PHYSICS

BOOKS - CHHAYA PHYSICS (BENGALI ENGLISH)

EXPANSION OF GASES

Examples

1. The volume of a fixed mass of gas at STP is $500 cm^3$. What will be its volume at 700

mmHg pressure if its temperature remains constant?

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2. While tabulating the pressures and volumes for a fixed mass of a gas at a fixed temperature , a student forgets to records a few observation, as shown below. Fill in the blanks.

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3. The volume of a gas at 1 standard atmosphere is compressed to $\frac{1}{6}th$ of its value at constant temperature.What will be its final pressure.

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4. A 100 cm long vertical cylinder,closed at the bottom end , has a movable,frictionless,air tight disattached at its other end. An ideal gas is confined within the cylinder. Initially when the disc between the confined gas and

atmosphere is in equilibrium,the length of the gas column is 90 cm. Mercury is poured slowly on the disc. When the disc descends by 32 cm,mercury over it is just about to overflow. Find the atmospheric pressure if the operation took place at a constant temperature of the gas. Neglect the weight or thickness of the disc.

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5. Volume of a gas is doubled by raising its temperature at constant pressure . Initial temperature of the gas was $13^{\circ}C$. Find the final temperature.

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6. The volume of fixed mass of a gas at $47^{\circ}C$ is $640cm^3$ and its pressure is 75 cm of Hg. To which temperature should the gas be related

at constant volume to make its pressure double?

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7. The volume of a fixed mass of gas is $300cm^3$ at STP. When the temperature is related to $50^\circ C$ at constant volume, the pressure exerted by the gas becomes 900mmHg. What is the pressure coefficient of the gas?

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8. At constant pressure if the volume of a fixed mass of gas at temperature $80^\circ C$ is $500cm^3$ and that at $150^\circ C$ is $600cm^3$, what is the coefficient of volume expansion (γ_p) of the gas?

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9. IF heated to $35^\circ C$ at constant pressure, the volume of gas increases from 5L to $0^\circ C$ by $640cm^3$. What should be the value of absolute zero for this gas in Celsius scale?

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10. A hydrogen cylinder can withstand an internal pressure of $7 \times 10^6 Pa$. The pressure of hydrogen inder at $15^\circ C$ is 1.7×10^6 Pa. At what minimum temperature an explosion may take place?

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11. A glass vessel is filled with air at $30^\circ C$. Up to which temperature should the vessel the heated kepping the pressure constant so that $\frac{1}{3}rd$ of the initial volume of air is expelled? $\gamma_p = \frac{1}{273^\circ}C^{-1}$.

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12. At $27^\circ C$ and at a pressure of 76 cmHg $100cm^2$ of a gas is collected over water surface. The space occupied by the gas is

saturated with water vapour. Maximum vapour pressure of water at $27^{\circ}C$ is 17.4mmHg. What will be the volume of dry gas at STP?

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13. A person measure the presssures of his car tyre to be $2 \times 10^5 Pa$ At that time the temperature and pressure of the atmosphere are $27^{\circ}C$and $1 \times 10^5 Pa$ respectively. Then he travels to another city where the temperature and pressure of the atmosphere are $12^{\circ}C$ and

$6.7 \times 10^4 Pa$ respectively. Them what will be the pressure of his car tyre at that time. Assume the volume of the tyre is same in both cases.

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14. Mass of 1 litre of hydrogen at STP is 0.0896 g. Calculate the value of R from this date.

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15. Mass of 3.76 litre of oxygen at 2 standard atmosphere pressure and $20^{\circ}C$ is 10 g. find the value of R.

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16. Density of air at STP $= 1.293g.\,L^{-1}$ and that of mercury $= 13.6g.\,cm^{-3}$. Find the value of the gas constant for 1 g of air.

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17. The masses, volumes and pressures of two samples of oxygen and hydrogen gases are equal.Find the ratio of their absolute temperatures.

18. Temperatures and pressure on top of the hill are $7^{\circ}C$ and 70 cmHg and the corresponding values at its base are $27^{\circ}C$ and 76cmHg. Compare the densities of air at the top and the base of the hill.

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19. Density of argon at $27^\circ C$ and 76 cmHg pressure is $1.6g.\,L^{-1}$ .An electric bulb of volume $200cm^3$ is filled with argon. The pressure of the gas inside the bulb is 75 cmHg and the average temperature is $127^\circ C$. Find the mass of argon gas in the bulb.

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20. At a place air pressure is 75 cmHg and temperature is $27^{\circ}C$. At another place, the respective values are 70 cmHg and $17^{\circ}C$. Compare the densities of air in the two places.

