1. In a container 3 mole of monoatomic gas and 2 mole of diatomic gas are mixed. What is the Cp/Cv value of the gas mixture ?
(a) $\frac{23}{13}$ (b) 7/5 (c) 5/3 (d) $\frac{29}{19}$

2. Two gases have same value of 'a' but different value of 'b' therefore which of the following is/are correct ?
(a) Both the gases have equally compressible
(b) Both the gases are incompressible
(c) Gas having greater value of 'b' is more compressible
(d) Gas having lesser value of b is more compressible

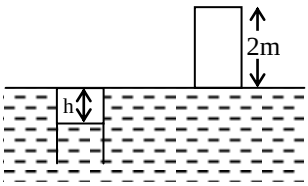
3. The value of compressibility factor at the critical state the gas matches with the Z_c is -
(a) CH_4 ; $Z_c = 0.29$ (b) CF_4 ; $Z_c = 0.375$
(c) CH_3CN ; $Z_c = 0.29$ (d) H_2O ; $Z_c = 0.35$

4. If $\overline{V}$ is the observed molar volume of real gas and $\overline{V}_{id}$ is the molar volume of an ideal gas then Z is ?
(a) $\overline{V}\ \overline{V}_{id}$ (b) $\frac{\overline{V}}{\overline{V}_{id}}$ (c) $\frac{\overline{V}_{id}}{\overline{V}}$ (d) $\frac{\overline{V}^2}{\overline{V}_{id}}$

5. If the mean free path of gaseous molecules is 60 cm at a pressure of 1×10^{-4} mm Hg, what will be its mean free-path when the pressure is increased by 100 times ?
(a) 6.0×10^{-1} cm (b) 6.0 cm
(c) 6.0×10^{1} cm (d) 6.0×10^{2} cm

6. A bulb was heated from 27ºC to 227ºC at constant pressure. Calculate the volume of bulb if 200 ml of air measured at 27ºC was expelled during process -
(a) 300 ml (b) 400 ml (c) 500 ml (d) 350 ml

7. A 2m long tube closed at one end is lowered vertically into water until the closed end is flush with the water surface. See figure below. Calculate 'h' as shown in fig.



(Barometric pressure = 1atm = 10 m of hydrosatic water head, tempt.= 25ºC, density of water = 1g/ml, Neglect water vapour pressure)
(a) 1.01m (b) 0.29m (c) 1.71m (d) 0.92m

8. Two vessels A and B have volumes V and 4V respectively. Both vessels contain some water. The pressure in the space above water is P_1 in vessel A and P_2 in vessel B at temperature T which one is correct -
(a) $P_1 = P_2$ (b) $4P_1 = P_2$ (c) $P_1 = 4P_2$ (d) $P_1 = 16P_2$

9. What volume of hydrogen gas, at 273 K and 1 atm pressure will be consumed in obtaining 21.6g of elemental boron (atomic mass = 10.8) from the reduction of boron trichloride by hydrogen?
(a) 89.6 L (b) 67.2 L (c) 44.8 L (d) 22.4 L

10. Which one of the following statements regarding helium is incorrect ?
(a) It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable
(b) It is used as a cryogenic agent for carrying out experiments at low temperatures
(c) It is used to produce and sustain powerful superconducting magnets
(d) It is used in gas-cooled nuclear reactors

11. 'a' and 'b' are van der Waals' constants for gases. Chlorine is more easily liquefied than ethane because :
(a) A and b for Cl_2 > a and b for C_2H_6
(b) A and b for Cl_2 < a and b for C_2H_6
(c) A and Cl_2 < a for C_2H_6 but b for Cl_2> b for C_2H_6
(d) A for Cl_2 > a for C_2H_6 but b for Cl_2 < b for C_2H_6

12. An amount of 1.00 g of a gaseous compound of boron and hydrogen occupies 0.820 liter at 1.00 atm and at 3^0C. The compound is (R = 0.0820 liter atm mole^{-1} K^{-1}; at. wt: H = 1.0, B = 10.8)
(a) BH_3 (b) B_4H_{10} (c) B_2H_6 (d) B_3H_{12}

