PHYSICS

BOOKS - DC PANDEY ENGLISH

THERMOMETRY THERMAL EXPANSION AND KINETIC THEORY OF GASES

Example

1. Express a temperature of $60^\circ F$ in degrees Celsius and in kelvin.

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2. The temperature of an iron piece is heated from $30^\circ C \text{to} 90^\circ C$. What is the change in its temperature on the fahrenheit scale and on the kelvin scale?

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3. On a new scale of temperature (which is linear) and called the W scale. The freezing and boiling points of water are $39^\circ W$ and $239^\circ W$ respectively. What will be the temperature on the new scale, corresponding to a temperature of $39^\circ C$ on the Celsius scale?

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4. An arbitrary scale has the ice point at -20° and the steam point at 180°. When the thermometer reads 5°, then find the read of centigrade thermometer.

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5. A faulty thermometer has its fixed points marked as 5° and 95°. The temperature of a bady as measured by the faulty therature is 59°. Find the correct temperature of the body on Celsisus scale.

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6. The steam point and the ice point of a mercury thermometer are marked as 80° and 10°. At what temperature on centigrade scale the reading of this thermometer will be 59° ?

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7. The pressures of the gas filled in the bulb of a constant volume gas thermometer are 66 cm and 88 cm of mercury column at $0^\circ C$ and $100^\circ C$ respectively. When its bulb is immersed in a liquid placed in a vessel, its pressure is 82.5 cm of mercury column. Calculate the temperature of the liquid.

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8. The following observation were recorded on a platinum resistance thermometer. Resistance at melting point of ice is $= 3.70\Omega,$ resistance

at boiling point of water at normal pressure is $= 4.71\Omega,$ and resistance at $t^{\circ}C = 5.29\Omega.$ Calculate

Temperature coefficient of resistance of platinum.

Value of temperature t.

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9. A steel rular exactly $20cm$ long is graduated to give correct measurements at $20^{\circ}C.$

(a) Will it give readings that are too long or too short at lower temperatures?

(b) What will be that actual length of the rular when it is used in the desert at a temperature of $40^{\circ}C$? $\alpha_{steel} = 1.2 \times 10^{-5}(.^{\circ}C)^{-1}.$

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10. The length of steel rod exceeds that of a brass rod by 5 cm. If the difference in their lengths remains same at all temperature, then the

length of brass rod will be: (α for iron and brass are $12 \times 10^{-6}/^{\circ}C$ and $18 \times 10^{-6}/^{\circ}C$, respectively)

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11. A metal ball having a diameter of 0.4 m is heated from 273 to $360K$. If the coefficient of areal expansion of the material of the ball is $0.000034K^{-1}$, then determine the increase in surface area of the ball.

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12. On heating a glass block of $10,000cm^3$ from $25^{\circ}C$ to $40^{\circ}C$, its volume increase by $4cm^3$. Calculate coefficient of linear expansion of glass.

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13. The volume of mercury in the bulb of thermometer is $10^{-6}m^3$. The area of cross-section of the capillary tube is $2 \times 10^{-7}m^2$. If the temperature is raised by 100^0C, the increase in the length of the mercury column is $\left(\gamma_{Hg} = 18 \times 10^{-5/\circ}C\right)$

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14. A clock with an iron pendulum keeps correct time at $20^\circ C$. How much time will it lose or gain in a day if the temperature changes to $40^\circ C$. Thermal coefficient of liner expansion $\alpha = 0.000012 per^\circ C$.

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15. A second's pendulum clock has a steel wire. The clock is calibrated at $20^\circ C$. How much time does the clock lose or gain in one week when the temperature is increased to $30^\circ C$? $\alpha_{steel} = 1.2 \times 10^{-5}.^\circ C^{-1}$.

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16. An aluminum cylinder 10 cm long with a cross section area of $20cm^2$ is used as a spacer between two steel walls. At $17.2^\circ C$ it just slips in between the walls. When it warms to $22.3^\circ C$ calculate the stress in the cylinder and the total force it exerts on each wall, assuming that the walls are perfectly rigid and a constant distance apart.

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17. A non-conductiong body floats in a liquid at $25^\circ C$ with $1/3$ of its volume immersed in the liquid. When liquid temperature is increased to $105^\circ C$, $1/2$ of body's volume is immersed is the liquid. Then, find the coefficient of real expansion of the liqquid (neglecting the expansion of container of the liquid) .

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18. The coefficient of apparent expansion of a liquid when determined using two different vessle A and B are γ_1 and γ_2, respectily. If the

coefficient of linerar expansion of vesel A is α. Find the coefficient of linear expension of the vessel B.

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19. A glass vessel of volume V_o is completed filled with volume of the liquid will overflow? Cofficient of linear expansion of gass =α and coefficient of volume expension of the liquid =γ_l

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20. Assume that one early morning when the temperature is $10^\circ C$ a driver of an automobile gets his gasoline tank which is made of steel, filled with 75 L of gasoline, which is also at $10^\circ C$ Durign the day, the temperature rises at $30^\circ C$ how much gasoline will overflow ?

(Given, α for steel = $1.2 \times 10^{-5\circ} C^{-1}$, γ for gasoline $= 9.5 \times 10^{-4\circ} C$)

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21. Assume that one early morning when the temperature is $10^{\circ}C$ a driver of an automobile gets his gasoline tank which is made of steel, filled with 75 L of gasoline, which is also at $10^{\circ}C$ Durign the day, the temperature rises at $30^{\circ}C$ how much gasoline will overflow ?

(Given, α for steel = $1.2 \times 10^{-5\circ}C^{-1}$, γ for gasoline $= 9.5 \times 10^{-4\circ}C$)

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22. A sphere of diameter 7.0 cm and mass 266.5 g float in a bath of liquid. As the temperature is raised, the sphere begins to sink at a temperature of $35^{0}C$. If the density of liquid is $1.527gcm^{-3}$ at $0^{o}C$, find the coefficient of cubical expansion of the liquid. Neglect the expansion of the sphere.

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23. The coefficient of volume expansion of glycerin is $49 \times 10^{-5}K^{-1}$. What is the fractional change in its density for a $30^{\circ}C$ rise in temperature ?

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24. If masses of all molecule of a gas are halved and their speed doubled then the ratio of initial and final pressure will be

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25. Oxygen is filled in a closed metal jar of volume $1.0 \times 10^{-3} m^3$ at a pressure of $1.5 \times 10^5 Pa.$ and temperature $400K$. The jar has a small leak in it. The atmospheric pressure is $1.0 \times 10^5 Pa$ and the atmospheric temperature is $300K$. Find the mass of the gas that leaks out by time the pressure and the temperature inside the jar equalise with the surrounding.

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26. The volume thermal expansion coefficient of an ideal gas at constant pressure is

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27. Find the average speed of nitrogen molecules at $25^\circ C$.

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28. In a container, two gases neon and argon are filled. Find the ratio of the root mean square of the molecules of the two gases. $M_{Ne} = 20.0\mu$ and $M_{Ar} = 39.9\mu$. The temperature of the system is $30^\circ C$.

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29. What is rms velocity of O_2 gas at $127^\circ C$. ? The molecular weight of oxygen is 32.

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30. Calculate the rms velocity of oxygen molecules at S.T.P. The molecular weight of oxygen is 32.

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31. The molecules of a given mass of a gas have root mean square speeds of $100 ms^{-1}$ at $27^{\circ} C$ and 1.00 atmospheric pressure. What will be the root mean square speeds of the molecules of the gas at $127^{\circ} C$ and 2.0 atmospheric pressure?

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32. Calculate the root mean square, average and most probable speeds of oxygen molecules at $27^{\circ} C$.

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33. At what temperarture, the kinetic energy of a gas molecule is half of the value at $27^{\circ} C$. ?

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34. Prove that the pressure of an ideal gas is numerically equal to two third of the mean translational kinetic energy per unit volume of the gas.

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35. A balloon has 5.0 g mole of helium at $7^{\circ} C$ Calculate

(a) the number of atoms of helium in the balloon,

(b) the total internal energy of the system.

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36. A tank used for filling helium balloons has a volume of $0.3m^3$ and contains (2.0) mol of helium gas at $20.0^\circ C$. Assuming that the helium behaves like an ideal gas.

(a) What is the total translational kinetic energy of the molecules of the gas ?

(b) What is the average kinetic energy per molecule ?

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37. Calculate the ratio of the mean free path of molecules of two gases in the ratio of the numbers density per cm^3 of the gases is $5:3$ and the ratio of the diameters of the molecules of the gases is $4:5$

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38. For a molecule of an ideal gas $n = 3 \times 10^8 cm^{-3}$ and mean free path is 10^{-2} cm. Calculate the diameter of the molecule.

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39. A gas at $27^{\circ}C$ in a cylinder has a volume of 4 litre and pressure $100Nm^{-2}$.

(i) Gas is first compressed at constant temperature so that the pressure is $150Nm^{-2}$. Calculate the change in volume.

(ii) It is then heated at constant volume so that temperature becomes $127^{\circ}C$. Calculate the new pressure.

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40. The pressure of a given mass of a gas filled in a vessel of volume V at constant temperature is reduced to $1/3$ rd of its initial value. Calculate the percentage change in its volume.

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41. Air is filled in a container of $333K$. Calculate the tempeture upto which it should be heated so that `1//3 rd of air may escope out of th vessel.

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42. If pressure of a gas contained in a closed vessel is increased by $0.4\,\%$ when heated by $1^\circ C$, the initial temperature must be

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43. One mole each of hydrogen, oxygen and nitrogen are mixed in a close container of volume 10 L and temperature $27^\circ C$. Calculate the pressure exerated by the mixture. $\left(R = .314 Jmol^{-1}K^{-1}\right)$

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44. $4g$ hydrogen is mixed with 11.2 litre of He at (STP) in a container of volume 20 litre. If the final temperature is $300K$, find the pressure.

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45. If pressure of CO_2 (real gas) in a container is given by $P = \frac{RT}{2V - b} - \frac{a}{4b^2}$, then mass of the gas in container is a) 11g b) 22g c) 33g d) 44g

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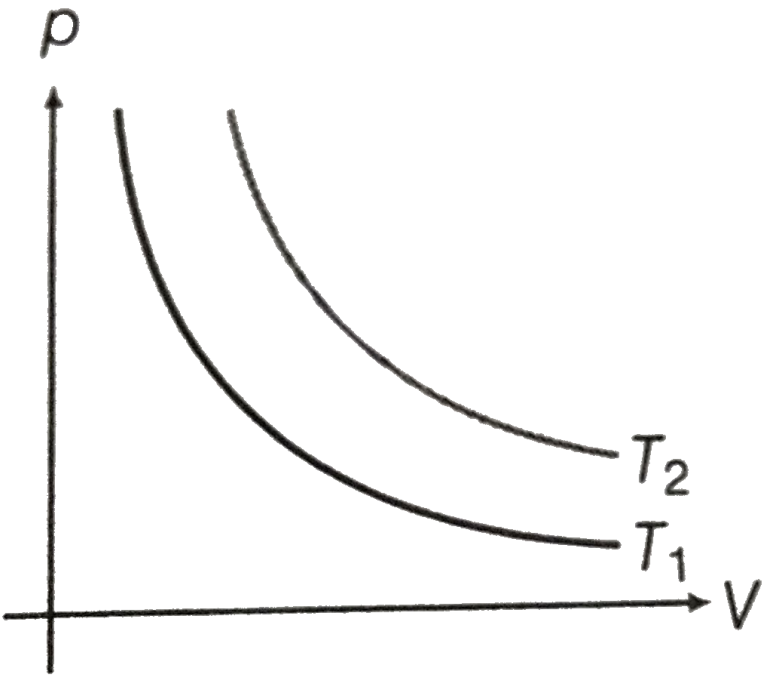
46. The $p - V$ diagrams of same mass of a gas are drawn at two different temperatues T_1 and T_2 Explain whether $T_1 > T_2$ or $T_2 > T_1$.



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47. The $p - V$ diagram of two different masses m_1 and m_2 are drawn (as shown) at constant temperature (T).