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21. When an air bubble rises from the bottom of a lake to the upper surface , its diameter increases from 1mm to 2mm. IF the atmospheric pressure is 76 cmHg,calculate the

depth of the lake. Density of mercury is $13.6g.\ cm^{-3}$.

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22. An electronic vaccum tube is constructed and sealed at $27^{\circ}C$ and $1.2 \times 10^{-6} cmHg$ pressure. The tube has a volume of $100 cm^3$. Calculate the number of gas molecules left in the tube.Avogadro number is 6.02×10^{23}, and the gas occupies a volume of 22.4 litre at STP.

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23. While constructing a bulb of volume $250cm^3$, it is sealed at $27^\circ C$ temperature and 10^{-3} mmHg pressure. Find the number of gas molecules in the bulb. Avogadro number $= 6.0 \times 10^{23}$.

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24. Two containers of volume 5L and 3L.contain air at 3 standard atmospheres and 7 standard atmospheres respectively. The containers are

now connected by a short narrow tube. What will be the common pressure in both the containers?

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25. Two bulbs of equal volume are connected by a narrow tube of negligible volume and filled with a gas at STP. IF one of the bulbs is kept in melting ice and the other in the water bath at $62^{\circ} C$,what will be the new pressure of the gas?

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26. An air bubble rises from the button of a lake to its upper surface.The diameters of the bubble at the bottom and the surface are 3.6mm and 4 mm respectively.Depth of the lake is 2.5m and the temperature at the upper surface is $40^{\circ}C$. Find the temperature at the bottom of the lake. Ignore the change in density of water with height. (Atmospheric pressure =76 cmHg and g=$980cm.\ s^{-2}$)

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27. A ballon at STP can lift a total mass of 175 kg attached with it.When the barometer reads 50 cmHg and the temperature becomes $-10^{\circ}C$ at an upper point to where the balloon rises, find the maximum mass that can be lifted.Consider the volume of the balloon to be a constant.

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28. A chamber contains a mass m_1 of a gas at pressure p_1.A second chamber contains a mass m_2 of the same gas at pressure p_2.IF the two chambers are now connected, what will be the pressure of the gas mixture?

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29. A 100cm long glass capillary tube closed at both ends, has a mercury thread of length 10 cm.When the tube is horizontal the mercury

thread stays at the middle of the tube with air columns of equal length on either side,at 76 cmHg pressure and $27^\circ C$. Now the temperature of one side is changed to $0^\circ C$,and of the other side to $127^\circ C$. Find the length and the pressure of the air column kept at $0^\circ C$. Neglect expansions of glass and mercury.

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30. Two heat proof containers of volumes 1L and 2L are connected by a tube.Keeping the valve attached to the tube closed,the 1st container is filled with nitrogen at $0^{\circ}C$ and at 0.5 standard atmosphere pressure, and the 2nd container with argon at $100^{\circ}C$ and 1.5 standard atmosphere pressure. The temperature of the gas mixture becomes $79^{\circ}C$ when the valve is opened,find the pressure of the gas mixture.

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31. Two glass bulbs of volumes 3L and 1L are connected by a narrow tube. The system is filled with air at$30^\circ C$ temperature and at 76 cmHg pressure. Now the bulb of volume 3L is immersed in water vapour at temperature $100^\circ C$ while the other bulb is kept at $30^\circ C$. Find the air pressures in the two bulbs.Neglect the volume expansion of the 3L bulb.

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32. A narrow tube of uniform cross-section is closed at one end.Inside this tube a mercury thread of length hcm detaches some air from the atmosphere outside.When the tube is held vertical keeping its closed ends up,the length of the confined air column becomes l_1 cm.Again the length of the air column becomes $l_2$cm. When the tube is held vertical keeping it open end up.Find the magnitude of the atmosphere spherical pressure.

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33. A glass tube of uniform area of cross section and open at one end encloses some air at $27^{\circ}C$ by a 4 cm long mercury thread that acts like a piston. When the tube is held vertical with its open end up length of the air column in the tube is 9 cm.When the open end is held downwards by turning the tube,the length of the enclosed air column becomes 10 cm. Find () the value of the atmospheric pressure (ii) the temperature at which the length of the air column becomes 9cm again,while the tube is still held inverted.

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34. A uniform gets tube closed at both ends, encloses air columns of equal lengths 5cm,when the tube is placed horizontally.The pressure of the enclosed air is p.When the tube is placed at 60° to the vertical the upper and the lower columns of air are of lengths 46 cm and 44.5 cm respectively.Find the value of p.temperature of the system remains constant at $30^\circ C$.

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35. The reading in a barometer changes from 75 cmHg to 25 cmHg when $10cm^3$ of air of atmospheric pressure is introduced in the vaccum space of the barometer tube. What is the volume of air in the tube?

