1 atm = 101.3 kPa = 760 mmHg = 29.8 in Hg   Key

Unit 9: Problem Set 3

Directions: Solve each problem by showing the following: formula, assignment of variables, plug in numbers with labels, answer with label. *(Numbers 7 and 8 may be solved a different way too. Do you remember how to do it?)*

12,400

1. A sample of argon gas is at a pressure of 1.24×10^4 kPa and a temperature of 24 °C in a rigid 25 L tank. How many moles of argon does this tank contain?

1. $PV = nRT$
2. $P = 1.24 \times 10^4$ kPa
   V = 25L
   n = X
   R = 8.31 $\frac{L\,kPa}{m\,K}$
   T = 24°C + 273 = 297 K

③ $\frac{1.24 \times 10^4\ kPa \cdot 25L}{8.31 \frac{L\,kPa}{m\,K} \cdot 297K} = n$

④ n = (126 m) = 130 moles Ar

2. A 35.0-L tank contains 7.00 mol of compressed air. If the pressure inside the tank is 4.94 atmospheres, what is the temperature of the compressed gas?

① $PV = nRT$

② P = 4.94 atm | $\frac{101.3\ kPa}{1\ atm}$ = 500 kPa
   V = 35.0L
   n = 7.00 m
   R = 8.31 $\frac{L\,kPa}{m\,K}$
   T = X

③ $\frac{(500\ kPa)(35.0L)}{(7.00m)(8.31 \frac{kPa\,L}{m\,K})} = T$

④ T = 301 K

3. How many grams of helium does a 25,000 ml balloon contain at 102.0 kPa and 24 °C?

① $PV = nRT$

② P = 102.0 kPa
   V = 25,000 ml × $\frac{1L}{1000ml}$ = 25L
   n = X
   R = 8.31 $\frac{L\,kPa}{m\,K}$
   T = 24°C + 273 = 297K

③ $\frac{102.0\ kPa \cdot 25L}{8.31 \frac{L\,kPa}{m\,K} \cdot 297K} = n$

④ n = 1.0 m He × $\frac{4.0g}{1m\ He}$ = 4.0g He

273K STP 101.3kPa

4. Calculate the volume that 2.25 mole of $O_2(g)$ will occupy at 0 °C and 1 atmosphere of pressure.

1. $PV = nRT$
2. P = 1 atm (1.000) × $\frac{101.3\ kPa}{1\ atm}$ = ~~101.3~~ kPa 100 kPa
   V = X
   n = 2.25 m
   R = 8.31 $\frac{L\,kPa}{m\,K}$
   T = 0°C + 273 = 273 K

3. $V = \frac{2.25m \times 8.31 \frac{L\,kPa}{m\,K} \cdot 273}{~~101.3~~\ kPa\ (100)}$

4. V = 50 L

1. 2.25n
2. L
3. $\frac{1m}{22.4L}$ 2.25m | $\frac{22.4L}{1m}$ =

$P_1 V_1$ — $P_2 V_2$
T_1 T_2

5. A sample of water vapor occupies a volume of 10.5 L at 200 °C and 1 00.0 kPa. What volume will the water vapor occupy when it is cooled to 27 °C if the pressure remains constant?

(1) $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

(2) $V_1 = 10.5L$

$T_1 = 200°C + 273 = 473K$

$V_2 = X$

$T_2 = 27°C + 273 = 300K$

(3) $\frac{10.5L}{473K} = \frac{V_2}{300K}$

(4) ~~6.7~~ 7L

7L

6. What is the volume occupied by 0.355 mole of nitrogen gas at 680. mm Hg and 20. °C?

1. $PV = nRT$
2. $P = \frac{680 mm Hg}{1} \cdot \frac{101.3 Kpa}{760 mm Kg} =$ ~~90.6~~ Kpa 90.6 Kpa

$V = X$

$n = .355m$

$R = 8.31 \frac{L Kpa}{m K}$

$T = 20°C + 273 = 293K$

(3) $V = \frac{.355m \cdot 8.31 \frac{LKpa}{mK} \cdot 293K}{90.6 Kpa}$

(4) V = ~~9.7~~ L 9.5L

7. What is the volume of a container that holds 25.0 g of carbon dioxide at STP?

1. $PV = nRT$
2. $P = 101.3Kpa$

$V = X$

$n = 25.0g \times \frac{1m CO_2}{44.0g} = .568m$

$R = 8.31 \frac{L Kpa}{m K}$

$T = 273 K$

3. $V = \frac{.568 m \times 8.31 \frac{LKpa}{mK} \cdot 273K}{101.3 kpa}$

4. $V = 12.7L$

or $\frac{25.0g}{} \Big| \frac{22.4L}{44.0g} = 12.7L$

8. What volume is occupied by 5.80 x 10^{20} molecules of an ideal gas at STP?

1. $PV = nRT$
2. $P = 101.3Kpa$

$V = X$

$n = \frac{5.80 \times 10^{20} mc}{} \Big| \frac{1m}{6.02 \times 10^{23} mc} = 9.62 \times 10^{-4} m$

.000962m

$R = 8.31 \frac{LKpa}{mK}$

$T = 273 K$

3. $V = \frac{9.62 \times 10^{-4} m \cdot 8.31 \frac{LKpa}{mK} \cdot 273K}{101.3 K pa}$

4. .0215 L

or $\frac{5.80 \times 10^{20} mc}{} \Big| \frac{22.4L}{6.02 \times 10^{23} mc} = .0216L$