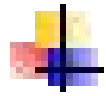


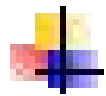
Midterm Revision



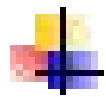
Stoichiometry



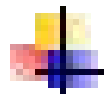
Ideal Gases,



Real Gases,



Liquids



Solids

MCQ

Question

✚ What is the term describing the **movement** of one gas particle through another?

- ▶ Diffusion
- ▶ Effusion
- ▶ Viscosity
- ▶ Surface tension

Solution

- ▶ **Diffusion**

Question

✚ What is the term describing the **resistance of a liquid to an increase in its surface area?**

- ▶ Diffusion
- ▶ Effusion
- ▶ Viscosity
- ▶ Surface tension

Solution

- ▶ **Surface tension**

Question

✚ What is the term describing the **resistance of a liquid to flow?**

- ▶ Diffusion
- ▶ Effusion
- ▶ Viscosity
- ▶ Surface tension

Solution

- ▶ **Viscosity**

Question

✚ What is the term describing the passage of a gas through a tiny orifice into an evacuated chamber?

- ▶ Diffusion
- ▶ Effusion
- ▶ Viscosity
- ▶ Surface tension

Solution

- ▶ Effusion

Question

✚ What is the law describing the **PV** relationship for a **fixed amount of a real gas at a constant temperature?**

- ▶ Charles's Law
- ▶ Boyle's Law
- ▶ van der Waals Law
- ▶ Dalton's Law

Solution

- ▶ **van der Waals Law**

Question

✚ How does the intermolecular attraction between molecules affect the real gas pressure?

- ▶ It duplicate the pressure
- ▶ It increases the pressure three times
- ▶ It does not affect the pressure
- ▶ It decreases the pressure

Solution

- ▶ It decreases the pressure

Question

✚ Which of the following exhibits dipole-dipole attraction between molecules?

- ▶ H – F
- ▶ O = O
- ▶ Cl – Cl
- ▶ H – H

Solution

- ▶ H – F

Question

✚ Which of the following **exhibits hydrogen bonding?**

- ▶ H–H
- ▶ CH₃OCH₃
- ▶ H–F
- ▶ CH₄

Solution

- ▶ H–F

Question

✚ Which of the following exhibits only London dispersion forces?

- ▶ H_2O
- ▶ CH_3OH
- ▶ $\text{H} - \text{F}$
- ▶ $\text{Cl} - \text{Cl}$

Solution

- ▶ $\text{Cl} - \text{Cl}$

Question

✚ Which of the following does not exhibit dipole-dipole interaction?

- ▶ H_2O
- ▶ CH_3OH
- ▶ $\text{H} - \text{F}$
- ▶ I_2

Solution

- ▶ I_2 (It has only London dispersion forces)

Question

✚ What is the opposite process to “**deposition**”?

- ▶ melting
- ▶ condensation
- ▶ freezing
- ▶ sublimation

Solution

- ▶ **sublimation**

Question

✚ What is the term describing the direct conversion from the solid state to gaseous state without passing by the liquid state?

- ▶ melting
- ▶ condensation
- ▶ freezing
- ▶ sublimation

Solution

- ▶ **sublimation**

Question

- ✚ The rate of vaporization of a liquid increases **when**:
- ▶ The temperature increases
 - ▶ The surface area of the liquid increases
 - ▶ The intermolecular forces between liquid molecules are weakened
 - ▶ All of the above

Solution

- ▶ **All of the above**

Question

✚ The number of **atom(s) per unit cell** in a certain metal in the body-centered cubic lattice is:

▶ 1

▶ 2

▶ 3

▶ 4

Solution

▶ 2

Question

✚ The amount of a gas that occupies **60.82 L** at **31°C** and **367 torr** is:

- ▶ 0.850 mol
- ▶ 0.12 mol
- ▶ 1.18 mol
- ▶ 2.3 mol

Solution

▶ **1.18 mol**

$$n = \frac{PV}{RT} = \frac{(367 \text{ torr}) \left(\frac{1 \text{ atm}}{760 \text{ torr}} \right) (60.82 \text{ L})}{\left(0.082 \text{ L} \cdot \text{atm} \cdot \text{K}^{-1} \text{ mol}^{-1} \right) (304 \text{ K})} = 1.178$$

Question

✚ The root mean square velocity of hydrogen gas at **25°C** is:

- ▶ 1928 m/s
- ▶ 1363 m/s
- ▶ 515 m/s
- ▶ 482 m/s

Solution

▶ **1928 m/s**

$$u_{\text{rms}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \times 8.314 (\text{J} / \text{K} \cdot \text{mol}) 298 \text{K}}{2 \times 10^{-3}}} = 1927.7858$$

Question

✚ Which gases from the following effuses 4 times slower than H_2 (2 g/mol)?

- ▶ He (4 g/mol)
- ▶ CH_4 (16 g/mol)
- ▶ O_2 (32 g/mol)
- ▶ CO_2 (44 g/mol)

Solution

- ▶ O_2 (32 g/mol)

$$\frac{u_{\text{rms}}(H_2)}{u_{\text{rms}}(\text{gas})} = \sqrt{\frac{M_{\text{gas}}}{M_{H_2}}} = \sqrt{\frac{M_{\text{gas}}}{2}} = 4$$

$$M_{\text{gas}} = 32$$

Question

- ✚ 2 g of H₂ gas and 64 g of O₂ gas and 42 g of N₂ g are mixed together at 25°C. What is the mole fraction of H₂?
- ▶ 1.000
 - ▶ 0.500
 - ▶ 0.333
 - ▶ 0.222

Solution

▶ 0.222

$$\chi_{\text{H}_2} = \frac{n_{\text{H}_2}}{n_T} = \frac{2 \text{ g} \times \left(\frac{1 \text{ mol}}{2 \text{ g}} \right)}{2 \text{ g} \times \left(\frac{1 \text{ mol}}{2 \text{ g}} \right) + 64 \text{ g} \times \left(\frac{1 \text{ mol}}{32 \text{ g}} \right) + 42 \text{ g} \times \left(\frac{1 \text{ mol}}{28 \text{ g}} \right)} = 0.222$$

Question

✚ What volume of acetylene gas, C_2H_2 , would be required at STP to obtain a 200.0 g C_2H_2 sample ?

▶ 344.6 L

▶ 172.3 L

▶ 582.4 L

▶ 86.2 L

Solution

▶ 172.3 L

$$V = \frac{nRT}{P} = \frac{\left(200g \times \frac{1 \text{ mol}}{26 g}\right) \left(0.082 \text{ L} \cdot \text{atm} \cdot \text{K}^{-1} \text{ mol}^{-1}\right) (273K)}{(1 \text{ atm})} = 172.2 \text{ L}$$

Question

✚ Which of the following exhibits dipole-dipole attraction between molecules?

- ▶ H – F
- ▶ O = O
- ▶ Cl – Cl
- ▶ H – H

Solution

- ▶ H – F

Question

✚ Which of the following exhibits only London dispersion forces?

- ▶ H_2O
- ▶ CH_3OH
- ▶ $\text{H} - \text{F}$
- ▶ $\text{Cl} - \text{Cl}$

Solution

- ▶ $\text{Cl} - \text{Cl}$

Question

✚ Which of the following does not exhibit dipole-dipole interaction?