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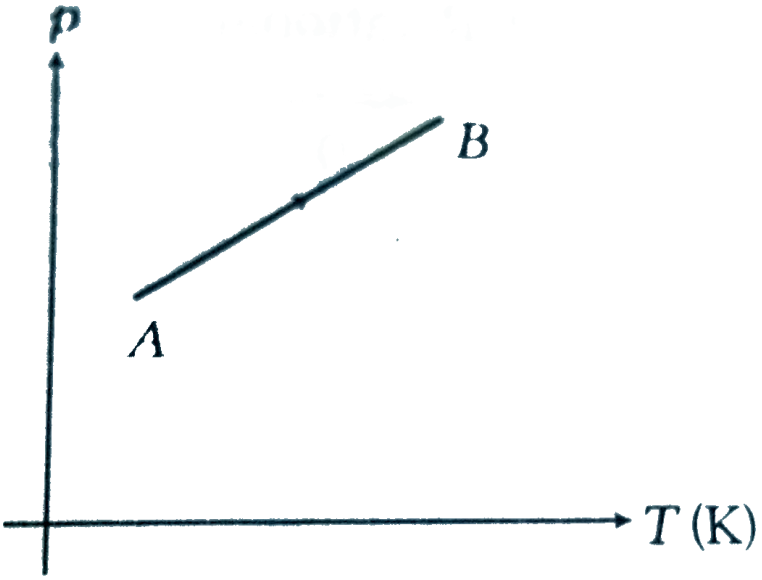
48. The $p - T$ graph for the given mass of an ideal gas is shown in figure. What inference can be drawn regarding the change in Volume (whtherit is constant, increasing or decreasing) ?



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49. Calculate the ratio of KE of molecule of oxygen and neon gas at $27^{\circ} C$.

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50. Calculate the average kinetic energy of oxygen molecule at 0°C. $\left(R = 8.314 Jmol^{-1}\ K^{-1}, N_A = 6.02 \times 10^{23}\right)$

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51. Find the average kinetic energy per molecule at temperature T for an equimolar mixture of two ideal gases A and B, where A is monoatmic and B is diamtomic.

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52. Calculate the change in internal energy of 3.0 mol of helium gas when its temperature is increased by $2.\ 0K$.

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53. Given, Avogadro's number $N = 6.02 \times 10^{23}$ and Boltzmann's constant $k = 1.38 \times 10^{-23} J/K$.

(a) Calculate the average kinetic energy of translation of the molecules of an ideal gas at $0^\circ C$ and $at 100^\circ C$.

(b) Also calculate the corresponding energies per mole of the gas.

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54. One mole of an ideal monoatomic gas is taken at a temperature of $300K$. Its volume is doubled keeping its pressure constant. Find the change in internal energy.

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Check Point 14 1

1. A device used to measure very high temperature is

A. pyrometer

B. Thermometer

C. Barometer

D. Calorimeter

Answer: B

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2. On which of the following scales of temperature, the temperature is never negative

A. Celsius

B. Fahrenheit

C. Reaumur

D. Kelvin

Answer: D

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3. A difference of temperature of $25^\circ C$ is equivalent to a difference of

A. $45^\circ F$

B. $72^\circ F$

C. $32^\circ F$

D. $25^\circ F$

Answer: A

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4. The absolute zero temperature in Fahrenheit scale is

A. $-273^\circ F$

B. $-32^\circ F$

C. $-460^\circ F$

D. $-132^\circ F$

Answer: C

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5. The freezing point on a thermometer is marked as -20° and the boiling point as 130°. A temperature of human body $(34^\circ C)$ on this thermometer will be read as

A. 31°

B. 51°

C. 20°

D. None of these

Answer: A

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6. At what temperature the Fahrenheit and Celsius scales of temperature give the same reading ?.

A. -40°

B. 40°

C. 36.6°

D. 38°

Answer: A

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7. A faulty thermometer has its fixed points marded 5 and 95. if the temperature of a body as shown on the Celsius scale is 40, then its temperature shown on this faulty thermometer is

A. 39°

B. 40°

C. 41°

D. 44.4°

Answer: C

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8. The temperature of a body on Kelvin scale is found to be x K . When it is measured by Fahrenheit thermometer, it is found to be $x^\circ F$, then the value of x is

A. 40

B. 313

C. 574.25

D. 301.25

Answer: C

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9. The readings of a thermometer at $0^\circ C$ and $100^\circ C$ are $50cm$ and $75cm$ of mercury column respectively. Find the temperature at which its reading is $80cm$ of mercury column ?

A. $105^\circ C$

B. $110^\circ C$

C. $115^\circ C$

D. $120^\circ C$

Answer: D

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10. The readings of a bath on Celsius and Fahrenheit thermometers are in the ratio 2 :5. The temperature of the bath is

A. $-26.66^\circ C$

B. $40^\circ C$

C. $45.71^\circ C$

D. $26.66^\circ C$

Answer: C

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Check Point 14 2

1. A solid metal ball has a spherical cavity. If the ball is heated, the volume of the cavity will

A. increase

B. decreases

C. remain uncharged

D. Data insufficient

Answer: A

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2. The ratio among coefficient of volume expansion, superficial expansion and linear expansion i.e.,

$\gamma : \beta : \alpha$ is

A. $1:2:3$

B. $3:2:1$

C. $4:3:2$

D. All of these

Answer: B

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3. Bimetal strips are used for

A. metal thermometer

B. opening or closing electrical circuits

C. thermomsats

D. All of the above

Answer: D

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4. The temperature of a physical pendulum, whose time period is T, is raised by $\Delta\theta$. The change in its time period is

A. $\frac{1}{2}\alpha\Delta\theta$

B. $2alpheT\Delta\theta$

C. $\frac{1}{2}\alpha\Delta\theta$

D. 2 alpha Delata theta`

Answer: A

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5. On heating a liquid having coefficient of volume expension α in a container having coefficient of linear expansion $\alpha/2$, the level of the liquid in the container would

A. rise

B. fall

C. remains almost stationary

D. Cannot be bredicted

Answer: B

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6. A metal sheet with a circular hole is heated. The hole

A. Radius will increase

B. Radius will decreases

C. It will remains constant

D. It can increase or decrease depending upn size

Answer: A

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7. A beaker is completely filled with water at $4^{\circ} C$. It will overflow if

A. heated above $4^{\circ} C$

B. cooled below $4^{\circ} C$

C. both heated and cooled above and below $4^{\circ} C$ respectively

D. None of the above

Answer: C

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8. A bar of iron is 10 cm at $20^\circ C$. At $19^\circ C$ it will be (α of iron $= 11 \times 10^{-6}/^\circ C$)

A. 11×10^{-6} cm longer

B. 11×10^{-6} cm shorter

C. 11×10^{-5} cm shorte

D. 11×10^{-5} cm longer

Answer: C

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9. A steel tape gives corrent measurement at $20^\circ C$. A piece of wood is being measured with the steel tape at $0^\circ C$. The reading is 25 cm on the tape. The real length of the given pices of wood must be

A. 25 cm

B. $> 25cm$

C. $< 25cm$

D. can not say

Answer: B

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10. Two rods of length l_1 and l_2 are made of material whose coefficient of linear expansion are α_1 and α_2 , respectively. The difference between their lengths will be independent of temperatiure if l_1 / l_2 is to

A. $\frac{L_1}{L_2} = \frac{\alpha_1}{\alpha_2}$

B. $\frac{L_1}{L_2} = \frac{\alpha_2}{\alpha_1}$

C. $L_2^2 \alpha_1 = L_1^2 \alpha$

D. $\frac{\alpha_1^2}{L_1} = \frac{\alpha_2^2}{L_2}$

Answer: D

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11. The radius of a ring is R and its coefficient of linear expansion is α. If the temperature of ring increases by θ then its circumfrence will increase by

A. $\pi R\alpha\theta$

B. $2\pi R\alpha\theta$

C. $\pi R\alpha\frac{\theta}{2}$

D. $\pi R\alpha\frac{\theta}{4}$

Answer: C

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12. If two rods of length L and 2L having coefficients of linear expansion α and 2α respectively are connected so that total length becomes 3L, the average coefficient of linear expansion of the composite rod equals

A. $\frac{2}{3}\alpha$

B. $\frac{5}{2}\alpha$

C. $\frac{5}{3}\alpha$

D. None of these

Answer: A

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13. A metal rod of length $100cm$, made of silver at $0^\circ C$ is heated to $100^\circ C$. It's length is increased by $0.19cm$. Coefficient of cubical expansion of the silver rod is

A. $5.7 \times 10^{-5}/^\circ C$

B. $0.63 \times 10^{-5}/^\circ C$

C. $1.9 \times 10^{-5}/^\circ C$

D. $16.1 \times 10^{-5}/^\circ C$

Answer: B

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14. A uniform metal rod is used as a bar pendulum. If the room temperature rises by $10^{\circ}C$, and the coefficient of linear expansion of the metal of the rod is $2 \times 10^{-6} per^{\circ}C$, the period of the pendulum will have percentage increase of

A. -2×10^{-3}

B. -1×10^{-3}

C. 2×10^{-3}

D. 1×10^{-3}

Answer: D

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15. Two rods of different materials having coefficient of thermal expansion α_1, α_2 and young's modulii Y_1, Y_2 respectively are fixed between two

rigid massive walls. The rods are heated such that they undergo the same increase in temperature. There is no bending of rods. If $\alpha_1 : \alpha_2 = 2:3$, the thermal stresses developed in the two rods are equal provided $Y_1 : Y_2$ is equal to

A. $2:3$

B. $1:1$

C. $3:2$

D. $4:9$

Answer: C

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16. Coefficient of volume expansion of mercury is $0.18 \times 10^{-3}/.^{\circ} C$. If the density of mercury at $0^{\circ} C$ is 13.6g/cc, then its density at $200^{\circ} C$ is

A. 13.11 g/cc

B. 52.11 g/cc

C. 16.11 g/cc

D. 26.11 g/cc

Answer: A

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17. A glass flask of volume $200cm^3$ is just filled with mercury at $20^\circ C$. The amount of mercury that will overflow when the temperature of the system is raised to $100^\circ C$ is $\left(\gamma_{glass} = 1.2 \times 10^{-5}/C^\circ, \gamma_{mercury} = 1.8 \times 10^{-4}/C^\circ\right)$

A. 2.15 cm^3

B. 2.69 cm^3

C. 2.52 cm^3

D. 2.25 cm^(3)`

Answer: B

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18. Solids expand on heating because

A. kinetic energy of atom increases

B. Potential energy of atom increases

C. Total energy of atom increases

D. The potential energy curve is asymetric about the equilbrium distance between neighbouring atoms

Answer: D

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19. The coefficient of linear expansion of crystal in one direction is α_1 and that in every direction perpendicular to it is α_2. The coefficient of cubical expansion is

A. $\alpha_1 + \alpha_2$

B. $2\alpha_1 + \alpha_2$

C. $\alpha_1 + 2\alpha_2$

D. None of these

Answer: C

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20. A steel rod of diameter 10 mm is clamped firmly at each end when its temperature is $25^\circ C$ so that it cannot contract on cooling The tension in the rod at $0^\circ C$ is approximately

$\left(\alpha = 10^{-5}/^\circ C, Y = 2 \times 10^{11} Nm^{-2}\right)$

A. 4000 N

B. 7000 N

C. 7400 N

D. 4700 N

Answer: A

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Check Point 14 3

1. Which one of the following is not an assumption in the kinetic theory of gases?

A. The volume occupied by the molecules of the gas in negligible

B. The force of attraction between the molecules is negligible

C. The collision between molecules are elastic

D. All molecules have same speed

Answer: D

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2. Vapor is injected at a uniform rate in a closed vessel which was initially evacuated. The pressure in the vessel

A. increases continuously

B. first increases and then remains constant

C. first increase and then remains constant

D. None of above

Answer: C

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3. The average velocity of molecules of a gas of molecular weight (M) at temperature (T) is

A. $\sqrt{\frac{3p}{p}}$

B. $\sqrt{\frac{\gamma p}{p}}$

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

D. $\sqrt{\frac{8p}{\pi p}}$

Answer: D

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4. For gas at a temperature T the root-mean-square speed v_{rms}, the most probable speed v_{mp}, and the average speed v_{av} obey the relationship

A. $v_{av} < v_{mp} < v_{rms}$

B. $v_{av} < v_{rms} < v_{mp}$

C. $v_{mp} < v_{av} < v_{rms}$

D. $v_{av} < v_{rms} < v_{mp}$

Answer: C

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5. The average kinetic energy of a gas molecule is

A. proportional to pressure of gas

B. inversely proportional to volume of gas

C. inversely proportional to absolute temperature of gas

D. directly proportional to absolute temperature of gas

Answer: D

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6. KE per unit volume is E. The pressure exerted by the gas is given by

A. $\frac{E}{3}$

B. `(2E)/3

C. $\frac{3E}{2}$

D. $\frac{E}{2}$

Answer: B

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7. If at the same temperature and pressure, the densities of two diatomic gases are d_1 and d_2 respectively. The ratio of mean kinetic energy permolecule of gasses will be

A. $1:1$

B. $d_1:d_2$

C. $\sqrt{d_1}:\sqrt{d_2}$

D. $\sqrt{d_2}:\sqrt{d_1}$

Answer: A

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8. Two vessels A and B having equal volume contain equal masses of hydrogen in A and helium in B at 300 K. Then, mark the correct statement?

