



**Short Answer**

14. Fill in the following table with one of these terms: increases, decreases, stays the same. Each term may be used more than once. Assume the amount of gas is constant.

Volume	Pressure	Temperature
increases	stays the same	
increases		stays the same
stays the same	increases	
	increases	stays the same
	stays the same	increases
stays the same		increases
decreases	stays the same	
decreases		stays the same
stays the same	decreases	
increases	decreases	
stays the same		decreases
	stays the same	decreases

Suppose that 5-mL containers of helium (He), neon (Ne), and argon (Ar) are at pressures of 1 atm, 2 atm, and 3 atm, respectively. The He and Ne are then added to the container of Ar.

15. What is the partial pressure of He in the container after the three gases are mixed?  
 16. What is the total pressure in the container after the three gases are mixed?

**Problem**

17. Titanium dioxide (TiO<sub>2</sub>) is an industrial chemical used as a white pigment in paint. The conversion of volatile TiCl<sub>4</sub> to TiO<sub>2</sub> occurs according to the reaction,  $\text{TiCl}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{TiO}_2(\text{s}) + 2\text{Cl}_2(\text{g})$ . If 15.70 g of TiCl<sub>4</sub> reacts in excess oxygen to form 10.40 g Cl<sub>2</sub>, what is the percent yield of the reaction?
18. Phosphorus pentachloride is formed when 17.2 g of chlorine gas react with 23.2 g of solid phosphorus (P<sub>2</sub>). Determine the reactant that is in excess.
19. A student produces carbon dioxide gas by heating calcium carbonate in a flask. She collects the gas by bubbling it into a test tube inverted in water. After filling the test tube, the student measures the pressure of the test tube's contents as 100.6 kPa at a temperature of 24.0°C. Find the partial pressure of carbon dioxide in the test tube. The partial pressure of water vapor at 24.0°C is 2.98 kPa.
20. An inflated balloon is left outside overnight. Initially, it has a volume of 1.74 L when the temperature is 20.2°C and the pressure is 1.02 atm. At what temperature will the balloon have a volume of 1.56 L if the pressure falls to 0.980 atm?
21. The volume and amount of gas are constant in a tire. The initial pressure and temperature are 1.82 atm and 293 K. At what temperature will the gas in the tire have a pressure of 2.35 atm?

Name: \_\_\_\_\_

ID: A

22. In one city, a balloon with a volume of 6.0 L is filled with air at 101 kPa pressure. The balloon is then taken to a second city at a much higher altitude. At this second city, atmospheric pressure is only 91 kPa. If the temperature is the same in both places, what will be the new volume of the balloon?
23. Maintaining constant pressure, the volume of a gas is increased from 18.0 dm<sup>3</sup> to 32.0 dm<sup>3</sup> by heating it. If the original temperature was 18.0°C, what is the new temperature in degrees Celsius?
24. If the gas pressure in an aerosol can is 148.5 kPa at 23°C, what is the pressure inside the can if it is heated to 298°C?
25. A balloon is filled with gas at a pressure of 102.3 kPa and a temperature of 45.5°C. Its volume under these conditions is 12.5 L. The balloon is then taken into a decompression chamber where the volume is measured as 2.50 L. If the temperature is 36.0°C, what is the pressure in the chamber?

## Midterm 1 review sheet

### Answer Section

#### MULTIPLE CHOICE

1. ANS: B

The mole ratio of water to hydrogen is 1:1.

DIF: 1 REF: Page 359 OBJ: 12.2.2 Use the steps to solve stoichiometric problems.

STO: UCP.1, UCP.3, B.3 TOP: Use the steps to solve stoichiometric problems.

KEY: Stoichiometric mole-to-mole conversion MSC: 3

NOT: /A/ Multiply the known number of moles by the mole ratio. /B/ Correct! /C/ Divide the unknown moles by the known moles. /D/ Balance the equation correctly.

2. ANS: A

The molar mass of carbon dioxide is 44 g.

DIF: 2 REF: Page 360 OBJ: 12.2.2 Use the steps to solve stoichiometric problems.

STO: UCP.1, UCP.3, B.3 TOP: Use the steps to solve stoichiometric problems.

KEY: Stoichiometric mole-to-mass conversion MSC: 3

NOT: /A/ Correct!/B/ Divide the unknown moles by the known moles. /C/ Multiply the known number of moles by the mole ratio and the molar mass. /D/ Balance the equation correctly.

