Self Practice Paper (SPP)

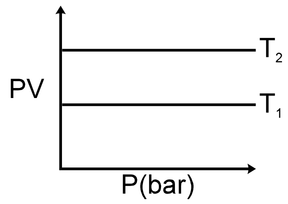
1. 2.5 L of a sample of a gas at 27°C and 1 bar pressure is compressed to a volume of 500 mL keeping the temperature constant, the percentage increase in pressure is
(1) 100 % (2) 400 % (3) 500% (4) 80%

2. For two gases, A and B with molecular weights M_A and M_B, it is observed that at a certain temperature, T, the mean velocity of A is equal to the root mean square velocity of B. Thus the mean velocity of A can be made equal to the mean velocity of B, if
(1) A is at temperature, T_1 and B at T_2 $T_1 > T_2$
(2) A is lowered to a temperature $T_2 < T$ while B is at T
(3) Both A and B are raised to a higher temperature
(4) Both A and B are lowered in temperature.

3. At what temperature, the average speed of gas molecules be double of that at temperature, 27ºC?
(1) 120ºC (2) 108ºC (3) 927ºC (4) 300ºC

4. Two glass bulbs A and B at same temperature are connected by a very small tube having a stop-corck. Bulb A has a volume of 100 cm^3 and contained the gas while bulb B was empty. On opening the stop-corck, the pressure fell down to 20%. The volume of the bulb B is :
(1) 100 cm^3 (2) 200 cm^3 (3) 250 cm^3 (4) 400 cm^3

5. The product of PV is plotted against P at two temperatures T_1 and T_2 and the 'result is shown in figure. What is correct about T_1 and T_2?



(1) $T_1 > T_2$ (2) $T_2 > T_1$ (3) $T_1 = T_2$ (4) $T_1 + T_2 = 1$

6. Match of following (where U_{rms} = root mean square speed, U_{av} = average speed, U_{mp} = most probable speed)

	List I		List II
(a)	U_{rms} / U_{av}	(i)	1.22
(b)	U_{av} / U_{mp}	(ii)	1.13
(c)	U_{rms} / U_{mp}	(iii)	1.08

(1) (a)-(iii), (b)-(ii), (c)-(i) (2) (a)-(i), (b)-(ii), (c)-(iii)
(3) (a)-(iii), (b)-(i), (c)-(ii) (4) (a)-(ii), (b)-(iii), (c)-(i).

7. $N_2 + 3H_2 \longrightarrow 2NH_3$. 1 mol N_2 and 4 mol H_2 are taken in 15 L flask at 27°C. After complete conversion of N_2 into NH_3, 5 L of H_2O is added. Pressure set up in the flask is :
(1) $\frac{3 \times 0.0821 \times 300}{15}$ atm (2) $\frac{2 \times 0.0821 \times 300}{10}$ atm
(3) $\frac{1 \times 0.0821 \times 300}{15}$ atm (4) $\frac{1 \times 0.0821 \times 300}{10}$ atm

8. Which of the following is not the correct set of pressure and volume at constant temperature and constant moles of gas ?

	P	V		P	V
(1)	1 atm	200 ml	(2)	760 mm	0.2 L
(3)	0.5 atm	100 L	(4)	2 atm	100 mL

9. 2 litres of moist hydrogen were collected over water at 26°C at a total pressure of one atmosphere. On analysis, it was found that the quantity of H_2 collected was 0.0788 mole. What is the mole fraction of H_2 in the moist gas

(1) 0.989 (2) 0.897 (3) 0.953 (4) 0.967

10. When CO_2 under high pressure is released from a fire extinguisher, particles of solid CO_2 are formed, despite the low sublimation temperature (– 77ºC) of CO_2 at 1.0 atm. It is

(1) the gas does work pushing back the atmosphere using KE of molecules and thus lowering the temperature

(2) volume of the gas is decreased rapidly hence, temperature is lowered

(3) both (1) and (2)

(4) None of the above

11. At what temperature will the total KE of 0.3 mol of He be the same as the total KE of 0.40 mol of Ar at 400 K ?

(1) 533 K (2) 400 K (3) 346 K (4) 300 K

12. Potassium hydroxide solutions are used to absorb CO_2. How many litres of CO_2 at 1.00 atm and 22ºC would be absorbed by an aqueous solution containing 15.0 g of KOH ? (Take R = $\frac{1}{12}$ ℓ atm / K/mole)

$$2KOH + CO_2 \longrightarrow K_2CO_3 + H_2O$$

(1) 3.24 L (2) 1.62 L (3) 6.48 L (4) 0.324 L

13. The volume of a gas increases by a factor of 2 while the pressure decreases by a factor of 3. Given that the number of moles is unaffected, the factor by which the temperature changes is :