A. The pressure exerted by hydrogen is half that exerted by helium

B. The pressure exerted by hydrogen is equal to that exacted by helium

C. Average KE of the molecule of hydrogen is half the average KE of the molecules of helium

D. The pressure exeted by hydrogen is twice theat exerted by helium

Answer: D

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9. A vessel contains 1 mole of O_2 gas (molar mass 32) at a temperature T. The preesure of the gas is p. An identical vessel containing one mole of

He gas (molar mass 4) at temperatuer 2T has a pressure of

A. p/8

B. p

C. 2p

D. 8p

Answer: C

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10. What will be the temperature when the rms velocity is double of that at 300 K?

A. 300 K

B. 600 K

C. 900 K

D. 1200 K

Answer: D

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11. By what factor the rms velocity will change, if the temperature is raised from $27^\circ C$ to $327^\circ C$?

A. $\sqrt{2}$

B. 2

C. $\sqrt{3}$

D. 1

Answer: A

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12. The velocities of three molecules are 3v, 4v and 5v. Calculate their root mean square velocity.

A. $\sqrt{\frac{50}{3}}v$

B. $\sqrt{\frac{5}{2}}v$

C. $\frac{7}{2}v$

D. $\frac{5}{2}v$

Answer: A

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13. The temperature at which the root mean squres speed of a gas will be half its value at $0^\circ C$ is (assume the pressure remains constant)

A. $-86.4^\circ C$

B. $-204.75^\circ C$

C. $-104.75^\circ C$

D. $-6825^\circ C$

Answer: A

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14. Four molecules of gas have speeds 1,2,3 and 4 km/s.The value of the root mean square speed of the gas molecules is

A. $\frac{1}{2}\sqrt{15}kms^{-1}$

B. $\frac{1}{2}\sqrt{10}kms^{-1}$

C. $2.5kms^{-1}$

D. $\sqrt{15/2}kms^{-1}$

Answer: D

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15. A sealed container with negiligible coefficient of volumetric expansion contains helium (a monatomic gas). When it is heated from 300 K to 600 K, the average KE of helium atoms is

A. halved

B. unchanged

C. doubled

D. increased by factor $\sqrt{2}$

Answer: C

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16. The gases carbon-monoxide (CO) and nitrogen at the same temperature have kinetic energies E_1 and E_2 respectively. Then

A. $E_1 = E_2$

B. $E_1 > E_2$

C. $E_1 < E_2$

D. None of these

Answer: A

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17. Pressure of an ideal gas is increased by keeping temperature constant.What is its effect on kinetic energy of molecules?

A. Increases

B. decreases

C. No change

D. Cannot be determined

Answer: C

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18. Some gas at 300K is enclosed in a container. Now the container is placed on a fast moving train. While the train is in motion, the temperature of the gas

A. rises above 300 K

B. falls below 300 K

C. remains unchanged

D. becomes unsteady

Answer: C

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19. The root-mean-square (rms) speed of oxygen molecules (O_2) at a certain absolute temperature is v.If the temperature is double and the oxygen gas dissociated into atomic oxygen, the rms speed would be

A. v

B. $\sqrt{2}v$

C. 2 v

D. $2\sqrt{2}v$

Answer: C

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20. The molecules of a given mass of a gas have rms velocity of $200m/sat27^\circ C$ and $1.0 \times 10^5 N/m_2$ pressure. When the temperature and pressure of the gas are respectively $127^\circ C$ and $0.05 \times 10^5 Nm^{-2}$, the rms velocity of its molecules in ms^{-1} is

A. $200ms^{-1}$

B. $400ms^{-1}$

C. $200\sqrt{2}ms^{-1}$

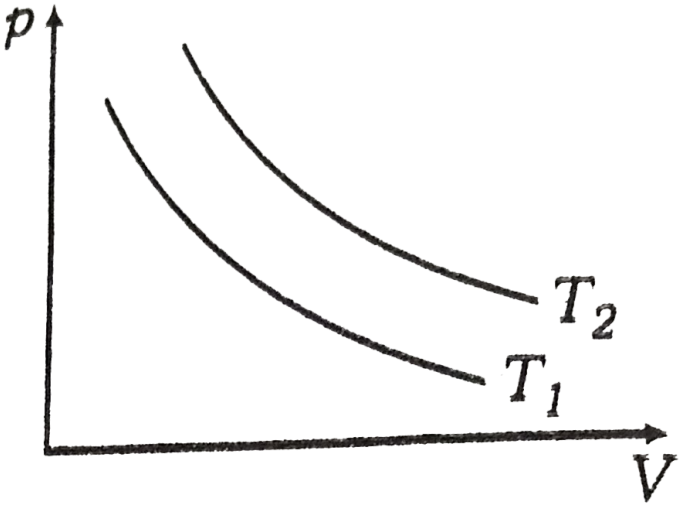
D. $\frac{400}{\sqrt{3}}ms^{-1}$

Answer: D

Watch Video Solution

Check Point 14 4

1. The adjoining fgure shows graph of pressure and volume of a gas at two temperatures T_1 and T_2 Which one the following is correct



A. $T_1 > T_2$

B. $T_1 = T_2$

C. $T_1 < T_2$

D. Nothing can be said about temperatures

Answer: C

Watch Video Solution

2. In a gas equation, $PV = RT$, V refers to the volume of

A. any amount of gas

B. one gram of gas

C. one gram mole of gas

D. one litre of the gas

Answer: C

Watch Video Solution

3. What is the degree of freedom in case of a monoatomic gas?

A. 1

B. 3

C. 5

D. None of these

Answer: B

Watch Video Solution

4. Calculate the total number of degree of freedom for a mole of diatomic gas at STP.

A. 2

B. 3

C. 5

D. 6

Answer: B

Watch Video Solution

5. The degrees of freedom of a molecul of a non-linear triatomic gas is (ignore vibraional motion)

A. 2

B. 4

C. 6

D. 8

Answer: C

Watch Video Solution

6. The mean kinetic energy of one mole of gas per degree of

A. $\frac{1}{2}kT$

B. $\frac{3}{2}kT$

C. $\frac{3}{2}RT$

D. $\frac{1}{2}RT$

Answer: D

Watch Video Solution

7. The average translational kinetic energy of O_2 (molar mass 32) molecules at a particular temperature is $0.048eV$. The translational kinetic energy of N_2 (molar mass 28) molecules in (eV) at the same temperature is (JEE 1997)

(a) 0.0015 (b) 0.003 (c) 0.048 (d) 0.768

A. 0.0015

B. 0.003

C. 0.048

D. 0.768

Answer: C

Watch Video Solution

8. A perfect gas at $27^\circ C$ is heated at constant pressure so as to triple its volume. The tmemperature of th gas will be

A. $84^\circ C$

B. $900^\circ C$

C. $627^\circ C$

D. $450^\circ C$

Answer: C

Watch Video Solution

9. 16 gram of oxygen, 14 gram of nitrogen and 11 gram of carbon dioxide are mixed in an enclosure of volume 5 L and temperature `27^(@)C. The pressure exerted by the mixture is

A. $4 \times 10^5 Nm^{-2}$

B. $5 \times 10^5 Nm^{-2}$

C. $6 \times 10^5 Nm^{-2}$

D. $9 \times 10^5 Nm^{-2}$

Answer: C

Watch Video Solution

10. A balloon is filled at $27^\circ C$ and 1 atm pressure by $500m^3$ He. At-$3^\circ C$ and 0.5 atm pressures, the volume of He-gas contained in balloon will be

A. 700 m^3

B. 900 m^3

C. 1000 m^3

D. 500 m^3

Answer: B

Watch Video Solution

11. Aperfect gas at $27^\circ C$ is heated at constant pressure soas to duuble its volume. The increase in temperature of the gas will be

A. $600^\circ C$

B. $327^\circ C$

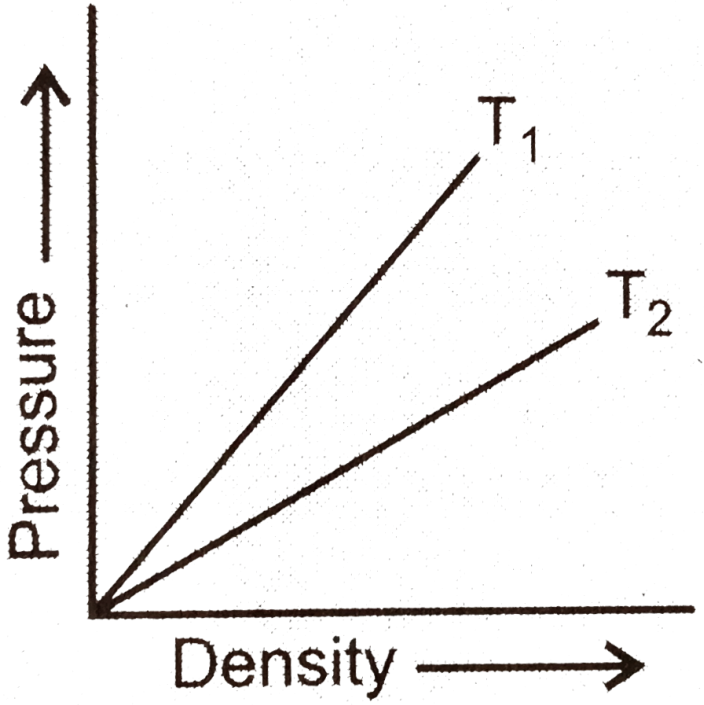
C. $54^\circ C$

D. $300^\circ C$

Answer: D

Watch Video Solution

12. Figure shows graphs of pressure versus density for an ideal gas at two temperatures T_1 and T_2 Which is correct ?



A. $T_1 > T_2$

B. $T_1 = T_2$

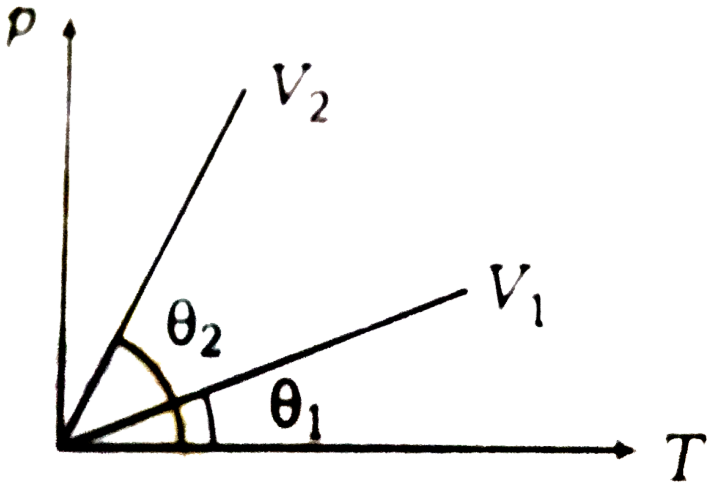
C. $T_1 < T_2$

D. None of these

Answer: A

Watch Video Solution

13. From the p-T graph what conclusion can be drawn?



A. $V_2 = V_1$

B. $V_2 < V_1$

C. $V_2 > V_1$

D. None of these

Answer: C

Watch Video Solution

14. A cylinder containe 20 kg of N_2 gas (M= 28 kg $K^{-1}mol^{-1}$) at a [ressire pf 5 atm. The mass of hydrogen (M = 28 kg $K^{-1}mol^{-1}$) at a pressure of 3 atm contained in the same cylinder at same temperature is

