DPP - Daily Practice Problems

Date : | Start Time : | End Time :

PHYSICS

CP12

SYLLABUS : Kinetic Theory

Max. Marks : 120 **Marking Scheme :** (+4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 30 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. Air is pumped into an automobile tube upto a pressure of 200 kPa in the morning when the air temperature is 22°C. During the day, temperature rises to 42°C and the tube expands by 2%. The pressure of the air in the tube at this temperature, will be approximately

(a) 212 kPa (b) 209 kPa
(c) 206 kPa (d) 200 kPa

2. 4.0 g of a gas occupies 22.4 litres at NTP. The specific heat capacity of the gas at constant volume is $5.0 JK^{-1}$. If the speed of any quantity x in this gas at NTP is $952\ ms^{-1}$, then the heat capacity at constant pressure is (Take gas constant $R = 8.3\ JK^{-1}\ mol^{-1}$)

(a) $7.5\ JK^{-1}\ mol^{-1}$ (b) $7.0\ JK^{-1}\ mol^{-1}$
(c) $8.5\ JK^{-1}\ mol^{-1}$ (d) $8.0\ JK^{-1}\ mol^{-1}$

3. A gaseous mixture consists of 16 g of helium and 16 g of oxygen. The ratio $\frac{C_p}{C_v}$ of the mixture is

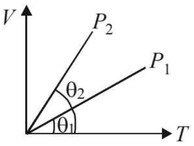
(a) 1.62 (b) 1.59
(c) 1.54 (d) 1.4

4. Two containers A and B are partly filled with water and closed. The volume of A is twice that of B and it contains half the amount of water in B. If both are at the same temperature, the water vapour in the containers will have pressure in the ratio of

(a) 1 : 2 (b) 1 : 1
(c) 2 : 1 (d) 4 : 1

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

5. The figure shows the volume V versus temperature T graphs for a certain mass of a perfect gas at two constant pressures of P_1 and P_2. What inference can you draw from the graphs?



(a) $P_1 > P_2$
(b) $P_1 < P_2$
(c) $P_1 = P_2$
(d) No inference can be drawn due to insufficient information.

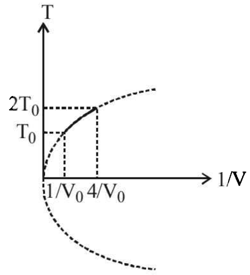
6. Consider an ideal gas confined in an isolated closed chamber. As the gas undergoes an adiabatic expansion, the average time of collision between molecules increases as V^q, where V is the volume of the gas. The value of q is : $\left(\gamma = \frac{C_p}{C_v}\right)$

(a) $\frac{\gamma+1}{2}$ (b) $\frac{\gamma-1}{2}$
(c) $\frac{3\gamma+5}{6}$ (d) $\frac{3\gamma-5}{6}$

7. Work done by a system under isothermal change from a volume V_1 to V_2 for a gas which obeys Vander Waal's equation $(V-\beta n)\left(P+\frac{\alpha n^2}{V}\right) = nRT$ is

(a) $nRT\log_e\left(\frac{V_2-n\beta}{V_1-n\beta}\right)+\alpha n^2\left(\frac{V_1-V_2}{V_1V_2}\right)$
(b) $nRT\log_{10}\left(\frac{V_2-n\beta}{V_1-n\beta}\right)+\alpha n^2\left(\frac{V_1-V_2}{V_1V_2}\right)$
(c) $nRT\log_e\left(\frac{V_2-n\beta}{V_1-n\beta}\right)+\beta n^2\left(\frac{V_1-V_2}{V_1V_2}\right)$
(d) $nRT\log_e\left(\frac{V_1-n\beta}{V_2-n\beta}\right)+\alpha n^2\left(\frac{V_1V_2}{V_1-V_2}\right)$

8. Figure shows a parabolic graph between T and 1/V for a mixture of a gases undergoing an adiabatic process. What is the ratio of V_{rms} of molecules and speed of sound in mixture?



