Chemistry 534 Practice Test

$R = 0.0821 \frac{atm\,L}{mol\,K}$

Name: Answer Key

or

$R = 8.314 \frac{kPa\,L}{mol\,K}$

1 The volume of a gaseous system is 25 L at a pressure of 100. kPa.

While the temperature is kept constant, the volume of this system is raised to 100. L.

What is the final pressure of the gas?

$$\frac{P_1 V_1}{V_2} = \frac{P_2 V_2}{V_2} = \frac{(100.\ kPa)(25\ L)}{100.\ L} = 25\ kPa$$

Answer: 25 kPa

— n — V — P

2 Four moles of oxygen (O_2) occupy a volume of 44.8 litres at a pressure of 1.48 atm.

What is the temperature in degrees Celsius of the oxygen?

T ?

$$PV = nRT \qquad \frac{PV}{nR} = \frac{nRT}{nR}$$

$$1.48\ atm \times \frac{101.3\ kPa}{1\ atm} = 150\ kPa$$

$$T = \frac{(150\ kPa)(44.8\ L)}{(4.00\ mol)(8.314\ \frac{kPa\,L}{mol\,K})}$$

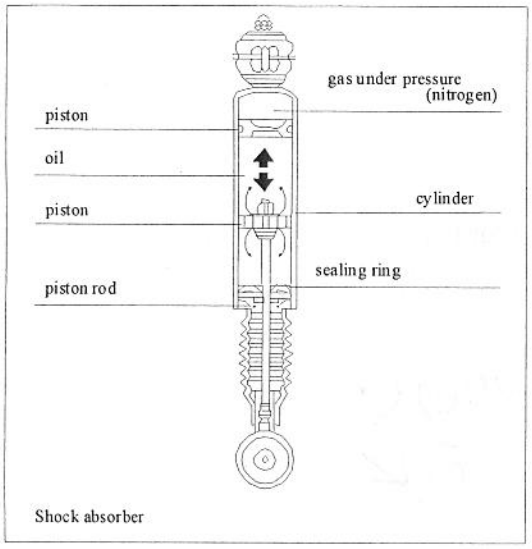
$$\frac{1}{\frac{1}{K}} \cdot \frac{K}{1} = K \text{ numerator}$$

$= 202\ K$

Answer: 202 K − 273 = −71 °C

watch this in multiple choice questions

3 The diagram shows the shock-absorber of an automobile :



Shock-absorber : A device for absorbing the energy of sudden impulses or shocks in machinery or structures

Reference : Petit Larousse illustré

From the list below, select the properties of gases that justify their use in a shock-absorber.

1. Malleability
2. Hardness
3. Compressibility ✓
4. Ductibility
5. Indefinite shape ✓
6. Viscosity
7. Conductivity

A) 2 and 7

B) 5, 6 and 7

C) 3 and 5

D) 1, 2 and 4

↑T ↑V

4 During Chantal's birthday party, on a warm summer day, several of the birthday balloons burst.

Which of the following statements best explains this occurrence?

A) Heat produces an increase in the mass of gas. stupid

B) Pressure produces an increase in the volume of gas. — P gets held constant by the balloon expanding (n also held constant)

C) Heat produces an increase in the volume of gas.

D) Pressure produces an increase in the mass of gas. stupid

$PV = nRT$

5 You conducted a laboratory experiment to determine how the volume of a given gas is affected by 3 factors.

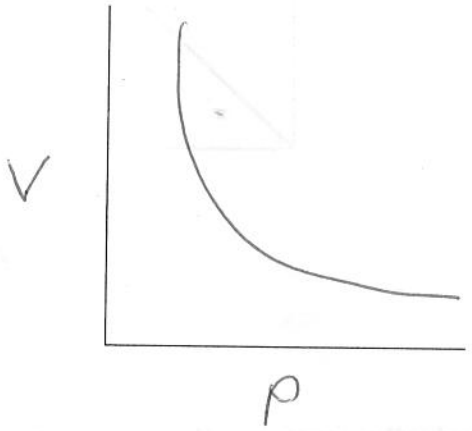
V vs P, n, T?