A. 1.08 kg

B. 0.86 kg

C. 0.68 kg

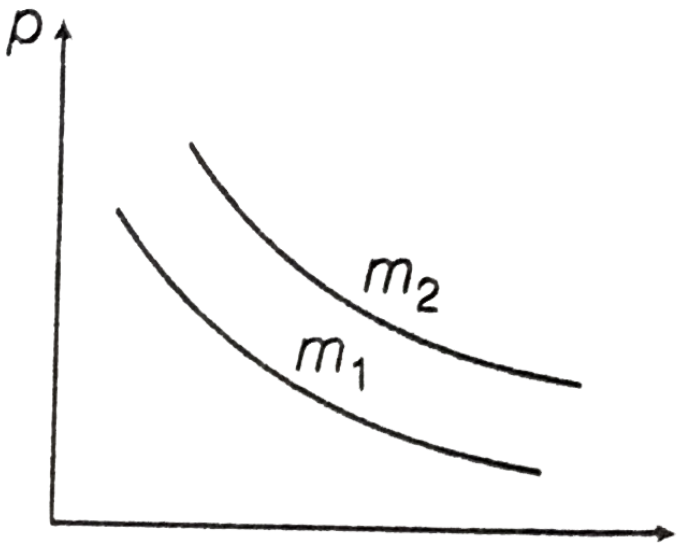
D. 1.68 kg

Answer: B

Watch Video Solution

15. Two different isotherms representing the relationship between pressure p and volume V at a given temperature of the same ideal gas are

shown for masses m_1 and m_2 then



A. $m_1 > m_2$

B. $m_1 = m_2$

C. $m_1 < m_2$

D. Nothing can be predicted

Answer: C

Watch Video Solution

16. A gas is found to obey the law $P^2V = constant$. The initial temperature and volume are T_0 and V_0. If the gas expands to a volume $3V_0$, its final temperature becomes

A. $\frac{T_o}{3}$

B. $\frac{T_o}{\sqrt{3}}$

C. $3T_o$

D. None of these

Answer: D

Watch Video Solution

17. A gas has volume V and pressure p. The total translational kinetic energy of all the molecules of the gas is

A. 3/2 pV only if th gas in monoatomic

B. 3/2 pV only if the gas is diatomic

C. 3/2 pV in all cases

D. None of above

Answer: C

Watch Video Solution

18. A vessel contains a mixture of one mole of Oxygen and two moles of Nitrogen at 300 K. The ratio of the average kinetic energy per O_2 molecule to that per N_2 molecule is :

A. $1:1$

B. $1:2$

C. $2:1$

D. $8:7$

Answer: A

Watch Video Solution

19. Two monoatomic gases are at absolute temperatures 300 K and 350 K respectively. Ratio of average kinetic energy of their molecules is

A. $7:6$

B. $6:7$

C. $36:49$

D. $49:36$

Answer: B

Watch Video Solution

20. At $27^\circ C$ temperature, the kinetic energy of an ideal gas is E_1. If the temperature is increassed to $327^\circ C$, then the kinetic energy will be

A. $\frac{E_1}{\sqrt{2}}$

B. $\sqrt{2}E$

C. $2E_1$

D. $\frac{E_1}{2}$

Answer: C

Watch Video Solution

21. Temperature remaining constant, the pressure of gas is decreased by 20%. The percentage change in volume

A. increases by 20%

B. decreases by 20%

C. increases by 25%

D. decreases by 25%

Answer: C

Watch Video Solution

22. One litre of an ideal gas st $27^{\circ}C$ is heated at a constant pressure to the $297^{\circ}C$. Then, the final volume is the approximately

A. 1.2 L

B. 1.9 L

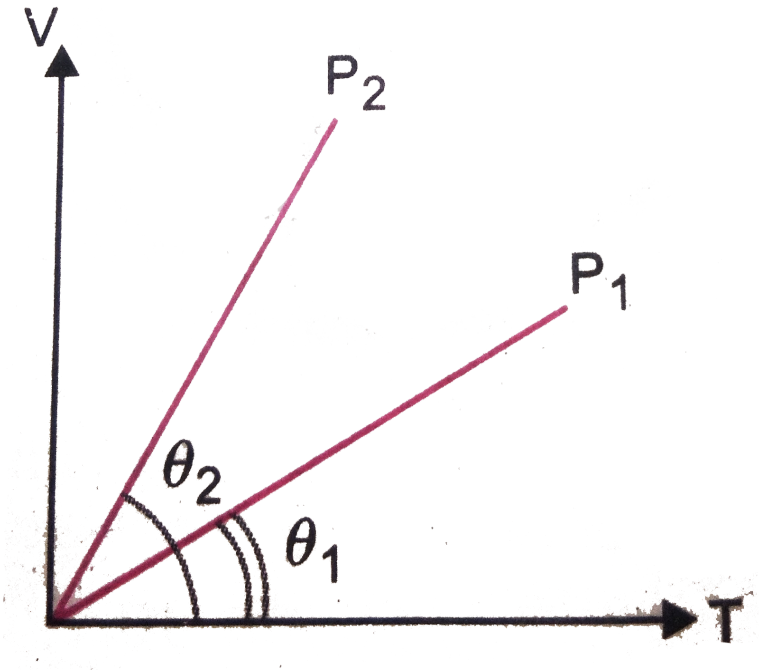
C. 19 L

D. 2.4 L

Answer: B

Watch Video Solution

23. In the given (V-T) diagram, what is the relation between pressure P_1 and P_2 ?



A. $p_2 = p_1$

B. $p_2 > p_1$

C. $p_2 < p_1$

D. Cannot be predicted

Answer: C

Watch Video Solution

24. The gas in a vessel is subjected to a pressure of 20 atmosphere at a temperature $27^{\circ} C$. The pressure of the gas in the vessel after one half of the gas is released from the vessel and the temperature of the remainder is raised by $50^{\circ} C$ is

A. 8.5 atm

B. 10.8 atm

C. 11.7 atm

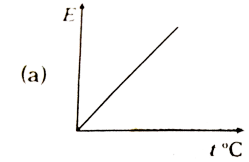
D. 17 atm

Answer: C

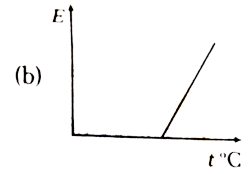
Watch Video Solution

25. The graph which represents the variation of mean kinetic energy of moleules with temperature $^{\circ} C$ is ?

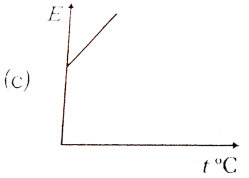
A.



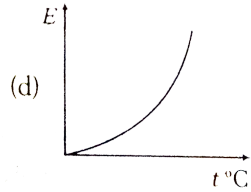
B.



C.



D.



Answer: C

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A Tacking It Together

1. Heat given to a system can be associated with

A. kinetic energy of amotion of molecules

B. kinetic energy of orderly motio of molecules

C. total kinetic energy of random and orderly motion of molecules

D. dinetic energy of random motion in some csases and kinetic energy of orderly motion in other

Answer: A

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2. Boyles's Law is applicable for an

A. adiabatic process

B. isothermal process

C. isobaric process

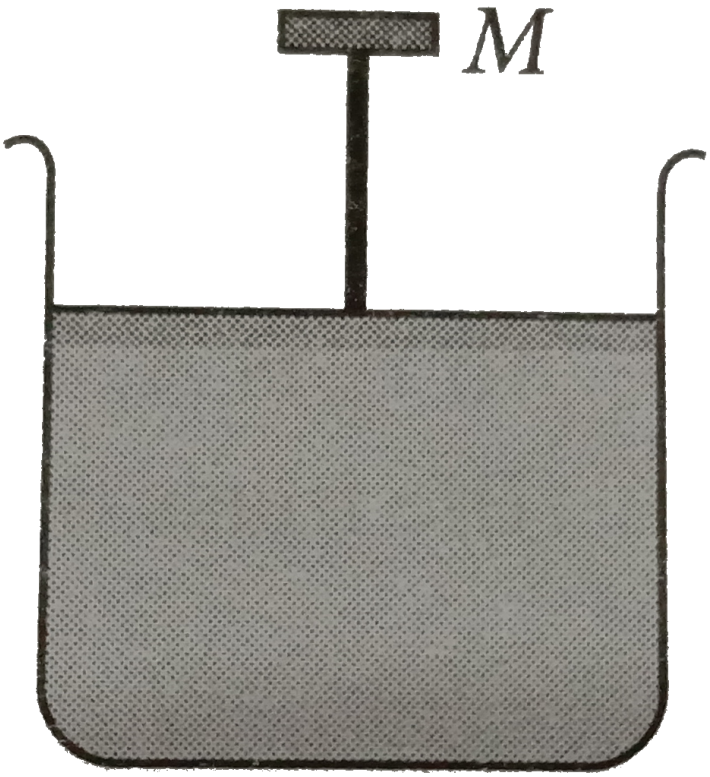
D. isochoric process

Answer: B

Watch Video Solution

3. A cylinder containing an ideal gas is in verticle postion and has a piston of mass M that is able to move up of down without friction. It the

temperature is increased,



A. both p and V of the gas will change

B. only p will increase according to Charles' law

C. V will change but not p

D. p will change but not V

Answer: A

Watch Video Solution

4. The absolute zero temperature in Fahrenheit scale is

A. $-273^\circ F$

B. $-32^\circ F$

C. $-460^\circ F$

D. $-132^\circ F$

Answer: C

Watch Video Solution

5. On which of the following scales of temperature, the temperature is never negative

A. Celsius

B. Fahrenheit

C. Reaumur

D. Kelvin

Answer: D

Watch Video Solution

6. In a mercury rhermometer the ice point (lower fixed point) is marked as 10° and the steam point (upper fixed point) is marked as 130°. At $40^\circ C$ tmperature, what will this thermometer read?

A. 78°

B. 66°

C. 62°

D. 58°

Answer: D

Watch Video Solution

7. On a new scale of tmperature (which is linear) and called the W scale, the freezing and voilling points of water are $39^\circ W$ and $239^\circ W$, respectively, What will be the temperature on the new scale, corresponding to a temperature of $39^\circ C$ on the Celsius scale ?

A. $200^\circ W$

B. $139^\circ W$

C. $78^\circ W$

D. $117^\circ W$

Answer: D

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8. A Centigrade and a Fahrenheit thermometer are dipped in boiling water. The water temperature is loweres until the Fahrenheit thermometer registers 140°. What is the fall in temperature as registered by Centigrade thermometer ?

A. 30°

B. 40°

C. 60°

D. 80°

Answer: B

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9. A constant volume gas thermometer show pressure reading of 50cm and 99 cm of mercury at $0^\circ C$ and $100^\circ C$ respectively. When the pressure reading is 60 cm of mercury, the temperature is

A. 25°

B. 40°

C. 15°

D. 12.5°

Answer: A

Watch Video Solution

10. A metal rod of silver of length $100cm$ at $0^\circ C$ is heated to $100^\circ C$. It's length is increased by $0.19cm$. Coefficient of cubical expansion of the silver rod is

A. $5.7 \times 10^{-5}/C$

B. $0.63 \times 10^{-5}/C$

C. $1.9 \times 10^{-5}/C$

D. $16.1 \times 10^{-5}/C$

Answer: A

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11. The volume of a gas at $20^\circ C$ is 100 cm 3 at normal pressure. If it is heated to $100^\circ C$, its volume becomes 125 cm 3 at the same pressure, then volume coefficient of the gas at normal pressure is

A. $0.0015/^\circ C$

B. $0.0045/^\circ C$

C. $0.0025/^\circ C$

D. $0.0033/^\circ C$

Answer: D

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12. Coefficient of apparent expansions of mercury is $0.18 \times 10^{-3} /^{0} C$. If the density of mercury at $0^{0} C$ is $13.6 g / cc$ its density at $473 K$ will be

A. $13.11 g / cc$

B. $26.22 g / cc$

C. $52.11 g / cc$

D. None of these

Answer: A

Watch Video Solution

13. A clock with a metal pendulum beating seconds keeps correct time at $0^{\circ} C$. If it loses 12.5s a day at $25^{\circ} C$ the coefficient of linear expansion of metal pendulum is

