PHYSICS

AIMED AT STUDENTS PREPARING FOR IIT JEE EXAMS

KINETIC THEORY OF GASES

LEVEL-1(C.W)

1. Gas at a pressure P_0 in contained as a vessel. If the masses of all the molecules are halved and their speeds are doubles. The resulting pressure P will be equal to

A. $4P_0$

B. $2P_0$

C. P_0

D. $\frac{P_0}{2}$

Answer: B

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2. At which of the following temperatures would the molecules of a gas have twice the average kinetic energy they have at $20^\circ C$?

A. $40^\circ C$

B. $80^\circ C$

C. $313^\circ C$

D. $586^\circ C$

Answer: C

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3. If number of molecules of H_2 are double than that of O_2, then ratio of mean kinetic energy per molecule of hydrogen to that of oxygen at 300K is

A. $1:1$

B. $1:2$

C. $2:1$

D. $1:16$

Answer: A

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4. The value of universal gas constant is 8.3J/mole-k, The mean kinetic energy of 32gm of oxygen at . $-73^{\circ}C$ will be

A. 480J

B. 4980J

C. 2490J

D. 100J

Answer: C

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5. The total kinetic energy of 8 litres of helium molecules at 5 atmosophere pressure will be (1 atmosphere $= 1.013 \times 10^5$ pascal)

A. 607J

B. 6078J

C. 607erg

D. 6078erg

Answer: B

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6. At a certain temperature, the rms velocity for O_2 is $400ms^{-1}$. At the same temperature, the rms velocity for H_2 molecules will be

A. 100m/s

B. 25m/s

C. 1600m/s

D. 6400m/s

Answer: C

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7. To what temperature should the hydrogen at $327^\circ C$ be cooled at constant pressure, so that the root mean square velocity of its molecules become half of its previous value?

A. $-123^\circ C$

B. $23^\circ C$

C. $-100^\circ C$

D. 0°

Answer: A

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8. At a pressure of $24 \times 10^5 dy \ne cm^{-2}$. The volume of O_2 is $10 litre$ and mass is $20g$. The rms velocity will be

A. 800

B. 400

C. 600

D. 200

Answer: C

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9. The molecules of a given mass of gas have a rms velocity of $200 m/\sec at 127^\circ C$ and $1.0 \times 10^5 N/m^2$ pressure. When the temperature is $127^{\circ} C$ and pressure is $0.5 \times 10^{5} N / m^{2}$ the rms velocity in $m / \sec$ will be

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

B. $100\sqrt{2}$

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

D. 400

Answer: C

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10. The respective speeds of five molecules are 2,1.5,1.6,1.6 and 1.2 km/sec. The most probable speed in km/sec will be

A. 2

B. 1.58

C. 1.6

D. 1.31

Answer: C

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11. In the two vessels of same volume, atomic hydrogen and helium at pressure 1 atm and 2 atm are filled. If temperature of both the sample is same then average speed of hydrogen atoms $< C_B <$ will be related to that of helium $< C_{He} >$ as

A. $< C_H \geq \sqrt{2} < C_{He} >$

B. $< C_H > \; = \; < C_{He} >$

C. $< C_H \geq 2 < C_{He} >$

D. $< C_H \geq \dfrac{< C_{He} >}{2}$

Answer: C

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12. The root mean square velocity of gas molecules of $0^\circ C$ will be if at N.T.P. its density is 1.43 kg/m^3

A. 461m/s

B. 164m/s

C. 461cm/s

D. 164cm/s

Answer: A

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1. At what temperature the mean kinetic energy of hydrogen molecules increases to energy of hydrogen molecules increaes to such that they will escape out of the gravitational field of earth for ever?

(take $v_e = 11.2k\frac{m}{\sec}$)

A. 12075K

B. 10000K

C. 20000K

D. 10075K

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2. At what temperature does the average translational kinetic energy of molecule in a gas become equal to kinetic energy of an electron accelerated from rest through a potential difference of 1 volt? $\left(K = 1.38 \times 10^{-23} J / k\right)$

A. 3770K

B. 7370K

C. 7730K

D. 7330K

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3. The mass of an oxygen molecule is about 16 times that of a hydrogen molecule. At room temperature the 'rms' speed of oxygen molecules is v. The 'rms' speed of oxygen molecules is v. the 'rms' speed of the hydrogen molecules at the same temperature will be

A. v/16

B. v/4

C. 4v

D. 16v

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4. At room temperature $(27^\circ C)$ the 'rms' speed of the molecules of a certain diatomic gas is found to be 1920 ms^{-1}. The gas is

A. H_2

B. F_2

C. O_2

D. Cl_2

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5. The temperature of an ideal gas is increased from 120K to 480K. If at 120K the root-mean-squre velocity of the gas molecules is v, at 480K it becomes

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LEVEL-3(C.W)

1. A vessel of volume , $V = 5.0$ litre contains $1.4g$ of nitrogen at a temperature $T = 1800K$. Find the pressure of the gas if 30% of its molecules are dissociated into atoms at this temperature.

A. $0.54 \times 10^5 N/m^2$

B. $1, 94 \times 10^5 N/m^2$

C. $2.62 \times 10^5 N/m^2$

D. $3.75 \times 10^5 N/m^2$

Answer: B

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2. The mass 15 gram of Nitrogen is enclosed in vessel at 300K. What heat must be supplies to it to double the 'rms' velocity of its molecules

A. 10J

B. 10KJ

C. $10^3 J$

D. $10^2 J$

Answer: B

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3. At what absolute temperature 'I', is 'rms' speed of a hydrogen molecule equal to its escape velocity from the surface of the moon? The radisuof moon is R,g is the acceleration due to gravity on moon's surface, m is the mass of a hydrogen molecule and k is the Boltzmann constant.

A. $\frac{mgR}{2k}$

B. $\frac{2mgR}{k}$

C. $\frac{3mgR}{2k}$

D. $\frac{2mgR}{3k}$

Answer: D

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4. Determine the gas temperature at which

(a) the root mean square velocity of hydrogen molecules exceeds their most probable velocity by $\Delta v = 400 m / s$,

(b) the velocity distribution function $F(v)$ for the oxygen molecules will have the maximum value at the velocity $v = 420 m / s$.

A. 384K

B. 342K

C. 300K

D. 280K

Answer: A

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5. Two cylinder having $m_1 g$ and $m_2 g$ of a gas at pressure P_1 and P_2 respectively are put in cummunication with each other, temperature remaining constant. The common pressure reached will be

A. $\frac{P_1 P_2 (m_1 + m_2)}{P_1 m_2 + P_2 m_1}$

B. $\frac{m_1 m_2 (P_1 + P_2)}{P_1 m_2 + P_2 m_1}$

C. $\frac{P_1 P_2 m_1}{P_1 m_2 + P_2 m_1}$

D. $\dfrac{m_1 m_2 P_2}{P_1 m_2 + P_2 m_1}$

Answer: A

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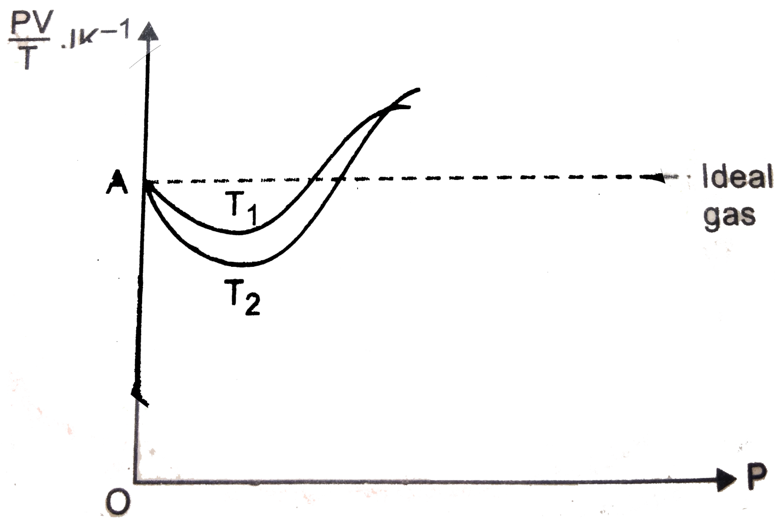
6. Given is the graph between $\dfrac{PV}{T}$ and P for 1 gm of oxygen gas at two different temperatures T_1 and T_2 Fig. Given, density of oxygen $= 1.427 kgm^{-3}$. The value of $(PV)/(T)$ at the point A and the relation between T_1 and T_2 are respectively :



A. $0.256J/K$ and $T_1 < T_2$

B. 8.314 J/K and $T_1 > T_2$

C. 8.314J/K and $T_1 < T_2$

D. 0.256J/K and $T_1 > T_2$

Answer: D

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7. The pressure of an ideal gas varies according to the law $P = P_0 - AV^2$, where P_0 and A are positive constants. Find the highest temperature that can be attained by the gas

A. $\frac{P_0}{nR}\sqrt{\frac{P_0}{A}}$

B. $\frac{P_0}{nR}\sqrt{\frac{P_0}{2A}}$

C. $\frac{2P_0}{nR}\sqrt{\frac{P_0}{2A}}$

D. $\frac{2P_0}{3nR}\sqrt{\frac{P_0}{3A}}$

Answer: D

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8. 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. 2

B. 3

C. 4

D. 5

Answer: D

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9. The temperature of a gas consisting of rigid diatomic molecules is $T = 300k$. Calculate the angular root mean square velocity of a rotating molecule if its moment of inertia is equal to $I = 2.1.10^{-39} g.\ cm^2$.

A. 6.3×10^{12} rad/sec

B. 6.8×10^{12} rad/sec

C. 3.6×10^{12} rad/sec

D. 3.2×10^{12} rad/ sec

Answer: A

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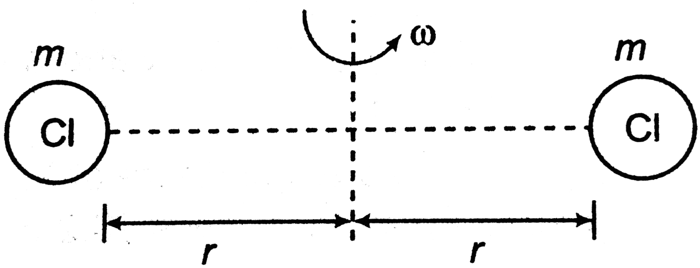
10. In a crude model of a rotating diatomic molecule of chlorine (Cl_2), the two (Cl) atoms are $2.0 \times 10^{-10} m$ apart and rotate about their centre of mass with angular speed $\omega = 2.0 \times 10^{12} \mathrm{rad}/s$. What is the rotational kinetic energy of one molecule of Cl_2 , Which has a molar mass of $70.0 g/mol$?



