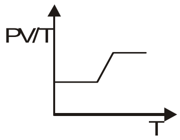
GASEOUS STATE

Single Correct Answer Type

1. A gas in an open container is heated from 27°C to 127°C. Then what fraction of original amount of gas will remain in the vessel ?
(A) 3/4 (B) 1/2 (C) 1/4 (D) 1/8

2. The chemical change that corresponds to the adjacent graph is
(A) $3H_{2(g)} + N_{2(g)} \rightarrow 2NH_{3(g)}$
(B) $SO_{2(g)} + Cl_{2(g)} \rightarrow SOCl_{2(g)}$
(C) $I_{2(g)} + H_{2(g)} \rightarrow 2HI_{(g)}$
(D) $PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$



3. Three vessels of capacities 300 ml, 600 ml and 100 ml contain gases A, B and C at a pressure of 2 atm, 1 atm and 6 atm. If these vessels are linked to one another, the total pressure of the mixture is equal to
(A) 1 atm (B) 1.8 atm (C) 1.2 atm (D) 1.6 atm

4. A uniform glass tube of 100 cm length is connected to a bulb containing hydrogen at one end and another bulb containing oxygen at the other end at the same temperature and pressure. The two gasses meet for the first time at the following distance from the oxygen end
(A) 80 cm (B) 50 cm (C) 20 cm (D) 6.66 cm

5. Equal weights of CH_4 and a gas X are present in a vessel at 27°C and 780 mm. If the partial pressure of X is 130 mm, the molecular weight of X is
(A) 64 (B) 128 (C) 48 (D) 80

6. The kinetic energy of N hydrogen molecules at -73°C is x joule. The kinetic energy of oxygen molecules at 127°C is 4x joule. Hence the number of oxygen molecules is (N = Avagadro number)
(A) 2N (B) N (C) N/2 (D) 4N

7. The density of a gas at 27°C and 1 atm is d. Pressure remaining constant, at which of the following temperatures will its density become 0.75d.
(A) 20°C (B) 30°C (C) 400 K (D) 300 K

8. 180 ml of a hydrocarbon diffuses through a porous membrane in 15 minutes, while 120 ml of SO_2 under similar conditions diffuse in 20 minutes. The molecular weight of hydrocarbon is
(A) 16 (B) 64 (C) 32 (D) 8

9. Balloons of 4 litres capacity are to be filled with hydrogen at a pressure of 1 atm and 27°C from an 8 litre cylinder containing hydrogen at 10 atm at the same temperature. The number of balloons that can be filled is
(A) 20 (B) 18 (C) 40 (D) 38

10. At a given temperature, average velocity of A is equal to RMS velocity of gas B. Then A and B are likely to be
(A) H_2, He (B) N_2, O_2 (C) SO_2, SO_3 (D) CO_2, CO

11. The most probable velocity of methane gas molecules at 100 Nm^{-2} pressure in 20 m^3 volume container is
(A) $5\sqrt{10}$ ms^{-1} (B) 500 ms^{-1} (C) $\sqrt{\frac{3\times1000}{8}}$ ms^{-1} (D) 2000 ms^{-1}

12. The kinetic energy of 8 grams of H_2 at 27°C is how many times the kinetic energy of 8 grams of O_2 at the same temperature?
(A) 2 times (B) 3 times (C) 8 times (D) 16 times

13. A gaseous mixture of He and O_2 is found to have a density of 0.543g dm^{-3} at 27°C and 760 Torr. The mass percent of helium in the mixture is
(A) 66.5 (B) 33.5 (C) 20.2 (D) 80.12

14. A mixture of NH_3(g) and N_2H_4(g) is placed in a sealed container at 300 K. The total pressure of the gas is 0.5 atm. The container is heated to 1200 K, where the following decomposition reactions take place.
$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$
$N_2H_4 (g) \rightarrow N_2(g) + 2H_2(g)$
The pressure of the vessel at this stage becomes 4.5 atm. The mole percent of N_2H_4(g) in the original mixture was
(A) 25 (B) 50 (C) 75 (D) 88

15. Which of the following expressions of compression factor Z of a real gas is applicable at low pressure ?
(A) Z = 1–a/VRT (B) Z = 1 + a/VRT (C) Z = 1 + pb/RT (D) Z = 1–pb/RT