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36. The reading of a barometer decreases from 75 cmHg to 65 cmHg when some air is

introduced in the vaccum space of the tube.Initial length of the space was 6 cm.IF the area of cross section of the tube is $1cm^2$ What is the volume of this air at standard pressure?

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37. An air bubble of volume $20cm^3$ forms in a lake at a depth of 40 m below the water surface.What will be its volume when it rises just below the water surface?(Standard atmospheric pressure=76 cmHg)

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38. In a capillary tube,closed at one end,some air is enclosed by a mercury thread of length 10 cm. When the tube is kept horizontal the length of the air column is 17 cm. When it is held vertical with the open ends up,the length changes to 15 cm,what will be the length of the air column when the tube is held vertical with the open ends downwards?

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39. Volume of a room is $15m \times 12m \times 8m$. The room was at $22^\circ C$ in the morning.What is the percentage of initial volume of air of the room that is expelled when the room temperature reaches $30^\circ C$ at noon? The pressure remains constant during the change of temperature.

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40. Air is enclosed in a glass container at $67^\circ C$. Find the temperature to which the

container is to be raised at constant pressure, so that $\frac{1}{3}rd$ of the final volume of the air is expelled from the vessel?{Neglect the expansion of glass}?

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Higher Order Thinking Skills Hots Questions

1. In case of volume expansion of a gas,mention of both the pressure and the temperature is necessary,whereas for

expansion of solids and liquids, only the temperature is mentioned.Why?

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2. When a balloon is inflated both its volume and its pressure increase.Is there any violation of Boyle's law?

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3. Unlike liquid there is no coefficient of apparent expansion in case of a gas-why?

On,during the expansion of a liquid ,volume expansion of the container is taken into account,but not for a gas-Why?

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4. Two identical spherical bulbs contain air and are connected by a short horizontal glass tube. The tube contains a short mercury

thread in it.Temperature of the two bulbs are $0^\circ C$ and $20^\circ C$ respectively. IF the temperature of each bulb is increased by $10^\circ C$. what will be the change in the position of the mercury thread?

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5. To definite the coefficient of gases, the initial volume or pressure is always taken at $0^\circ C$But for the coefficients of expansion of

solids and liquids , the initial temperature need not be taken as $0^{\circ} C$. Why?

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6. Air pressure in a car tyre increases during driving.Explain why?

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7. The expansion of a gas follows the condition pV^2=constant .Show that such an expansion

causes cooling of the gas.

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8. For a fixed pass of a gas at constant volume ,draw $p - t^{\circ}C$ and $p - TK$graphs. How can the value of absolute zero be obtained from the 1st graph?

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9. For a fixed mass of a gas at constant pressure ,draw $V - t^{\circ}C$ and $V - TK$graphs. How can the value of absolute zero be obtained from the 1st graph?

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10. Determine the value of universal gas constant R and gas constant K for 1g of air. {At STP the density of air =$1.293g.\ L^{-1}$ and that of mercury =$13.6g.\ cm^{-3}$)

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11. A given mass of an ideal gas is heated in a vessel. The same amount of gas is then heated by keeping it in a larger vessel. Assume that the volumes of both vessel remain the same during heating. What will be the nature of the pressure temperature $(p - T)$ graphs in the two cases.

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12. Draw p-T graph for masses m and 2m of the same gas, when heated in a container of constant volume. Interpret the slopes.

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13. Figure 6.18 shows the V-T graph for a fixed mass of an ideal gas at pressure p_1 and p_2. Can you infer from the graph whether p_1 is greater than p_2?

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14. In a faulty barometer some air occupying the space over mercury column. How can the air pressure be correctly determined with this faulty barometer?

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15. A container filled with oxygen is taken to the moon's surface from the earth. How will the volume and pressure of the gas change

when the container is

a rubber balloon

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16. A container filled with oxygen is taken to the moon's surface from the earth. How will the volume and pressure of the gas change when the container is

a steel cylinder.

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17. What is meant by specific gas constant? Is the value of this constant same for all gases?

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18. Equal number of hydrogen and helium molecules are kept in two identical gas jars at the same temperature .What will be the ratio of the pressures of the gases in the two jars?

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19. A gas container 1 mol of O_2 gas (specific molar mass 32) at pressure p and temperature T. In a similar container one mol of He gas (specific molar mass 4) is kept at temperature 2T. What is the pressure of this He gas?

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20. Same ideal gas is kept in two containers A and B fitted with frictionless pistons. Volume and temperature of the gas in both containers are the same. m_A and m_B are the masses of

the gas in A and B respectively.Volume of the gases in the two containers are changed to 2V keeping their temperature constant. Corresponding changes in pressure in A and B are Δp and $1.5\Delta p$. Find the ratio of the masses of the gas kept in A and in B.