A. $2.32 \times 10^{-21} J$

B. $2.32 \times 10^{21} J$

C. $2.32 \times 10^{-21} erg$

D. $2.32zz10^{21} erg$

Answer: A

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11. Find the number of degrees of freedom of molecules in a gas whose molar heat capacity at constant pressure is equal to $C_P = 20J/$(moL K)

A. 3

B. 4

C. 5

D. 6

Answer: A

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12. An ideal gas undergoes a process in which $PV^{-a} =$ constant, where V is the volume occupied by the gas initially at pressure P. At the end of the process, 'rms' speed of gas molecules has become $a^{1/2}$ times of its initial value. What will be the value of C_V so that energy transferred in the form of heat to the gas is 'a' times of the initial energy.

A. $\frac{(a^2+1)R}{a^2-1}$

B. $\frac{(a^2+1)R}{(a^2+1)}$

C. $\frac{(a+1)R}{(a-1)}$

D. $\frac{(a-1)R}{(a+1)}$

Answer: D

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13. N molecules each of mass m of gas A and 2 N molecules each of mass 2m of gas B are contained in the same vessel which is maintined at a temperature T. The mean square of the velocity of the molecules of B type is denoted by v^2 and the mean square of the x-component of the velocity of a tye is denoted by ω^2. What is the ratio of $\omega^2 / v^2 = ?$

A. 2

B. 1

C. $\frac{1}{3}$

D. $\frac{2}{3}$

Answer: D

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NCERT BASED QUESTIONS

1. The kinetic energy of a molecule of hydrogen at $0^{\circ}C$ is $5.64 \times 10^{-21} J$. Calculate Avogadro's number. Take $R = 8.31 J \text{mole}^{-1} K^{-1}$

A. 6.5×10^{23}

B. 6.43×10^{23}

C. 6.304×10^{23}

D. 6.034×10^{23}

Answer: D

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2. At what temperature is the root mean square speed of oxygen molecules equal to the r.m.s. speed of carbon dioxide molecules at $-23^{\circ} C$? Molecular weight of oxgen=32 and that of carbon dioxide=44.

A. $+91.2^{\circ} C$

B. $-91.2^{\circ} C$

C. $+112.2^{\circ} C$

D. $-112.2^{\circ} C$

Answer: B

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3. The r.m.s speed of oxygen molecule (O_2) at a certain temperature T is V. If on increasing the temperature of the oxygen gas to 2T, the oxygen molecules dissociate into atomic oxygen, find the speed of the oxygen atom.

A. 2V

B. V

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

D. $3V$

Answer: A

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4. If three gas molecules have velocity 0.5, 1 and $2km/s$ respectively, find the ratio of their root mean square speed and average speed.

A. $V_{rms} = \frac{V_{avg}}{2}$

B. $V_{rms} = V_{avg}$

C. $V(r. m. s) = 1.134V_{av}$

D. $V_{rms} = 2V_{avg}$

Answer: C

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5. Calculate the temperature at which root mean square velocity of SO_2 molecules is the same as that of O_2 molecules at $127^\circ C$. Molecular weights of O_2 and SO_2 are 32 and 64 respectively.

A. $527^\circ C$

B. $800^\circ C$

C. $500^\circ C$

D. $627^\circ C$

Answer: A

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6. From a certain apparatus, the diffusion rate of hydrogen has an average value of $28.7cm^3s^{-1}$. The diffusion of another gas under the same condition is measured to have an average rate of $7.2cm^3s^{-1}$. Identify the gas.

A. Carbon

B. Oxygen

C. Nitrogen

D. Boron

Answer: B

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7. Each molecule of nitrogen gas heated in a vessel to a temperature of 5000K has an average energy E_1. Some molecule of the gas escape into atmosphere at 300K. Due to collision with air molecules, average kinetic energy of the nitrogen molecule changes to E_2. Find the radio E_1 / E_2.

A. $\frac{7}{6}$

B. $\frac{3}{7}$

C. $\frac{6}{7}$

D. $\frac{7}{3}$

Answer: D

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8. Find the mean free path and collision frequency of a hydrogen molecule in a cylinder containing hydrogen at 3atm and temperature $27^{\circ}C$. Take the radius of a hydrogten molecule to be $1\overset{0}{A}$. Given, one atmospheric pressure $= 1.013 \times 10^{5} Nm^{-2}$ and molecular mass of hydrogen=2.

A. $7.66 \times 10^{-8} m, 2.52 \times 10^{5} s^{-1}$

B. $7.66 \times 10^{-5} m, 2.52 \times 10^{5} s^{-1}$

C. $7.66 \times 10^{-8} m, 2.52 \times 10^{10}$

D. $7.66 \times 10^{-10} m, 2.52 \times 10^{8} s^{-1}$

Answer: C

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9. The diameter of a gas molecule is $2.4 \times 10^{-10} m$. Calculate the mean free path at NTP. Given Boltzmann constant $k = 1.38 \times 10^{-23} Jmo \leq ce^{-1} K^{-1}$.

A. $2.45 \times 10^{-10} m$

B. $2.45 \times 10^{-7} m$

C. $1.45 \times 10^{-7} m$

D. $1.45 \times 10^{-10} m$

Answer: C

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10. A closed vessel contains a mixture of two diatomic gases A and B. Molar mass of A is 16 times that of B and mass of gas A

contained in the vessel is 2 times that of B. Which of the following statements are correct ?

A. Average kinetic energy per molecule of A is equal to that of B

B. Root mean square value of translational velocity of B is four times that of A

C. Pressure exerted by B is eight times that exerted by A.

D. Number of molecule of B, in the cylinder, is eight times that of A.

Answer: A::B::C::D

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11. Pick the correct statement (s) :

A. The 'rms' translational speed for all ideal gas molecules at the same temperature is not same but it depends on the mass

B. Each particle in a gas has average translational kinetic energy and the equation is $\frac{1}{2}mv^2_{\max} = \frac{3}{2}kT$

C. If the temperature of an ideal gas is doubled from $100^\circ C$ to $200^\circ C$, the average kinetic energy of each particle paerticle is also doubled.

D. It is possible for both pressure and voume of a monoatomic ideal gas to change simultaneously without causing the internal energy of the gas to be change

Answer: A::D

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12. ABCDEFGH is a hollw cube made of an insulator(figure)

face ABCD has positive charges on it. Inside the cube, we have ionsed hydrogen.

The usual kinetic theory expression for pressure

A. will be valid

B. will not be valid, since the ions would experience force other than due to collision with the walls

C. will not be valid, since collision with walls would not be elastic

D. will not be valid because isotropy is lost

Answer: B::D

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13. Diatomic molecules like hydrogen haven energy due to both translational as well as rotational motion. From the equation in kinetic theory $PV = \frac{2}{3}E$, E is

A. The total energy per unit volume

B. Only the translational part of energy because rotational energy is very small compared to translational part of energy because rotational energy is very small compared to translational energy

C. Only the translational part of the energy because during collisions with the wall pressure relates changes in linear momentum

D. The trnaslational part of the energy because roatational enegies of molecules can be of either sign and its average over all the molecules is zero

Answer: C

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14. In a diatomic molecule, the rotational energy at given temperature

A. Obeys Maxwell's distribution

B. Have the same value for all molecules

C. Equals the translational kinetic energy force molecule

D. Is (2/3) rd the translational kinetic enery each molecule

Answer: A::D

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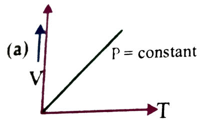
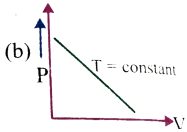
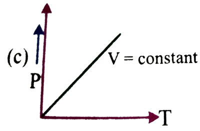
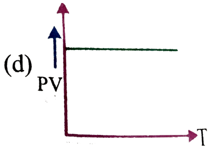
15. Which of the following diagrams, Fig. depicts ideal gas behaviour ?

A. 

B. 

C. 

D. 

Answer: A::C

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16. When an ideal gas is compressed adiabaticall, is temperature rises the molecule on the average have nore kinetic energy than before. The kinetic energy increases,

A. Because of collision with moving parts of the walls only

B. Because of collision with the entire wall

C. Because of molecules gats accelerated in this motion inside the volume

D. Because of redistribution of energy amongst the molecules

Answer: A

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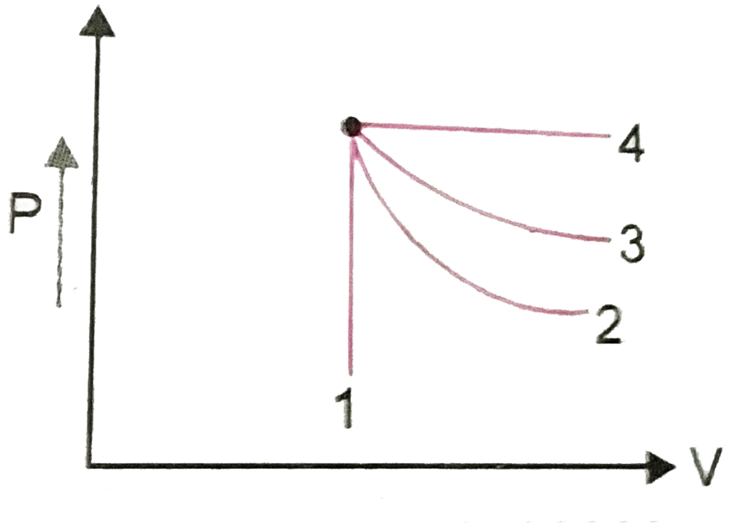
17. An ideal gas undergoes four different processes from the same initial state (figure). Four process are adiabatic, isothermal, isobaric and isochloric. Out of 1, 2, 3, and 4 which one is idabatic.