A. $\frac{1}{86400} /^{\circ} C$

B. $\frac{1}{43200} /^{\circ} C$

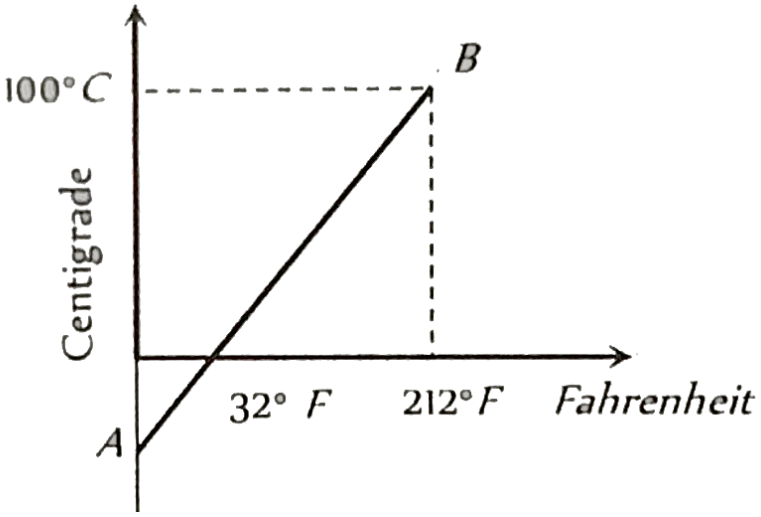
C. $\frac{1}{14400}/^{\circ}C$

D. $\frac{1}{28800}/^{\circ}C$

Answer: A

Watch Video Solution

14. The graph AB shown in figure is a plot of temperature of a body in degree celsius and degree Fahrenheit. Then



A. Slope of line AB is 9/5

B. Slope of line AB is 5/9

C. Slope of line AB is 1/9

D. Slope of line AB is 3/9

Answer: B

Watch Video Solution

15. If at same temperature and pressure, the densities for two diatomic gases are respectively d_1 and d_2, then the ratio of velocities of sound in these gases will be

A. $d_1 d_2$

B. $\sqrt{d_2 / d_1}$

C. $\sqrt{d_1 / d_2}$

D. $\sqrt{d_1 d_2}$

Answer: B

Watch Video Solution

16. A gas at the temperature 250 K is contained in a closed vessel. If the gas is heated through 1K, then the percentage increase in its pressure will be

A. $0.4\,\%$

B. $0.2\,\%$

C. $0.1\,\%$

D. $0.8\,\%$

Answer: A

Watch Video Solution

17. An electron tube was sealed off during manufacture at a pressure of 1.2×10^{-7} mm of mercury at $27^{\circ}C$. Its volume is 100 cm^3. The number of molecules that remain in the tube is

A. 2×10^{16}

B. 3×10^{15}

C. 3.86×10^{11}

D. 5×10^{11}

Answer: C

Watch Video Solution

18. At what temperature is the root mean square velocity of gaseous hydrogen molecules is equal to that of oxygen molecules at $47^{\circ} C$?

A. 20 K

B. 80 K

C. $-73K$

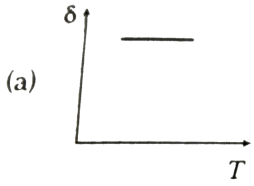
D. 3 K

Answer: A

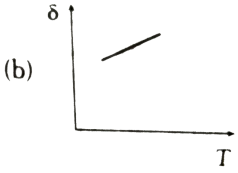
Watch Video Solution

19. An ideal gas is initially at temperature T and volume V. Its volume is increased by ΔV due to an increase in temperature ΔT, pressure remaining constant. The quantity $\delta = \frac{\Delta V}{V \Delta T}$ varies with temperature as

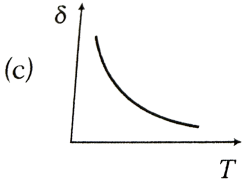
A.



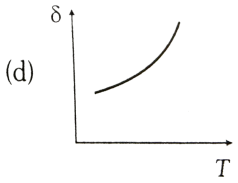
B.



C.



D.



Answer: C

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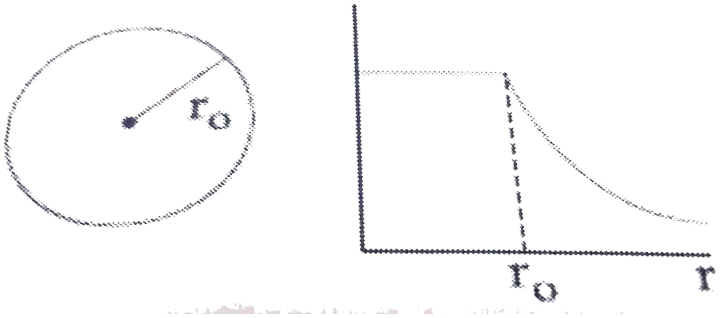
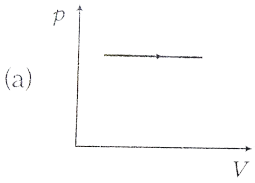
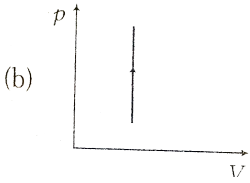
20. The given graph shows variation (with distance r form center) of :



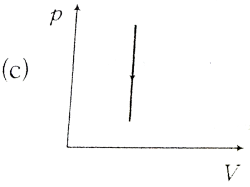
A.

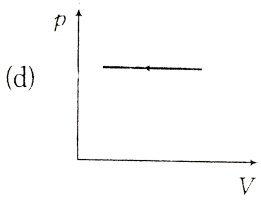


B.



C.





D.

Answer: D

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21. A chamber containing a gas was evacuated till the vacuum attained was 10^{-14} m of Hg. If the temperature of the chamber was $30^{\circ}C$, the number of molecules that remains in it per cubic metre is

A. 3.2×10^{11}

B. 3.2×10^{12}

C. 2.3×10^{12}

D. 2.3×10^{10}

Answer: A

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22. A bimetallic strip is made of aluminium and steel $(\alpha_{Al} > \alpha_{\text{steel}})$. On heating, the strip will

A. remains strsaight

B. get twisted

C. will bend with aluminium on concave side

D. will bend with steel on concave side

Answer: D

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23. A uniform metallic rod rotates about its perpendicular bisector with constant angular speed. If it is heated uniformly to raise its temperature slightly

A. its speed of rotation increases

B. its speed rotation decreases

C. its speed of rotation remains same

D. its speed increase because its moment of inertia increases

Answer: B

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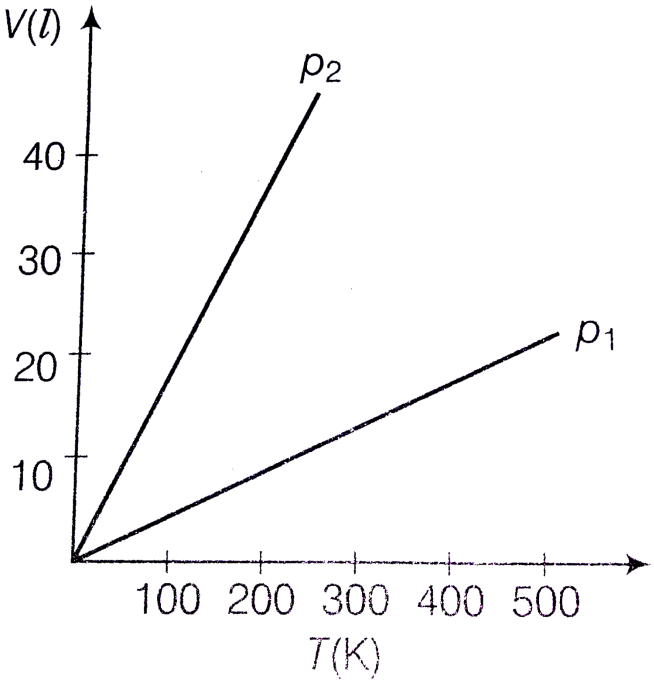
24. Volume versus temperature graphs for a given mass of an ideal gas are shown in figure. At two different values of constant pressure. What

can be inferred about relation between P_1 and P_2 ?



A. $p_1 > p_2$

B. $p_1 = p_2$

C. $p_1 < p_2$

D. Data is insufficient

Answer: A

Watch Video Solution

25. As the temperature is increased, the period of a pendulum

A. increase as its effective length increases even though its centre of mass still remains at the centre of the bob

B. decreases as its effective length increases even thought its centure of mass still remains at the centure of the bob

C. increases at is effective length increase due to shifting to centre of mass below the centre of the bob

D. decrease as its effective length remains same but the centre of mass shifts above the centre of the bob

Answer: A

Watch Video Solution

26. An aluminium sphere is dipped into water. Which of the following is true ?

A. Buoyancy will be less in water $0^\circ C$ than that in water at $4^\circ C$

B. Buoyance will be more in water at $0^\circ C$ than that in water at $4^\circ C$

C. Buoyancy in water at $0^\circ C$ will be same as that in water at $4^\circ C$

D. Buoyance may be more or less in water at $4^\circ C$ depending on the radius of the sphere

Answer: A

Watch Video Solution

27. The radius of a metal sphere at room temperature T is R, and the coefficient of linear expansion of the metal is α. The sphere is heated a little by a temperature ΔT so that its new temperature is $(T + \Delta T)$. The increases in the volume of the sphere is approximately

A. $2\pi R\alpha\Delta T$

B. $\pi R^2\alpha\Delta T$

C. $4\pi R^3\alpha\Delta T/3$

D. $4\pi R^3 \alpha \Delta T$

Answer: D

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28. A cubic vessel (with face horizontal + vetical) contains an ideal gas at NTP. The vessel is being carried by a rocket which is moving at a speed of $500 ms^{-1}$ in vertical direction. The pressure of the gas inside the vessel as observed by us on the ground.

A. remains the same because 500 ms^{-1} is very much smaller than v_{rms} of the gas

B. remains the same because motion of the vessel as a whole does not affect the relative motion of the gas molecules and the walls

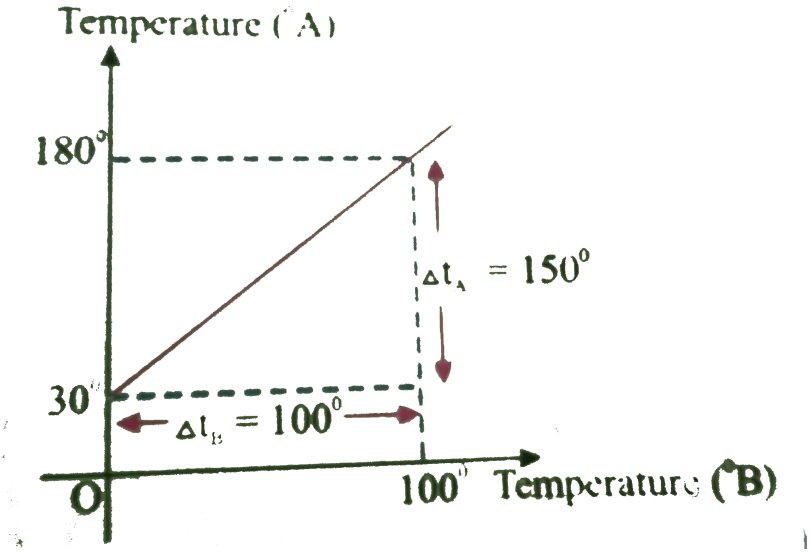
C. will increase by a factor equal to $\left(v^2{}_{rms} + (500)^2\right)/v^2$ where v_{rms} was the original mean squre velocity of the vessel

D. will be different on the top wall and bottom wall of the vessel

Answer: B

Watch Video Solution

29. The graph between two temperature scales A and B is shown in Fig. Between upper fixed point and lower fixed point there are 150 equal divisions on scales A and 100 on scale B. The relation between the temperature in two scales is given by_



A. $\frac{t_A - 180}{100} = \frac{t_B}{150}$

B. $\frac{t_A - 30}{150} = \frac{t_B}{100}$

C. $\frac{t_A - 180}{150} = \frac{t_A}{100}$

D. $\frac{t_B - 40}{100} = \frac{t_A}{180}$

Answer: C

Watch Video Solution

30. 1 mole of H_2 gas is contained in box of volume $V = 1.00m^3 atT = 300K$. The gas is heated to a temperature of T = 3000 K and the gas gets converted to a gas of hydrogen atoms. The final pressure would be (considering all gases to be ideal)

A. same as the pressure initially

B. 2 time the pressure initially

C. 10 times the pressure initially

D. 20 times the pressure initially

Answer: D

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31. An inflated rubber balloon contains one mole of an ideal gas has a pressure p, volume V and temperature T. if the temperature rises to 1.1 T, and the volume is increased to 1.05 V, the final pressure will be

A. 1.1 p

B. p

C. less than p

D. between p and 1.1

Answer: A

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32. A glass vessel of volume $100cm^3$ is filled with mercury and is heated from $25^\circ C \rightarrow 75^\circ C$. What volume of mercury will overflow? Coefficient

of linear expansion of glass $= 1.8 \times 10^{-6} / {}^{\circ} C$ and coefficient of volume expansion of mercury is $1.8 \times 10^{-4} / {}^{\circ} C$.