- ▶ H_2O
- ▶ CH_3OH
- ▶ $\text{H} - \text{F}$
- ▶ I_2

Solution

- ▶ I_2 (It has only London dispersion forces)

Question

✚ The number of **atom(s) per unit cell** in a certain metal in the body-centered cubic lattice is:

▶ 1

▶ 2

▶ 3

▶ 4

Solution

▶ 2

Question

✚ The general equation for a non-ideal gas is:

▶ $PV = nRT$

▶ $P_i = X_i P_{\text{total}}$

▶ $[P + a(n/V)^2](V - nb) = RT$

▶ $\ln P = -\Delta H_{\text{vap}}/RT + C$ (Clausius-Clapeyron)

Solution

▶ $[P + a(n/V)^2](V - nb) = RT$

Question

✚ **Underline the correct answer ?**

**Real gases approach the ideal behavior at
(high P and low T, high T and low P, normal T
and P, high P and high T) ?**

Solution

“(high P and low T, high T and low P, normal T
and P, high P and high T)

Question

✚ **Underline the correct answer ?**

The average kinetic energy of O_2 molecules increases with increasing
(volume, temperature, pressure, density) ?

Solution

(volume, temperature, pressure, density)

Question

✚ Complete the following:

A device to measure atmospheric pressure is called -----

Solution

The barometer

Question

✚ Complete the following:

The SI system of pressure is -----

Solution

(Pa: Pascal) = N m^{-2}

Question

✚ **Complete the following:**

“The volume of a gas at a constant pressure increases linearly with the gas temperature” is a statement for (Boyle, Charles, Avogadro, Dalton)’s law

Solution

Charles’s Law

Question

✚ State true or False correcting the false statements

According to KMT, particles of only noble gases are assumed to exert no forces on each other

Solution

False: According to KMT, particles of **ALL** gases are assumed to exert no forces on each other

Question

Underline the correct word between brackets

✚ Gas A and gas B are mixed together in a container at a certain temperature. The partial pressure of gas B will be

$$P_B = n_B P_{total}$$

$$P_B = \frac{n_B}{P_{total}}$$

$$P_B = X_B P_A$$

$$P_B = X_B P_{total}$$

Solution

$$P_B = X_B P_{total}$$

Question

 Calculate

To the correct number of significant figures:

$$(1.8 + 0.020) \times 0.3315 =$$

Solution

~~$$(1.820) \times 0.3315 =$$~~

~~$$(1.8) \times 0.3315 = 0.5967$$~~

$$= 0.60$$

Question

 **Solve**

The speed of light is 3.00×10^8 meters per second. What is the speed of light in kilometers per min.? (1 kilo-meter = 1000 meter, 1 min. = 60 second).

Solution

$$C = \frac{3.00 \times 10^8 \text{ m}}{\text{s}} =$$

$$\frac{3.00 \times 10^8 \text{ m}}{\text{s}} \times \frac{1 \text{ km}}{1000 \text{ m}} \times \frac{60 \text{ s}}{1 \text{ min}} = \frac{1.8 \times 10^7 \text{ km}}{\text{min}}$$

Question

 **Solve**

A sample of N_2 gas (2.0 mmole) effused through a pinhole in 5.5 s. How long will it take for the same amount of CH_4 to effuse under the same conditions?

Solution

$$\frac{\text{Rate of effusion for gas 1}}{\text{Rate of effusion for gas 2}} = \frac{u_{\text{rms}} \text{ for gas 1}}{u_{\text{rms}} \text{ for gas 2}} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$$

Effusion of the same amount

$$\frac{u_{\text{rms}} \text{ for gas 1}}{u_{\text{rms}} \text{ for gas 2}} = \frac{t_2}{t_1} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$$

$$t_2 = \frac{t_1 \sqrt{M_2}}{\sqrt{M_1}} = \frac{5.5\text{s} \sqrt{16}}{\sqrt{28}} = 4.16 \text{ s}$$

Question

 Calculate

The average kinetic energy and density of CO_2 gas at 100°C and 10.0 atm ?

Solution

$$(KE)_{avg} = \frac{3}{2}RT = \frac{3(8.314\text{ JK}^{-1}\text{ mol}^{-1})373\text{ K}}{2} = 4.65\text{ kJ mol}^{-1}$$

$$d = \frac{PM}{RT} = \frac{(10\text{ atm})(44\text{ g mol}^{-1})}{(0.082\text{ L atm K}^{-1}\text{ mol}^{-1})(373\text{ K})} = 14.39\text{ g L}^{-1}$$

Question

 **Solve:**

A sample of N_2 gas has a volume of 1.75 L at STP. How many molecules of N_2 are present?