Give the mathematical equation and draw the corresponding graph:

Factor 1: pressure

Equation: $P_1V_1 = P_2V_2$

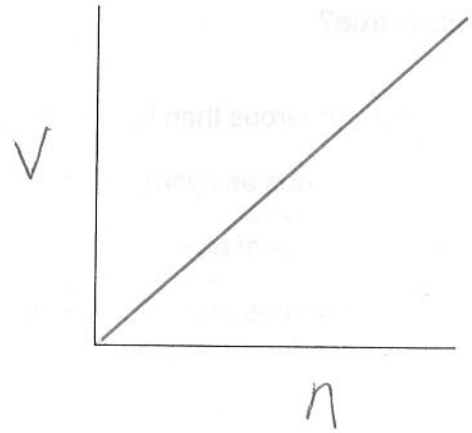
Graph including units:



Factor 2: moles

Equation: $\frac{V_1}{n_1} = \frac{V_2}{n_2}$

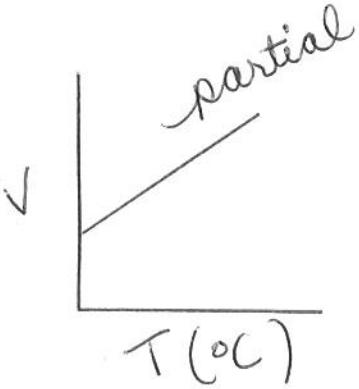
Graph including units:

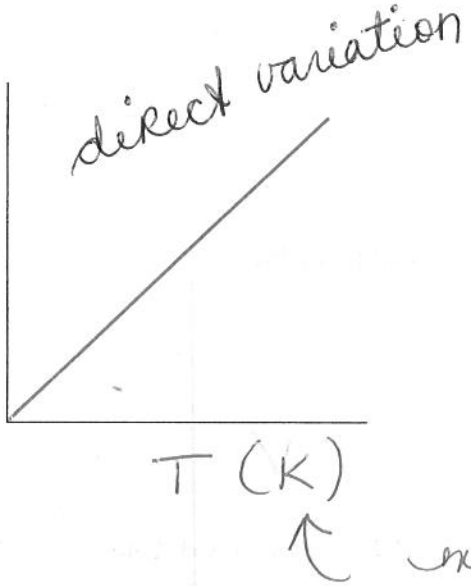


Factor 3: Temperature

Equation: $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

Graph including units:





must specify K otherwise partial with °C

identical

6 Two tanks filled with gas are under the same conditions of temperature and pressure.

One is filled with hydrogen H_2 and the other with nitrogen N_2.

According to Avogadro's law: if 2 diff gases are under the same P, V & T then n is the same too!

This is practice--use your phone to research this question!

$n_1 = n_2$

Which of the following statements is true?

A) Nitrogen molecules are more numerous than hydrogen molecules.

B) Nitrogen molecules are as numerous as hydrogen molecules.

C) The two tanks contain equal masses of gases.

D) Nitrogen molecules are less numerous than hydrogen molecules.

7 You bought a balloon filled with 10 L of helium. At the time, the temperature outside was 20°C and the atmospheric pressure was 100 kPa. Unfortunately, you let go of the balloon and it climbed to an altitude where the temperature was -20°C and the pressure was 80 kPa.

By how many litres did the volume of the balloon vary at this altitude?

V_1 P_1 T_1 P_2 T_2

$T_2 \times \frac{P_1 V_1}{P_2 T_1} = \frac{P_2 V_2}{T_2} \times \frac{T_2}{P_2}$

$\frac{(-20°C+273)(100\,kPa)(10.L)}{(80\,kPa)(20°C+273)} = V_2$

-2!!

10.79 L = new vol

Answer: 0.79 L

watch your English!!

8 Which of the following procedures would result in an increase in the pressure of a gas?

↑P bec?

↑n = ↑V

A) ~~Reduce~~ the number of moles without changing the volume or the temperature.

↑T = ↑P

n constant V constant

B) Increase the temperature of the gas without changing the number of moles or the volume of the gas.

C) ~~Increase~~ the volume of the gas without changing the number of moles or the temperature of the gas. ↑V = ↓P if n constant + T constant

D) Use the same number of moles of a more dense gas without changing the volume or the temperature.

