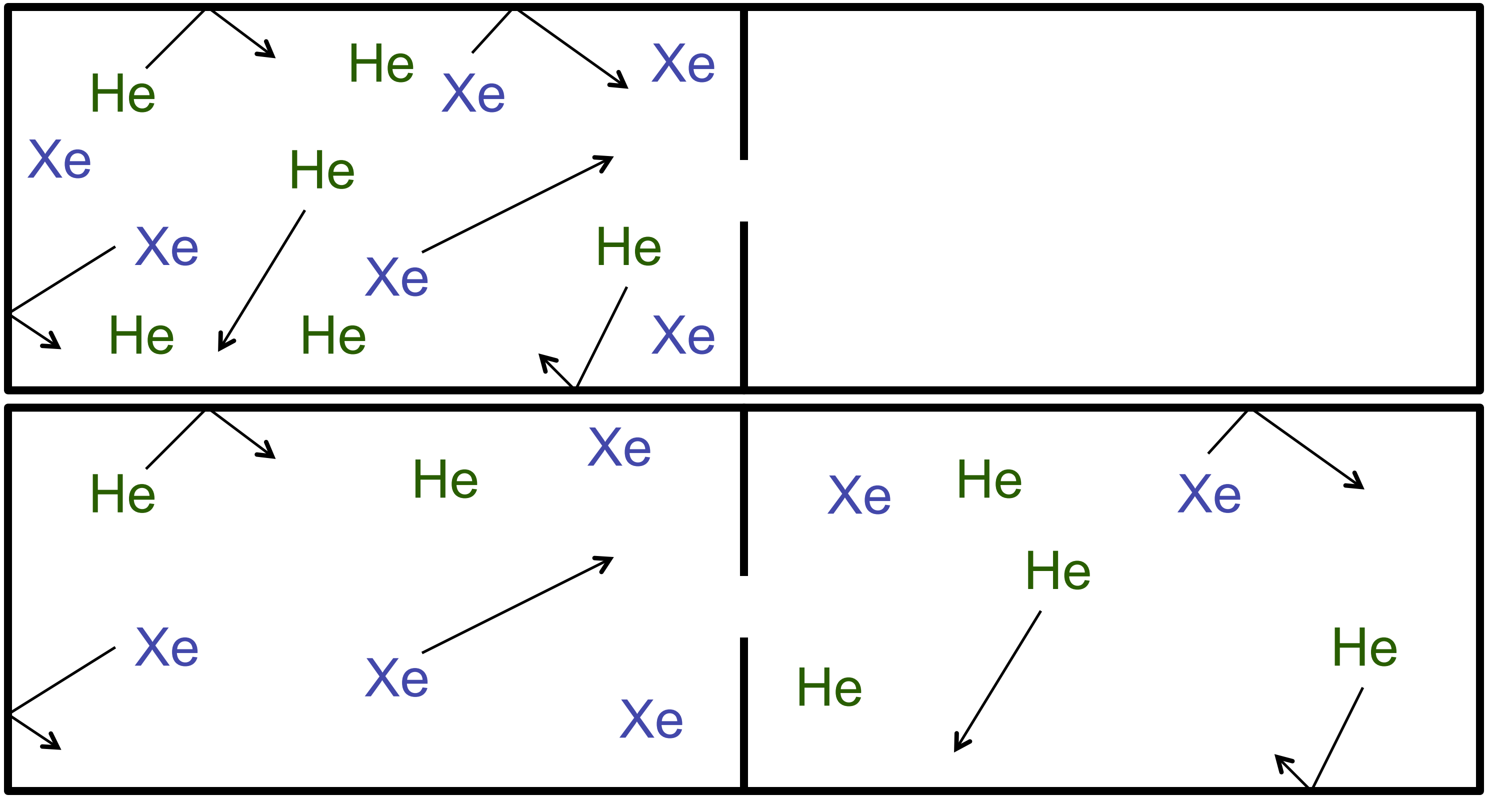
Why?