A. $2V_oAT(\gamma_l - 3\alpha_g)$

B. $V_o\Delta T(\gamma_l - 3\alpha_g)$

C. $V_o\Delta T(\gamma_l - \alpha_g)$

D. $\frac{V_o\Delta T}{2}(\gamma_l - 3\alpha_g)$

Answer: B

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33. The steam point and the ice point of a mercury thermometer are marked as 80° and 10°. At what temperature on centigrade scale the reading of this thermometer will be 59° ?

A. $70^{\circ} C$

B. $60^{\circ} C$

C. $40^{\circ} C$

D. $50^\circ C$

Answer: A

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34. Two unifrom brass rod A and B of length l and 2l and radii 2r respectively are heated to the same temperature. The ratio of the increase in the volume of A to that of B is

A. $1:1$

B. $1:2$

C. $2:1$

D. $1:4$

Answer: C

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35. The expansion of an ideal gas of mass (m) at a constant pressure (p) is given by the straight line (B) Then, the expansion of the same ideal gas of mass $2m$ at a pressure $2p$ is given by the straight line. (##DCP_V03_C20_E01_049_Q01##).

A. C

B. A

C. B

D. None of these

Answer: C

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36. The root mean square velocity of the molecules in a sample of helium is $5/7th$ that of the molecules in a sample of hydrogen. If the temperature of hydrogen sample is $0^\circ C$, then the temperature of the helium sample is about

A. $0^\circ C$

B. 0 K

C. $273^\circ C$

D. $100^\circ C$

Answer: A

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37. At room temperature, the rms speed of the molecules of a certain diatomic gas is found to be $1930 m / s$. The gas is

A. H_2

B. F_2

C. O_2

D. Cl_2

Answer: A

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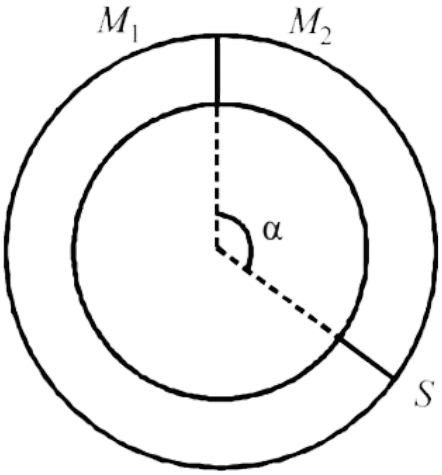
38. A ring shaped tube contain two ideal gases with equal masses and molar masses $M_1 = 32$ and $M_2 = 28$.

The gases are separated by one fixed partition P and another movable stopper S which can move freely without friction inside the ring. The angle α as shown in the figure is ..... degrees.



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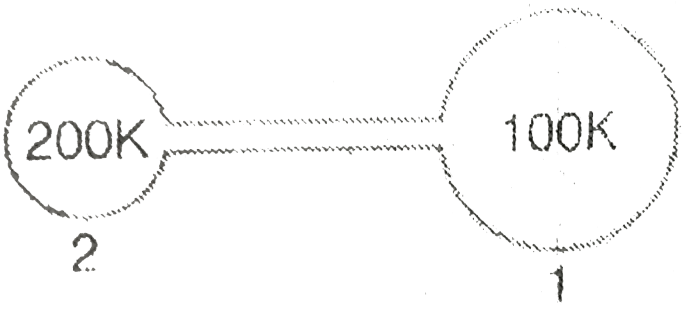
39. Figure shows two flasks connected to each other. The volume of flask 1 is twice that of flask 2. The system is filled with an ideal gas at temperature 100 K and 200 K respectively in the flasks. In equilibrium if the mass of the gas in 1 be m, then what is the mass of the gas in flask 2.



A. m

B. m/2

C. m/4

D. m/8

Answer: C

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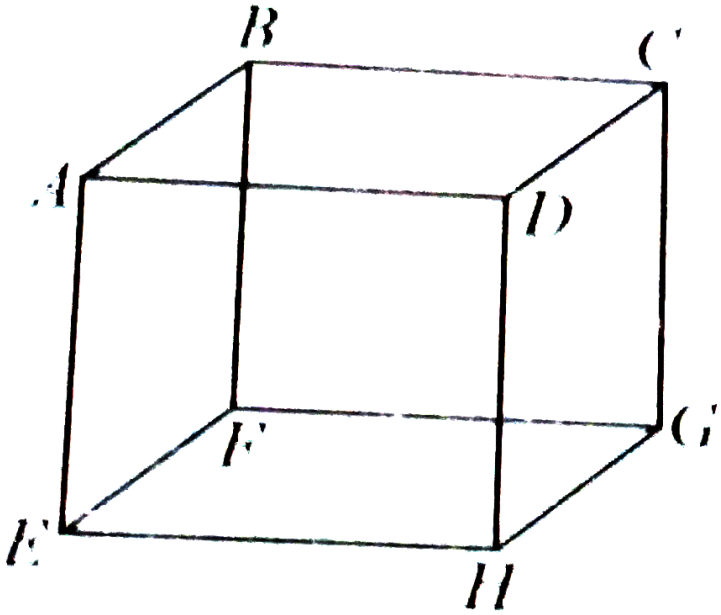
40. 1 mole of an ideal gas is contained in a cubical volume V, ABCDEFGH at 300 K as shown in figure. One face of the cube (EFGH) is made up of a material which totally absorbs any gas molecule incident on it. At any given time,



A. the pressure on EFGH would be zero

B. the pressur all the faces will the equal

C. the pressure pf EGGH would be double the pressure on ABCD

D. the pressure on EFGH would be half that on ABCD

Answer: A

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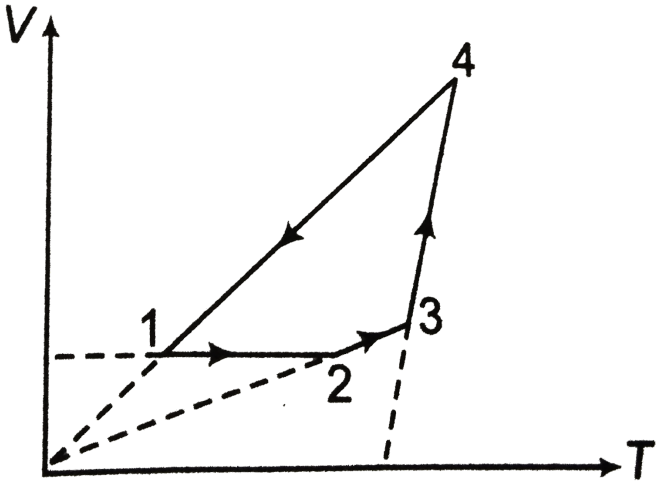
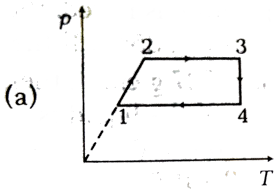
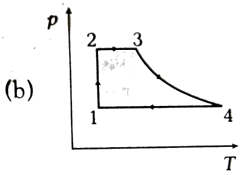
41. A cyclic process 1-2-3-4-1 is depicted on V-T diagram. The p-T and p-V diagrams for this cyclic process are given below. Select the correct choices (more than one options is/are correct)



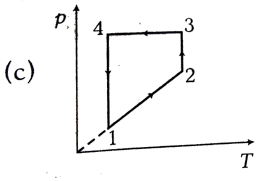
A.



B.



C.



D. None of these

Answer: C

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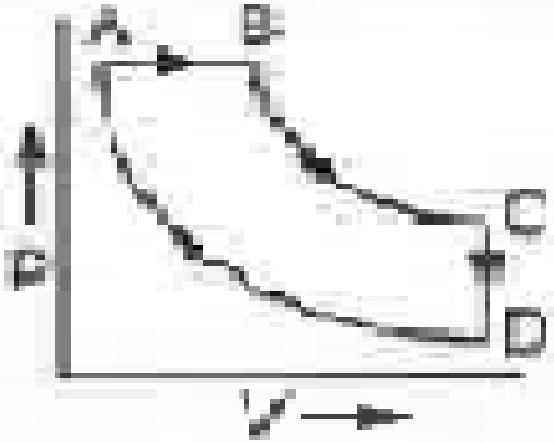
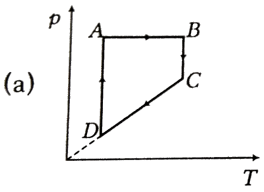


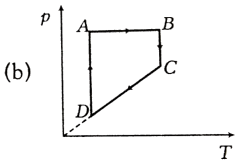
42.

A cyclic process ABCD is shown in the p-V diagram. Which of the following curves represent the same process?

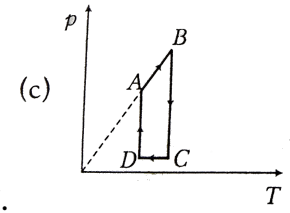
A.



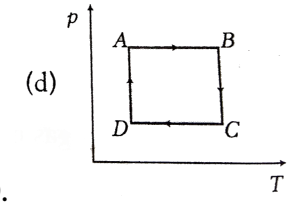
B.



C.



D.



Answer: A

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43. Find the average kinetic energy per molecule at temperature T for an equimolar mixture of two ideal gases A and B, where A is monoatmic and B is diamtomic.

A. 2 kT

B. 4 kT

C. 3 kT

D. 8 kT

Answer: B

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44. The p-T graph for the given mass of an ideal gas is shown in figure. What inference can be drawn regarding the change in volume (whether it is constant, increasing or decreasing) ?

A. remained constant

B. decreased

C. increased

D. changed erratically

Answer: C

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45. A sphere of diameter 7.0 cm and mass 266.5 g float in a bath of liquid. As the temperature is raised, the sphere begins to sink at a temperature of $35^\circ C$. If the density of liquid is $1.527 gcm^{-3}$ at$0^\circ C$, find the coefficient of cubical expansion of the liquid. Neglect the expansion of the sphere.

A. $0.0043/^\circ C$

B. $0.00083/^\circ C$

C. $0.00025/^\circ C$

D. $0.00010/^\circ C$

Answer: B

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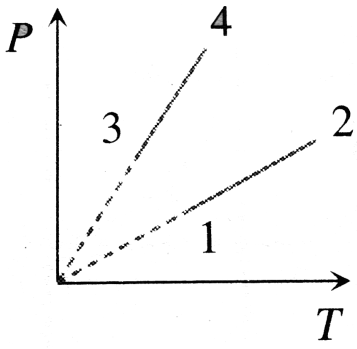
46. Pressure versus temperature graph of an ideal gas of equal number of moles of different volumes is plotted as shown in Fig. Choose the correct

alternative.