(a) $\sqrt{3/2}$
(b) $\sqrt{2}$
(c) $\sqrt{2/3}$
(d) $\sqrt{3}$

9. 1 mole of a monatomic and 2 mole of a diatomic gas are mixed. The resulting gas is taken through a process in which molar heat capacity was found 3R. Polytropic constant in the process is
(a) –1/5 (b) 1/5 (c) 2/5 (d) –2/5

10. A thermally insulated vessel contains an ideal gas of molecular mass M and ratio of specific heats γ. It is moving with speed v and it suddenly brought to rest. Assuming no heat is lost to the surroundings, its temperature increases by

(a) $\frac{(\gamma-1)}{2\gamma R}Mv^2K$ (b) $\frac{\gamma Mv^2}{2R}K$
(c) $\frac{(\gamma-1)}{2R}Mv^2K$ (d) $\frac{(\gamma-1)}{2(\gamma+1)R}Mv^2K$

11. The temperature at which proton in hydrogen gas would have enough energy to overcome a barrier of 4.14×10^{-14} J is (Boltzmann constant = 1.38×10^{-23} JK^{-1})
(a) 2×10^9 K (b) 10^9 K (c) 6×10^9 K (d) 3×10^9 K

12. If 2 moles of an ideal monatomic gas at temperature T_0 is mixed with 4 moles of another ideal monatomic gas at temperature $2T_0$, then the temperature of the mixture is
(a) $\frac{5}{3}T_0$ (b) $\frac{3}{2}T_0$ (c) $\frac{4}{3}T_0$ (d) $\frac{5}{4}T_0$

RESPONSE GRID	
5. ⓐⓑⓒⓓ 6. ⓐⓑⓒⓓ 7. ⓐⓑⓒⓓ 8. ⓐⓑⓒⓓ 9. ⓐⓑⓒⓓ	
10. ⓐⓑⓒⓓ 11. ⓐⓑⓒⓓ 12. ⓐⓑⓒⓓ	

13. The root mean square velocity of hydrogen molecules at 300 K is 1930 metre/sec. Then the r.m.s velocity of oxygen molecules at 1200 K will be

(a) 482.5 metre/sec (b) 965 metre/sec
(c) 1930 metre/sec (d) 3860 metre/sec

14. For a gas, difference between two specific heats is 5000 J/mole°C. If the ratio of specific heats is 1.6, the two specific heats in J/mole-°C are

(a) $C_P = 1.33 \times 10^4, C_V = 2.66 \times 10^4$
(b) $C_P = 13.3 \times 10^4, C_V = 8.33 \times 10^3$
(c) $C_P = 1.33 \times 10^4, C_V = 8.33 \times 10^3$
(d) $C_P = 2.6 \times 10^4, C_V = 8.33 \times 10^4$

15. A graph is plotted with PV/T on y-axis and mass of the gas along x-axis for different gases. The graph is

(a) a straight line parallel to x-axis for all the gases
(b) a straight line passing through origin with a slope having a constant value for all the gases
(c) a straight line passing through origin with a slope having different values for different gases
(d) a straight line parallel to y-axis for all the gases

16. A gas mixture consists of 2 moles of oxygen and 4 moles of Argon at temperature T. Neglecting all vibrational moles, the total internal energy of the system is

(a) 4 RT (b) 15 RT (c) 9 RT (d) 11RT

17. One mole of a gas occupies 22.4 lit at N.T.P. Calculate the difference between two molar specific heats of the gas. J = 4200 J/kcal.

(a) 1.979 k cal/kmol K (b) 2.378 k cal/kmol K
(c) 4.569 kcal/kmol K (d) 3.028 k cal/ kmol K

18. If the intermolecular forces vanish away, the volume occupied by the molecules contained in 4.5 g water at standard temperature and pressure will be

(a) 5.6 litre (b) 4.5 litre
(c) 11.2 litre (d) 6.5 litre

19. The temperature of the mixture of one mole of helium and one mole of hydrogen is increased from 0°C to 100°C at constant pressure. The amount of heat delivered will be

(a) 600 cal (b) 1200 cal
(c) 1800 cal (d) 3600 cal

20. The P-V diagram of a diatomic gas is a straight line passing through origin. The molar heat capacity of the gas in the process will be

(a) 4R (b) 2.5R (c) 3R (d) $\frac{4R}{3}$

21. Three perfect gases at absolute temperatures T_1, T_2 and T_3 are mixed. The masses of molecules are m_1, m_2 and m_3 and the number of molecules are n_1, n_2 and n_3 respectively. Assuming no loss of energy, the final temperature of the mixture is :

(a) $\frac{n_1T_1 + n_2T_2 + n_3T_3}{n_1 + n_2 + n_3}$ (b) $\frac{n_1T_1^2 + n_2T_2^2 + n_3T_3^2}{n_1T_1 + n_2T_2 + n_3T_3}$

