SI Chemistry - Full Discipline Demo

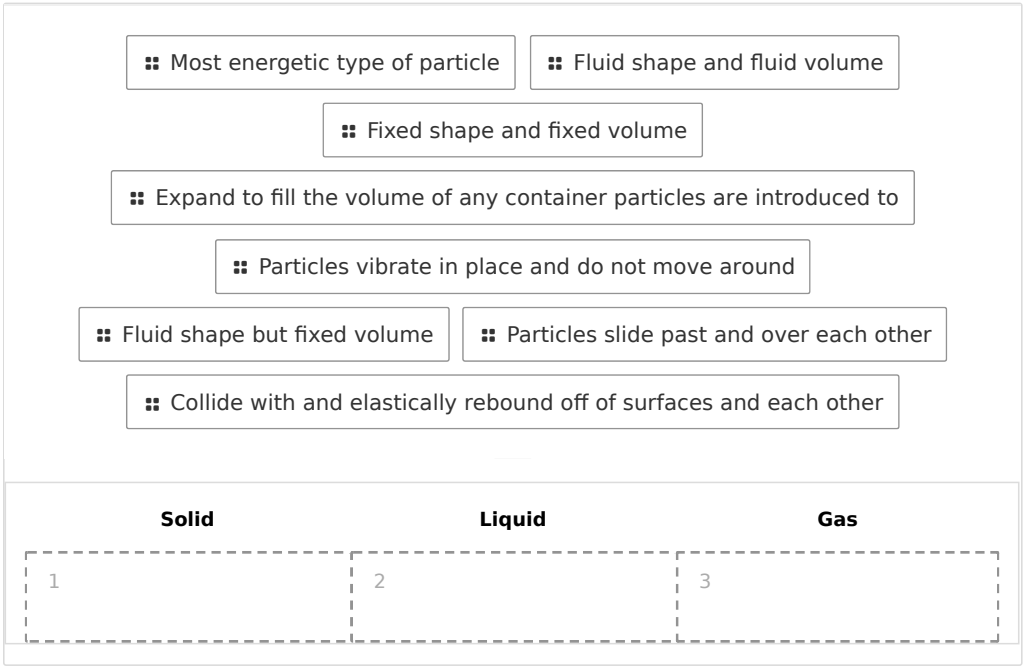
Digital Ideal Gas Law - Beyond Labz

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Classify each statement as pertaining to particles of a solid, liquid, or gas.



Correct answers:

1 Fixed shape and fixed volume

Particles vibrate in place and do not move around

2 Fluid shape but fixed volume Particles slide past and over each other

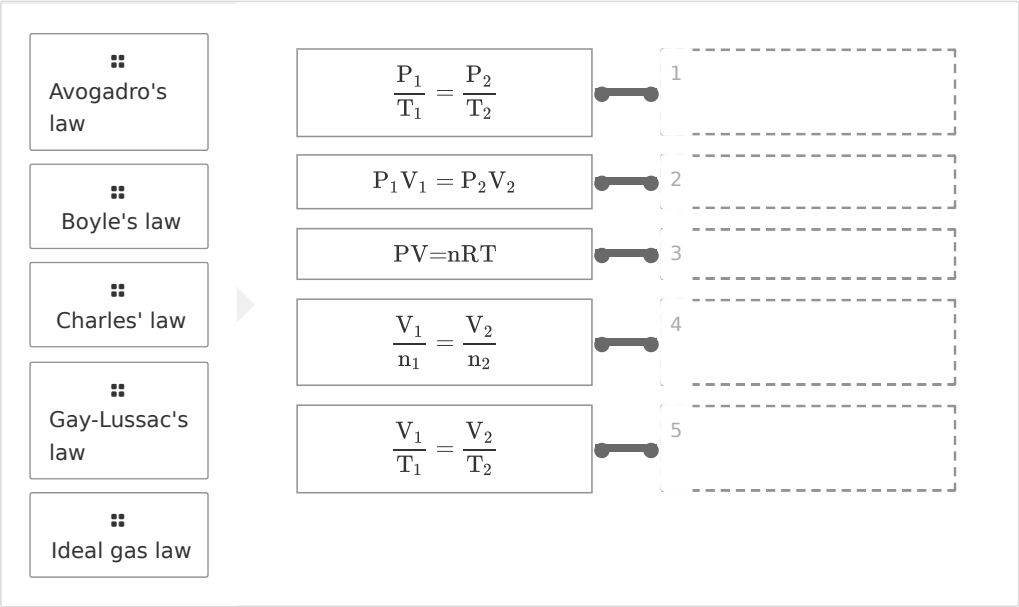
3 Most energetic type of particle Fluid shape and fluid volume

Expand to fill the volume of any container particles are introduced to

Collide with and elastically rebound off of surfaces and each other

Typesetting math: 100%

Match the name of each gas law to its equation.



