[TP] Express J/(K mol) in terms of m^3.

25% 1. m^3/(K mol)
25% 2. Pa m^3/(K mol)
25% 3. L m^3/(K mol)
25% 4. Something else

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Lecture 8 CH102 A1 (MWF 9:05 am)

Monday, February 6, 2017

Please see me: clicker “66F88E” and clicker “19”

- Units of pressure and of gas constant *R*
- Real gases: Effect of molecular attraction
- Real gases: Effect of molecular size

Next: Continue ch11: Real gases: van der Waals equation; phase diagrams

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Units of pressure and of gas constant *R*

In CH101 Fall 2016 (lecture 12) we discussed units of pressure

1 Pa = force/area = 1 kg m/s^2 / m^2 = 1 kg m^{-1} s^{-2}
1 bar = 100 kPa (exactly)
1 atm = 101.325 kPa (exactly)

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[TP] Express J/(K mol) in terms of m^3.

25% 1. m^3/(K mol)
25% 2. Pa m^3/(K mol)
25% 3. L m^3/(K mol)
25% 4. Something else

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Pressure = Force/Area

Pa = J/m^3

1 atm = 101325 Pa

m^3 = 1000 L

Convert R = 8.314 J / (K mol) to L atm / (K mol).

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Effect of intermolecular attraction

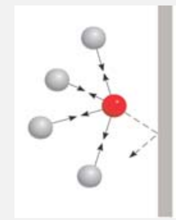
Gas particles attract one another: van der Waals a

$$p_{\text{observed}} = p_{\text{empty}} - a\,(\,n / V\,)^2$$

hitting wall $\propto n / V$

pulling back $\propto n / V$

combined effect $\propto (\,n / V\,)^2$



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[TP] Predict the effect of intermolecular attraction on the pressure exerted by a gaseous molecule in a collision with the wall of its container. The stronger the attraction, the ...

20% 1. greater the pressure
20% 2. smaller the pressure
20% 3. The pressure will not be affected
20% 4. Cannot answer without knowing the temperature
20% 5. Cannot answer without knowing the polarity of the molecule

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[TP] Equal amounts of gases A and C are in a single container. The molar masses of the gases are identical, but gas C has stronger intermolecular forces. The container is pierced with a hole 0.003 mm in diameter. After 5 minutes, the container will contain ...

33% 1. more A than C
33% 2. the same amount of A and C
33% 3. more C than A

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[Quiz] Which of the following is the correct order of species for increasing value of van der Waals *a* ?

20% 1. $H_2 < Kr < CO_2 < H_2O$
20% 2. $H_2 < Kr < H_2O < CO_2$
20% 3. $Kr < H_2 < CO_2 < H_2O$
20% 4. $Kr < H_2 < H_2O < CO_2$
20% 5. $H_2 < H_2O < Kr < CO_2$

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Contributions to van der Waals a

Van der Waals a reflects intermolecular attractions present when gas particles encounter one another.

Therefore, hydrogen bonding can make a contribution.

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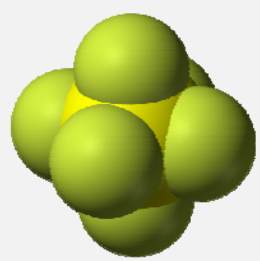
Effect of molecular size

While gas particles are tiny compared to the volume of their container, they do take up some space.

The graphic illustrates the electron cloud of SF_6.



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[TP] A gas in a rigid 2.5 L container has a pressure of 1.3 bar = 130 kPa. If 1.2 grams of small glass beads are added to the container (without changing the temperature), the pressure of the gas will …

33% 1. increase
33% 2. be unaffected
33% 3. decrease

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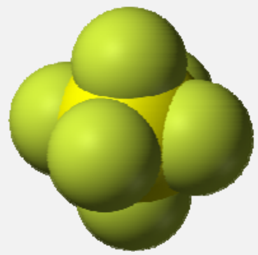
Effect of molecular size

Gas particles have a volume: van der Waals b

$V_{container} = V_{empty} + b\,n$



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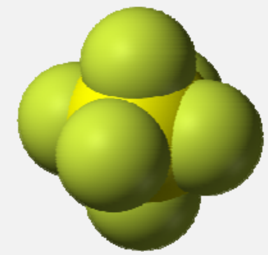
[TP] Gas particles have a volume measured by van der Waals b.
For SF_6, $b = 88$ mL/mol. The percent of gas container volume taken up by the SF_6 molecules themselves is …

17% 1. 0.01%
17% 2. 0.05%
17% 3. 0.1%
17% 4. 0.5%
17% 5. 1%
17% 6. 5%



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Effect of molecular size

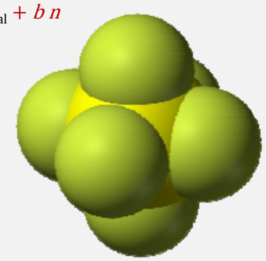
Gas particles have a volume: van der Waals b

$$V = V_{real} = V_{empty} + b\,n = V_{ideal} + b\,n$$

For SF_6, $b = 88$ mL/mol

% of molar gas volume …

$\approx (0.088 / 22) \times 100\% = 0.40\%$



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