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21. An ideal gas is found to obey a gas law, Vp^2 = constant .Initial temperature and volume of the gas are T and V respectively. IF the gas

expands to a volume 2V, what will be the effect on temperature?

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22. Figure 6.19 shows the p-T graphs for a fixed mass of an ideal gas at volumes V_1 and V_2.Can it be concluded from the graphs that V_1 is greater than V_2?

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23. An ideal gas is initially at temperature T and volume V. Its volume increases by DV due to an increase in Temperature.dT, while pressure remains constant

Here $\gamma = \frac{1}{V} = \frac{dV}{dT}$ What will be the nature of the graph between γ and l?

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24. An ideal gas is initially at pressure p and volume V. its pressure is increased by dp, so

that its volume decreases by dV, while temperatures remains constant. Here $B = -\frac{1}{V}\frac{dV}{dP}$.What will be the nature of the graph between B and p?

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25. Pressure coefficient of a gas is $\frac{1}{273^\circ}C^{-1}$ Explain.

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Exercise Multiple Choice Question

1. Both the volume and the pressure of a definite mass of gas are observed to increase. This is possible when the temperature of the gas

A. remains the same

B. decreases

C. increases

D. first decreases,then increases

Answer: C

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2. The value of the specific gas constant of hydrogen is

A. $4.16 \times 10^7 erg.\, g^{-1}.\, K^{-1}$

B. $0.26 \times 10^7 erg.\, g^{-1}.\, K^{-1}$

C. $4.80 \times 10^7 erg.\, g^{-1}.\, K^{-1}$

D. $5.16 \times 10^7 erg.\, g^{-1}.\, K^{-1}$

Answer: A

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3. At constan pressure , if the temperature of a gas is increased then its density

A. remains the same

B. decreases

C. increases

D. increases or decreases depending on the nature of the gas

Answer: B

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4. Isothermal (temperature=constant) graphs of a gas is its

A. p-V graph

B. $p - \frac{1}{v}$ graph

C. $pV - p$graph

D. $pV - V$graph

Answer: A

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5. At constant pressure the volume of a definite mass of gas changes with its temperature

A. non-linearly

B. linearly

C. in the form of a rectangular hyperbola

D. none of the above

Answer: B

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6. pV-p graph of an ideal gas in

A. parallel to p-axis

B. parallel to pV axis

C. not parallel to any axis

D. rectangular hyperbolic

Answer: A

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7. A vessel contains 1 mol of O_2 gas (specific molar mass 32) at a temperature T. pressure of this gas is p. In another idential vessel,1 mol of He gas (specific molar mass 4) is kept at a

temperature 2T. The pressure of this gas will be

A. $\frac{p}{B}$

B. p

C. 2p

D. 8p

Answer: C

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8. The unit of pV in the equation pV=RT is

A. $N.m^{-1}$

B. J

C. $J.K^{-1}$

D. None of these

Answer: B

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9. Two gases having the same pressure p,volume V and temperature T are mixed with each other. If the volume and temperature of the mixture are V and T respectively,then the value of pressure will be

A. 2p

B. p

C. $\frac{p}{2}$

D. 4p

Answer: A

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10. Compared to that of solids and liquids,value of the coefficient of volume expansion of gases

A. is same

B. is comparatively greater

C. is comparatively less

D.

Answer: B

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11. IF the coefficient of volume expansion of a solid, a liquid and a gas are γ_s, γ_l and γ_g respectively then

A. for different solids ,liquids and gases the values of γ_s, γ_l and γ_g are different

B. for different solids and liquids the values of γ_s and γ_l are different but for all gases the value of γ_g is the same

C. for different solids the values of γ_s are different but for all liquids the value of γ_l and for all gases the value of γ_g are the same

D. for all solids,liquids and gases the values of γ_s, γ_l and γ_g respectively are the same

Answer: B

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12. Coefficient of volume expansion of solids,liquids and gases are respectively γ_s. γ_l and γ_g. Usually

A. $\gamma_s < \gamma_l < \gamma_g$

B. $\gamma_s > \gamma_l > \gamma_g$

C. $\gamma_l < \gamma_s < \gamma_g$

D. $\gamma_l > \gamma_s > \gamma_g$

Answer: A

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13. The volume of a gas at STP is $150cm^3$ At constant volume the pressure of the gas becomes 850 mmHg at a temperature $25^\circ C$. Pressure coefficient of that gas is