Correct answers:

1 Gay-Lussac's law 2 Boyle's law 3 Ideal gas law 4 Avogadro's law

5 Charles' law

Arrange the variables and constants into the ideal gas law.

Correct answers:

1 P 2 V 3 n 4 R 5 T

Exploration

Gases have a fixed volume.

- True
- False ✔

Typesetting math: 100%

Gas molecule behavior is best described as _____.

- held together
- rebounding off of surfaces and each other ✔
- sliding past each other
- fixed in place

Holding temperature and pressure constant reduces the ideal gas law to Avogadro's law, where _____.

- $\frac{V_1}{n_1} = \frac{V_2}{n_2}$ ✔
- $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
- $\frac{P_1}{T_1} = \frac{P_2}{V_2}$
- $P_1V_1 = P_2V_2$

The ideal gas constant is symbolized with ___ in the ideal gas law.

- P
- T
- n
- R ✔

Exercise 1

What variables were being held constant when you collected data for:

a) Part 1: Boyle's law?

b) Part 2: Charles' law?

c) Part 3: Avogadro's law?

d) Part 4: Gay-Lussac's law?

a) number of moles and temperature

b) number of moles and pressure

c) temperature and pressure

d) number of moles and volume

Decide whether the following are directly or inversely proportional based on the data you collected.

a) Pressure and temperature (Gay-Lussac's law)

b) Pressure and volume (Boyle's law)

c) Volume and temperature (Charles' law)

d) Number of moles and volume (Avogadro's law)

a) Directly

b) Inversely

c) Directly

d) Directly

If more than one variable was being manipulated and others were not being held constant, explain what gas law equation would need to be used to determine the other values.

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Data Table 1: Pressure and Volume in Balloon Pressure Chamber

(SAMPLE ANSWER BELOW)

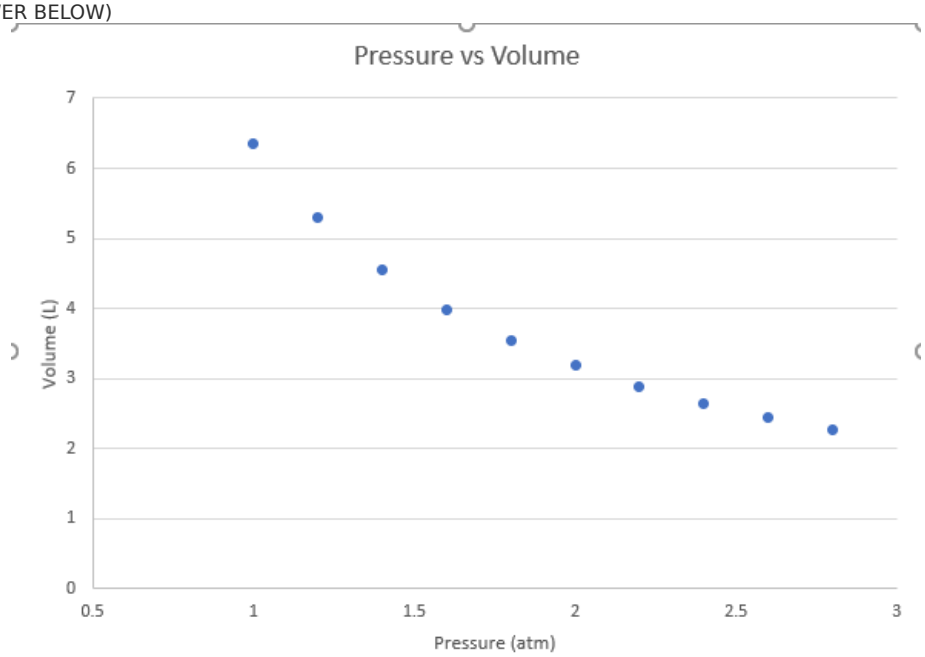
Pressure (atm)	**Volume (L)**
1.000	6.361
1.200	5.301
1.400	4.544
1.600	3.976
1.800	3.534
Typesetting math: 100%	3.180

2.200	2.891
2.400	2.650
2.600	2.447
2.800	2.272

Data Table 2: Pressure and Inverse Volume
(SAMPLE ANSWER BELOW)

