

Answers for Chapter 5 Study Questions

Sample questions:

1. A balloon is filled with air at room temperature (25 °C) and a pressure of 625 torr. Will the balloon get bigger, smaller, or stay the same size when:
- the pressure is increased to 758 torr.
 - it is placed in a freezer (-20 °C).

a) As P increases, V decreases – the balloon will get smaller

b) As T decreases, V decreases – the balloon will get smaller

2. A metal container is filled with O₂ gas at 1.0 atm and 37 °C. Will the pressure increase, decrease, or stay the same when:
- the container is cooled.
 - the container is crushed (the volume is reduced, but it does not leak)

a) As T decreases, P increases

b) As V decreases, P increases

3. Calculate the final volume of the balloon in 1a) if the original volume was 2.5 L.

$$\text{use } P_1 \times V_1 / T_1 = P_2 \times V_2 / T_2$$

$$625 \text{ torr} \times 2.5 \text{ L} / 298 \text{ K} = 758 \text{ torr} \times V_2 / 298 \text{ K}$$

$$V_2 = 625 \text{ torr} \times 2.5 \text{ L} \times 298 \text{ K} / 758 \text{ torr} \times 298 \text{ K} = 2.1 \text{ L}$$

(since T₁ = T₂, you can leave T out of the calculation and get the same answer)

4. Calculate the final volume of the balloon in 1b) if the original volume was 2.5 L.

$$\text{use } P_1 \times V_1 / T_1 = P_2 \times V_2 / T_2$$

$$625 \text{ torr} \times 2.5 \text{ L} / 298 \text{ K} = 625 \text{ torr} \times V_2 / 253 \text{ K}$$

$$V_2 = 625 \text{ torr} \times 2.5 \text{ L} \times 253 \text{ K} / 625 \text{ torr} \times 298 \text{ K} = 2.1 \text{ L}$$

(since P₁ = P₂, you can leave P out of the calculation and get the same answer)

5. Calculate the final pressure in 2a) if the final temperature is -100 °C.

$$\text{use } P_1 \times V_1 / T_1 = P_2 \times V_2 / T_2$$

since V does not change, V₁ = V₂

$$1.0 \text{ atm} \times V_1 / 310 \text{ K} = P_2 \times V_2 / 173 \text{ K}$$

$$P_2 = 1.0 \text{ atm} \times V_1 \times 173 \text{ K} / V_2 \times 310 \text{ K}$$

(since V₁ = V₂, V₁/V₂ = 1 and you do not need to know the volume)

$$P_2 = 1.0 \text{ atm} \times 173 \text{ K} / 310 \text{ K} = 0.56 \text{ atm}$$

6. Calculate the final pressure in 2b) if the original volume was 2.0 L and the final volume is 0.45 L.

use $P_1V_1/T_1 = P_2V_2/T_2$

$$1.0 \text{ atm} \times 2.0 \text{ L}/310 \text{ K} = P_2 \times 0.45 \text{ L}/310 \text{ K}$$

$$P_2 = 1.0 \text{ atm} \times 2.0 \text{ L} \times 310 \text{ K} / 0.45 \text{ L} \times 310 \text{ K} = 4.4 \text{ atm}$$

(since $T_1 = T_2$, you can leave T out of the calculation and get the same answer)

7. Calculate the number of moles of gas in the balloon ($V = 2.5 \text{ L}$, $P = 625 \text{ torr}$, $T = 25 \text{ }^\circ\text{C}$)

use $PV = nRT$

first need to convert P to atm ($625 \text{ torr} \times 1\text{atm}/760 \text{ torr} = 0.822 \text{ atm}$) & T to K ($273 + 25 = 298 \text{ K}$)

$$0.822 \text{ atm} \times 2.5 \text{ L} = n \times 0.0821 \text{ l}\cdot\text{atm}\cdot\text{mol}^{-1}\cdot\text{K}^{-1} \times 298 \text{ K}$$

$$n = 0.822 \text{ atm} \times 2.5 \text{ L} / 0.0821 \text{ l}\cdot\text{atm}\cdot\text{mol}^{-1}\cdot\text{K}^{-1} \times 298 \text{ K} = 0.084 \text{ mol}$$

8. Calculate the number of moles and the mass in grams of O_2 gas in the metal container.

use $PV = nRT$

first need to convert T to K ($273 + 37 = 310 \text{ K}$)

$$1.0 \text{ atm} \times 2.0 \text{ L} = n \times 0.0821 \text{ l}\cdot\text{atm}\cdot\text{mol}^{-1}\cdot\text{K}^{-1} \times 310 \text{ K}$$

$$n = 1.0 \text{ atm} \times 2.0 \text{ L} / 0.0821 \text{ l}\cdot\text{atm}\cdot\text{mol}^{-1}\cdot\text{K}^{-1} \times 310 \text{ K} = 0.078 \text{ mol}$$

formula mass of $\text{O}_2 = 32.00 \text{ amu}$, so $1 \text{ mol } \text{O}_2 = 32.00 \text{ g } \text{O}_2$

$$0.078 \text{ mol } \text{O}_2 \times 32.00 \text{ g } \text{O}_2 / 1 \text{ mol } \text{O}_2 = 2.5 \text{ g } \text{O}_2$$

9. A mixture of gases consist of 15% O_2 and 85% N_2 . If the gas pressure is 6.5 atm, what is the partial pressure of O_2 ?

the partial pressure of each gas equals the total pressure x the fraction of each gas in the mixture.

$$\text{partial pressure of } \text{O}_2 = 6.5 \text{ atm} \times 15/100 = 0.97 \text{ atm}$$

10. If a scuba diver returns to the surface too quickly, they risk getting the 'bends'. Gas bubbles appear in the blood and cause potentially fatal symptoms. Explain where these bubbles come from and why they are not a problem during the dive, only when the diver returns.

Gases dissolve in liquids and as pressure increases, more gas will dissolve.

We breathe in air and so we have the gases dissolved in our blood. When a diver goes down, pressure increases and more gases dissolve in the blood. When the diver goes back up the pressure decreases and gases cannot stay dissolved. Therefore bubbles of gas will form in the blood.