Teori Kinetik Gas

Disusun Oleh :

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KOMPETENSI DASAR

- 3.6 Menjelaskan teori kinetik gas dan karakteristik gas pada ruang tertutup
- 4.6 Menyajikan karya yang berkaitan dengan teori kinetik gas dan makna fisisnya

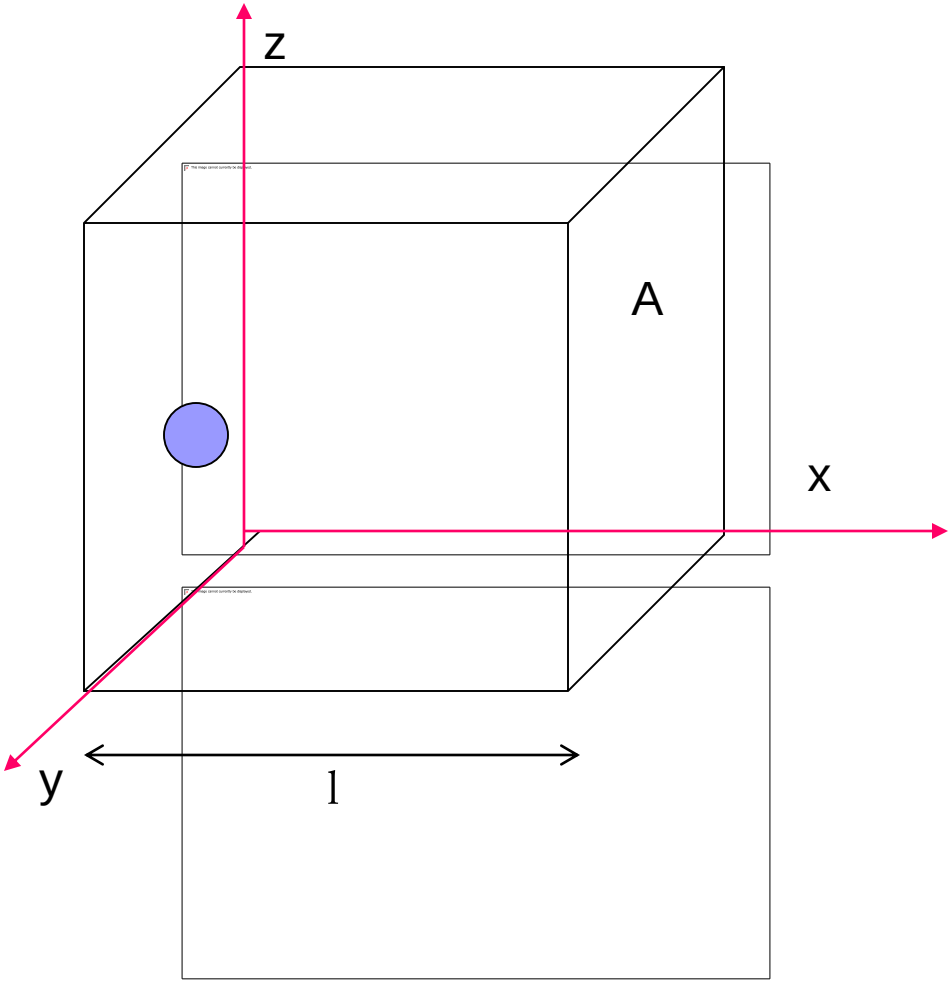
Indikator Pencapaian Kompetensi

- 3.6.5 Mendeskripsikan dan memformulasikan keterkaitan antara suhu dan energi kinetik gas
- 3.6.6 Memformulasikan besaran-besaran yang mempengaruhi kecepatan partikel gas.
- 3.6.7 Menerapkan persamaan ekuipartisi energi dan energi dalam untuk menyelesaikan persoalan

Characteristic of Ideal Gas

- Gas consists of a great number of particles called molecules
- Gas molecules move randomly and satisfy Newton's laws of motion.
- Molecules behave as particles where their sizws are very small compared to the average distance between particles and he size of their container.
- The collision among molecules and between molecules and their container is completely elastic.
- The intermoleculeforce are neglected, exept during collision. During collision, molecule exerts force to the container's wall.

Pressure of Monoatomic Gas



The time interval by particlefor doing a back-and-forth movement in the container is :

$$\Delta t = \frac{2l}{v_x}$$

The momentum change experienced by the gas when it hit the wall of the container :

$$I = -m_0 v_x - m_0 v_x$$

$$F.\Delta t = -2m_0 v_x$$

$$F.\Delta t = \left[-2m_0 v_x\right]$$

$$P.A\frac{2l}{v_x} = 2m_0 v_x$$

$$PV = m_0 v_x^2$$

In the model of kinetic of gas , there is no difference of vx, vy and vz therefore it appies $(v_x^2)_{av} = (v_y^2)_{av} = (v_z^2)_{av}$. Thereby, the following equation applies :

$(v^2)_{av} = (v_x^2)_{av} + (v_y^2)_{av} + (v_z^2)_{av,}$

$(v^2)_{av} = 3\ v_x^2$ so $v_x^2 = 1/3\ v_{av}^2$

$$PV = \frac{1}{3} m_0 \overline{v^2}$$

For total number of gas particles (N) :

$$P = \frac{1}{3} \frac{N m_0 \overline{v^2}}{V}$$

Because the average kinetic energy is Ek = ½ mv², so :

$$P = \frac{2}{3} \frac{N . \overline{Ek}}{V}$$

The total pressure exerted by the gas is becaused of total number kinetic energy of the gas particles

Student Activity #1

A tank contains of a gas at the pressure of P . If the pressure becomes twice, determine the speed of the air gas !