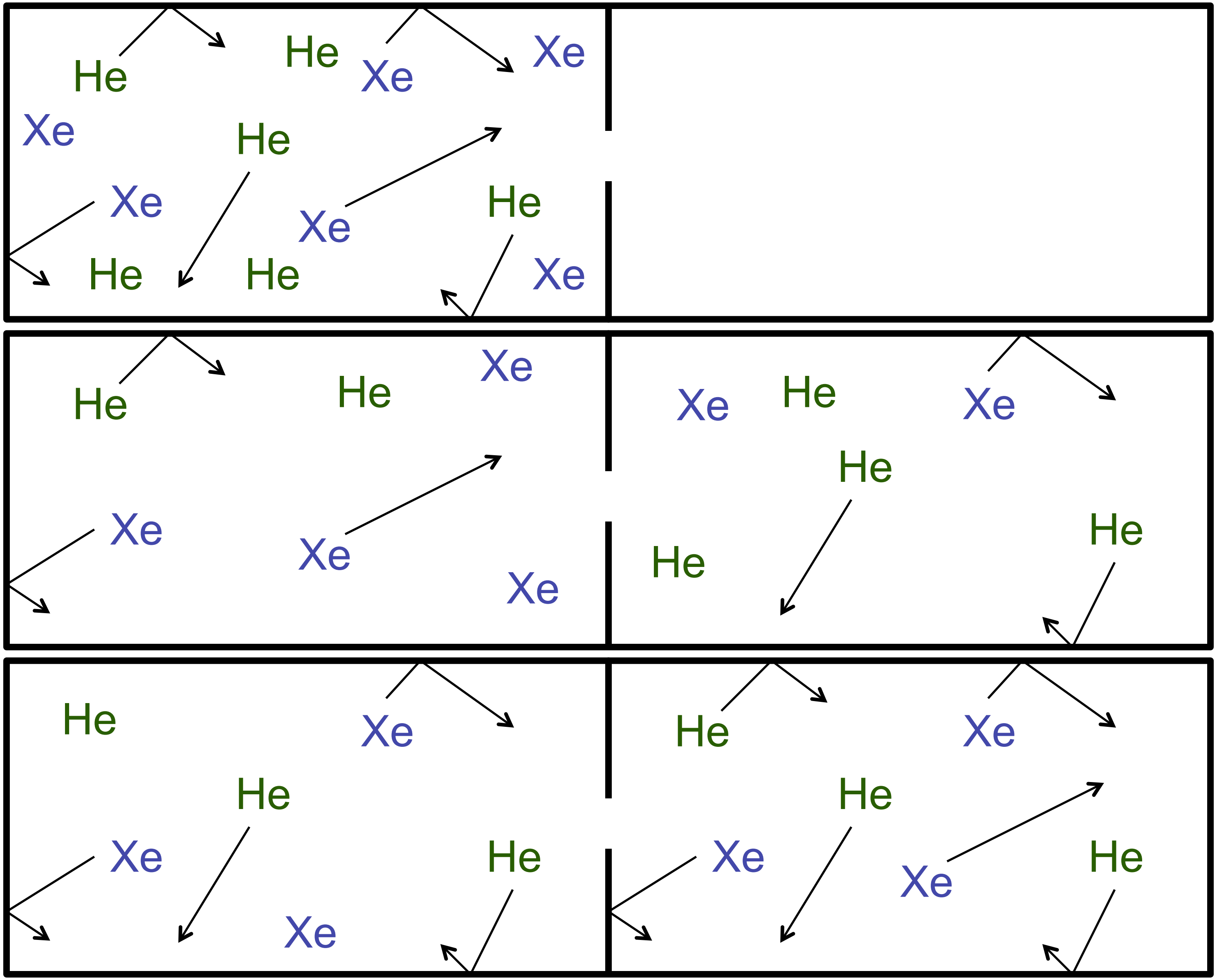
Kinetic-Molecular Theory of Gases



Kinetic-Molecular Theory of Gases



Kinetic-Molecular Theory of Gases



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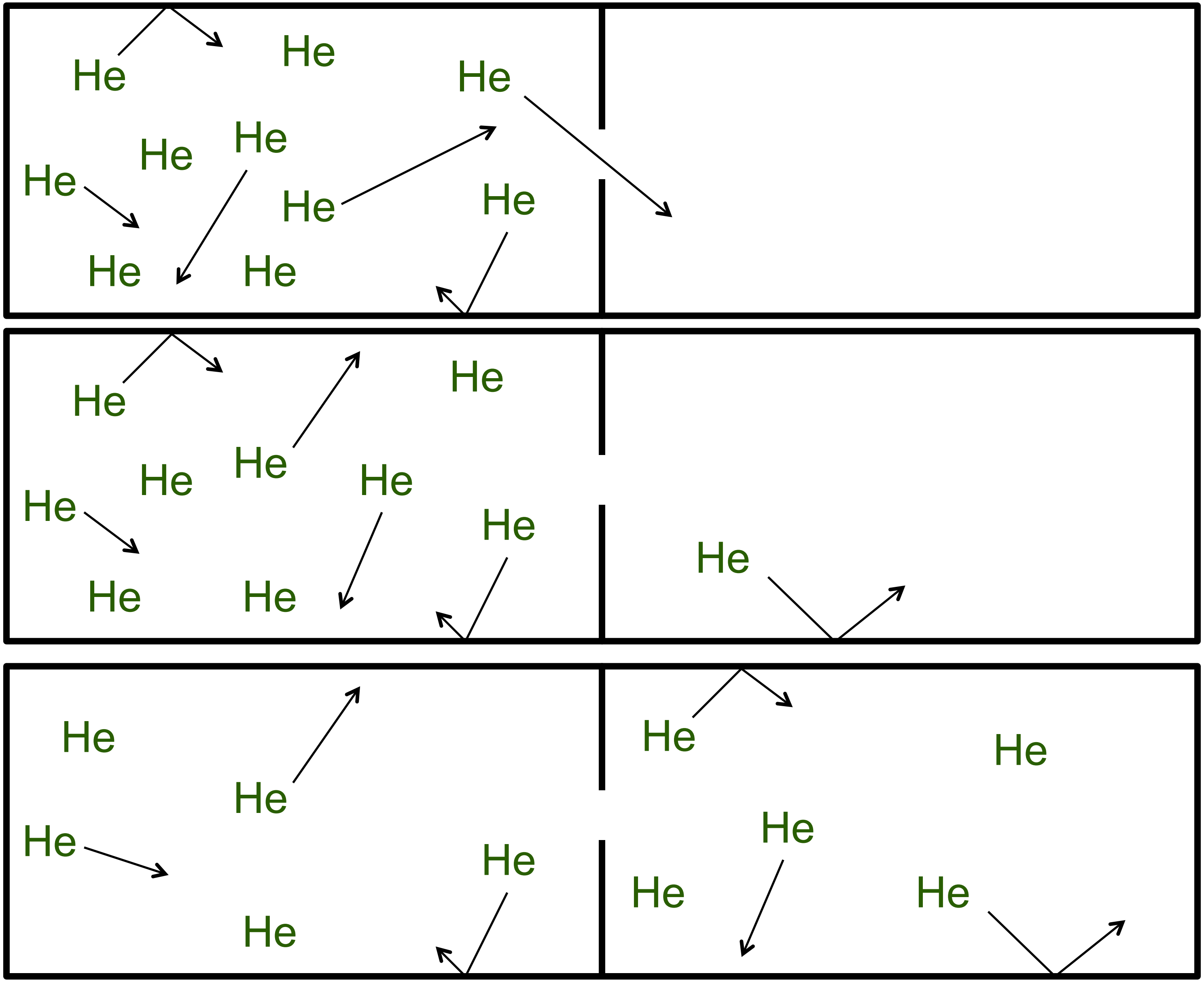