A. $V_1 = V_2, V_3 = V_4$ and $V_2 > V_3$

B. $V_1 = V_2, V_3 = V_4$ and $V_2 < V_3$

C. $V_1 = V_2 = V_3 = V_4$

D. $V_4 = V_3 = V_2 = V_1$

Answer: A

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47. A cylindrical steel plug is inserted into a circular hole of diameter 2.60 cm in a brass plate. When the plug and the plates are at a temperature of $20^\circ C,$ the diameter of the plug is 0.010 cm smaller than that of the hole. The temperature at which the plug will just fit in it is

$\left(\text{Given, } \alpha_{steel} = 11 \times 10^{-6} C^{-1} \text{ and } \alpha_{brass} = 19 \times 10^{-6} C^{-1}\right.$

A. $-48^\circ C$

B. $-20^\circ C$

C. $-10^\circ C$

D. $-458^\circ C$

Answer: D

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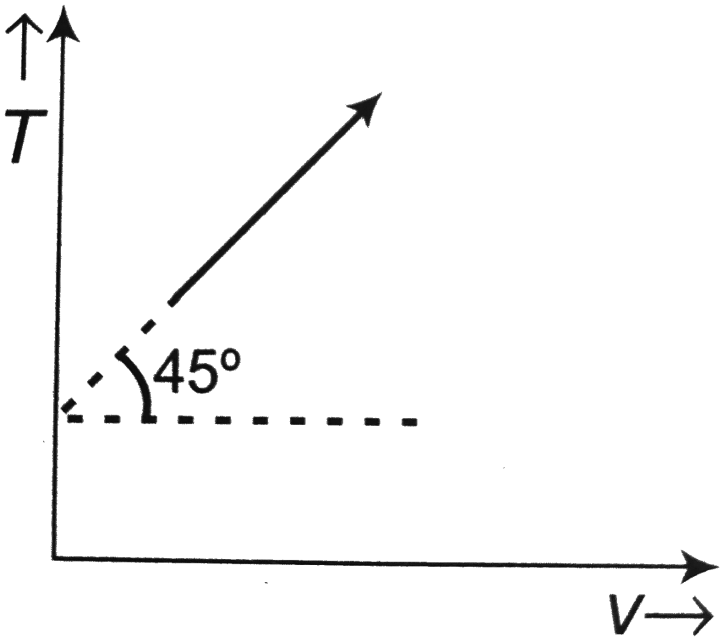
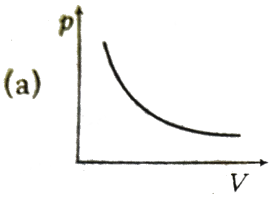
48. The given curve represents the variation of temperature as a function of volume for one mole of an ideal gas. Which of the following curves

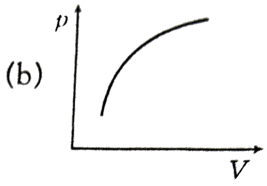
best represents the variation of pressure as a function of volume?



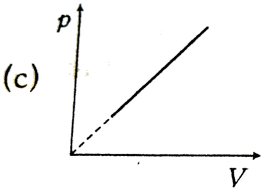
A.

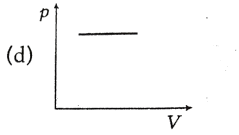


B.



C.





D.

Answer: A

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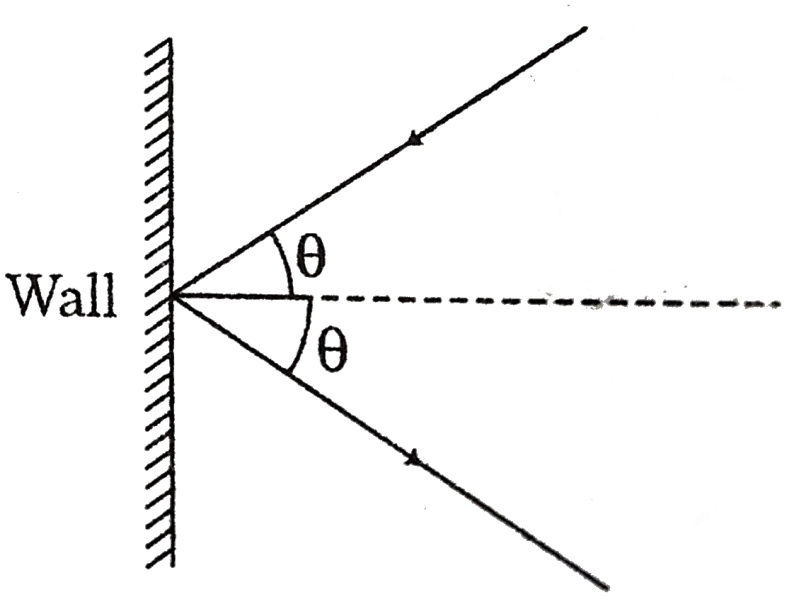
49. The mass of hydrogen molecule is 3.32×10^{-27} kg. If 10^{23} hydrogen molecules strikes per second at 2 cm^2 area of a rigid wall at an angle of 45° from the normal and rebound back with a speed of 1000 ms^{-1}, then

the pressure exerted on the wall is



A. 2.34×10^3 Pa

B. 0.23×10^6 Pa

C. 0.23×10^3 Pa

D. 23.4×10^3 Pa

Answer: A

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50. The coefficient of apparent expansion of a liquid in a copper vessel is C and in a silver vessel S. The coefficient of volume expansion of copper is γ_C. What is the coefficient of linear expansion of silver

A. $\frac{C+S-3A}{3}$

B. $\frac{C-S-3A}{3}$

C. $\frac{S+3A-C}{3}$

D. $\frac{C+S+3A}{3}$

Answer: B

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51. Two identical containers joned by a small pipe initially contain the same gas at pressue p_o and abosolute temperature T_o. One container is now mantained at the same temperature while the other is heated to $2T_0$. The commmon pressure of the gases will be

A. $\frac{3}{2}p_o$

B. $\frac{4}{3}p_o$

C. $\frac{3}{5}p_o$

D. $2p_o$

Answer: B

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52. A piece of metal weighs 46 g in air and 30 g in liquid of density $1.24 \times 10^3 kgm^{-3}$ kept at 27^0C. When the temperature of the liquid is raised to 42^0C, the metal piece weights 30.5 g . The density of the liquid at 42^0C is $1.20 \times 10^3 kgm^{-3}$. Calculate the coefficient of linear expansion of the metal.

A. $\frac{1.4 \times 10^{-5}}{^\circ C}$

B. $\frac{2.3 \times 10^{-5}}{^\circ C}$

C. $\frac{4.3 \times 10^{-5}}{^\circ C}$

D. $\frac{3.4 \times 10^{-5}}{^\circ C}$

Answer: B

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53. A vertical cylinder closed at both ends is fitted with a smooth piston dividing the volume into two parts each containing one mole of air. At the equilibrium temperature of 320 K, the volume of upper and lower parts are in the ratio 4:1. The ratio of volume will become 3:1 at a temperature of

A. 450 K

B. 228 K

C. 420 K

D. 570 K

Answer: A

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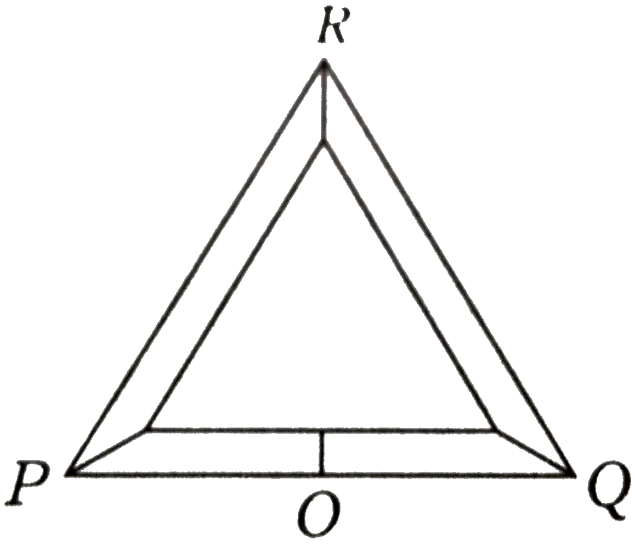
54. Three rods of equal length are joined to from an equilateral triangle PQR.O is the mid-point of PQ. Distance OR remains same for small change in temperature. Coefficient of linear expansion for PR and RQ is same i.e., α_2 but for PQ is α_1. Then



A. $\alpha_2 = 3\alpha_1$

B. $\alpha_2 = 4\alpha_1$

C. $\alpha_1 = 3\alpha_2$

D. $\alpha_1 = 4\alpha_2$

Answer: D

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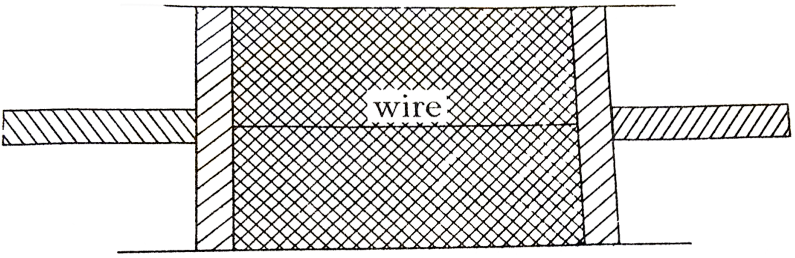
55. A cylindrical tube of uniform cross-sectional area A is fitted with two air tight frictionless position. The pistons are connected to each other by a metallic wire. Initially the pressure of the gas is p_o and temperature is T_o, atmospheric pressure is also p_o Now the temperature of the gas is increased to $2T_0$, the tension in the wire will be



A. $2p_oA$

B. p_oA

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

D. p_oA

Answer: B

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B Medical Entrance Special Format Questions

1. Assertion At the same temperature and pressure, equal volums of all gases gases contain equal numbe of molecules.

Reason In 1 L at NTP total number of molecules are 6.02×10^{23}.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: C

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2. Assertion: In isochoric process p-V graph is straight line parallel to p-axis.

Reason: In isochoric process density ρ remains constant.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: B

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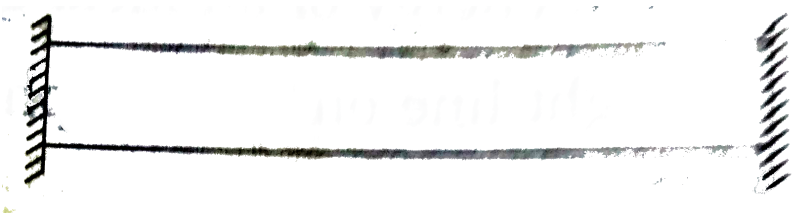
3. Assertion A metallic rod is fixed from two ends as shown in figure. When the temperature is increased compressive stresses are developed

in the rod.



Reason At higher temperature, natural length of the rod will be more.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

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4. Assertion Pressure of a gas id given as $p = \frac{2}{3}E$.

Reason In the above expession, E represnts kinetic energy of the gas per unit volume.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: C

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5. Assertion An actual gas behaves as an ideal gas most closely at low pressure and high temperature.

Reason At low pressure and high temperature, real gases obey the gasl laws.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

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6. Assertion In summers, a metallic scale will read more than the actual.

Reason In summers, length of methallic scale will increase.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

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7. Assertion Total kinetic energy of any gas at temperature T would be $\frac{1}{2}mv_{rms}^2$

Reason Translational kinetik energy of any type of gas temperature T would be $\frac{3}{2}$RT of one mole.

A. (a)If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. (b)If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. (c)If Assertionis true bur Reason is false.

D. (d)If Assertion is false but Reason is true.

Answer: B

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8. If a gas container is placed in a moving train, the temperature of gas will increase.

Kinetic energy of gas molecules will increase.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

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9. Assirtion Degree of freedom of a monjoatomic gas is always three, whether we concider vubrationaol effects or not.

Reason At all temperatures (low or high), vibrational kinetic energy of an ideal gas is zero

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: C

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10. Assertion Prssure of a gas is $\frac{2}{3}$ times translational kinetic energy of gas molecules.

ReasonTranslational degree of freedom of any type of gas is three, whether the gas is monoatomic, diatomic or polyatomic.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: C

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11. Assertion Total internal energy of oxygen gas at a given temperature is E of this energy $\frac{3}{5}$ E is rotational kinetic energy.

Reason Potantial energy of an ideal gas is zero.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: B

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12. Assertion Straight line on V-T graph represents isobaric process.

Reason If $V \propto T$, then p= constant i.e., orocess is isobaric.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

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13. Assertion Any straight line on V-T diagram represents iisobaric process.

Reason In isobaric process, if V is doubled, then T will also become two times.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

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14. Assertion At triple point, three stated (solid, liquid and gas) may co-exist simulaneously.

Reason For water, the values of pressur and temperature corresponding to triple point are 10 mm of Hg and 273.16 K.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are correct but Reason is not the correct explation os Assertion.

C. If Assertionis true bur Reason is false.

D. If Assertion is false but Reason is true.

Answer: C

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Match The Columns

1. For a monotomic gas at temperature T, match the following columns.

	ColumnI		ColumnII
(A)	Speed of sound	(p)	$\sqrt{2RT/M}$
(B)	RMS speed of gas molecules	(q)	$\sqrt{8RT/\pi M}$
(C)	Average speed of gas molecules	(r)	$\sqrt{3RT/M}$
(D)	Most probable speed of gas molecules	(s)	$\sqrt{5RT/3M}$

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2. Match the following columns.