A. $4.73 \times 10^{-3^\circ} C^{-1}$

B. $5.73 \times 10^{-3^\circ} C^{-1}$

C. $6.73 \times 10^{-3^\circ} C^{-1}$

D. $1^\circ C^{-1}$

Answer: A

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14. While detemining the value coefficient of a gas, the initial volume is taken as its volume at

A. $273^\circ C$

B. $0^\circ C$

C. $100^\circ C$

D. $27^\circ C$

Answer: B

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15. Volume coefficient and pressure coefficient are equal in case of

A. ideal gas

B. real gas

C. hydrogen

D. inert gases

Answer: A

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16. An ideal gas is expanding such that pT^2 =constant. The coefficient of volume expansion of the gas is

A. $\frac{1}{T}$

B. $\frac{2}{T}$

C. $\frac{3}{T}$

D. $\frac{4}{T}$

Answer: C

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17. Two identical containers A and B with frictionless pistons contain the same ideal gas at the same temperature and of volume. The mass of the gas in A is m_A and that same in B is m_g. The gas in each cylinder is now allowed to expand isothermally to the same final volume 2V. The change in the pressure in A and B are found to be Δp and $1.5\Delta p$ respectively then

A. $4m_A = 9m_B$

B. $2m_A = 3m_B$

C. $3m_A = 2m_B$

D. $9m_A = 4m_B$

Answer: C

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18. With respect to the three quantities- pressurep p, density d and absolute temperature T- the gas equation can be written as

A. $\frac{p_1}{T_1 d_1} = \frac{p_2}{T_2 d_2}$

B. $\frac{p_1 T_1}{d_1} = \frac{p_2 T_2}{d_2}$

C. $\frac{p_1 d_1}{T_2} = \frac{p_2 d_2}{T_1}$

D. $\frac{p_1 d_1}{T_1} = \frac{p_2 d_2}{T_2}$

Answer: A

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19. At a pressure p volume V and temperature

The equation of state for 5g of oxygen will be

[R=molar mass constant]

A. $pV = \frac{5}{32}RT$

B. $pV = 5RT$

C. $pV = \frac{5}{2}RT$

D. $pV = \frac{5}{16}RT$

Answer: A

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20. When an air bubble rises from the bottom of a lake to the surface,its radius is doubled. Atmospheric pressure is equal to the pressure

of a water column of height H. Depth of the lake is

A. H

B. 2H

C. 7H

D. 8H

Answer: C

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Exercise Very Short Answer Type Question

1. At what celcius temperature does the volume of a gas become zero according to Charle's law?

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2. How does the volume of a definite mass of a gas change with pressure at constant temperature?

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3. How does the volume of a definite mass of gas change with its absolute temperature at constant pressure?

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4. At constant volume, the pressure of a definite mass of gas is directly proportional to its absolute temperature Is the statement true or false?

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5. What is the value of the volume coefficient of a gas?

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6. What is the value of the pressure coefficient of a gas?

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Exercise Short Answer Type Question I

1. Pressure coefficient of a gas is $\frac{1}{273^{\circ}} C^{-1}$

What do you mean by this statement?

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2. In two identical gas containers, equal numbers of hydrogen and helium molecules are kept at the same temperature . What will be the ratio of their pressure?

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3. Under what conditions the density of a gas will be inversely proportional to its absolute temperature?

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4. Under what conditions the density of a gas is directly proportional to its pressure ?

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5. Can we ever attain any temperature lower than the absolute zero temperature .Why?

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6. What do you mean by the ideal gas equation?Is this equation valid for real gases?

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7. Is the value of the coefficient of expansion of a gas the same for all gases?

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Exercise Problem Set I

1. The volume of same amount of oxygen at $27^{\circ}C$ and at 70 cmHg pressure is $400cm^3$. What will be its volume at STP? What change

will be observed in the product of pressure and volume of the gas during this changes?

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2. The volume of some amount of gas at STP is 2L.What will be its volume at $91^{\circ}C$ and at 570 mmHg pressure?

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3. The pressure of a gas at $-73^{\circ}C$ is 60 cmHg.What will be its pressure at $27^{\circ}C$ when the volume is kept constant?

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4. At constant pressure if the temperature of 5L of a gas is increased from $0^{\circ}C$ to $35^{\circ}C$ the volume increases by $640cm^3$ From this data,determine the value of absolute zero temperature is Celsius scale.

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5. At some place atmospheric pressure is 74cmHg and temperature is $27^{\circ} C$ .At another place atmospheric pressure is 70cmHg and temperature is $23^{\circ} C$.Compare the densities of air at the two places.

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6. 1L of helium gas at $27^{\circ} C$ and at a pressure twice the atmospheric pressure is so heated

that both the volume and the pressure of the gas are doubled.Find the final temperature of gas.