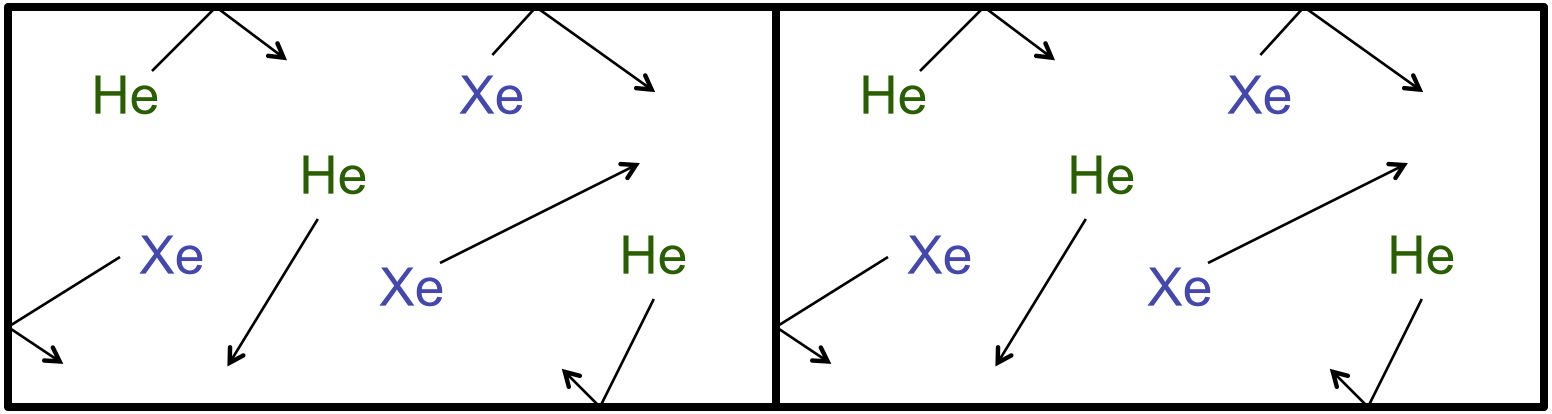


Kinetic-Molecular Theory of Gases



“Root mean squared velocity
(rms velocity)

$$\frac{\sqrt{\overline{v^{2}_{Xe}}}}{\sqrt{\overline{v^{2}_{He}}}} = \frac{\sqrt{m_{He}}}{\sqrt{m_{Xe}}}$$