16. Match the following :

Different units of p and V	R-value
A) atmosphere and litre	I) 8.314 J mol^{-1} K^{-1}
B) $dyne/cm^2$ and cm^3	II) 8.314×10^7 erg mol^{-1} K^{-1}
C) $newton/m^2$ and m^3	III) 0.0821 litre atm mol^{-1} K^{-1}
D) atmosphere and cm^3	IV) 82.1 cm^3 atm mol^{-1} K^{-1}

	A	B	C	D
(A)	III	II	IV	I
(B)	IV	V	I	II
(C)	III	V	I	IV
(D)	III	II	I	IV

17. A gas obeys the equation of state P(V–b) = RT, where 'b' is a constant. The slope of an isochore will be
(A) – ve (B) zero (C) $\frac{R}{V-b}$ (D) R/P

18. SO_2 and He are kept in a container at partial pressure P_1 and P_2. If the two gases effuse out at the same rate. The ratio of P_1 to P_2 will be
(A) 16 : 1 (B) 1 : 16 (C) 4 : 1 (D) 3 : 1

19. If A, B, C are Boyle temperature, Critical temperature and inversion temperature of a gas respectively, then
(A) A < C < B (B) B > A > C (C) A > B > C (D) C > A > B

20. Ratio of fraction of molecules moving with most probable velocity for O_2 to H_2 at same temperature is
(A) 1:1 (B) 1:2 (C) 2:1 (D) 1:4

Numerical based

21. Number of moles present in 6 litres of an ideal gas with a pressure of 8.2 atmosphere at 300 K is _______.

22. One mole of a van der Waals gas occupies 15 litres at a pressure of 0.82 atm at 300 K. Its compressibility coefficient is $x\times10^{-1}$. The value of x is ____________.

23. Dry air at one atmospheric pressure has 78% nitrogen, 21% oxygen and 1% other gases. The partial pressure of other gases is $x\times10^{-2}$atm, where x is ________.

24. A mixture of nitrogen and hydrogen initially in the molar ratio of 1:3 reached equilibrium to form ammonia when 25% of the material had reacted. If the total pressure of the system is 28 atm, calculate the partial pressure of ammonia at the equilibrium.

25. It take 2 times as long for a given quantity (moles) of gas A to effuse from a container than it takes for the same quantity of gas B. If the molar mass of A is 32g mol^{-1}, what is the molar mass of B in g mol^{-1}?

KEY

1.	A	**2.**	D	**3.**	B	**4.**	C	**5.**	D
6.	A	**7.**	C	**8.**	A	**9.**	B	**10.**	B
11.	A	**12.**	D	**13.**	C	**14.**	A	**15.**	A
16.	D	**17.**	C	**18.**	C	**19.**	D	**20.**	D
21.	2	**22.**	5	**23.**	1	**24.**	4	**25.**	8

SOLUTIONS

1. A

When a gas in open vessel is heated, certain amount of gas escapes and remaining molecules occupy the entire volume

$\therefore$ P and V remain constant

$P_1V_1 = P_2V_2$; $n_1T_1 = n_2T_2$

$1 \times 300 = n_2 \times 400$

$n_2 = 3/4$

2. D

$\frac{PV}{T} = nR$ $\frac{PV}{T} \alpha n$

$PCl_5 \rightarrow PCl_3 + Cl_2$; Once dissociation is complete 'n' value doubles.

3. B

$$P_{mix} = \frac{P_1V_1 + P_2V_2 + P_3V_3}{V_{mix}} = \frac{300 \times 2 + 600 \times 1 + 100 \times 6}{1000} = 1.8 \text{ atm}$$

4. C

Let these two gases meet at a distance of 'x' cm from oxygen end

$$\frac{r_{H_2}}{r_{O_2}} = \frac{100 - x}{x} = \sqrt{\frac{32}{2}}$$

$100 - x = 4x$

$5x = 100$ $x = 20$

5. D

$p_i = x_i p$; $\frac{p_1}{p_2} = \frac{n_1}{n_2} = \frac{w_1}{w_2} \times \frac{M_2}{M_1}$; If wts are same $\frac{p_1}{p_2} = \frac{M_2}{M_1}$