Pressure	**Inverse volume (L^{-1})**
1.000	0.1572
1.200	0.1886
1.400	0.2201
1.600	0.2515
1.800	1.2830
2.000	0.3145
2.200	0.3459
2.400	0.3774
2.600	0.4087
2.800	0.4401

Graph 1: Pressure vs. Volume
(SAMPLE ANSWER BELOW)



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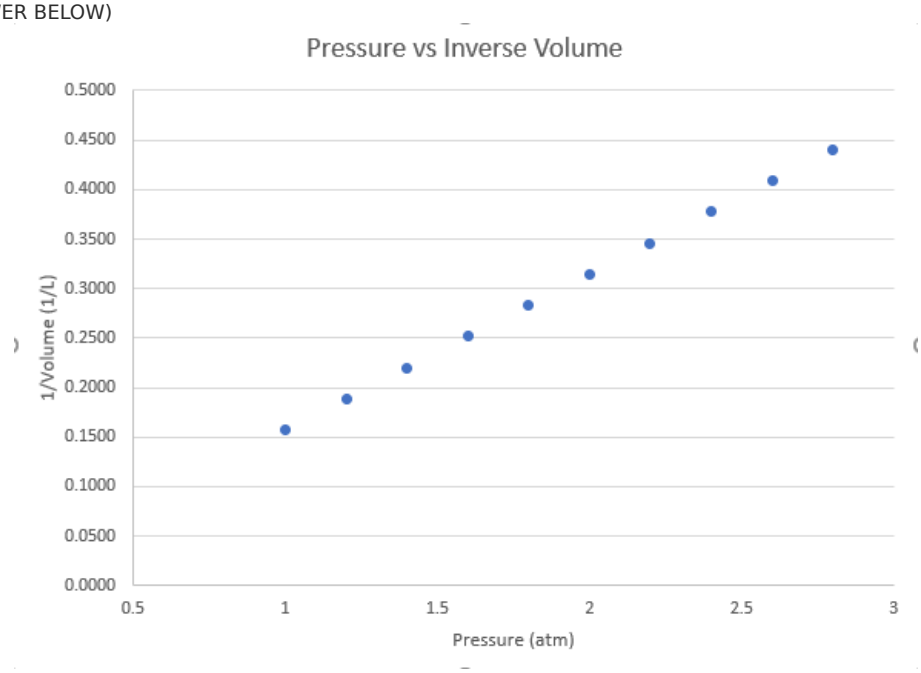
Graph 2: Pressure vs. 1/Volume

(SAMPLE ANSWER BELOW)



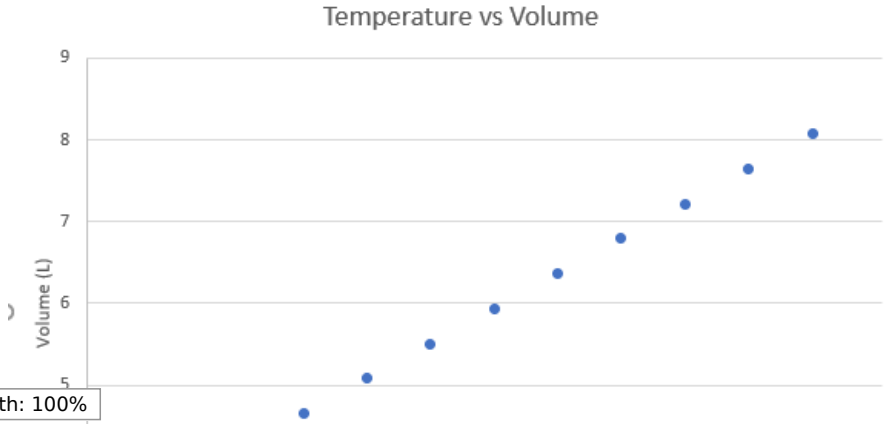
Data Table 3: Temperature and Volume in Balloon Pressure Chamber

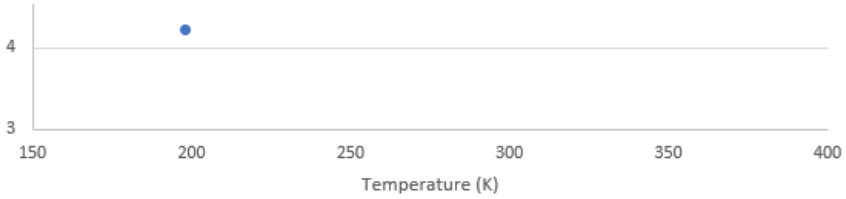
(SAMPLE ANSWER BELOW)

