Unit 5: Physical States of Matter
Exercise Questions

Exercise Multiple Choice Question Answers

1. How many times liquids are denser than gases?
(a) 100 times (b) 1000 times (c) 10,000 times (d) 10 times

2. Gases are the lightest form of matter and their densities are expressed in terms of:
(a) mg cm^{-3} (b) g cm^{-3} (c) g dm^{-3} (d) kg dm^{-3}

3. At freezing point which one of the following coexists in dynamic equilibrium:
(a) Gas and solid (b) liquid and gas (c) liquid and solid (d) all of these.

4. Solid particles possess which one of the following motions?
(a) Rotational motions (b) vibrational motions
(c) Translational motions (d) both translational and vibrational motions

5. Which one of the following is not amorphous?
(a) Rubber (b) plastic (c) glass (d) glucose.

6. One atmospheric pressure is equal to how many pascals:
(a) 101325 (b) 10325 (c) 106075 (d) 10523

7. In the evaporation process, liquid molecules which leave the surface of the liquid have:
(a) Very low energy (b) moderate energy (c) very high energy (d) none of these

8. Which one of the following gas diffuses faster?
(a) Hydrogen (b) helium (c) fluorine (d) chlorine

9. Which one of the following does not affect the boiling point?
(a) Intermolecular forces (b) external pressure
(c) Nature of liquid (d) initial temperature of liquid

10. Density of a gas increases, when its:
(a) Temperature is increased (b) pressure is increased
(c) Volume is kept constant (d) none of these

11. The vapour pressure of a liquid increases with the:
(a) Increase of pressure (b) increase of temperature
(c) Increase of intermolecular forces (d) increase of polarity of molecules

ANSWR KEY

1	a	4	b	7	c	10	b
2	c	5	d	8	a	11	b
3	c	6	a	9	d		

Exercise Short Question Answers

Q.1 What is diffusion, explain with an example?

Ans: *The spontaneous mixing of particles of a substance by random motion and collisions, to form a homogeneous mixture is called diffusion.*

OR

Movement of molecules of a substance from the region of higher concentration to the region of lower concentration is called diffusion.

Example: When a few drops of ink are added in beaker of water, ink molecules move around and after a while spread in whole of the beaker. This diffusion has taken place.

Q.2 Define standard atmospheric pressure. What are its units? How it is related to Pascal?

Ans: Standard atmospheric pressure:

It is the pressure exerted by the atmosphere at the sea level. It *is defined as* ***the pressure exerted by a mercury column of 760mm height at sea level****". It is sufficient pressure to support a column of mercury 760mm in height at sea level.*

Units:

i. One atmosphere (1 atm): 1 atm is called standard pressure

ii. One pascal (1 Pa)

1atm = 760mmHg = 760torr = 10132 Nm^{-2} = 101325Pa

(as 1mmHg = 1torr

$1Nm^{-2}$ = 1Pa)

Q.3 Why are the densities of gases lower than that of liquids?

Ans: Gases have lower densities than densities of liquids. It is due to the light mass and more volume occupied by the gases. Another reason for lower densities of gases is negligible intermolecular forces among the gases molecules. On the other hand liquid molecules are closely spaced and have strong intermolecular forces.

Q.4 What do you mean by evaporation, how it is affected by surface area?

Ans: Evaporation:

"*The process of changing of a liquid into a gas phase is called evaporation.*"

Affect of surface area on evaporation:

Evaporation is a surface phenomenon. Greater is surface area, greater is evaporation and vice versa.

Q.5 Define the term allotropy with examples.

Ans: Allotropy:

"The existence of an element in more than one forms, in same physical state is called allotropy."

Examples:

i. Oxygen has two allotropic forms i.e. oxygen (O_2) and ozone (O_3).

ii. Three allotropic forms of carbon are: Diamond, graphite and bucky balls.

Q.6 In which form sulphur exists at 100°C?

Ans: Sulphur exists in monoclinic form at 100°C

Q.7 What is the relationship between evaporation and boiling point of a liquid?

Ans: Relationship between evaporation and boiling point:

If the boiling point of a liquid is high, its evaporation is low. Because intermolecular forces are high in the liquid which have high boiling points. If boiling point is low then evaporation is high.

Exercise Long Question Answers

Q.1 Define Boyle's law and verify it with example.

Ans: See Q. No. **2** (Subjective Part, Long Questions Answers)

Q.2 Define and explain Charles law of gases.

Ans: See Q. No. **3** (Subjective Part, Long Questions Answers)

Q.3 What is vapour pressure and how it is affected by intermolecular forces.

