Inspiring Greatness

ISD

INDEPENDENCE SCHOOL DISTRICT

High School Science Virtual Learning

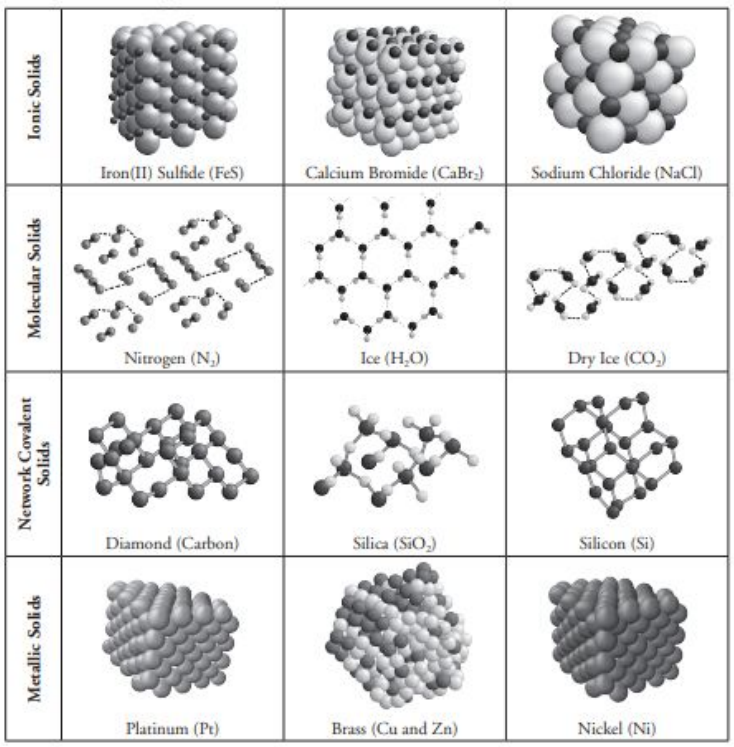
Chemistry

Ideal Gas Law

May 12, 2020

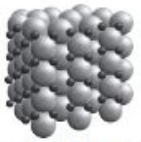
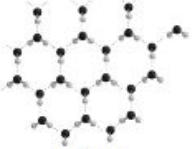
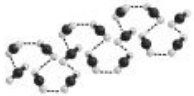
High School Chemistry
Lesson: [5/12/20]

Objective/Learning Target:
Students will be able to explain and do calculations with the Ideal Gas Law.



Let's Get Started:

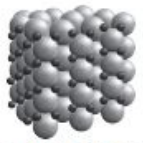
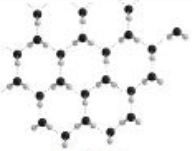
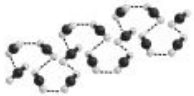
1. Complete columns A–C in the table on the next slide by referring to the examples in the diagram. Place a **check** in the box that appropriately describes the types of atoms that are usually seen in each type of solid.
2. Complete columns D and E in the table by placing an **X** in the box that appropriately describes the arrangement of atoms or molecules in the solid (either molecular—distinct molecules, or formula units—repeating units in three dimensions with no distinct molecules).
3. There are four possible forces of attraction that hold atoms or molecules together in a solid: covalent bonds, ionic bonds, metallic bonds and intermolecular forces. List your answers in column F in the table.

Ionic Solids	 Iron(II) Sulfide (FeS)	 Calcium Bromide ($CaBr_2$)	 Sodium Chloride (NaCl)
Molecular Solids	 Nitrogen (N_2)	 Ice (H_2O)	 Dry Ice (CO_2)
Network Covalent Solids	 Diamond (Carbon)	 Silica (SiO_2)	 Silicon (Si)
Metallic Solids	 Platinum (Pt)	 Brass (Cu and Zn)	 Nickel (Ni)

Let's Get Started:

	A	B	C	D	E	F
	All atoms are nonmetals	All atoms are metals	Atoms are metals and nonmetals	Molecular structure	Formula units	Attractive forces
Ionic Solids						
Molecular Solids						
Network Covalent Solids						
Metallic Solids						

Let's Get Started: Answer Key

Ionic Solids	 Iron(II) Sulfide (FeS)	 Calcium Bromide ($CaBr_2$)	 Sodium Chloride (NaCl)
Molecular Solids	 Nitrogen (N_2)	 Ice (H_2O)	 Dry Ice (CO_2)
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	A	B	C	D	E	F
	All atoms are nonmetals	All atoms are metals	Atoms are metals and nonmetals	Molecular structure	Formula units	Attractive forces
Ionic Solids			✓		X	Ionic bonds
Molecular Solids	✓			X		Covalent bonds, intermolecular forces
Network Covalent Solids			✓		X	Covalent Bonds
Metallic Solids		✓			X	Metallic Bonds

Lesson Activity:

Directions:

1. Take notes as you watch the following video.
2. Read and write down the important information in the notes section.

Links:

- Video: Ideal Gas Law

Notes:

$$PV = nRT$$

P = Pressure in kilopascals (kPa)
V = Volume in liters (L)
n = number of moles (mol)
R = ideal gas constant 0.0821 (L•atm)/(K •mol)
or 8.31 (L• kPa)/(mol•K))
T = temperature in Kelvins (K)

Notes:

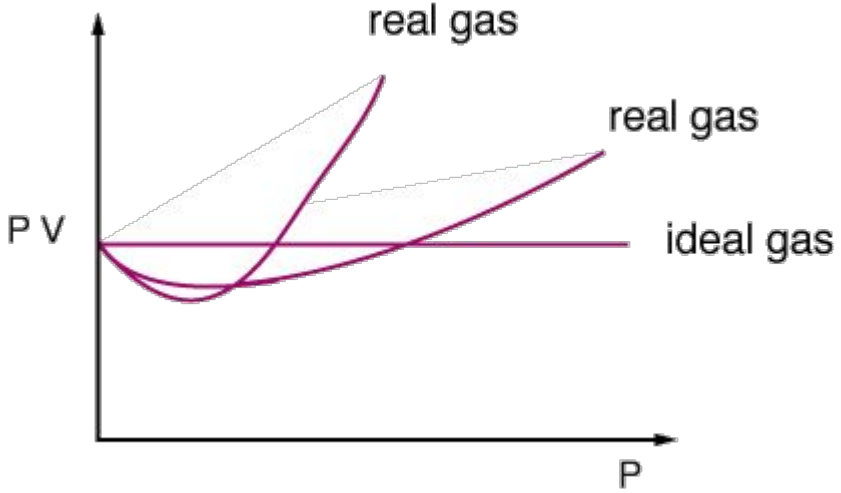
An ideal gas is a theoretical gas which perfectly fits into the equation PV= nRT. An ideal gas is different from a real gas in many ways. An ideal gases' mass can be disregarded in the equation because it has none; this is because an ideal gas is said to be a particle and particles do not have any mass. Ideal gases obtain no volume unlike real gases which obtain small volumes. Also, since ideal gas particles excerpt no attractive forces, their collisions are elastic.

Notes:

Real gases excerpt small attractive forces. The pressure of an ideal gas is much greater than that of a real gas since its particles lack the attractive forces which hold the particles back when they collide. Therefore, they collide with less force. The differences between ideal gases and real gases can be viewed most clearly when the pressure is high, the temperature is low, the gas particles are large, and when the gas particles excerpt strong attractive forces. Monoatomic gas molecules are much closer to ideal gases than other particles since their particles are so small. Because of the differences between ideal and real gases, Van der Waals created an equation to relate the two.

Notes:

Watch this video to see better understand the difference between real and ideal gases:
[Khan Academy]



Notes:

- Read more about Ideal Gas Law from Khan Academy

Practice

Complete the following questions using the information you learned during the lesson activity.

Questions:

1. How many moles of gas occupy 98 L at a pressure of 2.8 atmospheres and a temperature of 292 K?
2. A 35 L tank of oxygen is at 315 K with an internal pressure of 190 atmospheres. How many moles of gas does the tank contain?
3. A balloon that can hold 85 L of air is inflated with 3.5 moles of gas at a pressure of 1.0 atmosphere. What is the temperature in 0°C of the balloon?
4. A 75 L container holds 62 moles of gas at a temperature of 2150°C. What is the pressure in atmospheres inside the container?
5. A gas canister can tolerate internal pressures up to 210 atmospheres. If a 2.0 L canister holding 3.5 moles of gas is heated to 13500°C, will the canister explode?

Once you have completed the practice questions check with the answer key.

1. $n = \frac{PV}{RT} = \frac{(2.8\ atm)(98\ L)}{(0.0821\ L \cdot atm/mol \cdot K)(292\ K)} = 11$ moles of gas

2. $n = \frac{PV}{RT} = \frac{(190\ atm)(35\ L)}{(0.0821\ L \cdot atm/mol \cdot K)(315\ K)} = 260$ moles of gas

3. $T = \frac{PV}{nR} = \frac{(1\ atm)(85\ L)}{(3.5\ mol)(0.0821\ L \cdot atm/mol \cdot K)} = 296\ K = 23^0\ C$

4. $P = \frac{nRT}{V} = \frac{(62\ mol)(0.0821\ L \cdot atm/mol \cdot K)(488\ K)}{(75\ L)} = 33\ atm$

5. $P = \frac{nRT}{V} = \frac{(3.5\ mol)(0.0821\ L \cdot atm/mol \cdot K)(1623\ K)}{(2.0\ L)} = 230\ atm$

Yes, the canister will explode.

More Practice:

Follow the links below to do more practice.

1. Combined and Ideal Gas Law Worksheet
2. Ideal Gas Law Practice

Additional Practice:
Click on the link below for additional practice.
Quiz