Announcements – Lecture XXII – Tuesday, June 24th

1. **Final Lab:** Today, 1:30-4:30, ISB 155 (A-C)
   (Pre-Lab Quiz – TA Evaluation in Class Owls)

2. **Exam III:** Friday, June 27th, In Class
   3 or 4 questions will be taken from Lab Owls:-
   3.4 , 4.2 , 4.5 , 5.5 , 5.6

Quiz 18 – Last One ☺ Class #: ____ Last Name: _____

Given the standard enthalpy changes for the following two reactions:

(1) $N_2(g) + O_2(g) = 2\ NO(g)$ $\Delta H^o = 181.8$ kJ

(2) $N_2(g) + 2\ O_2(g) = N_2O_4(g)$ $\Delta H^o = 9.2$ kJ

what is the standard enthalpy change for the reaction:

(3) $2\ NO(g) + O_2(g) = N_2O_4(g)$ $\Delta H^o = ?$

(1) Reversed: $2NO(g) = N_2(g) + O_2(g)$ $\Delta H^o = -181.8$

(2) As is : $N_2(g) + 2O_2(g) = N_2O_4(g)$ $\Delta H^o = 9.2$

$2NO(g) + O_2(g) = N_2O_4(g)$ $\Delta H^o = -172.6$

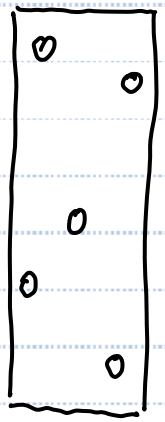
10.5 Kinetic Molecular Theory

The Postulates

1) The volume occupied by the gas molecules is negligible in comparison to the volume of the container they are in.

2) Collisions between gas molecules are totally elastic ... no loss of energy ... no intermolecular force of attraction

3) $\overline{KE}$ is proportional to temperature ... at a given temperature all gases have the same average kinetic energy ($\overline{KE}$), regardless of their mass.