Ans: See Q. No. **9** (Subjective Part, Long Questions Answers)

Q.4 Define boiling point and how explain, how it is affected by different factors.

Ans: See Q. No. **10** (Subjective Part, Long Questions Answers)

Q.5 Describe the phenomena of diffusion in liquids along with factors which influence it.

Ans: See Q. No. **12** (Subjective Part, Long Questions Answers)

Q.6 Differentiate between crystalline and amorphous solids.

Ans: See Q. No. **15** (Subjective Part, Long Questions Answers)

Exercise Solved Numericals

Q.1 Convert the following units:

a. 850 mm Hg to atm

b. 205000 Pa to atm

c. 560 torr to cm Hg

Solution:

a. 850 mmHg to atm

$$760\text{mmHg} = 1\text{atm}$$

$$1\text{mmhg} = \frac{1}{760}atm$$

$$850\text{mmHg} = \frac{1}{760}\times 850atm$$

$$= 1.12\text{atm}$$

b. 205000 Pa to atm

$$101325\text{Pa} = 1\text{atm}$$

$$1\text{Pa} = \frac{1}{101325}atm$$

$$205000\text{Pa} = \frac{1}{101325}\times 205000\ \text{atm}$$

$$= 2.02\ \text{atm}$$

c. 560 torr to cm Hg

$$760\ \text{torr} = 760\ \text{mmHg}$$

$$= 76\ \text{cmHg}$$

$$1\ \text{torr} = \frac{76}{760}\ \text{cmHg}$$

$$560\ \text{torr} = \frac{?}{760}\ 560cmHg$$

$$= 56\ \text{cmHg}$$

d. 1.25 atm to Pa

$$1\ \text{atm} = 101325\text{Pa}$$

$$1.25\ \text{atm} = 1.25\times 101325\text{Pa}$$

$$= 126656\ \text{Pa}$$

Q.2 Convert the following units.

a. 750°C to K **b. 50°C to K** **c. 100 K to °C** **d. 172 K to °C**

Solution:

a. 750°C to K

$$T\ (°C) = 750\ °C$$

$$T\ (K) = ?$$

$$T\ (K) = T(°C) + 273$$

$$= 750 + 273$$

$$= 1023K$$

b. 150°C to K

$$T(°C) = 150\ °C$$
$$T\ (K) = ?$$
$$T\ (K) = T(°C) + 273$$
$$= 150 + 273$$
$$= 423$$

c. 100 K to °C

$$T\ (K) = 100\ K$$
$$T\ (°C) = ?$$
$$T(°C) = T(K) - 273.15$$
$$= 100 - 273$$
$$= -173°C$$

d. 172 K to °C

$$T\ (K) = 172\ K$$
$$T\ (°C) = ?$$
$$T(°C) = T(K) - 273$$
$$= 172 - 273$$
$$= -\ 101°C$$

Q.3 A gas at pressure 912 mm of Hg has volume 450cm^3. What will be its volume at 0.4 atm.

Given Data:

$$P_1 = 912\ mm\ Hg = \frac{912\ mm\ Hg}{760\ mm\ Hg}$$
$$= 1.2\ atm$$
$$= 450\ cm^3$$
$$P_2 = 0.4\ atm$$

Required:

$$V_2 = ?$$

Using the equation of Boyle's Law:

$$P_1V_1 = P_2V_2$$

Solution:

By putting the values.

$$1.2\ atm \times 450\ cm^3 = 0.4\ atm \times V_2$$
$$V_2 = \frac{1.2\ atm \times 450\ cm^3}{0.4\ atm}$$
$$V_2 = \frac{12}{4} \times 450\ cm^3$$
$$V_2 = 3 \times 450\ cm^3$$
$$\mathbf{V2 = 1350\ cm^3}$$

Q.4 A gas occupies a volume of 800 cm^3 at 1 atm, when it is allowed to expand up to 1200 cm^3 what will be its pressure in mm of Hg.

Given Data:

$P_1 = 1$ atm

$V_1 = 800\ cm^3$

$V_2 = 1200\ cm^3$

Required:

$P_2 = ?$

Using the equation of Boyle's Law:

$P_1V_1 = P_2V_2$

Solution:

By putting the values

$1\ atm \times 800\ cm^3 = P_2 \times 1200\ cm^3$

$$P_2 = \frac{1\ atm \times 800\ cm^3}{1200\ cm^3}$$

$$P_2 = \frac{2}{3}\ cm^3$$

$P_2 = 0.667$ atm

As $1\ atm = 760mmHg$

So $0.66\ atm = 760 \times 0.66 mmHg$

$= 506.6 mmHg$

Q.5 It is desired to increase the volume of a fixed amount of gas from 87.5 to 118 cm^3 while holding the pressure constant. What would be the final temperature if the "initial temperature is 23°C.