Temperature (K)	**Volume (L)**
298.15	6.361
318.15	6.788
338.15	7.214
358.15	7.641
378.15	8.068
278.15	5.934
258.15	5.508
238.15	5.081
218.15	4.654
198.15	4.227

Graph 3: Temperature vs. Volume

(SAMPLE ANSWER BELOW)



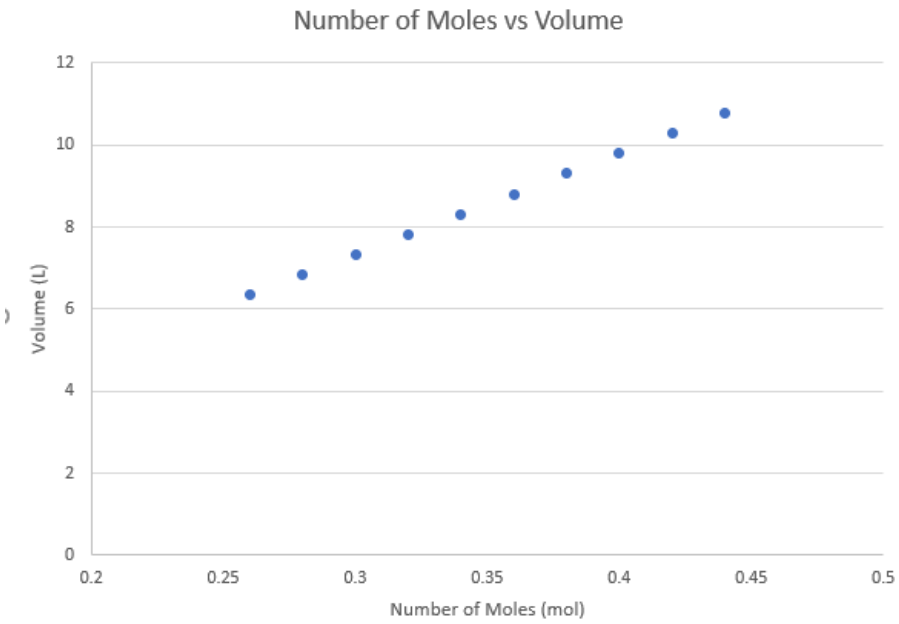


Data Table 4: Number of Moles and Volume in Balloon Pressure Chamber

(SAMPLE ANSWER BELOW)

Number of moles (mol)	**Volume (L)**
0.260	6.361
0.280	6.850
0.300	7.340
0.320	7.829
0.340	8.318
0.360	8.808
0.380	9.297
0.400	9.786
0.420	10.28
0.440	10.77

Graph 4: Number of Moles vs. Volume
(SAMPLE ANSWER BELOW)

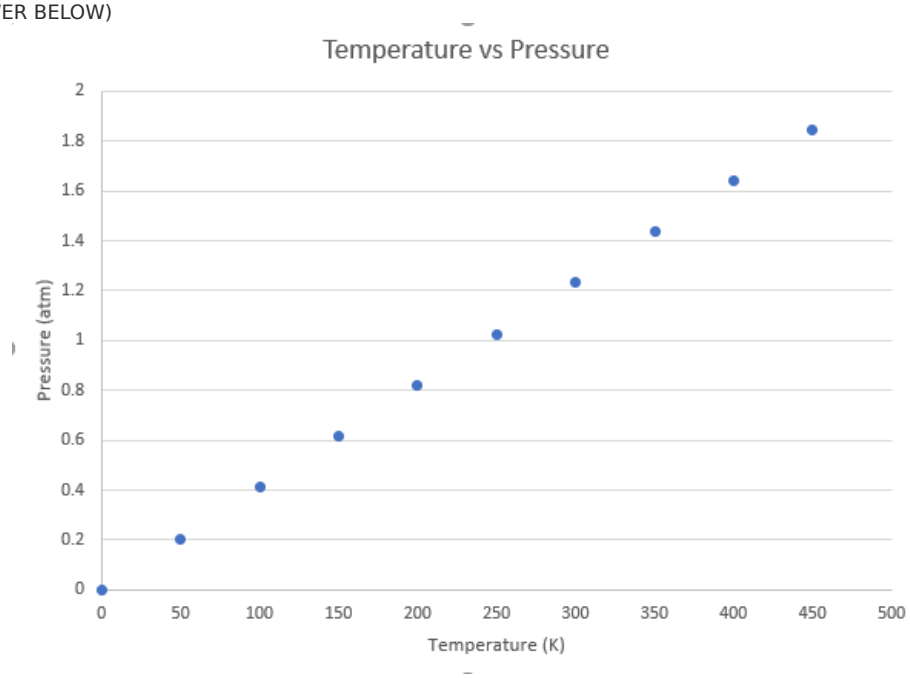


Data Table 5: Temperature and Pressure in Piston Pressure Cylinder
(SAMPLE ANSWER BELOW)