#### COMPLETION

3. ANS: chlorine

DIF: 2 REF: Page 365

OBJ: 12.3.1 Identify the limiting reactant in a chemical equation.

STO: B.3 TOP: Identify the limiting reactant in a chemical equation.

KEY: Limiting reactant MSC: 3

4. ANS: limiting reactant  
 5. ANS: actual yield  
 6. ANS: mole ratio  
 7. ANS: excess reactant  
 8. ANS: theoretical yield  
 9. ANS: stoichiometry  
 10. ANS: percent yield  
 11. ANS: limiting reactant  
 12. ANS: theoretical yield  
 13. ANS: excess reactant

## SHORT ANSWER

14. ANS:

<b>Volume</b>	<b>Pressure</b>	<b>Temperature</b>
increases	stays the same	<b>increases</b>
increases	<b>decreases</b>	stays the same
stays the same	increases	<b>increases</b>
<b>decreases</b>	increases	stays the same
<b>increases</b>	stays the same	increases
stays the same	<b>increases</b>	increases
decreases	stays the same	<b>decreases</b>
decreases	<b>increases</b>	stays the same
stays the same	decreases	<b>decreases</b>
increases	decreases	<b>stays the same</b>
stays the same	<b>decreases</b>	decreases
<b>decreases</b>	stays the same	decreases

15. ANS:

1 atm

16. ANS:

$$\begin{aligned}
 P_{\text{total}} &= P_{\text{He}} + P_{\text{Ne}} + P_{\text{Ar}} \\
 &= 1 \text{ atm} + 2 \text{ atm} + 3 \text{ atm} \\
 &= 6 \text{ atm}
 \end{aligned}$$

## PROBLEM

17. ANS:

88.61%

DIF: 3 REF: Page 371

OBJ: 12.4.2 Determine the percent yield for a chemical reaction.

STO: UCP.3, B.3 TOP: Determine the percent yield for a chemical reaction.

KEY: Percent yield MSC: 3

NOT: Percent yield = (actual yield/theoretical yield) \* 100

18. ANS:

Phosphorus is the reactant that is in excess.

DIF: 3 REF: Page 367

OBJ: 12.3.2 Identify the excess reactant and calculate the amount remaining after the reaction is complete.

STO: UCP.3, B.3

TOP: Identify the excess reactant and calculate the amount remaining after the reaction is complete.

KEY: Excess reactant MSC: 3

NOT: The actual ratio is less than the required ratio. The number of moles of chlorine needed in the reaction is 10, but only 1.29 moles of chlorine gas are available. Thus, chlorine acts as the limiting reactant and phosphorus as the excess reactant.

19. ANS:

$$\text{Pressure}_{TOTAL} = \text{Pressure}_{CO_2} + \text{Pressure}_{H_2O}$$

$$\text{Pressure}_{CO_2} = \text{Pressure}_{TOTAL} - \text{Pressure}_{H_2O}$$

$$= 100.6 \text{ kPa} - 2.98 \text{ kPa} = 97.6 \text{ kPa}$$

20. ANS:

$$T_1 = 273 + 20.2^\circ\text{C} = 293.2\text{K}; T_2 = P_2 V_2 T_1 / P_1 V_1$$

$$= (0.980\text{atm})(1.56\text{L})(293.2\text{K}) / (1.02\text{atm})(1.74\text{L}) = 253\text{K}$$

21. ANS:

$$T_2 = P_2 T_1 / P_1 = (2.35 \text{ atm})(293 \text{ K}) / 1.82 \text{ atm} = 378 \text{ K}$$

22. ANS:

$$P_1 V_1 = P_2 V_2; V_2 = \frac{P_1 V_1}{P_2}; V_2 = \frac{(101 \text{ kPa})(6.0 \text{ L})}{91 \text{ kPa}}$$

$$= 6.7 \text{ L}$$

23. ANS:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}; T_2 = \frac{V_2 T_1}{V_1}; T_2 = \frac{(32.0 \text{ dm}^3)(291 \text{ K})}{18.0 \text{ dm}^3}$$

$$= 517 \text{ K} = 244^\circ\text{C}$$

24. ANS:

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}; P_2 = \frac{P_1 T_2}{T_1}; P_2 = \frac{(148.5 \text{ kPa})(571 \text{ K})}{296 \text{ K}}$$

$$= 286 \text{ kPa}$$

25. ANS:

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

$$\frac{(102.3 \text{ kPa})(12.5 \text{ L})(309 \text{ K})}{(318.5 \text{ K})(2.50 \text{ L})} = 496 \text{ kPa}$$