Charles Law Chemistry Questions with Solutions

Q1. Suppose P, V, and T denote the gas's pressure, volume, and temperature. In that case, the correct representation of Chale's law is

(a) V is directly proportional to T (at constant P)
(b) V inversely proportional to T (at constant P)
(c) PV = nRT
(d) None of the above

Answer: (a), If P, V, and T denote the gas's pressure, volume, and temperature, then the correct representation of Chale's law is V is directly proportional to T (at constant P).

$$V \propto T$$
$$\text{Or, } V / T = k$$
$$\text{Or, } V = kT$$

Q2. How can we convert a Celsius temperature to Kelvin temperature?

(a) By adding 37
(b) By subtracting 37
(c) By subtracting 273
(d) By adding 273

Answer: (d), We can convert a Celsius temperature to Kelvin temperature by adding 273 to it.

Q3. Which element should remain constant if Charle's law is applied to a gas sample?

(a) Temperature and the number of moles of a gas
(b) Pressure and the number of moles of a gas
(c) Volume and the number of moles of a gas
(d) Pressure only

Answer: (d), If Charle's law is applied than the pressure of the gas sample should remain constant.

Q4. What is the value of the gas constant R?

(a) 8.314 J mol^{-1} K^{-1}
(b) 0.082 J litre atm
(c) 0.987 cal mol^{-1} K^{-1}
(d) 83 erg mol^{-1} K^{-1}

Answer: (a), The value of gas constant R is 8.314 J mol^{-1} K^{-1}.

Q5. According to Charle's law, if the temperature of a gas at constant pressure is increased, the volume will also

(a) Increase
(b) Decrease
(c) Remains the same
(d) Can't be determined

Answer: (a), Charle's law states that volume is directly proportional to the temperature at constant pressure.

$$V \propto T$$
$$\text{Or, } V / T = k$$
$$\text{Or, } V = kT.$$

Thus, if the system's temperature increases, its volume will increase.

Q6. What is Charle's law?

Answer: Charle's law states that the volume of the gas is directly proportional to the absolute temperature of the gas at constant pressure.

$$V \propto T$$
$$\text{Or, } V / T = k$$
$$\text{Or, } V = kT.$$

Thus, if the system's temperature increases, its volume will increase or if the system's temperature decreases, its volume will decrease.

Q7. Do you encounter any of the applications of Charle's law in everyday life? If yes, Where?

Answer: Yes, we encounter applications of Charle's law in everyday life. When we take a volleyball outside on a hot day, the ball expands a bit. As the temperature increases, its volume also increases, leading to the expansion of volleyball. Similarly, the volleyball shrinks on a cold day as the temperature drops; its size also decreases.

Q8. Is Charles Law indirect or direct relation?

Answer: Charle's law is a direct relation between the temperature and the volume of the gas. When the molecule's temperature rises, molecules move faster thereby creating more pressure on the gas container. Hence, increasing the volume of the container. If the pressure of the gas container remains constant then the number of the molecules also remains constant.

Q9. Can we use quantities in °C in Charle's law?

Answer: No, we can not use quantities in °C in Charle's law. The relationship between volume and temperature will work when the temperature is taken in kelvin while we can use any quantity for the volume of the gas.

Q10. Match the following.

Column 1	Column 2

Ideal Gas law	**$P_{TOTAL} = P_1 + P_2 + P_3 + P_4 + ... P_\infty$ (at constant volume and temperature)**
Boyle's law	**V = kN (at constant pressure and temperature)**
Charles' law	**V = kT (at constant pressure)**
Avogadro law	**PV = k (at constant temperature)**
Dalton's law	**PV = nRT**

Answer:

Column 1	Column 2
Ideal Gas law	**PV = nRT**
Boyle's law	**PV = k (at constant temperature)**
Charles' law	**V = kT (at constant pressure)**
Avogadro law	**V = kN (at constant pressure and temperature)**
Dalton's law	**$P_{TOTAL} = P_1 + P_2 + P_3 + P_4 + ... P_\infty$ (at constant volume and temperature)**

Q11. Calculate the decrease in temperature (in Celsius) when 2.00 L at 21.0 °C is compressed to 1.00 L.