13. Equal weights of ethane & hydrogen are mixed in an empty container at 25° C, the fraction of the total pressure exerted by hydrogen is:
(a) 1: 2 (b) 1: 1 (c) 1: 16 (d) 15: 16

14. 20 ℓ of SO_2 diffuses through a porous partition in 60 seconds. Volume of O_2 diffuse under similar conditions in 30 seconds will be :
(a) 12.14 ℓ (b) 14.14 ℓ (c) 18.14 ℓ (d) 28.14 ℓ

15. The ratio between the r.m.s. velocity of H_2 at 50 K and that of O_2 at 800 K is:
(a) 4 (b) 2 (c) 1 (d)¼

16. Helium atom is two times heavier than a hydrogen molecule. At 298 K, the average kinetic energy of a helium atom is
(a) Two times that of a hydrogen molecules
(b) Same as that of a hydrogen molecules
(c) Four times that of a hydrogen molecules
(d) Half that of a hydrogen molecule

17. A real gas obeying Vander Waal's equation will resemble ideal gas , if the :
(a) Constants a & b are small (b) A is large & b is small
(c) A is small & b is large (d) Constant a & b are large

18. Calculate the radius of he atoms if its Vander Waal's constant 'b' is 24 ml mol^{-1}.
(Note 1 ml = 1 cubic centimeter)
(a) 1.355 Å (b) 1.314 Å (c) 1.255 Å (d) 0.355 Å

19. In vander Waal's equation of state for a non ideal gas the term that accounts for intermolecular forces is :
(a) nb (b) nRT (c) n^2a/V^2 (d) $(nRT)^{-1}$

20. 15 ml of a gaseous hydrocarbon was required for complete combustion in 357ml of air (21% of oxygen by volume) and the gaseous products occupied 327 ml (all volumes being measured at NTP). What is the formula of the hydrocarbon ?
(a) C_3H_8 (b) C_4H_8 (c) C_5H_{10} (d) C_4H_{10}

21. LPG is a mixture of n-butane &iso-butane. The volume of oxygen needed to burn 1 kg of LPG at NTP would be :
(a) 2240 ℓ t (b) 2510 ℓ t (c) 1000 ℓ t (d) 500 ℓ t

22. Which of the following statements are correct ?
(a) Helium diffuses at a rate 8.65 times as much as CO does.
(b) Helium escapes at a rate 2.65 times as fast as CO does.
(c) Helium escapes at a rate 4 times as fast as CO_2 does.
(d) Helium escapes at a rate 4 times as fast as SO_2 does.

23. A vessel of volume 5 litre contains 1.4 g of nitrogen at a temperature 1800 K. The pressure of the gas if 30% of its molecules are dissociated into atoms at this temperature is :
(a) 4.05 atm (b) 2.025 atm
(c) 3.84 atm (d) 1.92 atm

24. A 40 ml of a mixture of H_2 and O_2 at 18^0C and 1 atm pressure was sparked so that the formation of waterwas complete. The remainingpure gas had a volume of 10 ml at 18°C and 1 atm pressure. If the remaining gas was H_2, the mole fraction of H_2 in the 40 ml mixture is :
(a) 0.75 (b) 0.5 (c) 0.65 (d) 0.85

25. One litre of a gaseous mixture of two gases effuses in 311 seconds while 2 litres of oxygen takes 20 minutes. The vapour density of gaseous mixture containing CH_4 and H_2 is

(a) 4 (b) 4.3 (c) 3.4 (d) 5

26. A sample of an ideal gas was heated from 30^0C to 60^0C at constant pressure. Which of the following statement(s) is/are true.
(a) Kinetic energy of the gas is doubled
(b) Boyle's law will apply
(c) Volume of the gas will be doubled
(d) None of the above