9 The combustion of acetylene, $C_2H_{2(g)}$, produces carbon dioxide gas, $CO_{2(g)}$, and water vapour, $H_2O_{(g)}$.

V = ?

If 15 g of acetylene is burned, what volume of $CO_{2(g)}$ will be obtained at **STP**? Stoich is your friend!

T = 0°C + 273 = 273 K

P = 101.3 kPa

The balanced equation for this reaction is :

Stoich then PV = nRT

$2\,C_2H_{2(g)} + 5\,O_{2(g)} \rightarrow 4\,CO_{2(g)} + 2\,H_2O_{(g)} + Energy$

1) $15\,g\,C_2H_2 \times \frac{1\,mol\,C_2H_2}{26\,g\,C_2H_2} \times \frac{4\,mol\,CO_2}{2\,mol\,C_2H_2} = 1.2\,mol\,CO_2$

2) $\frac{PV}{P} = \frac{nRT}{P}$

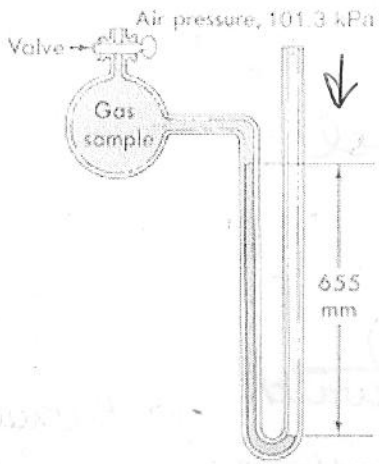
$= \frac{(1.2\,mol)(8.314\,\frac{kPaL}{molK})(273}{(101.3\,kPa)}$

Answer: 27 L

OR $1.2\,mol\,CO_2 \times \frac{22.4\,L}{1\,mol\,CO_2} = 27\,mol\,CO_2$ (STP)

10 On a given day a barometer reads 103.3 kPa.

What is the pressure of the gas in the bottle?



= Patm "winning" air is "winning" the push of wax

$\times \frac{101.3\,kPa}{760\,mmHg} = 87.3\,kPa$ = diff

$P_{gas} = P_{atm} - \text{diff in hts}$

$= 101.3\,kPa - 87.3\,kPa$

$P_{gas} = 14\,kPa$

Answer: 14 kPa = P_{gas}

11 Mark is given a sample of gas in the laboratory. He assumes that this gas behaves like an ideal gas.

To test his assumption, he conducts an experiment and makes the following observations :

Number of moles of gas	2.0 mol
Volume of gas	10.0 L
Temperature	–73°C $+273 = 200\,K$
Pressure	404 kPa

L

then

$R = 8.314\,\frac{kPa}{mol\,k}$

Given the above information, is his assumption correct?

$\frac{PV}{nT} = \frac{nRT}{nT} = \frac{(404\,kPa)(10.0\,L)}{(2.0\,mol)(200\,K)}$