$\frac{P_{CH_4}}{P_X} = \frac{650}{130} = \frac{M_x}{16}$ $M_x = 80$

6. A

$$\frac{KE_1}{KE_2} = \frac{\frac{3}{2}.\frac{N_1}{N_0}.RT}{\frac{3}{2}\frac{N_2}{N_0}RT_2} = \frac{N_1T_1}{N_2T_2}$$

$$\frac{KE(H_2)}{KE(O_2)} = \frac{x}{4x} = \frac{N \times 200}{N_2 \times 400} \Rightarrow N_2 = 2N$$

7. C

PM = dRT $d = \frac{PM}{RT}$

at constant pressure $d_1T_1 = d_2T_2$

$d \times 300 = \frac{3}{4} d.T_2$

$T_2 = 400\text{ K} = 127°C$.

8. A

$$\frac{r_1}{r_2}=\frac{V_1}{V_2}\times\frac{t_2}{t_1}=\sqrt{\frac{M_2}{M_1}}$$

$$\frac{180}{120}\times\frac{20}{15}=\sqrt{\frac{64}{M_1}} \qquad \frac{64}{M_1}=4 \qquad M_1=16$$

9. B

$P_1V_1 = P_2V_2$

$10 \times 8 = 1 \times V_2$ $\quad V_2 = 80$ L

Vol of the gas that comes out = 80 – 8 = 72

Number of 4lt ballons needed = $\frac{72}{4}=18$

10. B

$$\bar{C}=\sqrt{\frac{8RT}{\pi M}} \qquad C=\sqrt{\frac{3RT}{M}}$$

$$\frac{8RT}{\pi M_1}=\frac{3RT}{M_2}\,.\ \frac{M_1}{M_2}=\frac{8}{3\pi}=0.849$$

11. A

$$C_p=\sqrt{\frac{2RT}{M}}$$

$$=\sqrt{\frac{2PV}{M}}$$

$$=\sqrt{\frac{2\times100\times20}{16}}=\sqrt{250}=5\sqrt{10}.\ ms^{-1}$$

12. D

$$\frac{KE_1}{KE_2}=\frac{n_1}{n_2}=\frac{M_2}{M_1}(\text{when wts are same})$$

$$\frac{KE(H_2)}{KE(O_2)}=\frac{32}{2}=16$$

13. C

$$M=\frac{dRT}{P}=\frac{0.543\times8.314\times300}{101.325}=13.37$$

If 'x' is the mole fraction of He then

$$xM_{He}+(1-x)M_{O_2}=13.37$$

$$4x+(1-x)32=13.37$$

x = 0.67

Mass of He = 0.67 x 4 = 2.68g

Mass of O_2 = 0.33 x 32 = 10.56g

Mass percent of He = $\frac{2.68}{2.68+10.56}\times100=20.2$

14. A

	$2NH_3 \rightarrow$	N_2 +	$3H_2$	$N_2H_4 \rightarrow$	N_2 +	$2H_2$
Initial	a	0	0	b	0	0
after decomposition	0	$\frac{a}{2}$	$\frac{3a}{2}$	0	b	2b

$$\frac{P_1}{P_2}=\frac{n_1T_1}{n_2T_2}=\frac{0.5}{4.5}=\frac{(a+b)300}{(2a+3b)1200}$$

4a + 6b = 4.5a + 4.5b

0.5a = 1.5b

$\frac{a}{b} = \frac{3}{1}$

$\therefore$ Mole percent of N_2H_4 = $\frac{1}{4} \times 100 = 25\%$

15. A

16. D

17.. C

$P(V-b) = RT$

PV = Pb + RT

For isochors 'V' is constant $P = \frac{R}{V-b}.T$

18. C

$\frac{r_{SO_2}}{r_{He}} = \frac{P_{SO_2}}{P_{He}}\sqrt{\frac{4}{64}}$

$\therefore\ 1 = \frac{P_{SO_2}}{P_{He}}.\frac{1}{4}$ $\qquad \therefore \frac{P_{SO_2}}{P_{He}} = \frac{4}{1}$

19. D

$T_B = \frac{a}{Rb}.$ $\qquad T_i = \frac{2a}{Rb}.T_c = \frac{8a}{27Rb}$

$T_i > T_B > T_c$

20. D

Fraction of molecules moving with a particular velocity $\alpha \left[\frac{T}{M}\right]^{1/2}$

❇ *Wish You all the Best* ❇