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7. What will be the volume of one mole of oxygen at $27^{\circ}C$ and at a pressure twice the standard atmosphere $R = 8.31 \times 10^{7} erg.\, mol^{-1} K^{-1}$.

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8. The mass of 1L of a gas at STP is 1562 g.What will be the mass of 1L of the gas at $25^{\circ}C$ and at a pressure of 78 cmHg?

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9. The volume of a bulb is 1L. If its temperature is increased from $0^{\circ}C$ to $27^{\circ}C$ what percentage of air will be expelled from the bulb? Assume that the internal pressure remains the same?

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10. When the barometer reading on day is 75 cm,volume of some amount of hydrogen gas is $150cm^3$ On the next day the volume of that amount is $160cm^3$ What will be the barometric reading on that day if the temperature remains the same?

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11. Density of oxygen at STP is $1.429g.\,L^{-1}$ What will be the mass of 2.5 L of oxygen gas at $27^{\circ}\,C$ and at 780 mmHg pressure?

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12. At STP density of air is $1.29g.\,L^{-1}$ At a pressure 5 times the standard pressure and at $127^{\circ}\,C$ calculate the mass of 10 L of air.

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13. At what depth in water can an air bubble remain stationary? Density of air under normal pressure and temperature is $0.001293g.\ cm^{-3}$ and the atmospheric pressure is equal to 76 cmHg.

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14. A glass-vessel is filled with air at $67^{\circ}C$ .Keeping the pressure constant,up to what temperature should the vessel be heated so

that $\frac{1}{3}$ part of the initial volume of air will be expelled? (ignore the expansions of glass).

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15. Volume of a room is $15m \times 12m \times 8m$. The room was at $22^{\circ}C$ in the morning.What is the percentage of initial volume of air of the room that is expelled when the room temperature reaches $30^{\circ}C$ at noon? The pressure remains constant during the increase

in temperature ,atmospheric pressure remains constant.

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Exercise Problem Set Ii

1. When an air bubble rises from the bottom of a sea its volume increases to 4 times its initial value. IF the atmospheric pressure is 76 cmHg and the temperatures at the bottom and the surface of the sea are the same. Then what will

be the depth of the sea? Density of mercury= $13.6g.\ cm^{-3}$.

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2. An air bubble floats up on the surface of water from the bottom of a river of depth 34 m. At the bottom the temperature of water is $7^{\circ}C$ and the volume of the bubble is $14cm^3$ Temperature on the surface of the water is $27^{\circ}C$ and the pressure is 75 cmHg. IF the density of mercury is $13.6g.\ cm^{-3}$ them what

will be the volume of the bubble on the surface of water?

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3. A car tyre circumference 1m and annular diameter 10cm. Find out the volume of air to be introduced into the type at atmospheric pressure,so that the pressure inside it becomes 10 standard atmospheres.

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4. At STP the density of air is $0.00129g.\ cm^{-3}$ IF the barometric height decreases from 76 cm to 74 cm, then what will be the difference in the masses of 15 L of air?

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5. Volume of a vessel is V and its temperature is T. Three gases are introduced inside the vessel. The initial pressure,volume and temperature of the three gases are

respectively $(p_1, V_1, T_1), (p_2, V_2, T_2)$ and (p_3, V_3, T_3) Find the final pressure.

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6. Volume of a closed cylinder is 22.4 L and it contains 4g of hydrogen at $0^\circ C$ IF the temperature is $60^\circ C$, then what will be the pressure ? If 14 g nitrogen at $0^\circ C$ is filled in the cylinder instead of hydrogen,then what will be its pressure at $100^\circ C$?

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7. The volume of a container is 10L, It is filled with O_2 at STP. IF the container is heated to $27^\circ C$ and then opened at a pressure of 75 cmHg, then what will be the mass of gas expelled? Mass of 1L of oxygen at STP is $1.43g$.

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8. A horizontal glass tube, sealed at both ends contains a column of mercury of length 10 cm at its middle. The two ends of the tube contain

air at a pressure of 76 cmHg. IF the tube is held in a vertical position what will be the shift of the mercury column? Length of the capillary tube=100 cm.

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9. 1 mol of an ideal gas obeys the following equations

$$p = \frac{p_0}{1 + (V_0 / V)^2}$$

where p_0 and V_0 are constants. Find the

change in temperature the volume of the gas is doubled.

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10. A vessel of volume V contains a mixture os n_1 mol of nitrogen and n_2 mol of oxygen at temperature T. The molecular weights of nitrogen and oxygen are M_1 and M_2 respectively. Considering the gases are ideal, find the pressure and average molecular weight of the gas mixture.