27. Consider the following statements:
The coefficient B in the virial equation of state
Which of the above statements are correct.
(i) is independent of temperature
(ii) is equal to zero at boyle temperature $PV_m = RT\left(1+\frac{B}{V_m}+\frac{C}{V_m^2}+.....\right)$
(iii) has the dimension of molar volume
(a) i and ii (b) i and iii (c) ii and iii (d) i, ii and iii

28. Select correct statement(s):
(a) We can condense vapours simply by applying pressure
(b) To liquify a gas one must lower the temperature below T_C and also apply pressure
(c) At T_c, there is no distinction between liquid and vapour state, hence density of the liquid is nearly equal to density of the vapour
(d) All the statements are correct statements

29. The curve of pressure volume (PV) against pressure (P) of the gas at a particular temperature is as shown, according to the graph which of the following is incorrect (in the low pressure region):
(a) H_2 and He shows +ve deviation from ideal gas equation.
(b) CO, CH_4 and O_2 show negative deviation from ideal gas equation.
(c) H_2 and He show negative deviation while CO, CH_4 and O_2 show positive deviation.
(d) H_2 and He are less compressible than that of an ideal gas while CO, CH_4 and O_2 more compressible than that of ideal gas.

30. A chemist has synthesized a greenish yellow gaseous compound of chlorine and oxygen and finds that its density is 7.71 g/L at 36°C and 2.88 atm. Then the molecular formula of the compound will be
(a) ClO_3 (b) ClO_2 (c) ClO (d) Cl_2O_2

1. (d)

$$C_{P_{mix}} = \frac{n_A C_{P_A} + n_B C_{P_B}}{(n_A + n_B)} = \frac{3\times5+2\times7}{(3+2)} = \frac{29}{5}$$

$$C_{V_{mix}} = \frac{n_A C_{V_A} + n_B C_{V_B}}{(n_A + n_B)} = \frac{3\times3+2\times5}{3+2} = \frac{19}{5}$$

$$\therefore \frac{C_{P_{mix}}}{C_{V_{mix}}} = \frac{29}{19}$$

2. (d)

As per vanderwaals equation ,

$$\left(P + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

or $$P = \frac{RT}{(V_m - b)} - \frac{a}{V_m^2}$$

or $$\frac{PV_m}{RT} = Z = \frac{V_m}{(V_m - b)} - \frac{a}{RTV_m}$$

or $$Z = \left(1 - \frac{b}{V_m}\right)^{-1} - \frac{a}{RTV_m} \simeq 1 + \left(b - \frac{a}{RT}\right)$$

$$\frac{1}{V_m} + \ldots\ldots$$

Neglecting the higher terms

$$Z \simeq 1 + \left(b - \frac{a}{RT}\right)\frac{1}{V_m}$$

For more compressible gas Z is lesser , hence the value of b should be lesser

3. (a)

For the symmetrical and non polar molecular molecule the experimental value of Z_c is approximately equal to 0.29.

4. (b)

For ideal gas $$\frac{P\overline{V}_{id}}{RT} = 1$$

$$\therefore \overline{V}_{id} = \frac{RT}{P}$$

For real gas, $$P\overline{V} = RT$$

$$\frac{P\overline{V}}{RT} = Z$$

$$\frac{\overline{V}}{\overline{V}_{id}} = Z$$

5. (a)

$$\lambda \propto \frac{T}{P}$$

$$\frac{\lambda_2}{\lambda_1} = \frac{P_1}{P_2}$$

$$\lambda_2 = 60 \times \frac{1}{100} = 0.6$$

6. (c)

Let volume of bulb be V ml

Volume of air at 300K given out = 200 ml.

Volume of air at 500K given out :

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ Or, $\frac{200}{300} = \frac{V_2}{500}$

Or, $V_2 = \frac{100000}{300}$

Volume of air at 500 K $= \frac{100000}{300}$

Therefore, again using eq.