A. 4

B. 3

C. 2

D. 1

Answer: C

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18. If an avarage person jogs, he produces $14.5 \times 10^4 cal / \min$. This is removed by the evaporation of sweat. The amount of sweat evaporated per minute (assuming $1kg$ requites 580×10^3 cal for evaporation) is

A. 0.25kg

B. 2.25kg

C. 0.05kg

D. 0.20kg

Answer: A

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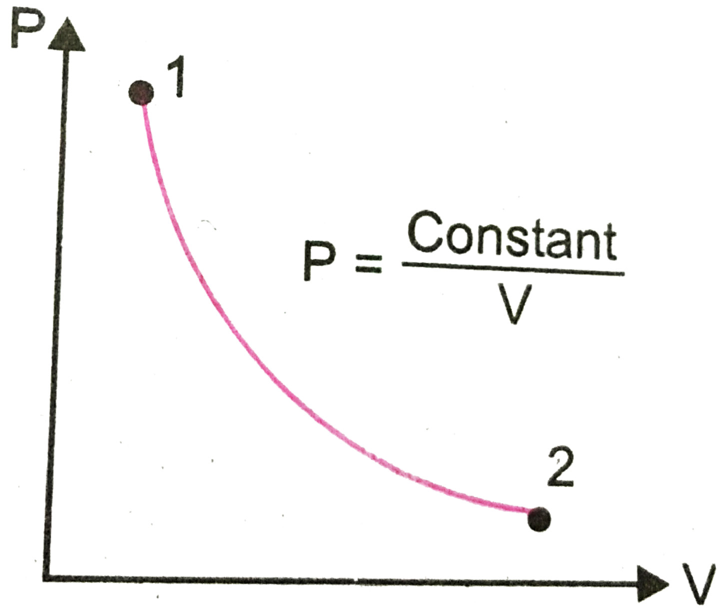
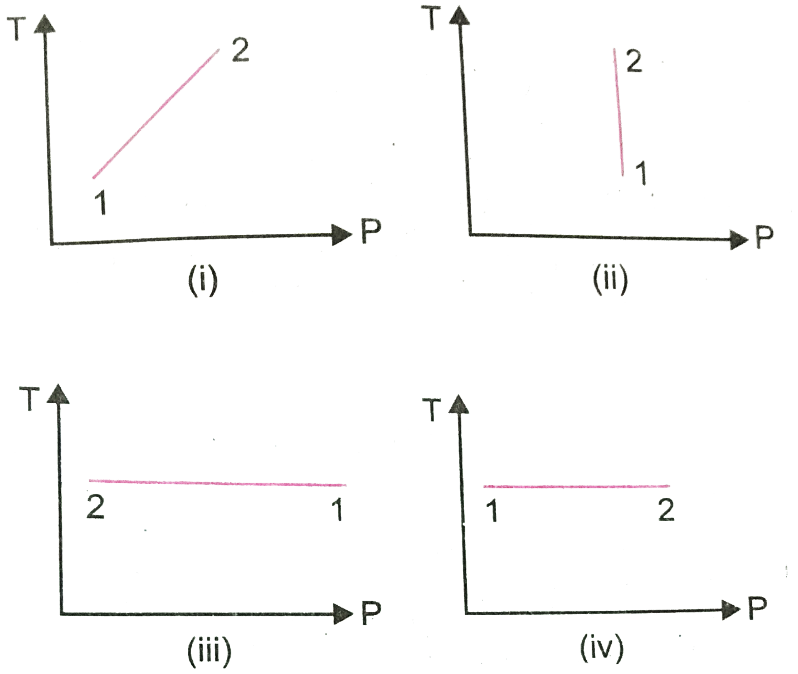
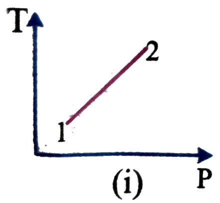
19. Consider $P - V$ diagram for an ideal gas shown in figure.

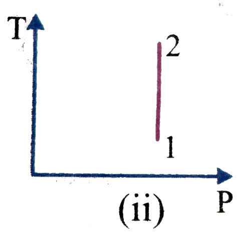


Out of following diagrams(figure). Which represents the $T - P$ diagram?

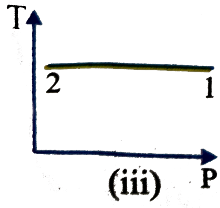


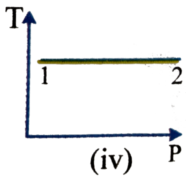


A.



B.

C. 

D. 

Answer: C

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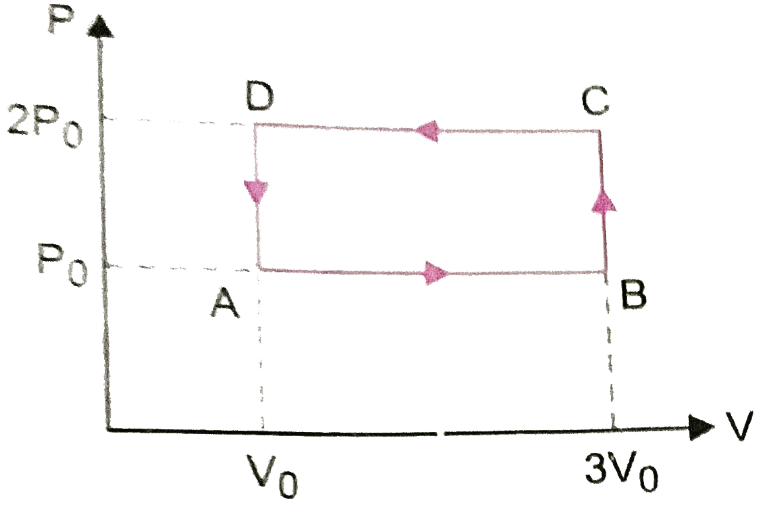
20. An ideal gas underoges cyclic process of ABCDA as shown in Given $P-V$ diagram (figure)



The amount of work done by the gas is

A. 6PoVo

B. $-2PoVo$

C. $+2PoVo$

D. $+4PoVo$

Answer: B

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21. Consider two containers A and B containing identical gases at the same pressure, volume and temperature. The gas in container A is compressed to half of its original volume isothermally while the gas in container B is compressed to half of its original value adiabatically. The ratio of final pressure of gas in B to that of gas in A is

A. $2^{\gamma - 1}$

B. $\left(\frac{1}{2}\right)^{\gamma - 1}$

C. $\left(\frac{1}{1-\gamma}\right)^{2}$

D. $\left(\frac{1}{\gamma - 1}\right)^{2}$ 1

Answer: A

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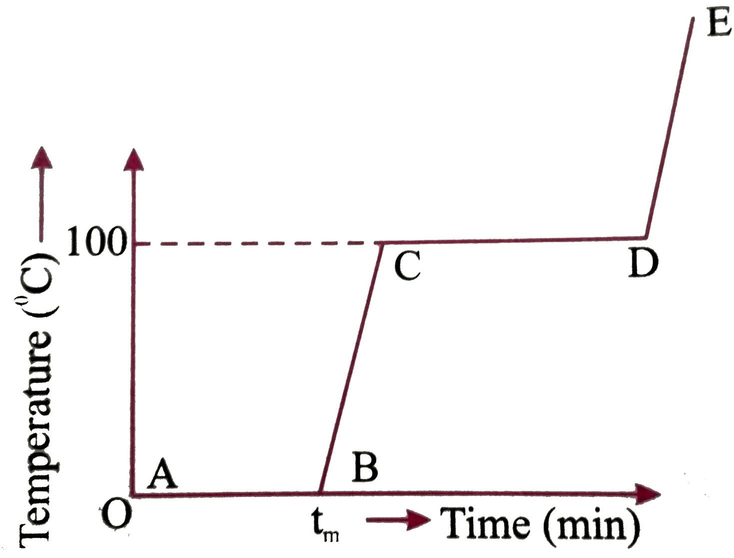
22. Refer to the plot of temperature versus time (figure) showing the changes in the state if ice on heating (not to scale). Which of the following is correct ?



A. The region AB represent ice and water in thermal equilibrium

B. At B water starts boiling

C. At C all the water gets converted into steam

D. C to D represents water and steam in equilibrium at biling point.

Answer: A::D

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23. A glass full of hot milk is poured in the table. It begins to cool gradually.

Which of the following is incorrect?

A. The rage of cooling is constant till milk attains the temperature of the surrounding

B. The temperature of milk falls off exponentially with time

C. While cooling there is a flow of heat from milk to the surrounding as well as from surrounding to the milk but net flow of heat is from milk to the surrounding and that is why it cools .

D. All three phenomenon, conduction, convection and radiation are responsible for the loss of heat from milk to the surrounding.

Answer: B::C::D

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24. Which of the process described below are irrevesible?

A. The increase in temperatre of an iron rod by hammering it

B. gas in a small container at a temperature T_1 is brough in contant with a big reservoir at a higher temperature T_2

which increase the temperature of the gas

C. A quasi-static isothermal expansion of a n ideal gas in cylinder fitted with a frictionless piston

D. An ideal gas is enclosed in apiston cylinder arrangement with adiabatic walls. A weight w is added to the piston, resulting in compression of gas.

Answer: A::B::D

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25. An ideal gas undergoes isothermal process from some initial state i to final state f. Choose the correct alternatives.

A. dU=0

B. dQ=0

C. dQ=dU

D. dQ=dW

Answer: A::D

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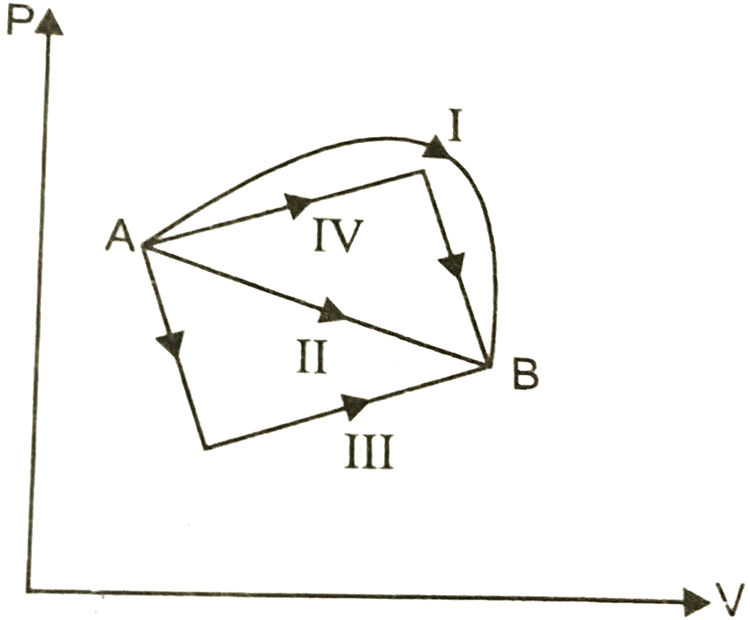
26. (figure). Shows the $P-V$ diagram of an ideal gas undergoing a change of state from A to B. Four different process I, II, III, IV, as shown in (figure) may lead to the same change of state.