(1) $\frac{3}{2}$ (2) 3×2 (3) $\frac{2}{3}$ (4) $\frac{1}{2} \times 3$

14. If V_0 is the volume of a given mass of gas at 273 K at constant pressure , then according to Charle's law , the volume at 10 ºC will be :

(1) $10\ V_0$ (2) $\frac{2}{273}\ (V_0 + 10)$ (3) $V_0 + \frac{10}{273}$ (4) $\frac{283}{273}\ V_0$

15. When a gas is compressed at constant temperature :

(1) the speeds of the molecules increase
(2) the collisions between the molecules increase
(3) the speeds of the molecules decrease
(4) the collisions between the molecules decrease

16. A cylinder is filled with a gaseous mixture containing equal masses of CO and N_2 . The partial pressure ratio is :

(1) $P_{N_2} = P_{CO}$ (2) $P_{CO} = 0.875\ P_{N_2}$ (3) $P_{CO} = 2\ P_{N_2}$ (4) $P_{CO} = \frac{1}{2} P_{N_2}$

17. Helium atom is two times heavier than a hydrogen molecule at 298 k , the average kinetic energy of helium is :

(1) two times that of hydrogen molecule
(2) same as that of the hydrogen molecule
(3) four times that of a hydrogen molecule
(4) half that of a hydrogen molecule

18. Two flasks A and B have equal volumes. A is maintained at 300 K and B at 600 K, while A contains H_2 gas, B has an equal mass of CO_2 gas. Find the ratio of total K.E. of gases in flask A to that of B.

(1) 1 : 2 (2) 11 : 1 (3) 33 : 2 (4) 55 : 7

19. A quantity of gas is collected in a graduated tube over the mercury. The volume of gas at 18 ºC is 50 ml and the level of mercury in the tube is 100 mm above the outside mercury level. The barometer reads 750 torr. Hence , volume at S.T.P. is approximately :

(1) 22 ml (2) 40 ml (3) 20 ml (4) 44 ml

20. If equal weights of oxygen and nitrogen are placed in separate containers of equal volume at the same temperature, which one of the following statements is true?
(mol wt: N_2 = 28, O_2 = 32)

(1) Both flasks contain the same number of molecules.
(2) The pressure in the nitrogen flask is greater than the one in the oxygen flask.
(3) More molecules are present in the oxygen flask.
(4) Molecules in the oxygen flask are moving faster on the average than the ones in the nitrogen flask.

21. Which of the following is NOT a postulate of the kinetic molecular theory of gases?

(1) The molecules possess a volume that is negligibly small compared to the of the container
(2) The pressure and volume of a gas are inversely related
(3) Gases consist of discrete particles that are in random motion
(4) The average kinetic energy of the molecules is directly proportional to the temperature

22. What is the total pressure exerted by the mixture of 7.0 g of N_2 , 2g of hydrogen and 8.0 g of sulphur dioxide gases in a vessel of 6 L capacity that has been kept in a reservoir at 27°C?

(1) 2.5 bar (2) 4.5 bar (3) 10 atm (4) 5.7 bar

23. At what temperature root mean square speed of N_2 gas is equal to that of propane gas at S.T.P. conditions.

(1) 173.7°C (2) 173.7 K (3) S.T.P. (4) – 40°C

24. 10 L of O_2 gas is reacted with 30 L of CO (g) at STP. The volume of each gas present at the end of the reaction are :

(1) O_2 = 10 L, CO_2 = 20 L
(2) CO = 10 L, CO_2 = 20 L
(3) CO = 20 L, CO_2 = 10 L
(4) CO = 15 L, CO_2 = 15 L

25. 1 mol of a gaseous aliphahatic compound $C_nH_{3n}O_m$ is completely burnt in an excess of oxygen. The contraction in volume is (assume water get condensed out)

(1) $\left(1+\frac{1}{2}n-\frac{3}{4}m\right)$ (2) $\left(1+\frac{3}{4}n-\frac{1}{4}m\right)$ (3) $\left(1-\frac{1}{2}n-\frac{3}{4}m\right)$ (4) $\left(1+\frac{3}{4}n-\frac{1}{2}m\right)$

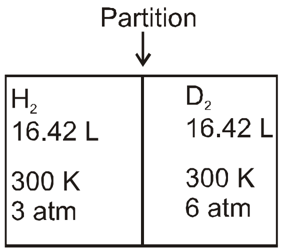
26. One mole of a gas is defined as -

(1) The number of molecules in one litre of gas
(2) The number of molecules in one formula weight of gas
(3) The number of molecules contained in 12 grams of (12 C) isotope
(4) The number of molecules in 22.4 litres of a gas at S.T.P.