$\frac{V}{300} = \frac{V + \frac{100000}{300}}{500}$

V = 500 ml

7. (c)

Applying Boyle's law

$P_1V_1 = P_2V_2$

$10 \times 2 = (10 + h) \times h$

$\Rightarrow$ h = 1.71 m

8. (c)

$P_1V_1 = P_2V_2$

9. (b)

$2BCl_3 + 3H_2 \longrightarrow 2B + 6HCl$

2 mol 3 mol 2 mol

21.6 g B = 2 mol B = 3 mol H_2

PV =nRT

$\therefore V = \frac{nRT}{P} = \frac{3 \times 0.0821 \times 273}{1} = 67.2L$

10. (c)

Helium is not used to produced and sustain powerful superconducting magnets. All others are the uses of helium.

11. (d)

Cl_2 6.579 L^2 bar mol^{-2} 0.05622 L mol^{-1}

C_2H_5 5.562 L^2 bar mol^{-2} 0.06380 L mol^{-1}

12. (c)

PV = nRT

$PV = \frac{1}{M} RT$

13. (d)

$\frac{p_{H_2}}{p_{C_2H_6}} = \frac{n_{H_2}}{n_{C_2H_6}} = \frac{30}{2} = \frac{15}{1}$

14. (b)

$\frac{20}{60} \times \frac{30}{V} = \sqrt{\frac{32}{64}}$

15. (c)

$$\frac{(V_{rms})_1}{(V_{rms})_2} = \sqrt{\frac{T_1 M_2}{M_1 T_2}}$$

16. (b)
It is factual question

17. (a)

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT.$$

18. (a)

$$4 \times \frac{4}{3}\pi r^3 \times N_A = 24$$

19. (c)
Factual question

20. (a)

$$C_xH_y + O_2 \longrightarrow x_{CO_2} + \frac{y}{2} + H_2O \;\; 15\text{ml}\;\frac{357 \times 21}{100}\text{ml}$$

75 ml

$$\left(x + \frac{y}{4}\right) \times 15 = 75$$

$$x + \frac{y}{4} = \frac{75}{15}$$

$$x + \frac{y}{4} = 5$$

$$x + \frac{y}{4} = 5$$

$$3 + \frac{y}{4} = 5$$

15 x + 15x + 282 = 327
y = 8
x = 3
Formula = C_3H_8

21. (b)

$$C_4H_{10} + \frac{13}{2}\;O2 \longrightarrow 4\,CO_2 + 5\,H_2O$$

x ml n-butane
y ml isobutane

Volume of O_2 = x ´ $\frac{13}{2}$ + y $\frac{13}{2}$

22. (b)

$$r \propto \frac{1}{\sqrt{M}}$$

23. (d)

$N_2 \rightarrow 2N$

at t = 0 $\frac{1.4}{28} = \frac{1}{20}$ 0

at $t = t_f$ $\frac{1}{20} - x$ 2x

but, x = 30% of $\frac{1}{20} = \frac{3}{200}$

Final number *of mole* = $\frac{1}{20} - x + 2x = \frac{1}{20} + x = \frac{1}{20} + \frac{3}{200} = \frac{13}{200}$

$\therefore \quad P = \frac{13}{200} \times \frac{0.0821 \times 1800}{5}$ = 1.92 atm.

24. (a)

$H_2 + 1/2O_2 \rightarrow H_2O_{(l)}$

a b 0

a–2b 0 b

Reaction is studied at constant P &T.

a+b = 40 a–2b = 10

a = 30 ml b = 10ml

mole fraction of H_2 = volume fraction of H_2 =30/40 = 0.75.

25. (b)

$\frac{r_{mixture}}{r_{O_2}} = \sqrt{\frac{32}{M}} = \frac{20 \times 60}{311}$

M = 2.16

V.D. = 4.32

26. (d)

Charles law is applicable

27. (c)

It is factual question

28. (d)

It is factual question

29. (c)

If Z > 1 positive deviation

Z < 1 negative deviation

30. (b)

$\rho = \frac{PM}{RT}$