(c) $\frac{n_1^2T_1^2 + n_2^2T_2^2 + n_3^2T_3^2}{n_1T_1 + n_2T_2 + n_3T_3}$ (d) $\frac{(T_1 + T_2 + T_3)}{3}$

22. A sample of an ideal gas occupies a volume V at a pressure P and absolute temperature T. The mass of each molecule is m. The equation for density is

(a) mkT (b) P/kT
(c) P/(kTV) (d) Pm/kT

23. N molecules, each of mass m, of gas A and 2 N molecules, each of mass 2 m, of gas B are contained in the same vessel which is maintained at a temperature T. The mean square velocity of molecules of B type is denoted by V_2 and the mean square velocity of A type is denoted by V_1, then $\frac{V_1}{V_2}$ is

(a) 2 (b) 1 (c) 1/3 (d) 2/3

RESPONSE GRID					
	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ
	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ
	23. ⓐⓑⓒⓓ				

24. A vessel has 6g of hydrogen at pressure P and temperature 500K. A small hole is made in it so that hydrogen leaks out. How much hydrogen leaks out if the final pressure is P/2 and temperature falls to 300 K ?

(a) 2g (b) 3g (c) 4g (d) 1g

25. The work of 146 kJ is performed in order to compress one kilomole of gas adiabatically and in this process the temperature of the gas increases by 7°C. The gas is ($R = 8.3$ J mol^{-1} K^{-1})

(a) diatomic

(b) triatomic

(c) a mixture of monatomic and diatomic

(d) monatomic

26. The molar heat capacities of a mixture of two gases at constant volume is 13R/6. The ratio of number of moles of the first gas to the second is 1 : 2. The respective gases may be

(a) O_2 and N_2 (b) He and Ne

(c) He and N_2 (d) N_2 and He

27. One litre of oxygen at a pressure of 1 atm, and 2 litres of nitrogen at a pressure of 0.5 atm are introduced in the vessel of 1 litre capacity, without any change in temperature. The total pressure would be

(a) 1.5 atm (b) 0.5 atm (c) 2.0 atm (d) 1.0 atm

28. If the potential energy of a gas molecule is $U = M/r^6 - N/r^{12}$, M and N being positive constants. Then the potential energy at equilibrium must be

(a) zero (b) $M^2/4N$ (c) $N^2/4M$ (d) $MN^2/4$

29. Consider a gas with density ρ and $\bar{c}$ as the root mean square velocity of its molecules contained in a volume. If the system moves as whole with velocity v, then the pressure exerted by the gas is

(a) $\frac{1}{3}\rho\bar{c}^2$ (b) $\frac{1}{3}\rho(c+v)^2$

(c) $\frac{1}{3}\rho(\bar{c}-v)^2$ (d) $\frac{1}{3}\rho(c^{-2}-v)^2$

30. At 10° C the value of the density of a fixed mass of an ideal gas divided by its pressure is x. At 110°C this ratio is:

(a) x (b) $\frac{383}{283}x$ (c) $\frac{10}{110}x$ (d) $\frac{283}{383}x$

RESPONSE GRID					
	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ
	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ			

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP12 - PHYSICS			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	45	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

1. (b) $\frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2}$ Here, $P_1=200\text{kPa}$

$T_1=22°C=295\text{ K}$ $T_2=42°C=315\text{K}$

$V_2=V_1+\frac{2}{100}V_1=1.02V_1$

$\therefore\ P_2=\frac{200\times315V_1}{295\times1.02V_1}=209.37\text{kPa}$

2. (d) Molar mass of the gas = 4g/mol

Speed of any quantity x

$V=\sqrt{\frac{\gamma RT}{m}}\Rightarrow 952=\sqrt{\frac{\gamma\times3.3\times273}{4\times10^{-3}}}$

$\Rightarrow\gamma=1.6=\frac{16}{10}=\frac{8}{5}$

Also, $\gamma=\frac{C_P}{C_V}=\frac{8}{5}$

So, $C_P=\frac{8\times5}{5}=8\text{JK}^{-1}\text{mol}^{-1}$

3. (a) For mixture of gas, $C_v=\frac{n_1C_{v_1}+n_2C_{v_2}}{n_1+n_2}$

$$=\frac{4\times\frac{3}{2}R+\frac{1}{2}\times\frac{5}{2}R}{\left(4+\frac{1}{2}\right)}=\frac{6R+\frac{5}{4}R}{\frac{9}{2}}=\frac{29R\times2}{9\times4}=\frac{29R}{18}$$

and $C_p=\frac{n_1C_{p_1}+n_2C_{p_2}}{(n_1+n_2)}=\frac{4\times\frac{5R}{2}+\frac{1}{2}\times\frac{7R}{2}}{\left(4+\frac{1}{2}\right)}$

$$=\frac{10R+\frac{7}{4}R}{\frac{9}{2}}=\frac{47R}{18}$$

$\therefore\ \frac{C_p}{C_v}=\frac{47R}{18}\times\frac{18}{29R}=1.62$

4. (b) Vapour pressure does not depend on the amount of substance. It depends on the temperature alone.