27. If two moles of an ideal gas at 546 K occupies a volume of 44.8 litres, the pressure must be -
(1) 2 atm (2) 3 atm (3) 4 atm (4) 1 atm

28. At STP the order of mean square velocity of molecules of H_2, N_2, O_2 and HBr is -
(1) $H_2 > N_2 > O_2 > HBr$ (2) $HBr > O_2 > N_2 > H_2$
(3) $HBr > H_2 > O_2 > N_2$ (4) $N_2 > O_2 > H_2 > HBr$

29. If all the oxygen atoms present in 4 mole H_2SO_4 2 mole P_4O_{10} & 2mole NO_2 are collected for the formation of O_2 gas molecules then calculate volume of O_2 gas formed at 2 atm pressure & 273 K temperature.
(1) 224 L (2) 448 L (3) 336 L (4) 112 L

30.


If the partition is removed the average molar mass of the sample will be (Assume ideal behaviour).
(1) $\frac{5}{3}$ gm/mol (2) $\frac{10}{3}$ gm/mol (3) $\frac{3}{2}$ gm/mol (4) 3 gm/mol

31. Which of the following relationship is false :
(1) Most probable velocity, $\propto = \sqrt{\frac{2RT}{M}}$ (2) $PV = \frac{1}{3}\ mnC_{rms}^2$
(3) Compressibility factor $Z = \frac{PV}{nRT}$ (4) Average kinetic energy of a gas = $\frac{1}{2}kT$

32. At constant temperature, the pressure for same mass of the gas is
(1) proportional to the volume (2)inversely proportional to the volume.
(3) remain same (4) none

33. The root mean square speed is always
(1) more than the average speed of molecules. (2) less than the average speed of molecules.
(3) remain constant (4) none

34. Which of the following exhibits the weakest intermolecular forces ?
(1) NH_3 (2) HCl (3) He (4) H_2O

35. At 0°C and one atm pressure, a gas occupies 100 cc. If the pressure is increased to one and a half-time and temperature is increased by one-third of absolute temperature, then final volume of the gas will be :
(1) 80 cc (2) 88.9 cc (3) 66.7 cc (4) 100 cc

36. The rms velocity of CO_2 at a temperature T (in kelvin) is x cm s^{-1}. At what temperature (inkelvin) the rms. velocity of nitrous oxide would be 4 x cm s^{-1} ?
(1) 16 T (2) 2T (3) 4T (4) 32 T

37. N_2 is found in a litre flask under 100 k Pa pressure and O_2 is found in another 3 litre flask under 320 k Pa pressure. If the two flasks are connected, the resultant pressure is

(1) 310 k Pa (2) 210 k Pa (3) 420 k Pa (4) 265 k Pa

38. The numerical value of N/n (where N is the number of molecules in a given sample of the gas and n is the number of moles of the gas) is.

(1) 8.314 (2) 6.02×10^{23} (3) 0.0821 (4) 1.66×10^{-19}

39. Slope of the plot between PV and P at constant temperature is :

(1) zero (2) 1 (3) 1/2 (4) $1/\sqrt{2}$

40. What is the pressure of 2 mole of NH_3 at 27°C when its volume is 5 litre in van der waals equation ? (a = 4.17, b = 0.03711)