Student Activity #2

A container with volum of 0,5 m^3 is filled 4 mol of neon gas at temperature of 27^oC,

a. Determine the total kinetic energy of the gas

b. What is the kinetic energy each particle ?

Student Activity #3

A container with volum of 25 L is filled by 2 mol of monoatomic gas. If each gas molecule has average kinetic energy of $2{,}8 \times 10^{-21}$J, Determine the pressure in the container.

Quiz

The average kinetic energy of the mono atomic molecule of gas which is saved in the 30 L of enclosed tube, with 1 atm of pressure is 2.52×10^{-21}J. Determine the mol of the gas !

Relation the temperature of the gas with its kinetic energy

$$pV = NkT$$

$$p = kT\left[\frac{N}{V}\right]$$

$$P = \frac{2N.Ek}{3V}$$

$$p = \frac{2}{3}Ek\left(\frac{N}{V}\right)$$

$$kT = \frac{2}{3}Ek$$

$$Ek = \frac{3}{2}kT$$

The average kinetic energy of the gas is proportional to the temperature

The effective velocity of the gas molecule :

The effective velocity (v_{eff} or v_{rms}) can be determined by :

$$v_{rms} = \sqrt{\overline{v^2}}$$

HUBUNGAN KECEPATAN EFFEKTIF DENGAN BESARAN LAIN

$$E_k = \frac{3}{2} PV$$

$$1/2 m_{total} v^2 = \frac{3}{2} NkT$$

$$1/2 mN v_{rms}^2 = \frac{3}{2} NkT$$

$$v_{rms} = \sqrt{\frac{3kT}{m}}$$

V_{rms} = effective velocity
m = mass of gas particle
k = Boltzmann's constant

$$E_k = \frac{3}{2} PV$$

$$1/2 m_{total} v^2 = \frac{3}{2} nRT$$

$$1/2 nM_r v_{rms}^2 = \frac{3}{2} nRT$$

$$v_{rms} = \sqrt{\frac{3RT}{M_r}}$$

Mr = Relative molecules mass
R = General Gas constant
T = absolute temperature

$$E_k = \frac{3}{2} PV$$

$$1/2 m_{total} v^2 = \frac{3}{2} PV$$

$$1/2 \rho V v_{rms}^2 = \frac{3}{2} PV$$

$$v_{rms} = \sqrt{\frac{3P}{\rho}}$$

P = pressure
ρ = specific mass
T = absolute temperature

Student Activity #1

A tank contains argon gas with relative atomic mass of 40 kg/kmol at temperature of 27^{o}C. Determine :

a. The average translation of kinetic energy permolecules

b. Its effective velocity

Quiz

At some pressure, the velocity of 10 numbers molecules of gas follows :

Velocity (m/s)	20	30	40	50	80
Numbers of molecule	3	2	1	3	1

Determine :

a. Average of the velocity

b. Effective velocity of the gas

Student Activity #3

Hidrogen gas (M = 2 kg/kmol) and nitrogen gas (M =28 kg/kmol) is at the same temperature,

Determine :

a. The Ratio of average kinertic energy between hidrogen gas and nitrogen gas

b. The ratio of effective velocity between hidrogen and nitrogen

Student Activity #4

Determine the ratio of effective velocity at the same temperature between :

a. Molecule N_2 and molecule CO_2

b. Molecule H_2 and molecule H_2O

(N = 14 g/mol, C = 12 g/mol, O = 16 g/mol, H = 1 g/mol)

Quiz

An air gas at room's temperature has mass density of 1.29 kg/m^3. If the air pressure 100kPa. Determine the molecules effective velocity !

Student Activity # 5

Determine the average kinetic energy and internal energy in 5 mol ideal gas at temperature 400 K, if the gas is :

a. Monoatomic gas

b. Diatomic gas

Student Activity # 6

2.O mol of polyatomic gas has internal energy of 6.21×10^4 J. Determine the sum of degree of freedom of polyatomic gas.

Student Activity # 7

At normal condition nitrogen gas has density of 1.25 kg/m^3. Calculate :

a. Effective velocity of nitrogen gas molecule at temperature of 50^oC

b. Average kinetic energy

(M nitrogen = 28 kg/kmol)

Student Activity # 8

Neon is a monoatomic gas, what is internal energy of two grams neon gas at temperature of $50^{o}C$

(M neon = 10 g/mol)