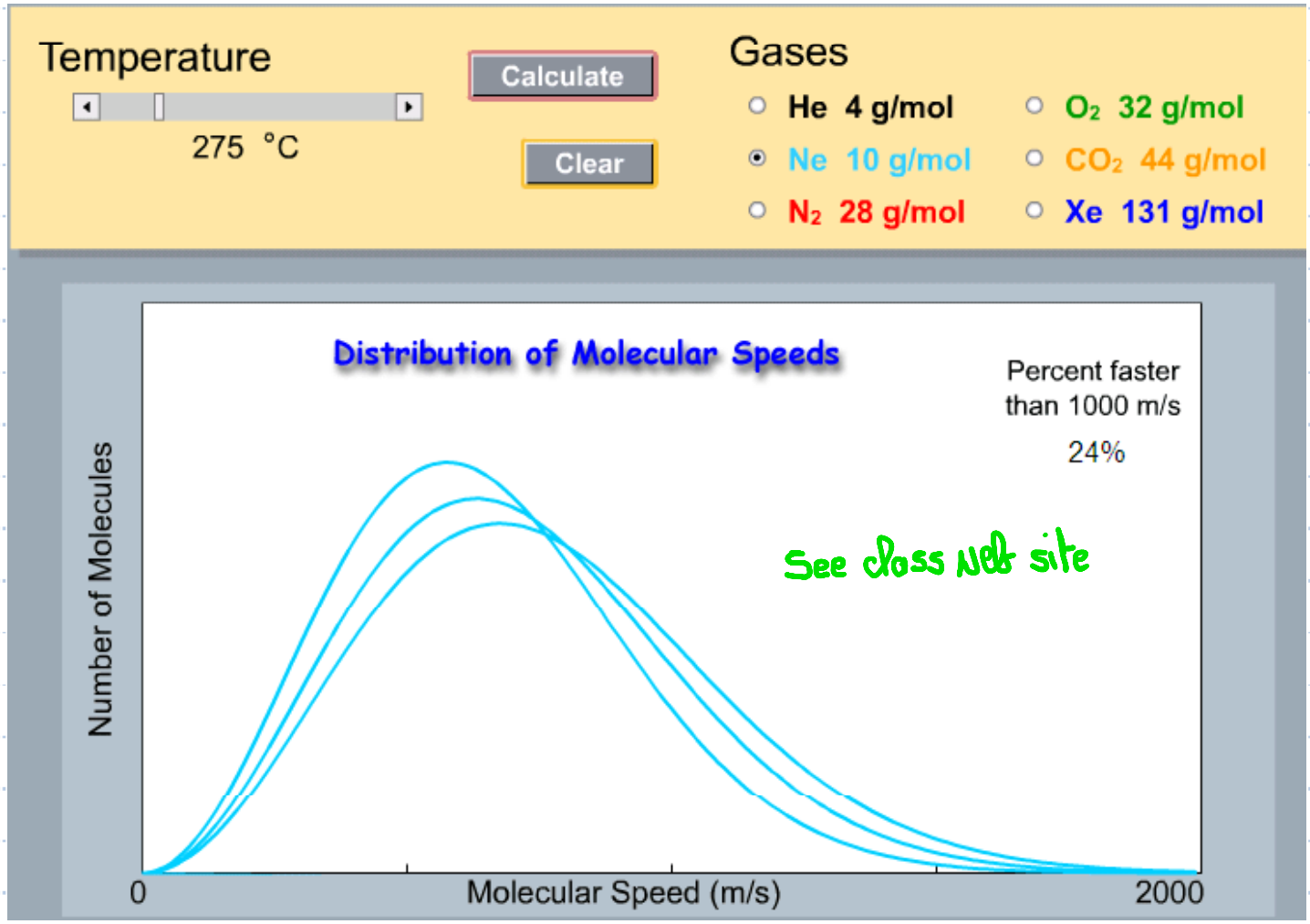
PRESSURE = force per unit area

a) Energy of the collisions with the walls of the container.

b) The frequency of these collisions.