(1) 10.33 atm (2) 9.33 atm (3) 9.74 atm (4) 9.2 atm

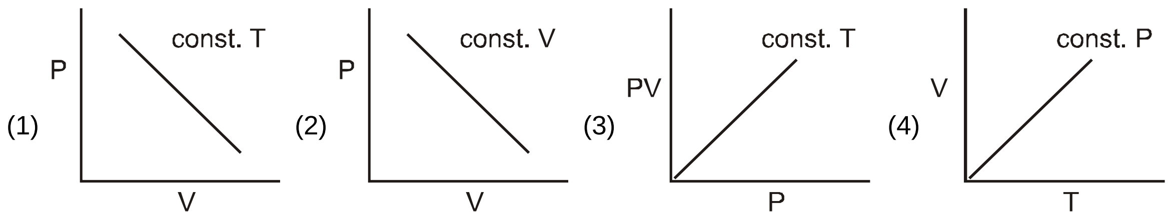
41. Equation for Boyle's law is

(1) $\frac{dP}{P} = -\frac{dV}{V}$ (2) $\frac{dP}{P} = +\frac{dV}{V}$ (3) $\frac{d^2P}{P} = -\frac{d^2V}{dT}$ (4) $\frac{d^2P}{P} = +\frac{d^2V}{dT}$

42. Two gas bulbs A and B are connected by a tube having a stopcock. Bulb A has a volume of 100 ml and contains hydrogen. After opening the gas from A to the evacuated bulb B, the pressure falls down by 40%. The volume (mL) of B must be :

(1) 75 (2) 150 (3) 125 (4) 200

43. Which of the following diagram correctly describes the behaviour of a fixed mass of an ideal gas ? (T is measured in K)



44. A 4.0 dm^3 flask containing N_2 at 4.0 bar was connected to a 6.0 dm^3 flask containing helium at 6.0 bar, and the gases were allowed to mix isothermally, then the total pressure of the resulting mixture will be

(1) 10.0 bar (2) 5.2 bar (3) 1.6 bar (4) 5.0

45. In order to increase the volume of a gas by10%, the pressure of the gas should be

(1) decreased by 10% (2) decreased by 1%

(3) increased by 10% (4) increased by 1%

SPP Answers

1.	(2)	**2.**	(2)	**3.**	(3)	**4.**	(4)	**5.**	(2)	**6.**	(1)	**7.**	(4)
8.	(3)	**9.**	(4)	**10.**	(1)	**11.**	(1)	**12.**	(1)	**13.**	(3)	**14.**	(4)
15.	(2)	**16.**	(1)	**17.**	(2)	**18.**	(2)	**19.**	(2)	**20.**	(2)	**21.**	(2)
22.	(4)	**23.**	(2)	**24.**	(2)	**25.**	(4)	**26.**	(4)	**27.**	(1)	**28.**	(1)
29.	(1)	**30.**	(2)	**31.**	(4)	**32.**	(2)	**33.**	(1)	**34.**	(3)	**35.**	(2)
36.	(1)	**37.**	(4)	**38.**	(2)	**39.**	(1)	**40.**	(2)	**41.**	(1)	**42.**	(2)
43.	(4)	**44.**	(2)	**45.**	(1)								

SPP Solutions

1. Using $p_1V_1 = P_2V_2$ $1 \times 2.5 = 0.5 \times P_2 = 5$ bar.

$\therefore$ % increase in pressure = $\frac{(5-1)\text{bar}}{1\text{bar}} \times 100\% = 400\ \%$.

2. Given $\sqrt{\frac{8RT}{\pi M_A}} = \sqrt{\frac{3RT}{M_B}} \Rightarrow 8M_B = 3\pi\ M_A$

& $\sqrt{\frac{3RT_A}{M_A}} = \sqrt{\frac{3RT_B}{M_B}}$ $\Rightarrow \frac{T_A}{M_A} = \frac{T_B}{M_B}$ $\Rightarrow M_B\ .\ T_A = M_A\ .\ T_B$

$\Rightarrow \frac{3\pi}{8} M_A\ .\ T_A = M_A\ .\ T_B$ $\Rightarrow T_B > T_A$ Hence (2)

3. $\sqrt{\frac{8RT}{\pi M}} = 2\sqrt{\frac{8 \times R \times 300}{\pi\ \ M}} \Rightarrow T = 1200\ K = 927^oC$

4. $100\ P = 0.2\ P \times 100 + 0.2\ P \times V$

$\frac{1000}{2} = 100 + V$

$V = 400$ ml

5. PV T

6. $\mathbf{U_{MPS}} = \sqrt{\frac{2RT}{M}}$; $\mathbf{U_{RMS}} = \sqrt{\frac{3RT}{M}}$

$\mathbf{U_{av}} = \sqrt{\frac{8RT}{\pi M}}$

7.