	Pressure (atm)

0	0
50.00	0.205
100.00	0.410
150.00	0.615
200.00	0.821
250.00	1.026
300.00	1.231
350.00	1.436
400.00	1.641
150.00	1.846

Graph 5: Temperature vs. Pressure
(SAMPLE ANSWER BELOW)



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Competency Review

Gas particles in a closed container _____.

- are highly energetic
- expand to fill the volume of the container
- collide elastically with each another and the sides of the container
- All of the above ✔

A graph that describes the relationship of pressure versus the inverse value of volume ($^{1}/_{V}$) displays a linear relationship.

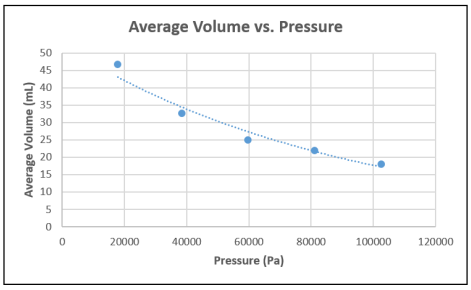
- True ✔
- False

A syringe is filled with gas and sealed to create a closed system. When the plunger of the syringe is depressed, _____.

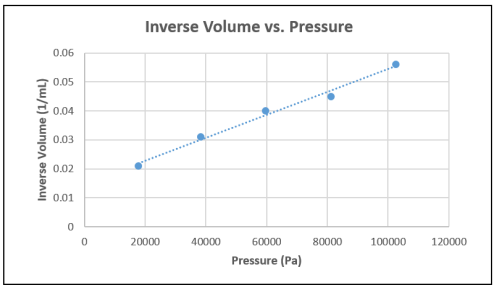
- the volume of the gas will increase
- the number of gas particles will decrease
- the pressure will increase ✔
- the number of gas particles will increase

The graph(s) that show(s) a linear relationship is/are ___.

A:



B:



- A
- B ✔
- both A and B
- neither A nor B

A substance in the ____ state of matter has neither a fixed volume nor a fixed shape.

- solid
- liquid
- gas ✔
- plasma

Charles' law states that ____ and ___ are directly proportional.

- temperature; volume ✔
- volume; number of moles
- volume; pressure
- temperature; pressure

Typesetting math: 100%

Avogadro's law states that the relationship between ___ and ___ is directly proportional.

- number of moles; temperature
- temperature; volume
- pressure; volume
- volume; number of moles ✔

The ideal gas law equation describes the way that _____ relate(s) to the number of moles of gas and temperature.

- pressure and volume ✔
- the gas constant
- pressure and quantity
- the gas constant and volume

Extension Questions

The compound sodium azide explodes in a chemical reaction that converts the solid to broken-down gas components in one of the fastest reactions known, and it was therefore used as the species that inflated airbags for many years. If an accident occurs at a temperature of 299.65 K and an atmospheric pressure of 1.000 atm, releasing 0.156 moles of gas, apply your knowledge of the ideal gas law to determine the volume of the gas that will fill the airbag. To align with the units, use the value of the gas constant R = 0.08206 $^{L \cdot atm}/_{mol \cdot K}$. Show all of your calculations in your answer. (SAMPLE ANSWER BELOW)

PV=nRT

V= nRT/P

V= (0.156)(0.08206)(299.65)/(1.000)

V=3.83 L

3.83 L of gas would be released to fill the airbag.

A vehicle sitting outside after a hot day experiences an unexpected freeze overnight. Despite the tires being well-sealed, they decrease in size and get flatter. Which gas law must be used to describe this scenario with the gas within the tires? What variable(s) remained constant? What variable(s) changed? (SAMPLE ANSWER BELOW)

The ideal gas law (PV=nRT) must be used to describe this scenario, as only one variable is being held constant. The number of moles, *n*, is the only constant variable. The volume *V*, pressure *P*, and temperature *T* are the variables that changed.