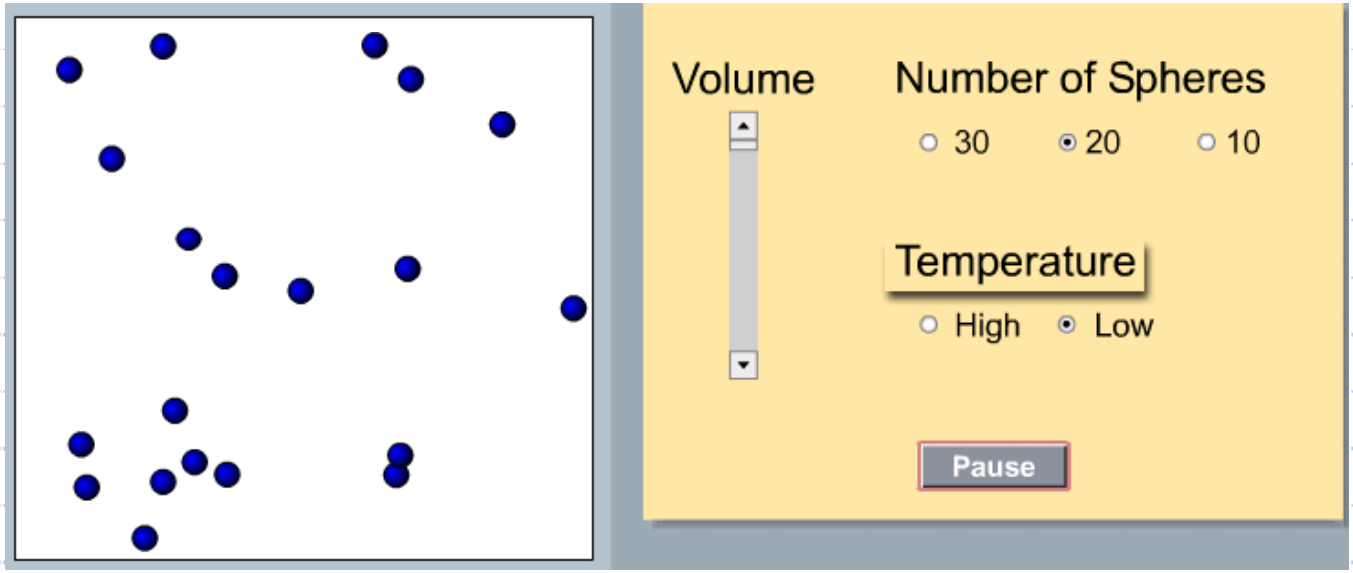
10.5 Kinetic Molecular Theory

A: Kinetic Molecular Theory and the Gas Laws



10.5 Kinetic Molecular Theory

A: Kinetic Molecular Theory and the Gas Laws – Charles's Law



n and V are held constant

Increase T, what happens to P?

P↑ ... Why?

a) Collisions more energetic ... $\overline{KE}$ ↑

b) Collision frequency increases.

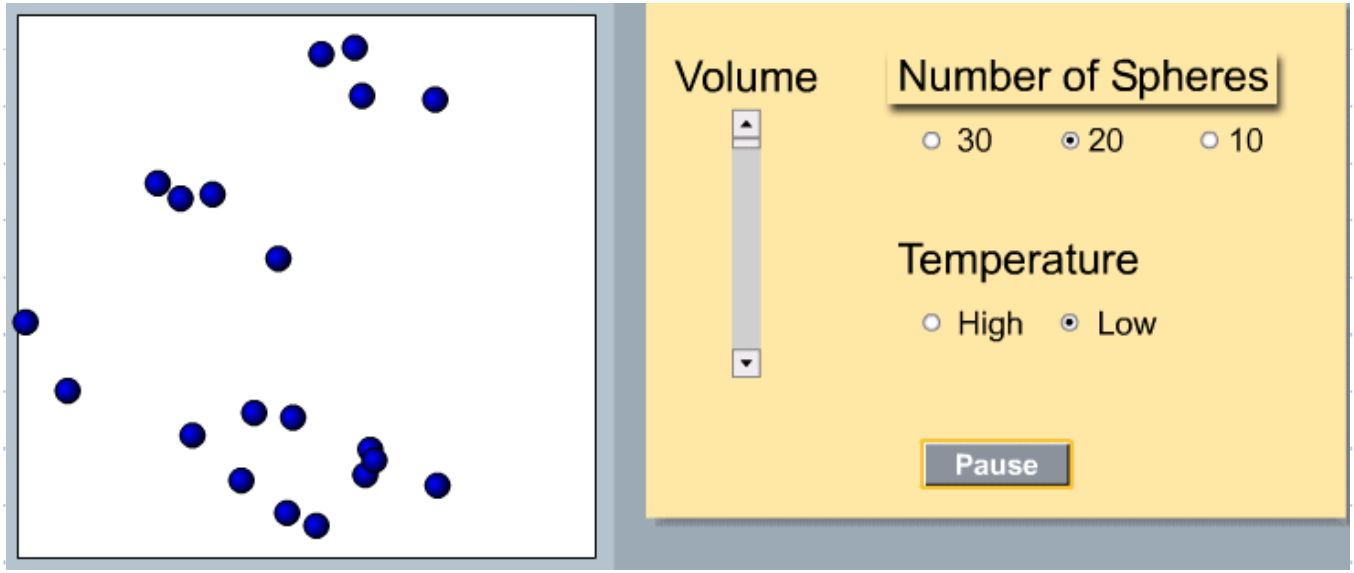
$P \propto T$

$\frac{P}{T} = \text{constant}$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ ... Charles's Law

10.5 Kinetic Molecular Theory

A: Kinetic Molecular Theory and the Gas Laws – Avogadro's Law



V and T are held constant

Increase n, what happens to P?

P↑ ... why?

With more particles the frequency of the collisions increases.