5. (a) $\because\theta_1<\theta_2\Rightarrow\tan\theta_1<\tan\theta_2\Rightarrow\left(\frac{V}{T}\right)_1<\left(\frac{V}{T}\right)_2$

From $PV=\mu RT$; $\frac{V}{T}\propto\frac{1}{P}$

Hence $\left(\frac{1}{P}\right)_1<\left(\frac{1}{P}\right)_2\Rightarrow P_1>P_2$.

6. (a) $\tau=\frac{1}{\sqrt{2}\pi d^2\left(\frac{N}{V}\right)\sqrt{\frac{3RT}{M}}}$

$\tau\propto\frac{V}{\sqrt{T}}$

As, $TV^{\gamma-1}=K$

So, $\tau\propto V^{\gamma+1/2}$

Therefore, $q=\frac{\gamma+1}{2}$

7. (a) According to given Vander Waal's equation

$P=\frac{nRT}{V-n\beta}-\frac{\alpha n^2}{V^2}$

Work done,

$$W=\int_{V_1}^{V_2}PdV=nRT\int_{V_1}^{V_2}\frac{dV}{V-n\beta}-\alpha n^2\int_{V_1}^{V_2}\frac{dV}{V^2}$$

$$=nRT\left[\log_e(V-n\beta)\right]_{V_1}^{V_2}+\alpha n^2\left[\frac{1}{V}\right]_{V_1}^{V_2}$$

$$=nRT\log_e\left(\frac{V_2-n\beta}{V_1-n\beta}\right)+\alpha n^2\left[\frac{V_1-V_2}{V_1V_2}\right]$$

8. (b) From graph, $T^2V=\text{const.}$ .....(1)

As we know that $TV^{\gamma-1}=\text{const}$

$\Rightarrow VT^{\frac{1}{\gamma-1}}=\text{const.}$ ....(2)

On comparing (1) and (2), we get

$\Rightarrow\gamma=3/2$

Also $v_{rms}=\sqrt{\frac{3P}{\rho}}$ and $v_{sound}=\sqrt{\frac{P\gamma}{\rho}}$

$\Rightarrow\ \frac{v_{rms}}{v_{sound}}=\sqrt{\frac{3}{\gamma}}=\sqrt{2}$

9. (a) $C=C_{v\text{ mix}}+\frac{R}{1-n}$ .....(1)

Now, $C_{v\text{mix}}=\frac{n_1C_{v1}+n_2C_{v2}}{n_1+n_2}$

$$=\frac{1\times\frac{3R}{2}+2\times\frac{5R}{2}}{1+2}=\frac{13R}{6}$$

From (1), $3R=\frac{13R}{6}+\frac{R}{1-n}\Rightarrow n=-\frac{1}{5}$

10. (c) As no heat is lost,

Loss of kinetic energy = gain of internal energy of gas

$$\frac{1}{2}mv^2=nC_V\Delta T\ \Rightarrow\frac{1}{2}mv^2=\frac{m}{M}\cdot\frac{R}{\gamma-1}\Delta T$$

$$\Rightarrow\ \Delta T=\frac{Mv^2(\gamma-1)}{2R}K$$

11. (a) $\frac{3}{2}k_BT = K_{av}$ ...(i)

where K_{av} is the average kinetic energy of the proton.

$\therefore\ T = \frac{2K_{av}}{3k_B}$

$T = \frac{2\times 4.14\times 10^{-14}\ J}{3\times 1.38\times 10^{-23} JK^{-1}} = 2\times 10^9 K.$

12. (a) Let T be the temperature of the mixture, then

$U = U_1 + U_2$

$\Rightarrow \frac{f}{2}(n_1+n_2)RT$

$= \frac{f}{2}(n_1)(R)(T_0) + \frac{f}{2}(n_2)(R)(2T_0)$

$\Rightarrow (2+4)T = 2T_0 + 8T_0\ (\because\ n_1 = 2, n_2 = 4)$

$\therefore\ T = \frac{5}{3}T_0$

13. (b) Root-mean square-velocity is given by

$v_{rms} = \sqrt{\frac{3RT}{M}}$ i.e., $v_{rms} \propto \sqrt{\left(\frac{T}{M}\right)}$