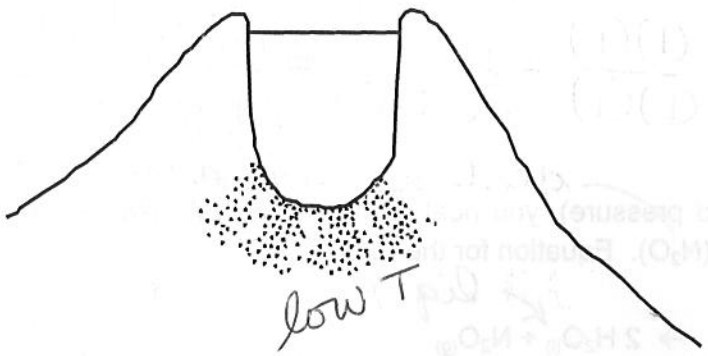
$R = 10.\,\frac{kPa\,L}{mol\,K}$ ✗

Answer: No **because** R is not $8.314\,\frac{kPa\,L}{mol\,K}$

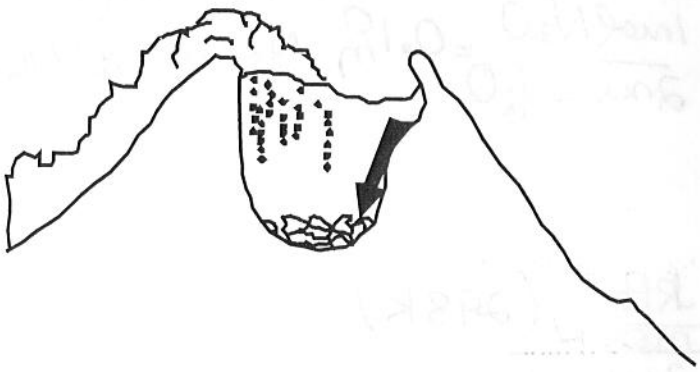
12 On August 26, 1986, 1 200 residents of a village in Cameroon, West Africa, died within a few minutes.

The tragedy was attributed to a cloud of carbon dioxide that escaped from a lake inside a crater of an extinct volcano.

Here is what happened :



For thousands of years, carbon dioxide, produced by underground reactions, accumulated in the cold, deep waters of the lake.



In 1986, an earthquake caused a landslide, permitting CO_2 to escape from the surface of the lake.

Because of atmospheric conditions **near** the volcano, the volume of CO_2 increased. Because it is heavier than air, it drifted down the side of the mountain and asphyxiated the residents of the village in the valley below.

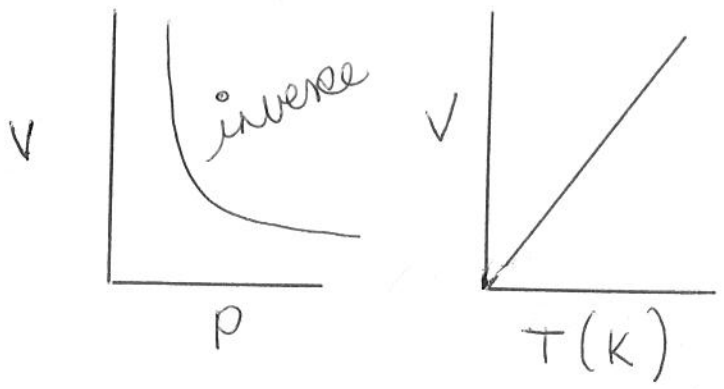
Knowing that the atmospheric conditions on August 26, 1997 favoured an increase in the volume of CO_2, which combinations below might best describe atmospheric temperature and pressure that fatal day?

A) COLD temperature; HIGH pressure

B) COLD temperature; LOW pressure

C) HIGH temperature; HIGH pressure

D) HIGH temperature; LOW pressure



since they don't give us initial conditions we can say $P_1 = 1$ $n_1 = 1$ $V_1 = 1$ $T_1 = 1$

13 What happens to the volume of a gas if we double the pressure, halve the number of gas molecules, and quadruple the temperature?

$$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$$

A) It doubles.

B) It is reduced by half.

C) It remains the same.

D) It quadruples.

$\frac{(1)(1)}{(1)(1)} = 1$ initially $= \frac{(2)(V_2)}{(\frac{1}{2})(4)}$ = same

25°C + 273 = 298 K

14 At SATP (Standard ambient temperature and pressure), you heat ammonium nitrate (NH_4NO_3) and obtain 3.6 g of water (H_2O) and laughing gas (N_2O). Equation for the reaction:

dentists use as anaesthetic

101.3 kPa

liq Not a gas

$$NH_4NO_{3(s)} \rightarrow 2\,H_2O_{(l)} + N_2O_{(g)}$$

so can't put into $PV = nRT$ = ideal GAS law

What volume of laughing gas will be produced?

Not ideal LIQUID law

(1) $3.6\,g\,H_2O \times \frac{1\,mol\,H_2O}{18\,g} \times \frac{1\,mol\,N_2O}{2\,mol\,H_2O} = 0.10\,mol\,N_2O$

(2) $\frac{PV}{P} = \frac{nRT}{P}$

$$= \frac{(0.10\,mol)(8.314\,\frac{kPa\,L}{mol\,K})(298\,K)}{(101.3\,kPa)}$$

Answer: 2.4 L N_2O

15 According to the KMT, particles of a gas:

A) attract each other but do not collide

B) repel each other and collide

C) neither attract nor repel each other but collide

D) neither attract nor repel each other and do not collide