Answer: Given

Initial Volume (V_1) = 2 L

Initial Temperature (T_1) = 21.0 °C = (21 + 273) K = 294 K

Final Volume (V_2) = 1 L

To Find: Final Temperature (T_2) = ?

We can calculate the final temperature of the gas using Charle's law.

$V_1 / T_1 = V_2 / T_2$

$2 / 294 = 1 / T_2$

$T_2 = 294 / 2$

$T_2 = 147$ K

$T_2 = (147 - 273) = - 126$ °C

Hence the final temperature of the gas at volume 1 L is equivalent to - 126 °C.

Q12. A gas occupies a volume of 600.0 mL at a temperature of 20.0 °C. What will be its volume at 60.0 °C?

Answer: Given

Initial Volume (V_1) = 600.0 mL

Initial Temperature (T_1) = 20.0 °C = (20 + 273) K = 293 K

Final Temperature (T_2) = 60.0 °C = (60 + 273) K = 333 K

To Find: Final Volume (V_2) = ?

We can calculate the final volume of the gas using Charle's law.

$V_1 / T_1 = V_2 / T_2$

$600 / 293 = V_2 / 333$

$V_2 = (600 \times 333) / 293$

$V_2 = 199800 / 293$

$V_2 = 681.91 \approx 682$ mL

Hence the final volume of the gas at 60.0 °C is equivalent to 681.91 ≈ 682 mL.

Q13. A gas occupies a volume of 900.0 mL at a temperature of 27.0 °C. What is the volume at 132.0 °C?

Answer: Given

Initial Volume (V_1) = 900.0 mL

Initial Temperature (T_1) = 27.0 °C = (27 + 273) K = 300 K

Final Temperature (T_2) = 132.0 °C = (132 + 273) K = 405 K

To Find: Final Volume (V_2) = ?

We can calculate the final volume of the gas using Charle's law.

$V_1 / T_1 = V_2 / T_2$

$900 / 300 = V_2 / 405$

$V_2 = (900 \times 405) / 300$

$V_2 = 364500 / 300$

$V_2 = 1215$ mL

Hence the final volume of the gas at 132.0 °C is equivalent to 1215 mL or 1.215 L.

Q14. What change in volume results if 60.0 mL of gas is cooled from 33.0 °C to 5.00 °C?

Answer: Given

Initial Volume (V_1) = 60.0 mL

Initial Temperature (T_1) = 33.0 °C = (33 + 273) K = 306 K

Final Temperature (T_2) = 5.0 °C = (5 + 273) K = 278 K

To Find: Final Volume (V_2) = ?

We can calculate the final volume of the gas using Charle's law.

$V_1 / T_1 = V_2 / T_2$

$60 / 306 = V_2 / 278$

$V_2 = (60 \times 278) / 306$

$V_2 = 16680 / 306$

V_2 = 54.50 mL
Change in the volume = 60.0 - 54.5 = 5.5 mL.
Hence the change in the volume of the gas at 5.0 °C is equivalent to 5.5 mL.

Q15. A gas occupies a volume of 300.0 mL at a temperature of 17.0 °C. What is the volume at 10.0 °C?
Answer: Given
Initial Volume (V_1) = 300.0 mL
Initial Temperature (T_1) = 17.0 °C = (17 + 273) K = 290 K
Final Temperature (T_2) = 10.0 °C = (10 + 273) K = 283 K
To Find: Final Volume (V_2) = ?
We can calculate the final volume of the gas using Charle's law.
$V_1 / T_1 = V_2 / T_2$
300 / 290 = V_2 / 283
V_2 = (300 X 283) / 290
V_2 = 84900 / 290
V_2 = 292.75 mL
Hence the final volume of the gas at 10.0 °C is equivalent to 292.75 mL.