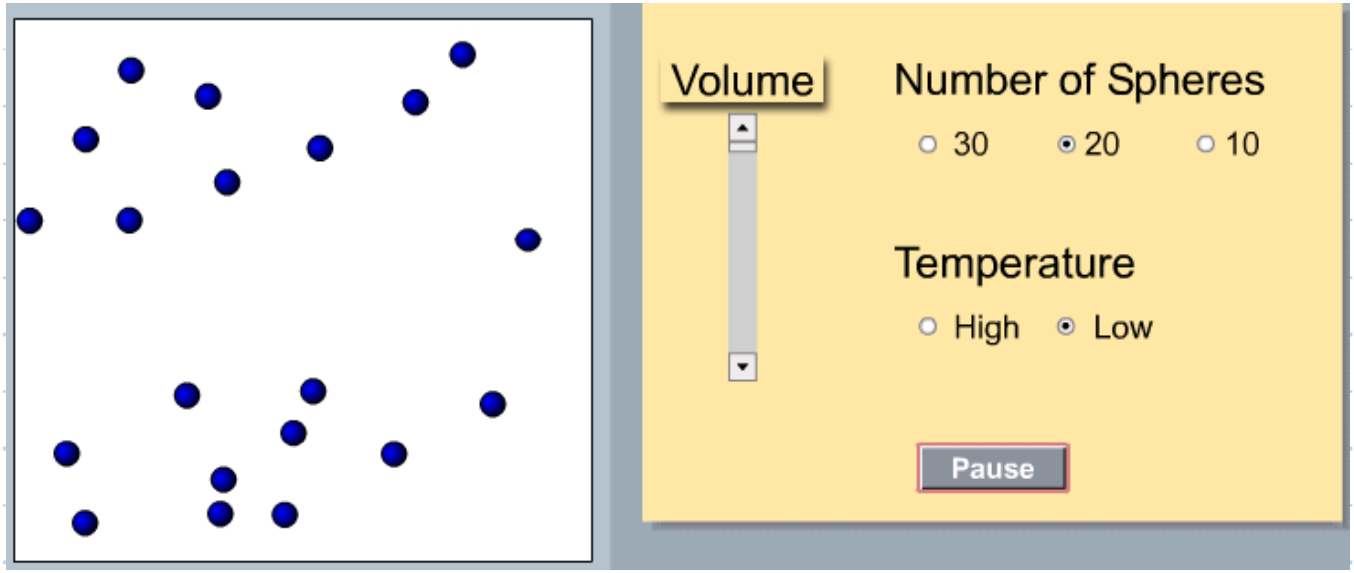
$P \propto n$

$\frac{P}{n} = \text{Constant}$

$\frac{P_1}{n_2} = \frac{P_2}{n_2}$ ... Avogadro's Law

10.5 Kinetic Molecular Theory

A: Kinetic Molecular Theory and the Gas Laws – Boyle's Law



n and T are held constant.

Decrease V, what happens to P?

P↑ ... why?

↓ in a smaller volume the frequency of the collisions increases.

$P \propto \frac{1}{V}$

$PV = \text{constant}$

$P_1V_1 = P_2V_2$ ... Boyle's Law

10.5 Kinetic Molecular Theory

A: Kinetic Molecular Theory and the Gas Laws – Ideal Gas Law

$$P \propto \frac{nT}{V}$$

$$\frac{PV}{nT} = \text{Constant} = R = \text{Ideal Gas Constant}$$

$R = 8.314\ J.mol^{-1}.K^{-1}$

$R = 0.0821\ L.atm.K^{-1}.mol^{-1}$

$$\frac{PV}{nT} = R$$

$$\boxed{PV = nRT} \Rightarrow \text{Ideal Gas Law}$$

10.5 Kinetic Molecular Theory

Memorizing all the Gas Laws ... ☺

GENERAL GAS LAW : n held constant

$$PV = nRT$$

$$\frac{PV}{T} = nR \text{ ... Constant}$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Your turn ... pick two from P, V, n, T ... these to be held constant ... derive the associated Gas Law.

10.5 Kinetic Molecular Theory

D: Nonideal Gases

a) Gas has negligible volume
b) No intermolecular forces

} Want $PV = nRT$ to work { keep the pressure low.
keep the temperature high.

van der Waals

$$\left(P + a\left[\frac{n}{V}\right]^2\right)(V - bn) = nRT$$

a: intermolecular forces correction
b: gas molecule volume correction.