A. Change in internal energy is same in IV and III cases, but not in I and II.

B. Change in internal energy is ame in all the four cases.

C. Work done is maximum in case I

D. Work done is minimum in case II

Answer: B::C

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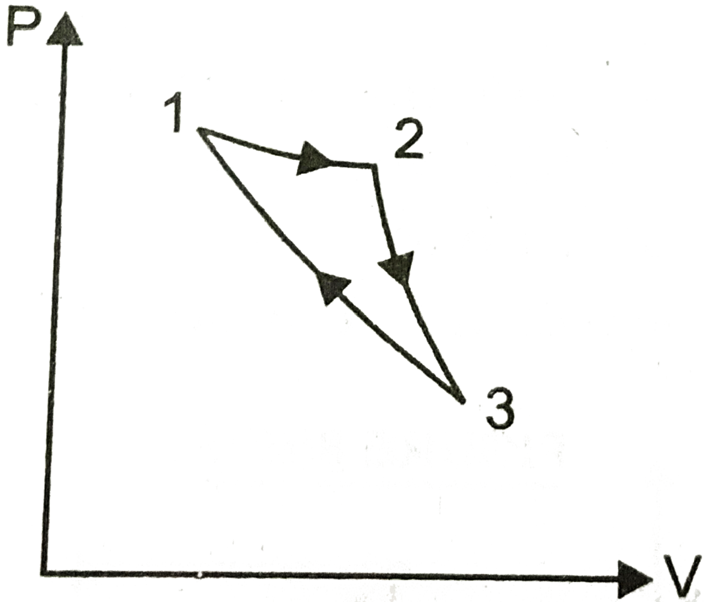
27. Consider a cycle followed by an engine, (figure)



1 to 2 is isothermal 2 to 3 is adiabatic 3 to 1 is adiabatic

such a process does not exist because

A. heat is completely converted to mechanical energy is completely converted to heat in this process, which is not possible.

B. mechanical energy is completely converted to heat in this process, which is not possible.

C. curves representing two adiabatic processes don’t' intersted.

D. curves representing an adiabatic process and an isothermal process don't intersect.

Answer: A::C

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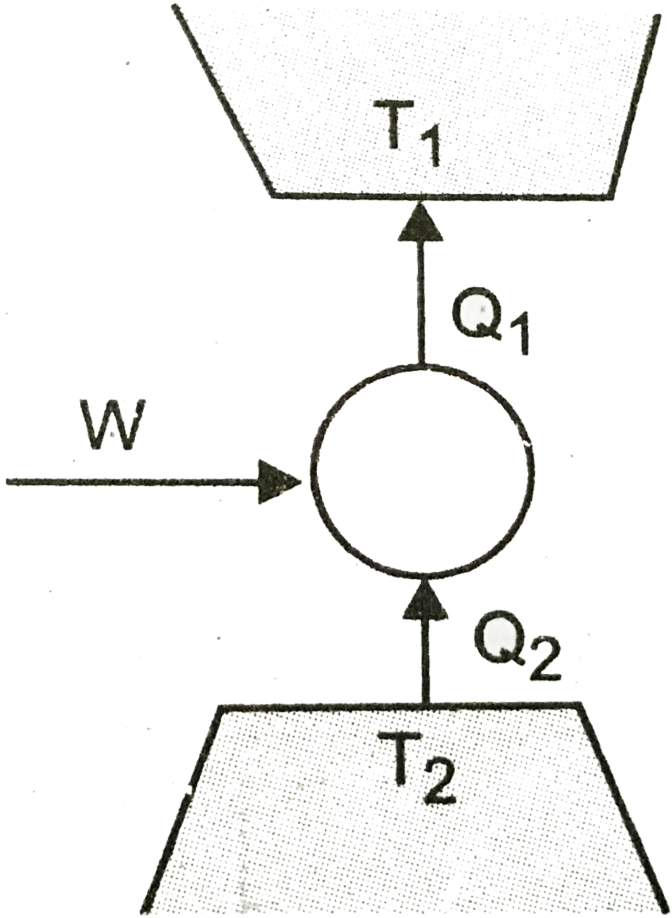
28. Consider a heat engine as shown in (figure). Q_1 and Q_2 are heat added to heat bath T_1 and heat taken from T_2 one cycle of engine. W is the mechanical work done on the engine.



If $W > 0$, then possibillities are:

A. $Q_1 > Q_2 > 0$

B. $Q_2 > Q_1 > 0$

C. $Q_3 < Q_1 < 0$

D. $Q_1 < 0, Q_2 > 0$

Answer: A::C

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LEVEL-V

1. During an experiment, an ideal gas is found to obey a condition $\frac{p^2}{\rho} = \text{constant}$. ($\rho$ = density of the gas). The gas is initially at temperature (T), pressure (p) and density ρ. The gas expands such that density changes to $\rho/2$.

A. The pressure of the gas changes to $\sqrt{2}p$

B. The temperature of the gas changes to $\sqrt{2}T$

C. The graph of the above process on the P-T diagram is parabola

D. The graph of the above process on the P-T diagram is straight line

Answer: B

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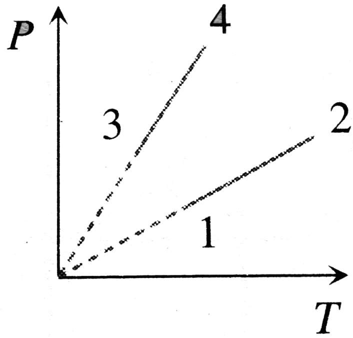
2. Pressure versus temperature graph of an ideal gas of equal number of moles of different volumes is plotted as shown in Fig.

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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3. One mole of an ideal gas undergoes a process $P = P_0\left[1 + \left(\frac{2V_0}{V}\right)^2\right]^{-1}$, where $P_0 V_0$ are constants. Change in temperature of the gas when volume is changed from $V = V_0 \rightarrow V = 2V_0$ is:

A. $-\frac{2P_0V_0}{5R}$

B. $\frac{11R_0V_0}{10R}$

C. $-\frac{5P_0V_0}{4R}$

D. P_0V_0

Answer: B

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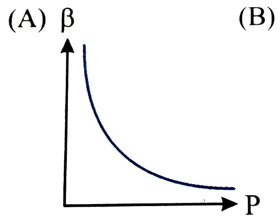
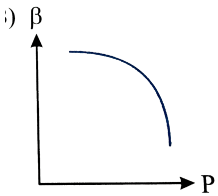
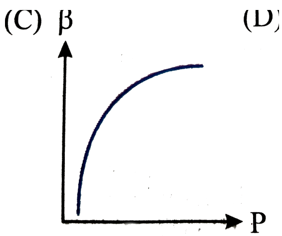
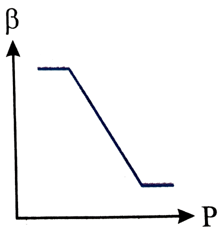
4. Which of the following graphs correctly represents the variation of $\beta = -\frac{dV/dP}{V}$ with P for an ideal gas at constant temperature?

A. 

B. 

C. 

D. 

Answer: A

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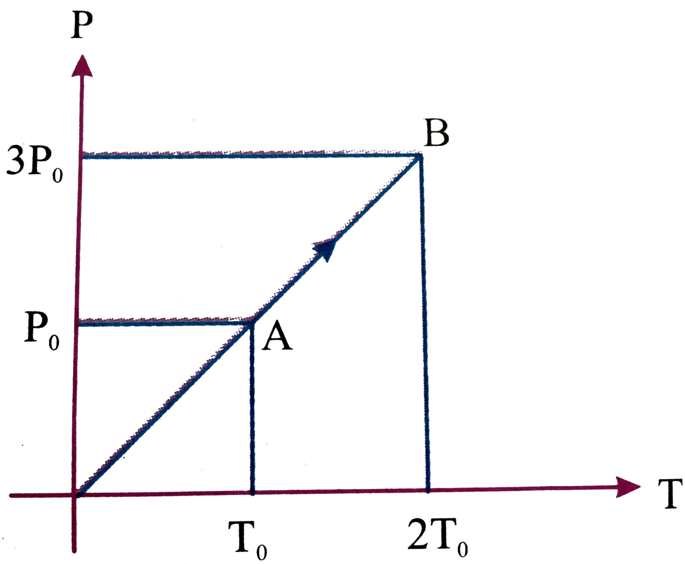
5. Pressure versus temperature graph of an ideal gas is shown in figure. Density of the gas at point A is P_0. Density at B will be



A. $\frac{3}{4}\rho_0$

B. $\frac{3}{2}\rho_0$

C. $\frac{4}{3}\rho_0$

D. $2\rho_0$

Answer: B

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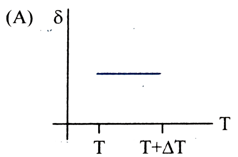
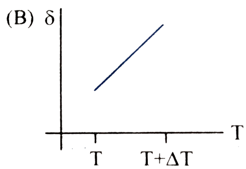
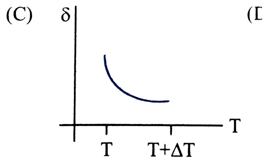
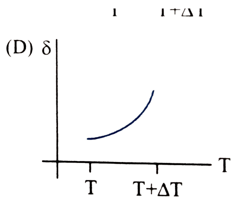
6. An ideal gas is initially at temperature T and volume V. Its volume is increased by ΔV due to an increase in temperature ΔT, pressure remaining constant. The quantity $\delta = \frac{\Delta V}{V\Delta T}$ varies with temperature as

A. 

B. 

C. 

D. 

Answer: C

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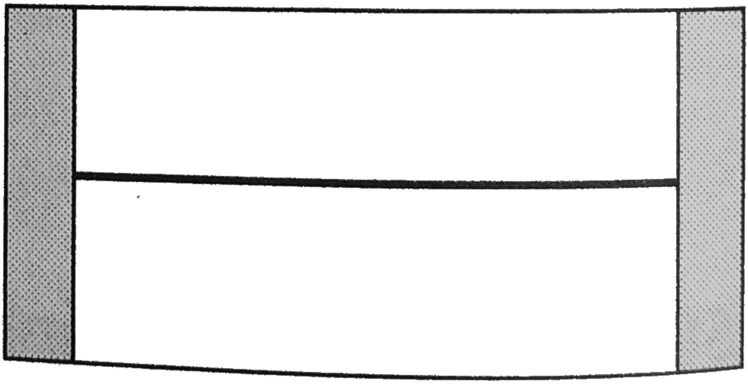
7. The air tight and smooth piston of a cylindrical vessel are connected with a string as shown. Initially pressure and temperature of the gas are P_0 and T_0. The atmospheric pressure is also P_0. At a later time, tension in the string is $\frac{3}{8}P_0A$ where A is cthe cross-sectional are of the cylinder. at this time, the temperature of the gas has become.