	N_2	+ $3H_2$	$\longrightarrow 2NH_3$
t = 0	1 mole	4 mole	0
$t = t_{final}$	0	1 mole	2 mole

NH_3 will absorb by water and volume will be 15 – 5 = 10 L

$P = \frac{nRT}{V} = \frac{1 \times 0.0821 \times 300}{10}$ atm

8. (1) Total moles $= \frac{1 \times 0.2}{RT}$

(2) Total moles $= \frac{1 \times 0.2}{RT}$

(3) Total moles $= \frac{0.5 \times 100}{RT}$

(4) Total moles $= \frac{2 \times 0.1}{RT}$

9. $n_{Total} = \frac{PV}{RT} = \frac{1 \times 2}{0.0821 \times 299} = 0.081$ moles

$X_{H_2} = \frac{n_{H_2}}{n_{total}} = \frac{0.0788}{\frac{0.0821}{2} \times 299} = 0.967$

10. K.E. $\propto$ Temperature

11. $\left[\frac{3}{2}nRT\right]_{He} = \frac{3}{2}nRT$

0.3 T = 0.4 × 400

T = 533 K

12. $V = \frac{15}{56} \times \frac{1}{2} \times \frac{0.0821 \times 295}{1} = 3.24$ L

13. PV = nRT

$\frac{P}{3} \times 2V = nRT$

$T' = \frac{2}{3}\ T$

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

$\frac{V_0}{273} = \frac{V_2}{283} \Rightarrow V_2 = \frac{283}{273} V_0$

15. Frequency of collision will increase.

16. $\frac{P_{N2}}{P_{CO}} = \frac{X_{N2}}{X_{CO}} = \frac{n_{N2}}{n_{co}} = \frac{x \times 28}{28 \times x} = 1\ P_{N2} = P_{co}$

Where x_{n2}, x_{co} is mole fraction of N_2 & CO and x is wt. of N_2 & CO taken.

17. Average K.E. $\frac{3}{2}$ = RT and T is constant 298 K

K.E. is same for all gases at same Temperature.

18. $\frac{n_A T_A}{n_B T_B} = \frac{m}{2} \times \frac{44}{m} \times \frac{300}{600}$

19. Net pressure of gas = P_{gas}

P_{gas} = 650 mm.

$$\frac{P_1V_1}{T_1} = \left(\frac{P_2V_2}{T_2}\right)_{STP}$$

$$\frac{650\times50}{291} = \frac{760\times V_2}{273}$$

V_2 = 40.11 ml

P_1 = 9 atm P_2 = 6 atm

V_1 = 5ℓ V_2 = 10 ℓ

20. $n_{N_2} > n_{O_2}$ where 'n' is no of moles of gases.

$P_{N_2} > P_{O_2}$ because $P_{gas} \alpha$ n.

22. No. of moles of N_2 = $\frac{7}{28} = \frac{1}{4}$

No. of moles of H_2 = 1 Mole

Total moles = $\frac{1}{4} + 1 + \frac{1}{8}$

No. of moles of SO_2 = $\frac{1}{8}$ moles

$= \frac{1}{8}(2 + 8 + 1) = \frac{11}{8}$

$$P = \frac{nRT}{V} = \frac{11}{8} \times \frac{0.0821\times300}{6} = 5.64 \approx 5.7 \text{ atm.}$$

23. Let Temp (T) where V_{rms} of N_2 = V_{rms} of C_3H_8 at STP

$$= \sqrt{\frac{3RT_1}{M_{N2}}} = \sqrt{\frac{3RT_2}{M_{C_3H_8}}} = \sqrt{\frac{3\times8.314\times273}{44\times10^{-3}}}$$

$$= \sqrt{\frac{3RT_1}{M_{N2}}} = 393.38$$

T_1 = 173.72 K

24. $2CO + O_2 \longrightarrow 2CO_2$

30/22.4 10/22.4

O_2 is limiting reagent

10/22.4 0 20/22.4

$\therefore$ at the end of reaction CO_2 = 20 L

CO = 10 L

25. $C_nH_{3n}O_m + yO_2 \longrightarrow nCo_2(g) + H_2O(\ell)$

Contraction in volume = Contraction in moles of gas = $1 + \frac{3n}{4} - \frac{m}{2}$

$= 1 + \frac{3n}{4} - \frac{m}{2}$

$\Rightarrow \left(2n + \frac{3n}{2} - m\right) \times \frac{1}{2} = y$ $\Rightarrow$ **$n + \frac{3n}{4} - \frac{m}{2} = y$**

26. No. of molecules in 22.4 L at STP
is 6.0210^{23} = 1 mole of gas.

27. $P = \frac{nRT}{V} = \frac{2 \times 0.0821 \times 546}{44.8}$ = 2 atm

28. $V_{rms} \propto \frac{1}{\sqrt{M}}$ 'M' is Molecular wt.
order of M.wt. = $H_2 < N_2 < O_2 <$ HBr
order of $V_{rms} = H_2 > N_2 > O_2 >$ HBr.

