

Give answers to 3 significant figures. Molar mass of $\text{CO}_2 = 44.01 \text{ g/mol}$.

4 marks

3 marks

3 marks

D Gay-Lussac's law (constant V)

2 marks

11. A tire is at 220. kPa and 15.0 °C. After driving, it reaches 45.0 °C. Find the new pressure (volume constant).

12. A sealed can is at 150. kPa and 20.0 °C. At what temperature will the pressure reach 300. kPa?

E Combined gas law

4 marks

2 marks each.

13. 5.00 L of gas at 100. kPa and 27.0 °C is changed to 200. kPa and 127.0 °C. Find the new volume.

14. 2.50 L of gas at STP (0 °C, 101.325 kPa) is moved to 25.0 °C and 98.0 kPa. Find the new volume.

F Ideal gas law

6 marks

2 marks each.

15. How many moles of gas are in a 10.0 L tank at 200. kPa and 300. K?

16. What volume do 2.00 mol of gas occupy at 100. kPa and 25.0 °C?

17. What mass of CO₂ is in a 5.00 L container at 150. kPa and 20.0 °C?

G Molar volume

2 marks

18. What volume does 0.500 mol of gas occupy at STP?

19. How many moles of gas are in 74.4 L at SATP?

H Spot the mistake

2 marks

20. A student heats 2.00 L of gas from 10.0 °C to 20.0 °C and predicts the volume doubles to 4.00 L. Explain the error and correct it.

21. A student says doubling the pressure on a gas (at constant temperature) doubles its volume. Explain the error and correct it.

I Challenge

2 marks

22. 1.00 g of an unknown gas occupies 0.500 L at 100. kPa and 27.0 °C. Find its molar mass.

Gas Laws **ANSWER KEY****Key formulas****Always use kelvin:** $T(K) = T(^{\circ}C) + 273.15$ · 1 atm = 101.325 kPa = 760 mmHg**Boyle:** $P_1V_1 = P_2V_2$ · **Charles:** $V_1/T_1 = V_2/T_2$ · **Gay-Lussac:** $P_1/T_1 = P_2/T_2$ · **Combined:** $P_1V_1/T_1 = P_2V_2/T_2$ **Ideal gas law:** $PV = nRT$, $R = 8.314 \text{ kPa}\cdot\text{L}/(\text{mol}\cdot\text{K})$ · **Molar volume:** 22.4 L/mol at STP (0 °C, 101.325 kPa), 24.8 L/mol at SATP (25 °C, 100 kPa)Give answers to 3 significant figures. Molar mass of $\text{CO}_2 = 44.01 \text{ g/mol}$.**A Temperature and pressure conversions**

4 marks

- | | | | |
|---------------------|---------|------------------------|---------|
| 1. 25.0 °C = ____ K | 298 K | 2. -40.0 °C = ____ K | 233 K |
| 3. 350. K = ____ °C | 76.9 °C | 4. 2.50 atm = ____ kPa | 253 kPa |

B Boyle's law (constant T)

3 marks

5. A gas occupies 4.00 L at 100. kPa. It is compressed to 2.00 L at constant temperature. Find the new pressure.

$$P_2 = P_1V_1 \div V_2 = (100. \times 4.00) \div 2.00 = 200 \text{ kPa}$$

6. 250. mL of gas at 95.0 kPa is compressed until its pressure is 190. kPa. Find the new volume.

$$V_2 = (95.0 \times 250.) \div 190. = 125 \text{ mL}$$

7. A 3.0 L sample of gas at 1.5 atm is squeezed to 4.5 atm. Find the new volume.

$$V_2 = (1.5 \times 3.0) \div 4.5 = 1.0 \text{ L}$$

C Charles's law (constant P)

3 marks

8. A 2.00 L balloon at 25.0 °C is heated to 100.0 °C at constant pressure. Find the new volume.

$$V_2 = V_1T_2 \div T_1 = 2.00 \times 373.15 \div 298.15 = 2.50 \text{ L}$$

9. 500. mL of gas at 300. K is cooled to 150. K. Find the new volume.

$$V_2 = 500. \times 150. \div 300. = 250 \text{ mL}$$

10. A 1.50 L balloon at 20.0 °C must expand to 2.00 L. To what temperature (in K and °C) must it be heated?

$$T_2 = T_1V_2 \div V_1 = 293.15 \times 2.00 \div 1.50 = 391 \text{ K (118 }^{\circ}\text{C)}$$

D Gay-Lussac's law (constant V)

2 marks

11. A tire is at 220. kPa and 15.0 °C. After driving, it reaches 45.0 °C. Find the new pressure (volume constant).

$$P_2 = P_1 T_2 \div T_1 = 220. \times 318.15 \div 288.15 = 243 \text{ kPa}$$

12. A sealed can is at 150. kPa and 20.0 °C. At what temperature will the pressure reach 300. kPa?

$$T_2 = 293.15 \times 300. \div 150. = 586 \text{ K (313 °C)}$$

E Combined gas law

4 marks

2 marks each.

13. 5.00 L of gas at 100. kPa and 27.0 °C is changed to 200. kPa and 127.0 °C. Find the new volume.

$$V_2 = V_1 \times (P_1 \div P_2) \times (T_2 \div T_1) = 5.00 \times (100. \div 200.) \times (400.15 \div 300.15) = 3.33 \text{ L}$$

14. 2.50 L of gas at STP (0 °C, 101.325 kPa) is moved to 25.0 °C and 98.0 kPa. Find the new volume.

$$V_2 = 2.50 \times (101.325 \div 98.0) \times (298.15 \div 273.15) = 2.82 \text{ L}$$

F Ideal gas law

6 marks

2 marks each.

15. How many moles of gas are in a 10.0 L tank at 200. kPa and 300. K?

$$n = PV \div RT = (200. \times 10.0) \div (8.314 \times 300.) = 0.802 \text{ mol}$$

16. What volume do 2.00 mol of gas occupy at 100. kPa and 25.0 °C?

$$V = nRT \div P = (2.00 \times 8.314 \times 298.15) \div 100. = 49.6 \text{ L}$$

17. What mass of CO₂ is in a 5.00 L container at 150. kPa and 20.0 °C?

$$n = (150. \times 5.00) \div (8.314 \times 293.15) = 0.308 \text{ mol}; m = 0.308 \times 44.01 = 13.5 \text{ g}$$

G Molar volume

2 marks

18. What volume does 0.500 mol of gas occupy at STP?

$$V = 0.500 \text{ mol} \times 22.4 \text{ L/mol} = 11.2 \text{ L}$$

19. How many moles of gas are in 74.4 L at SATP?

$$n = 74.4 \text{ L} \div 24.8 \text{ L/mol} = 3.00 \text{ mol}$$

H Spot the mistake

2 marks

20. A student heats 2.00 L of gas from 10.0 °C to 20.0 °C and predicts the volume doubles to 4.00 L. Explain the error and correct it.

Gas laws need kelvin. 283.15 K → 293.15 K is only a small increase: $V_2 = 2.00 \times 293.15 \div 283.15 = 2.07 \text{ L}$

21. A student says doubling the pressure on a gas (at constant temperature) doubles its volume. Explain the error and correct it.

Boyle's law is an inverse relationship: doubling the pressure halves the volume.

I Challenge

2 marks

22. 1.00 g of an unknown gas occupies 0.500 L at 100. kPa and 27.0 °C. Find its molar mass.

$$n = (100. \times 0.500) \div (8.314 \times 300.15) = 0.0200 \text{ mol}; M = 1.00 \text{ g} \div 0.0200 \text{ mol} = 49.9 \text{ g/mol}$$