A. $\frac{3}{8}T_0$

B. $\frac{3}{4}T_0$

C. $\frac{11}{8}T_0$

D. $\frac{13}{8}T_0$

Answer: C

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8. A real gas behaves like an ideal gas if its

A. pressure and temperature are both high

B. pressure and temperature are both low

C. pressure is high and temperature is low

D. pressure is low and temperature is high

Answer: D

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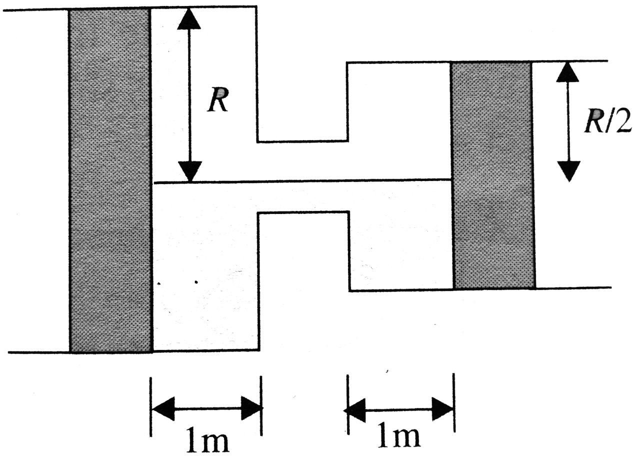
9. Two cylinders fitted with pistons and placed as shown, connected with string through a small tube of negligible volume, are filled with gas at pressure P_0 and temperature T_0. The radius of smaller cylinder is half of the other. If the temperature is increased to $2T_0$, find the pressure if the piston of bigger cylinder moves towards left by 1 metre ?



A. $\frac{4}{5}P_0$

B. $\frac{3}{5}P_0$

C. $\frac{2}{5}P_0$

D. $\frac{5}{4}P_0$

Answer: D

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10. One mole of an ideal gas undergoes a process $P = P_0\left[1+\left(\frac{2V_0}{V}\right)^2\right]^{-1}$, where P_0V_0 are constants. Change in temperature of the gas when volume is changed from $V = V_0 \to V = 2V_0$ is:

A. $\frac{4}{5}\frac{P_0V_0}{nR}$

B. $\frac{3}{4}\frac{P_0V_0}{nR}$

C. $\frac{2}{3}\frac{P_0V_0}{nR}$

D. $\frac{7}{9}\frac{P_0V_0}{nR}$

Answer: A

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LEVEL-VI

1. A vessel of volume V_0 contains an ideal gas at pressure p_0 and temperature T. Gas is continuously pumped out of this vessel at a constant volume-rate $d\frac{V}{dt} = r$ keeping the temperature constant.The pressure of the gas being taken out equals the pressure inside the vessel. Find

(a) the pressure of the gas as a function of time,

(b) the time taken before half the original gas is pumped out.

A. $2Pe^{-rt/V_0}$

B. $3Pe^{-^rt/V_0)}$

C. $-Pe^{-rt/V_0}$

D. P_0e^{-rt/V_0}

Answer: D

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2. Assume that the temperature remains essentially constant in the upper parts of the atmosphere. The atmospheric pressure varies with height as. (the mean molecular weight of air is M, where $P_0 =$ atmospheric pressure at ground reference)

A. $Pe^{\frac{-3Mgh}{2RT}}$

B. $P_0e^{\frac{-Mgh}{2RT}}$

C. $P_0e^{\frac{-3Mgh}{RT}}$

D. $P_0e^{\frac{Mgh}{RT}}$

Answer: D

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3. Assume a sample of a gas in a vessel. The speeds of molecules are between 2 m/s to 5 m/s, The number of molecules for speed v (m/s) is given by $n = 7v - v^2 - 10$. The most probable speed in the sample is

A. 3.5m/s

B. 5m/s

C. 10m/s

D. 4m/s

Answer: A

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4. Tyre of a bicycle has voulme $2 \times 10^{-3} m^3$ Initially the tube is filled to 75% of its volume by air at atmospheric pressure of $P_0 = 10^5 N/m^2$. When a rider rides the bicycle the area of contact of tyre with road is $A = 24 \times 10^{-5} m^2$. The mass of rider with bicycle is 120kg. The number of stokes which delivers,

$V = 500cm^3$ volume of air in each stroke required to infalte the tyres is [Take $g = m/s^2$]

A. 10

B. 11

C. 20

D. 21

Answer: D

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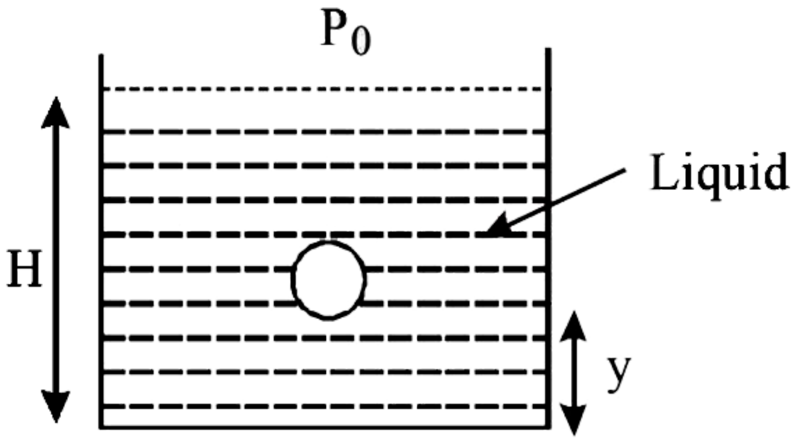
5. A small spherical monoatomic ideal gas bubble $(\gamma = 5/3)$ is trapped inside a liquid of density ρ (see figure). Assume that the bubble does not exchange any heat with the liquid. The bubble contains n moles of gas. The temperature of the gas when the bubble is at the bottom is T_0, the height of the liquid is H and the atmospheric pressure P_0 (Neglect surface tension).



When the gas bubble is at a height y from the bottom, its temperature is-

A. Only the force of gravity

B. The force due to gravity and the force due pressure of the liquid

C. The force due to gravity, the force due pressure of the liquid and the force due to visco of the liquid.

D. The force due to gravity and the force due viscosity of the liquid.

Answer: D

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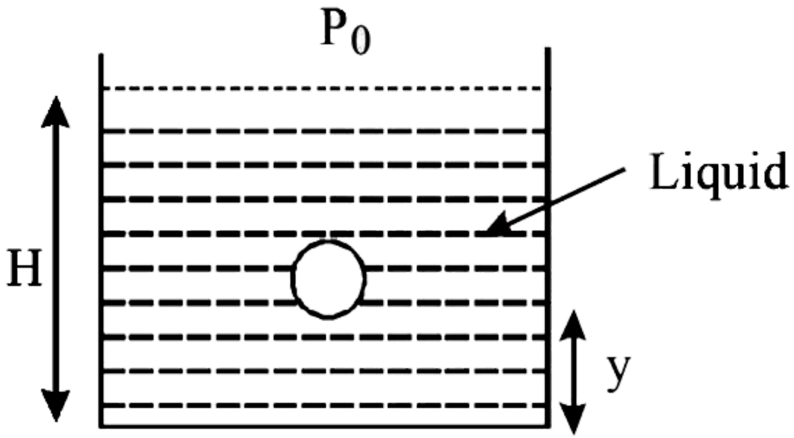
6. A small spherical monoatomic ideal gas bubble $(\gamma = 5/3)$ is trapped inside a liquid of density ρ (see figure). Assume that the bubble does not exchange any heat with the liquid. The bubble contains n moles of gas. The temperature of the gas when the bubble is at the bottom is T_0, the height of the liquid is H and the atmospheric pressure P_0 (Neglect surface tension).



When the gas bubble is at a height y from the bottom, its temperature is-

A. $T_0\left(\frac{P_0 + P_l gh}{P_0 + \rho_l gy}\right)^{2/5}$

B. $T_0\left(\frac{P_0 + \rho_l g(H - y)}{P.(0) + \rho_l gH}\right)^{2/5}$

C. $T_0\left(\frac{P_0 + \rho_l gH}{P_0 + \rho_l gy}\right)^{3/5}$

D. $T_0\left(\frac{P_0 + \rho_l g(H - y)}{P_0 + \rho_l gH}\right)^{3/5}$

Answer: B

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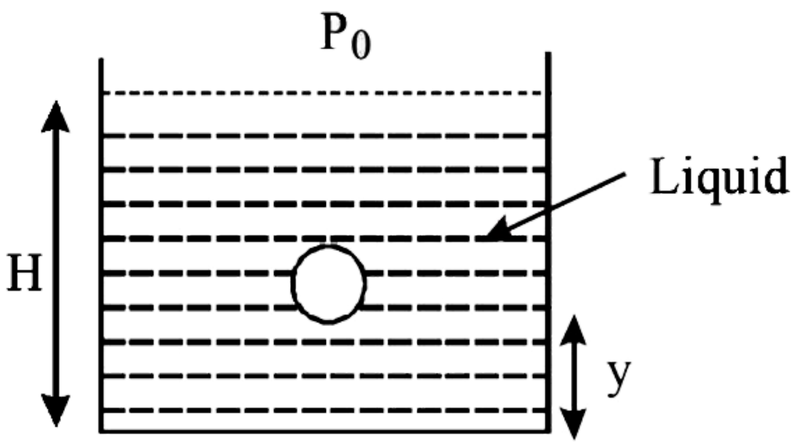
7. A small spherical monoatomic ideal gas bubble $(\gamma = 5/3)$ is trapped inside a liquid of density ρ (see figure). Assume that the bubble does not exchange any heat with the liquid. The bubble contains n moles of gas. The temperature of the gas when the bubble is at the bottom is T_0, the height of the liquid is H and the atmospheric pressure P_0 (Neglect surface tension).