29. moles of O_2 in 4 mole (H_2SO_4) = 4 × 2
moles of O_2 in 2 mole (P_4O_{10}) = 10
moles of O_2 in 2 mole (NO_2) = 2
$\therefore$ total moles of O_2 = 20 mole
volume of 20 mole at 1 atm = 22.4 × 20 L
$\therefore$ at 2 atm = $\frac{1}{2} \times 22.4 \times 20 = 224$ L

30. mole of $H_2 = \frac{3 \times 16.42}{0.0821 \times 300} = 2$
mole of $D_2 = \frac{6 \times 16.42}{0.0821 \times 300} = 4$
average molecular weight = $\frac{2 \times 2 + 4 \times 4}{4 + 2} = \frac{10}{3}$

31. Average kinetic energy of a gas/ molecule = $\frac{3}{2}$ KT.

32. PV = nRT (at constant n,T)
$P \propto \frac{1}{V}$

33. $\sqrt{\frac{3RT}{M}} > \sqrt{\frac{8RT}{\pi M}}$
$\sqrt{3} > \sqrt{\frac{8}{\pi}}$
When T and M are same.

34. He contain very weak vanderwall force i.e. London force.

35. $P_1V_1/T_1 = P_2V_2/T_2$
i.e. (1 × 100) / 273 = (1.5 × V_2)/ (273 + 91)
or V_2 = 88.9 cc.

36. $u = \sqrt{\frac{3RT}{M}}$ $\therefore$ $\frac{u_{CO_2}}{u_{N_2O}} = \sqrt{\frac{T_{CO_2}}{M_{CO_2}} \times \frac{M_{N_2O}}{T_{N_2O}}}$

i.e. $\frac{x}{4x} = \sqrt{\frac{T}{44} \times \frac{44}{T_{N_2O}}}$ or $T_{N_2O} = 16\ T.$

37. $P_1V_1 + P_2V_2 = P_3(V_1 + V_2)$,

$100 \times 1 + 320 \times 3 = P_3(1 + 3)$ or $P_3 = 265$ kPa

39. Plot is a horizontal line. hence, slope = 0.

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

or $P = \frac{n\ \ RT}{V - nb} - \frac{an^2}{V^2}$

$= \frac{2 \times 0.0821 \times 300}{5 - 2 \times 0.03711} - \frac{4.17 \times 2^2}{5^2}$

$= 10 - 0.66 = 9.33$ atm.

41. By Boyle's law, PV = constant. Differentiating this equation, we get

$PdV + VdP = 0$ or $VdP = -PdV$

or $\frac{dP}{P} = -\frac{dV}{V}$

42. Applying Boyle's law

$P_AV_A = (0.40\ P_A)(V_A + V_B)$

$P_A \times 100 = 0.40\ P_A\ (100 + V_B)$

or $100 = 0.4\ (100 + V_B)$ or $100 + V_B = 250$

or $V_B = 150$ mL.

43. By Charle's law, at constant P and n $\frac{V}{T}$ = const. i.e., V = k.T. Hence, plot of V vs T is a straight line passing through the origin.

44. At constant temperature,

$P_1\ V_1 + P_2\ V_2 = P_3\ (V_1 + V_2)$

$(4.0\text{ bar})(4.0\text{ dm}^3) + (6.0\text{ bar})(6.0\text{ dm}^3) = P_3\ (4.0 + 6.0\text{ dm}^3)$

or $P_3 = \frac{16 + 36}{10} = \frac{52}{10} = 5.2$ bar.

45. $P_1V_1 = P_2\ V_2$. If $V_1 = V$,

$V_2 = V + \frac{10}{100}V = V + \frac{V}{10} = \frac{11V}{10}$

$P_1V = P_2\frac{11V}{10}$ or $P_2 = \frac{10}{11}P_1 = 0.9\ P_1 = 90\%$ of P_1

$\therefore$ Decreases in pressure = 10%.