B7 · Combining volumes, Avogadro's idea and molar volume · Practice key

This is the worked key. Every practice question is worked step by step.

Worked examples

Read these first. There is one for each kind of question in this lesson.

Example 1 · Find gas volumes from a balanced equation

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ All volumes are measured at the same temperature and pressure. 6.0 L of methane burns. What volume of oxygen reacts, and what volume of carbon dioxide forms?

1. Read the coefficients. The ratio of methane to oxygen to carbon dioxide is 1 to 2 to 1.
2. The volumes are in the same ratio as the coefficients.
3. Oxygen: 6.0 L × 2 / 1 = 12 L.
4. Carbon dioxide: 6.0 L × 1 / 1 = 6.0 L.

Answer: 12 L of oxygen reacts, and 6.0 L of carbon dioxide forms.

Example 2 · Change moles to litres

SATP is 25 °C and 100 kPa. The molar volume at SATP is 24.8 L/mol. What is the volume of 1.75 mol of gas at SATP?

1. Read the conditions: SATP.
2. Choose the molar volume for them: 24.8 L/mol.
3. Multiply moles by it to get litres: 1.75 mol × 24.8 L/mol = 43.4 L.
4. Check: litres is a bigger number than moles.

Answer: The volume is 43.4 L.

Example 3 · Change litres to moles

STP is 0 °C and 101.325 kPa. The molar volume at STP is 22.4 L/mol. How many moles of gas are in 5.60 L at STP?

1. Read the conditions: STP.
2. Choose the molar volume for them: 22.4 L/mol.
3. Divide litres by it to get moles: 5.60 L ÷ 22.4 L/mol = 0.250 mol.
4. Check: litres is a bigger number than moles.

Answer: The amount is 0.250 mol.

Practice

Questions 1 to 4 are easy. Questions 5 to 8 are medium. Questions 9 and 10 are harder.

EASY

1. Two balloons have equal volumes, at the same temperature and pressure. One holds helium and one holds oxygen. What did Avogadro say about the number of particles in each balloon?

1. Equal volumes of gases hold equal numbers of particles, at the same temperature and pressure.
2. So the two balloons hold the same number of particles.

EASY

2. $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$ All volumes are measured at the same temperature and pressure. 4.0 L of hydrogen reacts. What volume of hydrogen chloride forms?

1. The ratio of hydrogen to hydrogen chloride is 1 to 2.
2. Hydrogen chloride: 4.0 L × 2 / 1 = 8.0 L.

EASY

3. STP is 0 °C and 101.325 kPa. The molar volume at STP is 22.4 L/mol. What is the volume of 2.00 mol of gas at STP?

1. The conditions are STP, so the molar volume is 22.4 L/mol.
2. 2.00 mol × 22.4 L/mol = 44.8 L.

EASY

4. SATP is 25 °C and 100 kPa. The molar volume at SATP is 24.8 L/mol. How many moles of gas are in 49.6 L at SATP?

1. The conditions are SATP, so the molar volume is 24.8 L/mol.
2. 49.6 L ÷ 24.8 L/mol = 2.00 mol.

MEDIUM

5. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ All volumes are measured at the same temperature and pressure. 12 L of hydrogen reacts. What volume of nitrogen reacts, and what volume of ammonia forms?

1. The ratio of nitrogen to hydrogen to ammonia is 1 to 3 to 2.
2. Nitrogen: 12 L × 1 / 3 = 4.0 L.
3. Ammonia: 12 L × 2 / 3 = 8.0 L.

MEDIUM

6. SATP is 25 °C and 100 kPa. The molar volume at SATP is 24.8 L/mol. What is the volume of 0.350 mol of gas at SATP?

1. The conditions are SATP, so the molar volume is 24.8 L/mol.
2. 0.350 mol × 24.8 L/mol = 8.68 L.

MEDIUM

7. STP is 0 °C and 101.325 kPa. The molar volume at STP is 22.4 L/mol. How many moles of gas are in 3.36 L at STP?

1. The conditions are STP, so the molar volume is 22.4 L/mol.
2. 3.36 L ÷ 22.4 L/mol = 0.150 mol.

MEDIUM

8. $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$ All volumes are measured at the same temperature and pressure. 2.50 L of propane burns. What volume of oxygen reacts, and what volume of carbon dioxide forms?

1. The ratio of propane to oxygen to carbon dioxide is 1 to 5 to 3.
2. Oxygen: 2.50 L × 5 / 1 = 12.5 L.
3. Carbon dioxide: 2.50 L × 3 / 1 = 7.50 L.

HARDER

9. STP is 0 °C and 101.325 kPa. The molar volume at STP is 22.4 L/mol. SATP is 25 °C and 100 kPa. The molar volume at SATP is 24.8 L/mol. A reaction makes 0.800 mol of carbon dioxide gas. Find its volume at STP and at SATP. Then explain why the volume at SATP is bigger.

1. 0.800 mol × 22.4 L/mol = 17.9 L.
2. 0.800 mol × 24.8 L/mol = 19.8 L.
3. SATP is warmer than STP, and a warmer gas fills more space.

HARDER

10. $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$ SATP is 25 °C and 100 kPa. The molar volume at SATP is 24.8 L/mol. All volumes are measured at SATP. 37.2 L of carbon monoxide burns. Find the volume of oxygen that reacts. Then find the amount of oxygen in moles.

1. The ratio of carbon monoxide to oxygen is 2 to 1.
2. Oxygen: 37.2 L × 1 / 2 = 18.6 L.
3. The conditions are SATP, so the molar volume is 24.8 L/mol.
4. 18.6 L ÷ 24.8 L/mol = 0.750 mol.