The buoyancy force acting on the gas bubble is (Assume R is the universal gas constant)

A. $\rho_1 nRgT_0 \frac{(P_0 + \rho_l gH)^{2/5}}{(P_0 + \rho_l gy)^{7/5}}$

B. $\dfrac{\rho_l nRgT_0}{(P_0+\rho_l gH)^{2/5}\{(P_0+\rho_l g)(H-y)\}^{3/5}}$

C. $\rho_l nRgT_0\dfrac{(P_0+\rho_l gH)^{3/5}}{(P_0+\rho_l gy)^{8/5}}$

D. $\dfrac{\rho_l nRgT_0}{(P_0+\rho_l gH)^{3/5}\{(P_0+\rho_l g)(H-y)\}^{2/5}}$

Answer: B

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8. A very tall vertical cylinder is filled with a gas of molar mass M under isothermal conditions temperature T. the density and pressure of the gas at the base of the container is ρ_0 and P_0, respectively

Select the incorrect statement

A. Pressure decreases with height

B. The rate of decrease of pressure with height is a constant

C. $\frac{dP}{dh} = -\rho g$ where ρ is density of the gas at a height h

D. $P = \rho \frac{RT}{M}$

Answer: B

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9. A very tall vertical cylinder is filled with a gas of molar mass M under isothermal conditions temperature T. the density and pressure of the gas at the base of the container is ρ_0 and P_0, respectively

Select the incorrect statement if gravity is assumed to be constant throughout the container

A. Both pressure and density decreases exponetially with height

B. The variation of pressure is $P = P_0 e^{-\frac{Mgh}{RT}}$

C. The variation of density $\rho = \rho_0 e^{\frac{Mgh}{RT}}$

D. The molecular density decreases as one moves upwards.

Answer: C

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10. A very tall vertical cylinder is filled with a gas of molar mass M under isothermal conditions temperature T. the density and pressure of the gas at the base of the container is ρ_0 and P_0, respectively

Select the correct statement

A. The density of gas cannot be uniform throughout the cylinder

B. The density of gas cannot be uniform throughout the cylinder under isothermal conditions

C. The rate of change of density $\left|\frac{d\rho}{dh}\right| = \frac{\rho Mg}{RT}$

D. All of the above

Answer: D

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LEVEL-I (H.W)

1. Gas at a pressure P_0 in contained as a vessel. If the masses of all the molecules are halved and their speeds are doubles. The resulting pressure P will be equal to

A. $4P_0$

B. $2P_0$

C. P_0

D. $\frac{\rho_0}{2}$

Answer: D

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2. At what temperature is the $K.\ E.$ Of a gas molecules half that of its value at $27^\circ C$

A. $54^\circ C$

B. $300K$

C. $327^\circ C$

D. $108^\circ C$

Answer: C

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3. The average kinetic energy of a gas $-23^\circ C$ and 75Cm pressure is 5×10^{-14} erg for H_2. The mean kinetic energy of the O_2 at $227^\circ C$ and 150cm pressure will be

A. $80 \times 10^{-14} eg$

B. $20 \times 10^{-14} erg$

C. $40 \times 10^{-14} erg$

D. $10 \times 10^{-14} erg$

Answer: D

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4. The kinetic energy of translation of 20gm of oxygen at $47^{\circ}C$ is (molecular wt. of oxygen is 32 gm/mol and R=8.3 J/mol/K)

A. 2490 joules

B. 2490 ergs

C. 830 joules

D. 124.5 joules

Answer: A

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5. The total kinetic energy of 10 litres of helium molecules at 5 atmosphere pressure will be

A. 7589J

B. 7597erg

C. 7575 J

D. 7957J

Answer: C

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6. molecules have 'rms' velocity 2km/s. The 'rms' velocity of the oxygen molecules at same temperature is.

A. 2km/s

B. 8km/s

C. 0.5km/s

D. 1km/s

Answer: C

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7. To what temperature should the oxygem at $27^\circ C$ be heated at constant pressure, so that the root mean square velocity of its molecules becomes thrice of its previous value.

A. $2700^\circ C$

B. $2700K$

C. $2327^\circ C$

D. 270K

Answer: B

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8. At a pressure of 24×10^5 dyne/cm^2, the volume of N_2 is 5litre and mass is 20gm. The 'rms' velocity will be (in m/sec)

A. 800

B. 425

C. 1800

D. 134.1

Answer: B

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9. A sample of gas is at $0^\circ C$. To what temperature it must be raised in order to double the rms speed of the molecule.

A. $270^\circ C$

B. $819^{\circ} C$

C. $1092^{\circ} C$

D. $100^{\circ} C$

Answer: B

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10. Four molecule of a gas are having speeds of $1, 4, 8$ and $16 ms^{-1}$. The root mean square velocity of the gas molecules is

A. 7.25m/s

B. 52.56m/s

C. 84.25m/s

D. 9.2m/s

Answer: D

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11. Two vessels having equal volume contain molecular hydrogen at one atmosphere and helium at two atmospheres respectively. What is the ratio of rms speeds of hydrogen molecule to that of helium molecule if both the samples are at same temperature.

A. $(V_{rms})_n = (V_{rms})_{He}$

B. $(V_{rms})_{He} = \sqrt{2}(V_{rms})_H$

C. $(V_{rms})_H = \sqrt{2}(V_{rms})_{He}$

D. $(V_{rms})_H = 2(V_{rms})_{He}$

Answer: C

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12. Calculate the rms velocity of molecules of a gas of density $1.5 g litre^{-1}$ at a pressure of $2 \times 10^6 N/m^2$.

A. $2 \times 10^2 \frac{m}{s}$

B. $2 \times 10^2 cm/s$

C. $2 \times 10^3 m/s$

D. $2 \times 10^3 cm/s$

Answer: C

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SOLVED EXAMPLE

1. Fig shows of PV/T versus P for $1.00 \times 10^{-3} kg$ of oxygen gas at two different temperatures.

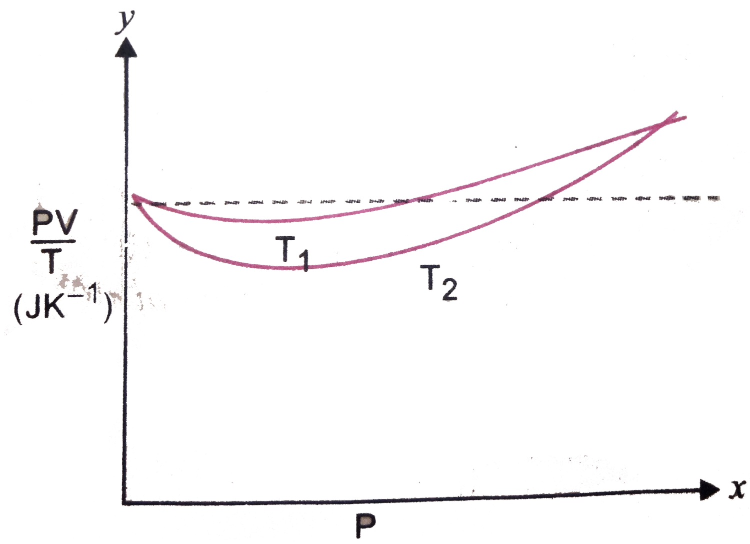
(a) What does the dotted plot signify ?

(b) Which is true : $T_1 < T_2$ or $T_2 < T_1$?

(c) What is the value of PV/T where the curves meet on the Y-axis ?

(d) If we obtained similar plot for $1.00 \times 10^{-3} kg$ of hydrogen, would we get the same value of PV/T at the point where the curves meet on the y-axis ? If not, what mass of hydrogen yield the same value of PV/T (for low pressure high temperature region of the plot) ? (Molecular mass of $H = 2.02u$, of

$O = 32.0u, R = 8.31 J mol^{-1} K^{-1}$



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2. A vessel contains two non-reactive gases neon (monoatomic) and oxygen (diatomic). The ratio of their partial pressures is 3:2. Estimate the ratio of

(i) number of molecules, and

(ii) mass density of neon and oxygen in the vessel.

Atomic mass of neon = 20.2 u, and molecular mass of oxygen = 32.0 u.

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3. The total number of air molecules in a room of capacity $20m^3$ at a temperature of $27^\circ C$ and 1 atm pressure is

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4. A vessel is filled with a gas at a pressure of 76 cm of mercury at a certain temperature. The mass of the gas is increased by 50% by introducing more gas in the vessel at the same temperature. Find the resultant pressure of the gas.

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5. What is the total kinetic energy of 2g of Nitrogen gas at temperature 300K.

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6. Your are given the following group of particles, n_i represents the number of molecules with speed v_i

$$\frac{P_2}{P_1}=\frac{m_2}{m_1}:\frac{p_2}{76}=\frac{m_1+\frac{50}{100}m_1}{m_1}=\frac{3}{2}$$

calculate (i) average speed (ii) rms speed

(iii) most probable speed.

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7. Two vessels have equal volums. One of them contains hydrogen at one atmosphere and the other helium at two atmosphere. If both the samples are at the same temperature, the rms velocity of the hydrogen molecules is

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8. At what temperature , will the rms speed of oxygen molecules be sufficient for escaping from the earth ? Take $m = 2.76 \times 10^{-26} kg, k = 1.38 \times 10^{-23} J/K$ and $v_e = 11.2 km/s$

.

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9. Calculate (i) rms velocity and (ii) mean kinetic energy of one gram molecule of hydrogen at STP. Given density of hydrogen at STP is $0.09 kgm^{-3}$.

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10. Two moles of an idel gas X occupying a volume V exerts a pressure P. The same pressure is exerted by one mole of another gas Y occupying a volume 2V. (if the molecular weight of Y is 16 times the molecular weight of X), find the ratio of the 'rms' speeds of the molecules of X and Y.

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11. Three vessel of equal capacity have gases at the same temperature and pressure. The first vessel contains neon (monoatomic), the second contains chlorine (diatomic), and the third contains uranium hexafluoride (polyatomic). Do the vessels contains equal number of respectice molecules ? Is the root mean square speed of molecules the same in the three cases ? If not, which case is v_{rms} the largest?

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12. At what temperature is the root mean square speed of an atom in an argon gas cylinder equal to the r.m.s. speed of a helium gas atom at $-20^{\circ}C$? (Atomic mass of Ar = 39.9 u, of He = 4.0 u).

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13. A nitrogen molecule at the surface of earth happens to have 'rms' speed for that gas at $0^{\circ}C$. If it were to go straight up without colliding with other molecules, how high would it rise? (Mass of nitrogen molecule, $m = 4.65 \times 10^{-26} kg, R = 8.3 J/mol/K$)

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

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15. One kg of a diatomic gas is at pressure of $8 \times 10^4 N/m^2$. The density of the gas is $4kg/m^3$. What is the energy of the gas due to its thermal motion?

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16. Calculate the total kinetic energy of one kilo mole of Oxygen gas at $27^\circ C$

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17. Two perfect gases at absolute temperature T_1 and T_2 are mixed. There is no loss of energy. The masses of the molecules are m_1 and m_2. The number of molecules in the gases are n_1 and n_2. The temperature of the mixture is

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18. A cylinder of fixed capacity 22.4 litre contains helium gas at standard temperature and pressure. What is the amount of heavy needed to raise the temperature of the gas in the cylinder by $30^{\circ}C$? $\left(R = 8.31J\text{mol}^{-1}K^{-1}\right)$

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19. A gas has molar heat capacity $C = 37.55 J \text{mole}^{-1} K^{-1}$, in the process PT = constant, find the number of degree of freedom of the molecules of the gas.

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20. Estimate the mean free path for a water molecule in water vapour at 373 K. Given diameter of water molecule $= 2 \text{Å}$ and number density of water molecule (at NTP) $= 2.7 \times 10^{25} m^{-3}$. Compare it with interatomic distance for water $= 40 \text{Å}$.