Solution

$$PV = nRT$$

$$(1 \text{ atm})(1.75) = n \left(\frac{0.082 \text{ L atm}}{\text{K mol}} \right) (273 \text{ K})$$

$$n = 0.0782 \text{ mol}$$

$$\begin{aligned} \text{no. of molecules} &= (0.0782 \text{ mol}) \left(\frac{6.023 \times 10^{23}}{\text{mol}} \text{ molecule} \right) \\ &= 4.7 \times 10^{22} \text{ molecule} \end{aligned}$$

Question

✚ **Alternatively**

You may utilize the fact that a mole of any gas occupy 22.4L at STP

Solution

$$22.4L \rightarrow 1mol$$

$$1.75 \rightarrow n \text{ mole}$$

$$n = \frac{1.75}{22.4} = 0.078 \text{ mol}$$

no. of molecules =

$$= 4.7 \times 10^{22} \text{ molecule}$$

$$(0.0782 \text{ mol}) \left(\frac{6.023 \times 10^{23}}{\text{mol}} \text{ molecule} \right)$$

Question

✚ Calculate the root mean square velocity for the atoms in a sample of helium gas at 25°C.

Solution

The mass of a mole of He in kilograms?

$$M = 4.0 \frac{\text{g}}{\text{mol}} \times \frac{1 \text{ kg}}{1000 \text{ g}} = 4.0 \times 10^{-3} \frac{\text{kg}}{\text{mol}}$$

$$u_{\text{rms}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \left(\frac{8.314 \text{ J}}{\text{K mol}} \right) (298 \text{ K})}{\left(4.0 \times 10^{-3} \frac{\text{kg}}{\text{mol}} \right)}} = \sqrt{1.86 \times 10^6 \frac{\text{J}}{\text{kg}}}$$
$$= \sqrt{1.86 \times 10^6 \frac{\text{kg m}^2}{\text{kg s}^2}} = \frac{1.36 \times 10^3 \text{ m}}{\text{s}}$$

Question

At the same temperature, compare $U_{\text{rms}} \text{H}_2$ with $U_{\text{rms}} \text{O}_2$

Solution

$$\frac{u_{\text{rms}}(\text{H}_2)}{u_{\text{rms}}(\text{O}_2)} = \frac{\sqrt{\frac{3RT}{M_{\text{H}_2}}}}{\sqrt{\frac{3RT}{M_{\text{O}_2}}}} = \sqrt{\frac{M_{\text{O}_2}}{M_{\text{H}_2}}} = \sqrt{\frac{32}{2}} = 4$$

Hydrogen moves 4 times faster than oxygen

Question

The density of a gas was measured at 1.50 atm and 27°C and found to be 1.95 g/L. Calculate the molar mass of the gas

Solution

$$\begin{aligned}M &= \frac{dRT}{P} \\&= \frac{\left(1.95 \frac{g}{L}\right) \left(\frac{0.08206 \text{ L atm}}{K \text{ mol}}\right) (300 \text{ K})}{1.0 \text{ atm}} \\&= 32.0 \frac{g}{mol}\end{aligned}$$

Question

✚ The normal boiling of liquid ammonia is -33.4°C and it has a heat of vaporization of 23.5 kJ/mol . Calculate its vapor pressure at -50.0°C ?

Solution

$$P_1 = 760 \text{ torr}$$

$$\ln P = -\frac{\Delta H_{vap}}{RT} + C$$

$$\ln \frac{P_1}{P_2} = \frac{\Delta H_{vap}}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

$$\ln \frac{760}{P_2} = \frac{23.5 \times 1000}{8.314} \left(\frac{1}{-50 + 273} - \frac{1}{-33.4 + 273} \right) = 0.876$$

$$P_2 = 316 \text{ torr}$$