	ColumnI		ColumnII
(A)	$Inp = \frac{2}{3}E, Eis$	(p)	isochoric
(B)	$InU = 3RT$for and monotomic gasUis	(q)	Translational kinetic e
(C)	$\frac{V}{T} =$ constant is valid for	(r)	Internal energy of one r
(D)	$\frac{p}{T} =$ constant is associated with	(s)	isobaric process

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3. In the proscess T $\propto$ W, pressure of the gas increase from p_o to t_o

Match the columns.

	ColumnI		ColumnII
(A)	Temperature of teh gas	(p)	Pssitive
(B)	Volume of the gas	(q)	Nagative
(C)	work done by the gas	(r)	Two times
(D)	Heat supplies to the gas	(s)	Cannot say anything

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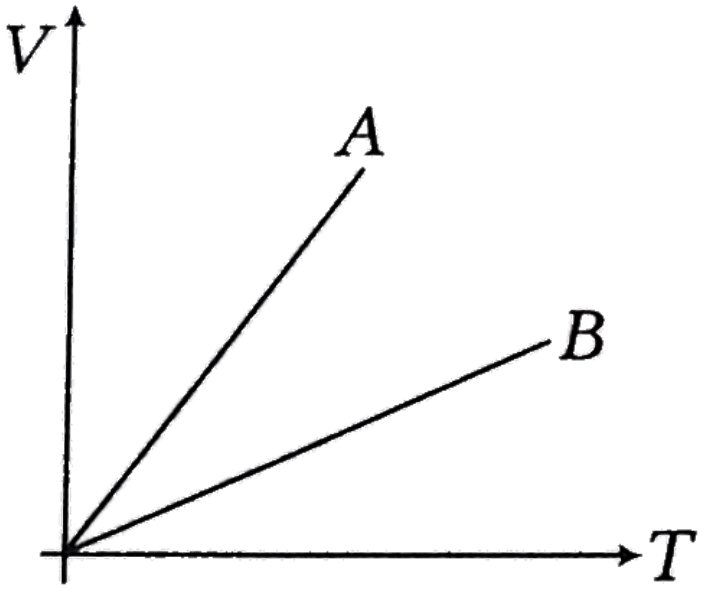
4. In the V-T graph shown in the figure match the following columns.



Column I		Column II	
(A)	Gas A is ... and gas B is ...	(p)	Monoatomic, diatomic
(B)	p_A/p_B is	(q)	Diatomic, monoatomic
(C)	n_A/n_B is	(r)	>1
		(s)	<1
		(t)	Cannot say anything

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5.

	ColumnI		ColumnII
(A)	Gas A is ... and gas B is ...	(p)	Monoatomic, diatomic
(B)	$p_A / p_B$is	(q)	Diatomic, monoatomic
(C)	$n_A / n_B$is	(r)	> 1
		(s)	< 1
		(t)	cannot say anything

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Medical Entrance Gallary

1. A sample of an ideal gas occupies a volume V at pressure P and absolute temperature T. The masss of each molecule is m, then the density of the gas is

A. p/(Kt)

B. pm/(kT)

C. p/(kTV)

D. mkT

Answer: B

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2. Two rods, one of aluminum and the other made of steel, having initial length l_1 and l_2 are connected togther to form a single rod of length $l_1 + l_2$. The coefficients of linear expansion for aluminium and steel are α_a and α_s respectively. if the length of each rod increases by the same amount when their temperature are raised by $t^\circ C$, then find the ratio $\frac{l_1}{(l_1 + l_2)}$.

A. $\alpha_1 l_2^2 = \alpha_2 l_1^2$

B. $\alpha_1^2 l_2 = \alpha_2^2 l_1$

C. $\alpha_1 l_1 = \alpha_2 l_2$

D. $\alpha_1 l_2 = \alpha_2 l_1$

Answer: C

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3. The molecules of a given mass of a gas have rms velocity of $200\frac{m}{s}at27^{\circ}C$ and $1.0\times10^{5}N/m_{2}$ pressure. When the temperature and pressure of the gas are respectively $127^{\circ}C$ and $0.05\times10^{5}Nm^{-2}$, the rms velocity of its molecules in ms^{-1} is

(a) $\frac{400}{\sqrt{3}}$ (b) $\frac{100\sqrt{2}}{3}$ (c) $\frac{100}{3}$ (d) $100\sqrt{2}$

A. $\frac{400}{\sqrt{3}}$

B. $\frac{100\sqrt{2}}{3}$

C. $\frac{100}{3}$

D. $100\sqrt{2}$

Answer: A

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4. The rms speed of oxygen molecule in a gas at $27^{\circ}C$ would be given by

A. 483 ms^{-1}

B. 966 ms^{-1}

C. 4.83 ms^{-1}

D. 9.66 ms^{-1}

Answer: A

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5. The pressure of an ideal gas is directly proportional to

A. total kinetic energy

B. translational kinetic energy

C. rotational kinetic energy

D. vibrational kinetic energy

Answer: A

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6. Two different wires having lengths L_1 and L_2 and respective temperature coefficient of linear expansion α_1 and α_2 are joined end - to - end . Then the effective temperature coefficient of linear expansion is :

A. $\frac{L_1\alpha_1^2 - L_2\alpha_2^2}{L_1^2 + L_2^2}$

B. $\frac{L_1^2\alpha_1 - L_2^2\alpha_2}{L_1^2 + L_2^2}$

C. $\frac{L_1\alpha_1 + L_2\alpha_2}{L_1 - L_2}$

D. $\frac{L_1\alpha_1 + L_2\alpha_2}{L_1 + L_2}$

Answer: D

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7. The ratio of rms speed of an ideal gas molecules at pressure p to that at pressure 2p is

A. $1:2$

B. $2:1$

C. $1:\sqrt{2}$

D. $\sqrt{2}:1$

Answer: C

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8. The rms speed of oxygen molecules in a gas in a gas is v. If the temperature is doubled and the oxygen molecules dissociate into oxygen atoms, the rms speed will become

A. v

B. $\sqrt{2}v$

C. 2v

D. 4v

Answer: C

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9. The deviation of a real gas from the ideal one is minimum at

A. low pressure and high temperature

B. low temperaturer and low pressure

C. high pressure and low temperature

D. high pressure and high temperature

Answer: A

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10. (a) Calculate (i) root-mean-square speed and (ii) the mean energy of 1 mol of hyderogen at STP given that density of hydrogen is $0.09 kg/m^3$. (b) Given that the mass of a molecule of hydergen is 3.34×10^{-27} kg, calculate Avogadro's number. (c) Calculate Boltmann's constant.

A. 3403 T

B. 3500 J

C. 3704 J

D. 3207 J

Answer: A

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11. The value of coefficient of volume expansion of glycerin is $5 \times 10^{-4} K^{-1}$. The fractional change in the density of glycerin for a rise of $40^{\circ} C$ in its temperature is

A. 0.0012

B. 0.1280

C. 0.0235

D. 0.0145

Answer: D

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12. Pressure remaining the constant, the volume of a given mass of an ideal gas increases for every degree centigrade rise in temperature by definite fraction of its volume at:

A. 1/T

B. $1/T^2$

C. T

D. T^2

Answer: A

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13. When water is heated from $0^\circ C$ to $10^\circ C$, its volume

A. does not change

B. decreases

C. first decreases and then increases

D. increases

Answer: C

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14. The length of s steel rod exceeds that of a brass rod by 5 cm. If the difference in their lengths remains same at all temperature, then the length of brass rod will be: (α for iron and brass are $12 \times 10^{-6}/^{\circ} C$ and $18 \times 10^{-6}/^{\circ} C$, respectively)

A. 20 cm

B. 15 cm

C. 5 cm

D. 10 cm

Answer: D

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15. The density of water is maximum at:

A. $4^\circ C$

B. $> 4^\circ C$

C. $< 4^\circ C$

D. $10^\circ C$

Answer: A

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16. A metal rod if fixed rigidly at two ends so as to prevent its thermal expension. If L,α , Y respectively denote the length of the rod , coefficient of linear thermal expension and Young's modulus of its material, then for

an increase in temperature of the rod by ΔT, the longitudinal stress developed in the rod is

A. inversely proportional to α

B. inversely proportional to Y

C. directly proportinal to $\Delta T/Y$

D. independent of L

Answer: C

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17. Which one of the following is a wrong statement in kinetic theory of gases?

A. The gas molecules are in random motion.

B. The gas molecules are perfect elastic spheres.

C. The volum occupied by the molecules of a gas is negligible.

D. The collision between molecules is inelastic.

Answer:

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18. The mean free path of molecules of a gas (radius r) is inversely proportional to

A. r^3

B. r^2

C. r

D. $\sqrt{r}$

Answer: B

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19. Prove that the pressure of an ideal gas is numerically equal to two third of the mean translational kinetic energy per unit volume of the gas.

A. $p = (1/3)mnV_{av}^2$

B. $p = (1/2)mnV_{av}$

C. $p = (1/4)mnV_{av}^2$

D. $p = (1/3)mnV_{av}$

Answer: A

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20. According to equipartition law of energy each particle in a system of particles have thermal energy E equal to

A. $E = k_B T$

B. $E = (1/2)k_B T$

C. $E = 3k_B T$

D. $E = (3/2)k_BT$

Answer: B

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21. When a liquid is heated in a glass vessel, its coefficient of apparent expension is $1.03 \times 10^{-3}/^{\circ}C$. When the same liquid is heated in a copper vessel, its coefficient of apparent expansion is $1.006 \times 10^{-3}/^{\circ}C$. If the coefficient of linear expension of copper is $17 \times 10^{-6}/^{\circ}C$, then the coefficient of linear expansion of glass

A. $8.5 \times 10^{-4}/^{\circ}C$

B. $9 \times 10^{-6}/^{\circ}C$

C. $27 \times 10^{-6}/^{\circ}C$

D. $10 \times 10^{-4}/^{\circ}C$

Answer: B

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22. Let γ : coefficient of volume expansion of the liquid and α : coefficient of linear expansion of the material of the tube

A. $\gamma = 2\alpha$

B. $\gamma = 3\alpha$

C. $\gamma = 4\alpha$

D. $\gamma = \alpha$

Answer: A

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23. The average kinetic energy of a molecule of a gas at absolute temperature T is proportional to

A. directly temperture T is

B. inversely proportional to T^2

C. directly proportional to T^2

D. inversely proprtional to T

Answer: C

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24. At what temperature. The rms velocity of gas molecules would be double of its value at NTP,if pressure is remaining constant?

A. $819^\circ C$

B. 819 K

C. 546 K

D. $546^\circ C$

Answer: A

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25. The average kinetic energy per mole of hydrogen at given temperature is

A. equal of that of oxygen

B. 16 times that of oxygen

C. $1/16$ times that of oxygen

D. $1/8$ times that of oxygen

Answer: A

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26. In kinetic theory of gases, it is assumed that molecular collisions are

A. for negligible duration

B. inelastic

C. one-dimensional (head on)

D. unable to exert nutual force

Answer: A

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27. The number of molecules in a litre of a gas at temperature of $27^\circ C$ and a pressure of 10^6 dyne cm^{-2}

A. 2.4×10^{20}

B. 2.4×10^{21}

C. 2.4×10^{22}

D. 2.4×10^{23}

Answer: C

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28. How many degress of freedom have the gas molecules, if under standard conditions the gas density is $\rho = 1.3kg/m^3$ and velocity of

sound propagation o it is $v = 330m/s$?

A. 5

B. 6

C. 7

D. 8

Answer: A

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29. A non-conductiong body floats in a liquid at $25^\circ C$ with $1/3$ of its volume immersed in the liquid. When liquid temperature is increased to $105^\circ C$, $1/2$ of body's volume is immersed is the liquid. Then, find the coefficient of real expansion of the liqquid (neglecting the expansion of container of the liquid) .

A. $15.6 \times 10^{-4}/^\circ C$

B. $156 \times 10^{-4}/^\circ C$

C. $1.56 \times 10^{-4} / ^{\circ} C$

D. $0.156 \times 10^{-4} / ^{\circ} C$

Answer: A

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30. During an experiment, an ideal gas is found to obey an additional law VP^2 =constant. The gas is initially at a temperatur T and volume V. When it expands to a volume $2V$, the temperature becomes_____. $^{\circ} C$.

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

B. 2T

C. $\sqrt{T}2$

D. $\frac{T}{\sqrt{2}}$

Answer: C

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