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21. Estimate the mean free path and collision frequency of a nitrogen molecule in a cylinder containing nitrogen at 2 atm and temperature $17^{\circ} C$. Take the radius of a nitrogen molecule to be roughly 1.0Å. Compare the collision time with the time the molecule moves freely between two successive collisions. (Molecular mass of nitrogen = 28.0 u).

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22. A 10kw drilling machine is used for 5 minutes to bore a hole in an aluminium block of mass $10 \times 10^3 kg$. If 40% of the work done is utilised to raise the temperature of the block, then find the raise in temperature of the aluminium block?

(Specific heat of Aluminium $= 0.9 Jkg^{-1}k^{-1}$)

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23. Hailstones fall from a certain height. If they melt completely on reaching the ground, find the height from which they fall. (

$g = 10ms^{-2}, L = 80$ calorie/g and J=4.2 J/calorie.)

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24. A girl weighing 42 kg eats bananas whose energy is 980 calories. If this energy is used to height h find the value of h. (J=4.2J calorie)

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25. A lead bullet of mass 21g travelling at a speed of 100 ms^{-1} comes to rest in a wooden block. If no heat is taken away by the wood, the rise in temperature of the bullet in the wood nearly is (Sp. Heat of lead 80cal/kg .$^{\circ} C$)

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26. The height of Niagra falls is 50 m. Calculate the difference in temperature of water at the top and at the bottom of fall, if $J = 4.2 J cal^{-1}$.

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27. A piece of ice at $0^\circ C$ falls from rest into a take of water which is also at $0^\circ C$ and 0.5% of ice melts. Find the minimum height from which the ice falls.

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28. When heat energy of 1500J is supplied to a gas the external workdone by the gas is 525J what is the increase in its internal energy

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29. $1gm$ water at $100^\circ C$ is heated to convert into steam at $100^\circ C$ at $1atm$. Find out chage in internal energy of water. It is given that volume of $1gm$ water at $100^\circ C = 1cc$, volume of $1gm$ steam at $100^\circ C = 1671cc$. Latent heat of vaporization $= 540cal/g$. (Mechanical equivalent of heat $J = 4.2J/cal$)

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30. Calculate the external workdone by the system in Kcal, when 40 Kcal of heat is supplied to the system and internal energy rises by 8400J.

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31. In a thermodynamic process, pressure of a fixed mass of a gas is changed in such a manner that the gas release $20J$ of heat and $8J$ of work is done on the gas. If initial internal energy of the gas was $30J$, what will be the final internal energy?

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32. Consider the vaporization of 1g of water at $100^\circ C$ at one atmosphere pressure. Compute the work done by the water system in the vaporization and change internal energy of the system.

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33. Calculate difference in specific heats for 1 gram of air at $N.T.P.$ Given density of air at N.T.P. is

$1.293 glitre^{-1}, j = 4.2 \times 10^7$ erg cal^{-1}.

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34. Four moles of a perfect gas is heated to increaes its temperature by $2^\circ C$ absorbs heat of 40cal at constant volume. If the same gas is heated at constant pressure find the amount of heat supplied.

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35. When an ideal diatomic gas is heated at constant pressure fraction of the heat energy supplied which increases the internal energy of the gas is

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36. A quantity of heat Q is supplied to a monoatomic ideal gas which expands at constant pressure. The fraction of heat that goes into work done by the gas $\left(\frac{W}{Q}\right)$ is

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37. The specific heat capacity of a metal at low temperature (T) is given as

$$C_p\left(kJK^{-1}kg^{-1}\right) = 32\left(\frac{T}{400}\right)^3$$

A 100 gram vessel of this metal is to be cooled from $20^\circ K$ to $4^\circ K$ by a special refrigerator operating at room temperaturte $(27^\circ C)$. The amount of work required to cool the vessel is

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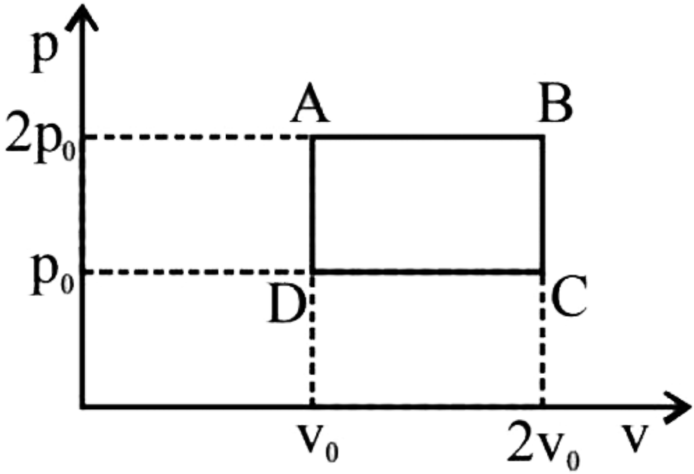

38.

The above p-v diagram represents the thermodynamic cycle of an engine, operating with an ideal monoatomic gas. The amount of heat, extracted from the source in a single cycle is

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39. A piston divides a closed gas cylinder into two parts. Initially the piston is kept pressed such that one part has a pressure P and volume 5V and the other part has pressure 8P and volume V, the piston is now left free. Find the new pressure and volume for the isothermal and aidabatic process. $(\gamma = 1.5)$

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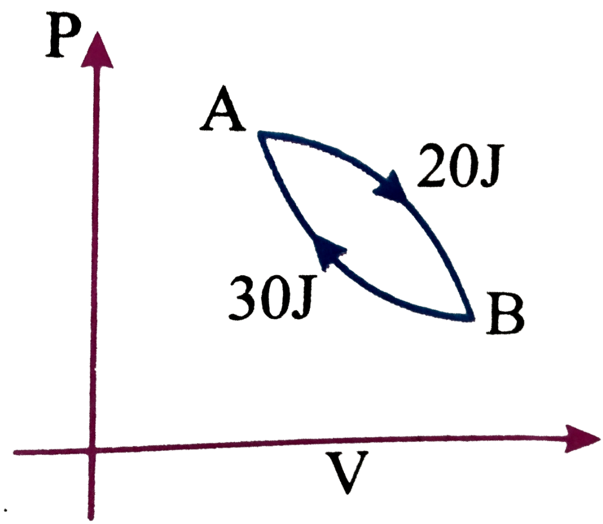
40. In a cyclic process shown in the figure an ideal gas is adiabatically taken from $B \text{to} A$, the work done on the gas during the process $B \text{to} A$ is $30, J$ when the gas is taken from A to B the heat absorbed by the gas is $20J$ Then change in internal energy of the gas in the process A to B is :



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41. A gas undergoes a change of state during which 100J of heat is supplied to it and it does 20J of work. The system is brough back to its original state through a process during which 20 J of heat is released by the gas. What is the work done by the gas in the second process?

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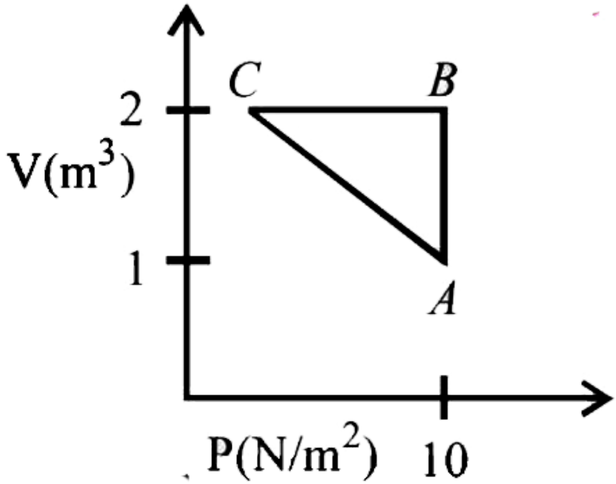
42. An ideal gas is taken through the cycle $A \rightarrow B \rightarrow C \rightarrow A$, as shown in the figure, If the net heat supplied to the gas in the cycle is 5J, the work done by the gas in the process CtoA is



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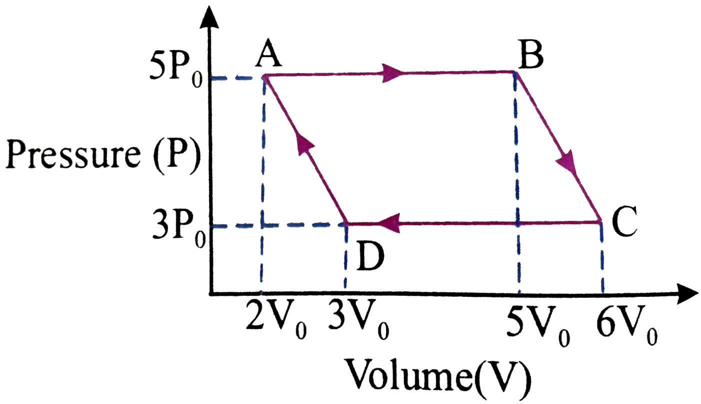
43. An ideal monoatomic gas is taken round the cycle ABCDA as shown in the P-V diagram. Compute the work done in the process.



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44. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio C_P / C_V for the gas is

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45. When 5 moles of an ideal gas is compressecd isothermally, its volume decreases from 5 litre to 1 litre. If the gas is at $27^{\circ}C$, find the work done on the gas $\left(\log_{10}\left(\frac{1}{5}\right) = -0.6990\right)$.

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46. A gas is expanded to double its volume by two different processes. One is isobaric and the other is isothermal. Let W_1 and W_2 be the respective work done, then find W_1 and W_2

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47. Temperature of 1 mole of an ideal gas is increased from 300K to 310K under isochoric process. Heat supplied to the gas in this process is Q=25R, where R=universal gas constant. What amount of work has to be done by the gas if temperature of the gas decreases from 310K to 300K adiabatically?

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48. A tyre pumped to a pressure of 6 atmosphere suddenly bursts. Room temperature is $25^\circ C$. Calculate the temperature of escaping air. $(\gamma = 1.4.)$

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49. Three samples of the same gas A,B and C $(\gamma = 3/2)$ have initially equal volume. Now the volume of each sample is doubled. The process is adiabatic for A. Isobaric for B and isothermal for C. If the final pressures are equal for all three samples, find the ratio of their initial pressures

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50. An ideal gas mixture filled inside a balloon expands according to the relation expands according to the relation $PV^{2/3} =$ constant. What will be the temperature inside the balloon

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51. Find the amount of work done to increase the temperature of one mole jof an ideal gas by $30^{\circ}C$, if it is expanding under condition $V \infty T^{2/3}$.