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Exercise Hot Numerical Problems

1. The sum of the volumes of some amount of gas at $27^{\circ}C$ and a piece of glass in it is $100cm^3$. IF the both the pressure and the celsius temperature are doubled, the volume becomes $60cm^3$.What is the volume of the piece of glass?

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2. Some air is enclosed in a flask at a temperature of $20^{\circ}C$ and at atmospheric pressure, by means of a cork at the mouth of the flask. Due to rise in temperature,if the pressure inside the flask becomes 1.7 times,then the cork is blown out,Determine the increased temperature.

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3. Volume of some air saturated with water vapour is $80cm^3$ at the pressure of 74 cmHg .Keeping the temperature fixed, if pressure is taken to 146 cmHg, then the volume is halved. What is the pressure of the water vapour in this state?

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4. A uniform narrow tube closed at one end contains some air confined by a mercury

column. The length of the column is 10 cm at $20^{\circ}C$ IF the temperature is increased to $70^{\circ}C$, then what will be the shift of the mercury column? $\gamma_p = 0.00366^{\circ}C^{-1}$

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5. A glass tube open at both ends is immersed vertically in mercury in such a way that 13 cm length of the tube remains above the mercury surface. Now closing the upper end of the tube,it is raised through a further 35 cm.

Determine the length of the air column above mercury in the closed tube. Atmospheric pressure =76 cmHg.

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6. A container having a volume of $800cm^3$ is dipped in water. The opening of the container faces downwards .At what depth should the container be dipped so that $300cm^3$ of water enters the container? The barometric reading

=76 cmHg, and density of mercury= $13.6g.\,cm^{-3}$

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7. A uniform tube closed at one end contains some air confined by a mercury thread of length 15 cm. When the tube is held vertically,with the open end at the top,the air column is 10 cm long at $27^{\circ}C$. IF the tube is inverted, the length of the air column becomes 15 cm. At what temperature will the

air column be 20 cm long in its inverted position.

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8. A glass tube of small bore is sealed at both ends,inside the tube a mercury thread is so confined that it divides the length of the tube in the ratio of 3:1 IF the temperature of the whole system is raised from $0^{\circ}C$ to $273^{\circ}C$, them what will be the observed change in the pressure of air columns inside the tube?

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9. A uniform glass tube closed at one end contains some air at $27^{\circ}C$ confined by a mercury thread of length 4 cm. When the tube is held vertically with its open end at the top,the length of the confined air column is 9cm. IF the tube is inverted then the length of that air column becomes 10 cm. Determine the atmospheric pressure.

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10. A helicopter is flying at an altitude of 400m above the ground. IF the average density of air around the helicopter is $1.2 \times 10^{-3} g.\, cm^{-3}$ and the atmospheric pressure on the ground is 1010 millibar,then what will be the air pressure on the helicopter.

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11. In a faulty barometer some air is trapeed above the mercury column in the tube when the barometer reads 760mm and 750mm, a

correct barometer reads 770mm and 750mm respectively.What is the length of the air column entrapped in the first case? When the faulty barometer reads 752mm,What is the reading in the correct barometer? Assume that the temperature remains constant throughout.

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12. Half the length of a 80cm long open glass tube of narrow bore is immersed in mercury

vertically. The open end of the tube is then closed and it is raised upwards so that a column of mercury of length 23 cm remains inside the tube.What is the atmospheric pressure?

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13. At standard condition $40cm^3$ of oxygen gas is introduced into a tube closed at one end and having a cross sectional area of $1.2cm^2$. The open end is dipped in mercury and the

tube is held vertically. The mercury meniscus in the tube stands at a height of 15.6 cm above the surface of mercury kept in the trough.IF the atmospheric pressure is 75.6 cm and the room temperature is $31^{\circ}C$ then what the length of the tube was filled with the gas?

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14. A container contains $m_1 g$ of a gas at a pressure p_1 In another container $m_2 g$ of the gas is kept at a pressure p_2. IF the two

containers are connected by a tube, then what will be the pressure of the gas mixture.

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Entrance Corner Assertion Reason Type

1. Statement I: Equal masses of helium and oxygen gases are given equal quantities of heat. There will be a greater rise in the temperature of helium compared to that of oxygen.

Statement II: The molecular weight of oxygen is more than the molecular weight of helium.

A. Statement I is true,statement II is true,statement II is a correct explanation for statement I

B. Statement I is true,statement II is true,statement II is not a correct explanation for statement I

C. Statement I is true,statement II is false

D. Statement I is false,statement II is true

Answer: B

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2. Statement I:In the upper part of the atmosphere.the temperature of air is of the order of 1000 K,even then it is quite cold there.

Statement II:Molecular density at high altitude is low.