Given Data:

$V_1 = 87.5\ cm^3$

$V_2 = 118\ cm^3$

$T_1 = 23°C\ (23+273)\ K = 296K$

Required:

$T_2 = ?$

By using the equation of Charle's law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Solution $T_2V_1 = V_2 \times T_1$

Or

$$T_2 = \frac{V_2 T_1}{V_1}$$

By putting the values

$$T_2 = \frac{118cm^3 \times 296K}{87.5\ cm^3}$$

$T_2 = 399K$

T_2 can be converted into Celsius scale as:

$T_2 = 299 - 273 = 126°C$

Q.6 **A sample of gas is cooled at constant pressure from 30°C to 10°C. Comment:**

a. Will the volume of the gas decrease to one third of its original volume?

b. If not, then by what ratio will the volume decrease?

Solution:

a.

$T_1 = 30°C = (30+273)\ K = 303K$

$T_2 = 10°C = (10+273)K = 283K$

$V_1 = 1\ dm^3$

Required: $V_2 = ?$

Solution:

By using the equation of Charle's law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V_2 = \frac{V_1}{T} \times T_2$$

By putting the values

$$= \frac{1dm^3}{303K} \times 28.$$

$$V_2 = 0.93dm^3$$

The volume of gas will not decrease to one th rd of its original volume.

(b) The volume decreases in the ration 1:0.93.

Q.7 **A balloon that contains 1.6 dm^3 of air standard temperature and pressure is taken under water to a depth at which its pressure increases to 3.0 atm. Suppose that temperature remain unchanged what would be the new volume of the balloon. Does it contract or expand?**

Given Data:

$= 1\ atm$

$V_1 = 1.6\ dm^3$

$P_2 = 3.0\ atm$

Required:

$V_2 = ?$

Solution:

By using the equation of Boyle's law

$P_1V_1 = P_2V_2$

By putting values

$atm \times 1.6\ dm = 3\ atm \times V_2$

$$V_2 = \frac{1\ atm \times 1.6\ dm^3}{3\ atm}$$

$V_2 = 0.53\ dm^3$

The new volume of balloon is 0.55dm^3. It will contract.

Q.8 **A sample of neon gas occupies 75.0 cm^3 at very low pressure of 0.4 atm. Assuming temperature remain constant what would be the volume at 1.0 atm pressure?**

Given Data:

$$P_1 = 0.4 \text{ atm}$$
$$V_1 = 75.0 \text{ cm}^3$$
$$P_2 = 1 \text{ atm}$$

Required:

$$V_2 = ?$$

Solution

By using the equation of Boyle's law

$$P_1V_1 = P_2V_2$$

By putting the values

$$0.4 \text{ atm} \times 75 \text{ cm}^3 = 1 \text{ atm} \times V_2$$

$$V_2 = \frac{0.4 \text{ atm} \times 75 \text{ cm}^3}{1 \text{ atm}}$$

$$\mathbf{V_2 = 30 \text{ cm}^3}$$

Q.9 **A gas occupies a volume of 35.0 dm^3 at 17°C If the gas temperature rises to 34°C at constant pressure, would you expect the volume to double? If not calculate the new volume.**

Given Data:

$$T_1 = 17 \text{ °C}$$
$$= 273 + 17 = 290 \text{ K}$$
$$V_1 = 35 \text{ dm}^3$$
$$T_2 = 34 \text{ °C}$$
$$= 273 + 34 = 307 \text{ K}$$

Required:

$$V_2 = ?$$

Solution:

Volume will not be doubled because the absolute temperature is not doubled.

By using the equation of Charles law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

By putting the values

$$\frac{35 \text{ dm}^3}{290 \text{ K}} = \frac{V_2}{307 \text{ K}} \text{ or}$$

$$V_2 = \frac{35 \text{ dm}^3 \times 307 \text{ K}}{290 \text{ K}}$$

$$37 \text{ dm}^3 = V_2$$

Q.9 **The largest moon of Saturn, is Titan. It has atmospheric pressure of 1.6×10^5 Pa. What is the atmospheric pressure in atm? Is it higher than earth's atmospheric pressure?**

Solution:

We know that

$$1 \text{atm} = 101325 \text{ Pa}$$

Atmospheric pressure of titan in Pascal $= 1.6\times10^5$Pa.

Atmospheric pressure of titan in atm $= \dfrac{1.6\times10^5}{101325}$

$= 1.58$atm

Thus the atmosphere pressure of titan (1.58 atm) is greater than the atmospheric pressure of earth (1.0atm).