Practise Questions on Charles Law

Q1. Differentiate between Boyle's law and Charle's law.

Answer:

S. No.	Boyle's Law	Charle's Law
1.	Boyle's law gives a relation between the pressure and the volume of the gas.	Charle's law gives a relation between the temperature and the volume of the gas.
2.	Temperature is kept constant.	Pressure is kept constant.
3.	Pressure is inversely proportional to the volume.	Temperature is directly proportional to the volume.
4.	$P \propto 1 / V$	$T \propto V$
5.	The product of the pressure and the volume is constant.	The ratio of the temperature and the volume is constant.
6.	PV = k	V = kT

Q2. A gas occupies a volume of 500.0 mL at a temperature of 10.0 °C. What will be its volume at 50.0 °C?

Answer: Given

Initial Volume (V_1) = 500.0 mL

Initial Temperature (T_1) = 10.0 °C = (10 + 273) K = 283 K

Final Temperature (T_2) = 50.0 °C = (50 + 273) K = 323 K

To Find: Final Volume (V_2) = ?

We can calculate the final volume of the gas using Charle's law.

$V_1 / T_1 = V_2 / T_2$

$500 / 283 = V_2 / 323$

$V_2 = (500 \times 323) / 283$

$V_2 = 161500 / 283$

$V_2 = 570.67 \approx 571$ mL

Hence the final volume of the gas at 50.0 °C is equivalent to 570.67 ≈ 571 mL.

Q3. A gas occupies a volume of 100.0 mL at a temperature of 27.0 °C. What is the volume at 10.0 °C?

Answer: Given

Initial Volume (V_1) = 100.0 mL

Initial Temperature (T_1) = 27.0 °C = (27 + 273) K = 300 K

Final Temperature (T_2) = 10.0 °C = (10 + 273) K = 283 K

To Find: Final Volume (V_2) = ?

We can calculate the final volume of the gas using Charle's law.

$V_1 / T_1 = V_2 / T_2$

$100 / 300 = V_2 / 283$

$V_2 = (100 \times 283) / 300$

$V_2 = 28300 / 300$

$V_2 = 94.33 \approx 94$ mL

Hence the final volume of the gas at 10.0 °C is equivalent to 94.33 ≈ 94 mL.

Q4. What change in volume results if 10.0 mL of gas is cooled from 33.0 °C to 15.0 °C?

Answer: Given

Initial Volume (V_1) = 10.0 mL

Initial Temperature (T_1) = 33.0 °C = (33 + 273) K = 306 K

Final Temperature (T_2) = 15.0 °C = (15 + 273) K = 288 K

To Find: Final Volume (V_2) = ?

We can calculate the final volume of the gas using Charle's law.

$V_1 / T_1 = V_2 / T_2$

$10 / 306 = V_2 / 288$

$V_2 = (10 \times 288) / 306$

$V_2 = 2880 / 306$

V_2 = 9.41 mL
Change in the volume = 10.0 - 9.41 = 0.59 mL.
Hence the change in the volume of the gas at 15.0 °C is equivalent to 0.59 mL.

Q5. A gas occupies a volume of 1 L at a temperature of 17.0 °C. What is the volume at 10.0 °C?
Answer: Given
Initial Volume (V_1) = 1 L
Initial Temperature (T_1) = 17.0 °C = (17 + 273) K = 290 K
Final Temperature (T_2) = 10.0 °C = (10 + 273) K = 283 K
To Find: Final Volume (V_2) = ?
We can calculate the final volume of the gas using Charle's law.
$V_1 / T_1 = V_2 / T_2$
$1 / 290 = V_2 / 283$
$V_2 = (1 X 283) / 290$
$V_2 = 283 / 290$
V_2 = 0.97586 L = 975.86 mL ≈ 976 mL
Hence the final volume of the gas at 10.0 °C is equivalent to 976 mL.