A. Statement I is true,statement II is true,statement II is a correct explanation for statement I

B. Statement I is true,statement II is true,statement II is not a correct explanation for statement I

C. Statement I is true,statement II is false

D. Statement I is false,statement II is true

Answer: A

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3. Statement I: If V-T graph is rectangular hyperbola,with increase in T, volume will decrease and hence,pressure will increase

Statement II: IF V-T graph is rectangular hyperbola,with increase in T,volume will decrease and hence,pressure will increase.

A. Statement I is true,statement II is true,statement II is a correct explanation for statement I

B. Statement I is true,statement II is true,statement II is not a correct explanation for statement I

C. Statement I is true,statement II is false

D. Statement I is false,statement II is true

Answer: B

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4. Statement I: The size of a hydrogen balloon increases as it rises in air.

Statement II:The material of the balloon can be easily stretched

A. Statement I is true,statement II is true,statement II is a correct explanation for statement I

B. Statement I is true,statement II is true,statement II is not a correct explanation for statement I

C. Statement I is true,statement II is false

D. Statement I is false,statement II is true

Answer: B

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Entrance Corner Multiple Correct Answer Type

1. In the thermal expansion of an ideal gas

A. there is no change in the temperature of the gas

B. there is no change in the internal energy of the gas

C. the work done by the gas is equal to the heat supplied to the gas

D. the work done by the gas is equal to the change in its internal energy

Answer: A::B::C

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2. From the following statements concerning ideal gas at any given temperature T,select the correct one(s).

A. The coefficient of volume expansion at constant pressure is the same for all ideal gases

B. The coefficient of pressure expansion at constant volume is the same for all ideal gases

C. The coefficient of pressure expansion and volume expansion are not equal for any ideal gas

D. The coefficient of pressure expansion and volume expansion are equal for all ideal gases

Answer: A::B::D

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3. Which of the following statements are true?

A. The density of a gas is proportional to the absolute temperature at a constant pressure

B. The density of a gas is inversely proportional to the absolute temperature at constant pressure

C. The density of a gas is proportional to the pressure at constant temperature

D. The density of a gas is inversely proportional to the pressure at constant temperature

Answer: B::C

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Entrance Corner Comprehension Type

1. An air bubble starts rising from the bottom of a lake. Its diameter is 3.6 mm at the bottom

and 4mm at the surface. The depth of the lake is 250 cm and the temperature at the surface is $40^{\circ}C$. The atmospheric pressure is 76 cm of Hg and $g = 980cm.\ s^{-2}$.

What is the pressure at the bottom of the lake?

A. $1279325dyn.\ cm^{-2}$

B. $1359943dyn.\ cm^{-2}$

C. $1257928dyn.\ cm^{-2}$

D. $1378174dyn.\ cm^{-2}$

Answer: A

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2. An air bubble starts rising from the bottom of a lake. Its diameter is 3.6 mm at the bottom and 4mm at the surface. The depth of the lake is 250 cm and the temperature at the surface is $40^{\circ}C$. The atmospheric pressure is 76 cm of Hg and $g = 980cm.\ s^{-2}$.

What is the temperature at the bottom of the lake?

A. $9.77^{\circ}C$

B. $10.37^{\circ} C$

C. $11.31^{\circ} C$

D. $11.67^{\circ} C$

Answer: B

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Entrance Corner Integer Answer Type

1. An ideal gas is heated from $27^{\circ} C$ to $627^{\circ} C$ at constant pressure. If initial volume was $3m^3$

, then what will be the final volume (in m^3) of gas?

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2. An air bubble of diameter 1cm is formed at a depth of 238ft in a lake. What will be the diameter (in cm) of the bubble when it reaches the free surface? Given that the temperature from top to bottom in the lake is same and the height of a water barometer is 34 ft.

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3. Volume of some air saturated with water vapour is $80cm^3$ at the pressure of 74 cmHg .Keeping the temperature fixed, if pressure is taken to 146 cmHg, then the volume becomes halved. What will be the pressure (in cmHg) of water vapour then?

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4. Find the percentage increase in the tyre pressure when air enclosed at $30^\circ C$ is raised

to $57^{\circ} C$ at a constant volume.

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Examination Archive With Solutions Jee Main

1. The temperature of an open room of volume $30 m^3$ increases from $17^{\circ} C$ to $27^{\circ} C$ due to the sunshine. The atmospheric pressure in the room remains 1×10^5Pa. IF n_i and n_f are the number of molecules in the room before and after heating then $n_f - n_i$ will be

A. -1.61×10^{23}

B. 1.38×10^{23}

C. 2.5×10^{25}

D. -2.5×10^{25}

Answer: D

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1. Explain why air pressure in a car tyre increases during driving.

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