$\therefore\ \frac{(v_{rms})O_2}{(v_{rms})H_2} = \sqrt{\left[\frac{T_{O_2}}{T_{H_2}}\times\frac{M_{H_2}}{M_{O_2}}\right]}$

$= \sqrt{\left[\left(\frac{1200}{300}\right)\times\left(\frac{2}{32}\right)\right]} = \frac{1}{2}$

$\therefore\ (v_{rms})O_2 = (v_{rms})H_2 \times \frac{1}{2} = \frac{1930}{2}$

$= 965$ m/s

14. (c) Given

$C_P - C_V = 5000$ J / mole°C ....(i)

$\frac{C_P}{C_V} = 1.6$ ....(ii)

From Equation (i) & (ii),

$\Rightarrow \frac{C_P}{C_V} - \frac{C_V}{C_V} = \frac{5000}{C_V}$

$\Rightarrow 1.6 - 1 = \frac{5000}{C_V}$

$\Rightarrow C_V = \frac{5000}{0.6} = 8.33\times 10^3$

Hence $C_P = 1.6\ C_V = 1.6 \times 8.33 \times 10^3$

$C_P = 1.33 \times 10^4$

15. (c) $\frac{PV}{T} = nR = \left(\frac{m}{M}\right)R$ or $\frac{PV}{T} = \left(\frac{R}{M}\right)m$

i.e., $\frac{PV}{T}$ versus m graph is straight line passing through origin with slope R/M, i.e. the slope depends on molecular mass of the gas M and is different for different gases.

16. (d) Internal energy of 2 moles of oxygen

$Uo_2 = \mu\left(\frac{5}{2}RT\right) = 2.\frac{5}{2}RT = 5RT$

Internal energy of 4 moles of Argon.

$U_{Ar} = \mu\left(\frac{3}{2}RT\right) = 4.\frac{3}{2}RT = 6RT$

$\therefore$ Total internal energy

$U = U_{O_2} + U_{Ar} = 11RT$

17. (a) V = 22.4 litre = 22.4×10^{-3} m^3, J = 4200 J/kcal

by ideal gas equation for one mole of a gas,

$R = \frac{PV}{T} = \frac{1.013\times 10^5 \times 22.4\times 10^{-3}}{273}$

$C_p - C_v = \frac{R}{J} = \frac{1.013\times 10^5\times 22.4}{273\times 4200} = 1.979$ kcal/kmol K

18. (a) 1 mole = 22.4 L at S.T.P.

$\frac{4.5g}{18g} = 22.4\times\frac{4.5}{18} = 5.6\,L$

19. (b) $(C_p)_{mix} = \frac{\mu_1 C_{p_1} + \mu_2 C_{p_2}}{\mu_1+\mu_2}$

$(C_{p_1}(He) = \frac{5}{2}R$ and $C_{p_2}(H_2) = \frac{7}{2}R)$

$(C_p)_{mix} = = \frac{1\times\frac{5}{2}R + 1\times\frac{7}{2}R}{1+1}$ $3R = 3\times 2 = 6$ cal/mol.°C

$\therefore$ Amount of heat needed to raise the temperature from 0°C to 100°C

$(\Delta Q)_p = \mu C_p \Delta T = 2\times 6\times 100 = 1200\,cal$

20. (c) P-V diagram of the gas is a straight line passing through origin. Hence $P \propto V$ or PV^{-1} = constant

Molar heat capacity in the process PV^x = constant is

$C = \frac{R}{\gamma-1} + \frac{R}{1-x}$; Here $\gamma = 1.4$ (For diatomic gas)

$\Rightarrow C = \frac{R}{1.4-1} + \frac{R}{1+1} \Rightarrow C = 3R$

21. (a) Number of moles of first gas = $\frac{n_1}{N_A}$

Number of moles of second gas = $\frac{n_2}{N_A}$

Number of moles of third gas = $\frac{n_3}{N_A}$

If there is no loss of energy then

$P_1V_1 + P_2V_2 + P_3V_3 = PV$

$\frac{n_1}{N_A}RT_1 + \frac{n_2}{N_A}RT_2 + \frac{n_3}{N_A}RT_3 = \frac{n_1+n_2+n_3}{N_A}RT_{mix}$

$\Rightarrow T_{mix} = \frac{n_1T_1 + n_2T_2 + n_3T_3}{n_1+n_2+n_3}$

22. (d) We know that $PV = nRT = (m/M)RT$

where M = Molecular weight.

Now $P \times \left(\frac{m}{d}\right) = \left(\frac{m}{M}\right) R\,T$ ...(1)

where d = density of the gas

$\frac{P}{d} = \frac{R\,T}{M} = \frac{k\,N_A\,T}{M}$ ... (2)

where $R = k\,N_A$, k is Boltzmann constant.

But $\frac{M}{N_A} = m$ = mass of each molecule so

$d = \frac{P \times m}{kT}$

23. (b) For 1 molecule of a gas, $v_{rms} = \sqrt{\frac{3KT}{m}}$

where m is the mass of one molecule

For N molecule of a gas, $v_1 = \sqrt{\frac{3KT \times N}{m}}$

For 2N molecule of a gas $v_2 = \sqrt{\frac{3KI \times N}{(2m)}} \times N$

$\therefore \frac{v_1}{v_2} = 1$

24. (d) $PV = \frac{m}{M} RT$

Initially, $PV = \frac{6}{M} R \times 500$

Finally, $\frac{P}{2} V = \frac{(6-x)}{M} R \times 300$ (if x g gas leaks out)

Hence, $2 = \frac{6}{6-x} \times \frac{5}{3}$ $\therefore$ x = 1 gram

25. (a) $W = \frac{nR\Delta T}{1-\gamma} \Rightarrow -146000 = \frac{1000 \times 8.3 \times 7}{1-\gamma}$

or $1-\gamma = -\frac{58.1}{146} \Rightarrow \gamma = 1 + \frac{58.1}{146} = 1.4$

Hence the gas is diatomic.

26. (c) $C_{v_{mix}} = \frac{n_1 C_{v_1} + n_2 C_{v_2}}{n_1 + n_2}$

$\Rightarrow \frac{13R}{6} = \frac{n_1 C_{v_1} + 2n_1 C_{v_2}}{n_1 + 2n_1}$ $\left[\because \frac{n_1}{n_2} = \frac{1}{2}\right]$

$\Rightarrow \frac{13R}{2} = C_{v_1} + 2C_{v_2}$

Possible values are, $C_{v_1} = \frac{3R}{2}$, $C_{v_2} = \frac{5R}{2}$

$\therefore$ Gases are monatomic (like He) and diatomic (like N_2)

27. (c) According to Dalton's Law

$P = P_1 + P_2$....................

here 1 litre of orygen at a pressure of 1atm, & 2 litre of nitrogen at a pressure of 5 atm are introduced in a vessel of 1 litre capacity.

so $P = \frac{V_1P_1 + P_2V_2}{\text{volume of vessel}} = \frac{1 \times 1 + 2 \times .5}{1} = 2\text{atm}$

28. (b) $F = \frac{dU}{dr} = -\frac{d}{dr}\left[\frac{M}{r^3} - \frac{N}{R^{12}}\right] = -\left[\frac{-6M}{r^2} + \frac{12N}{r^{13}}\right]$

In equilibrium position, F = 0

$\therefore \frac{6M}{r^2} - \frac{12N}{r^{13}} = 0$ or, $r^6 = \frac{2N}{M}$

$\therefore$ Potential energy at equilibrium position

$U = \frac{M}{(2N/M)} = \frac{N}{(2N/M)^2} = \frac{M^2}{2N} - \frac{M^2}{4N} = \frac{M^2}{4N}$

29. (a) Pressure of the gas will not be affected by motion of the system, hence by

$v_{rms} = \sqrt{\frac{3P}{\rho}} \Rightarrow \bar{c}^2 = \frac{3P}{\rho} \Rightarrow P = \frac{1}{3} p\bar{c}^2$

30. (d) Let the mass of the gas be m.

At a fixed temperature and pressure, volume is fixed.

Density of the gas, $\rho = \frac{m}{V}$

Now $\frac{\rho}{P} = \frac{m}{PV} = \frac{m}{nRT}$

$\Rightarrow \frac{m}{nRT} = x$ (By question)

$\Rightarrow xT = \text{constant} \Rightarrow x_1T_1 = x_2T_2$

$\Rightarrow x_2 \Rightarrow \frac{x_1T_1}{T_2} = \frac{283}{383} x$ $\left[\begin{matrix} \therefore & & \\ T_1 & = & 283K \\ T_2 & = & 383K \end{matrix}\right]$