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

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53. The molar heat capacity in a process of a diatomic gas if it does a work of $\frac{Q}{4}$ when a heat of Q is supplied to it is

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54. A monoatomic gas undergoes a process given by $2dU + 3dW = 0$, then what is the process

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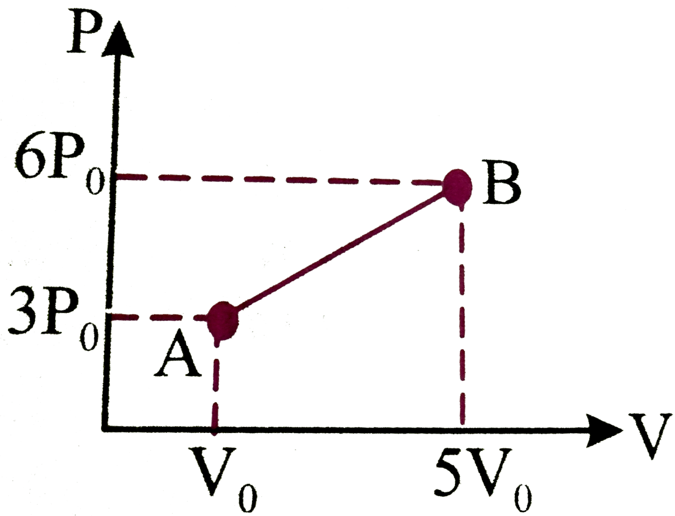
55. The relation between U, P and V for an iodeal gas is U=2+3PV. What is the atomicity of the gas.

56. One mole of a monoatomic ideal gas undergoes the process $A \rightarrow B$ in the given P-V diagram. What is the specific heat for this process?



57. If C_P and C_v denote the specific heats nitrogen per unite mass at constant pressure and constant volume respectively, then

(1) $C_P - C_v = \frac{R}{28}$ (2) $C_P - C_v = \frac{R}{14}$

(3) $C_P - C_v = R$ (4) $C_P - C_v = 28R$

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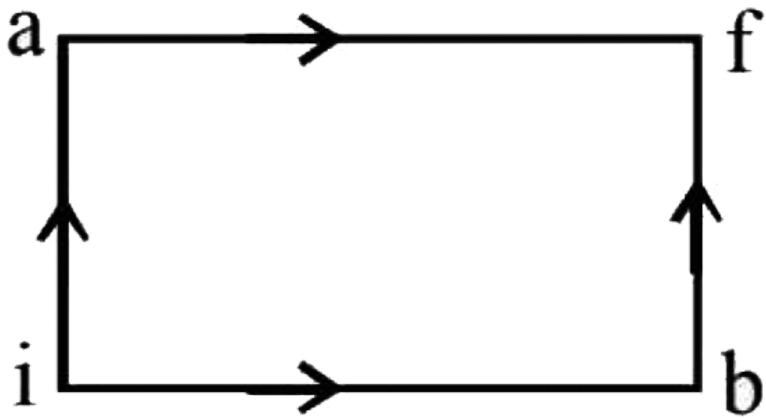
58. When a system is taken from state i to state f along the path iaf, it is found that $Q = 50 cal$ and $W = 20 cal$. Along the path

ibf $Q = 36cal$. W along the path ibf is



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

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60. 100g of water is heated from $30^{\circ}C \rightarrow 50^{\circ}C$. Ignoring the slight expansion of the water, the change in its internal energy is (specific heat of water is $4184 J / kg / K$):

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61. Five moles of hydrogen initially at STP is compressed adiabatically so that its temperature becomes 673K. The increase in internal energy of the gas, in kilo joule is (R=8.3J/molK, γ=1.4 for diatomic gas)

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62. If the ratio of specific heat of a gas of constant pressure to that at constant volume is γ, the change in internal energy of the mass of gas, when the volume changes from V to $2V$ at constant pressure p is

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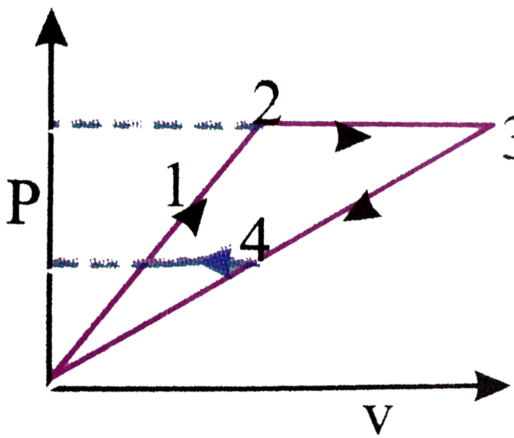
63. Three moles of an ideal monoatomic gas undergoes a cyclic process as shown in the figure. The temperature of the gas in different states marked as 1,2,3 and 4 are 400K, by the gas during the process 1-2-3-4-1 is (universal gas constant is R)



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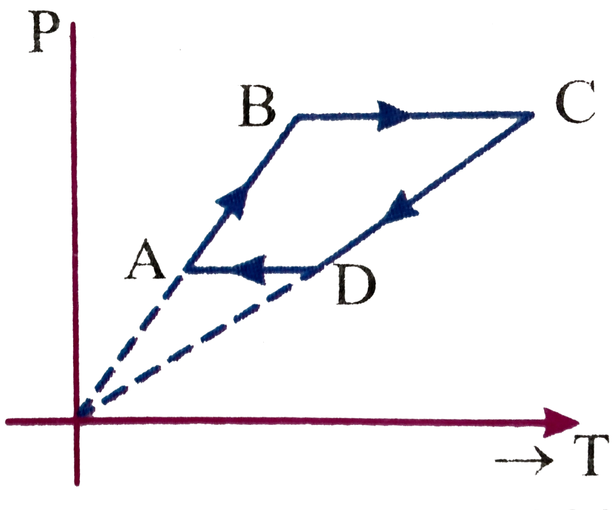
64. 3 moles of an ideal mono atomic gas performs a cycle as shown in fig. If gas temperature $T_A = 400K$ $T_B = 800K, T_C = 2400K$, and $T_D = 1200K$. Then total work done by gas is



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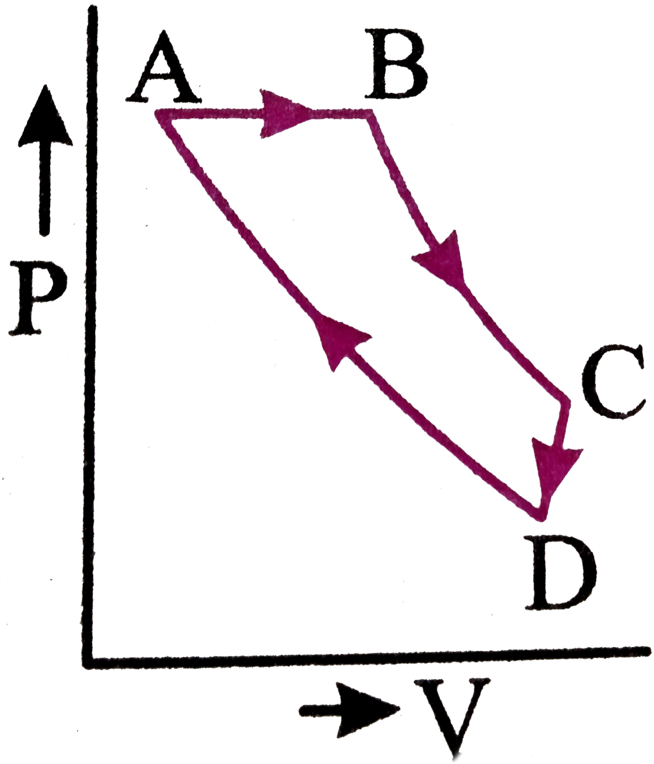
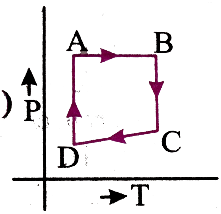
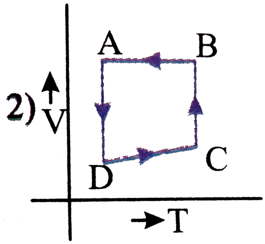
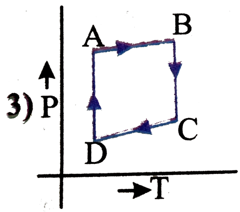
65. An ideal gas is subjected to a cyclic process ABCD as depicted in the P-V diagram given below

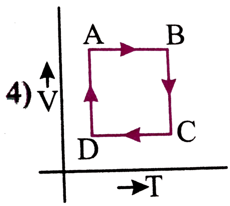


Which of the following curves represents the equivalent cyclic process?

A. 1) 

B. 

C. 

D. 

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66. A refrigerator, whose coefficient performance β is 5, extracts heat from the collingcompartment at the rate of 250 J per cycle.

(a) How much work per cycle is required to operate the refrigerator?

(b) How much heat per cycle is discharges the room which acts as the high temperature revervoir?

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67. A carnot engine operating between temperatures T_1 and T_2 has efficiency. When T_2 is lowered by 62K, its efficience increases to $\frac{1}{3}$. Then T_1 and T_2 are respectively:

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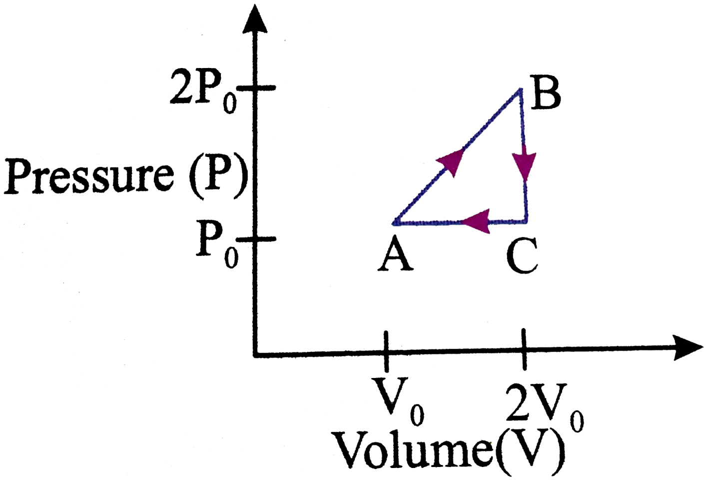
68. Find the efficeincy of the thermodynamic cycle shown in figure for an ideal diatomic gas.



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69. A Carnot's engine whose sink is at temperature of 300K has an efficiency of 40% By how much should the temperature of the source be increased so as to increase the efficiency to 60%?

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70. A Carnot engine, having an efficiency of $\eta = 1/10$ as heat engine, is used as a refrigerator. If the work done on the system is 10J, the amount of energy absorbed from the reservoir at lower temperature is

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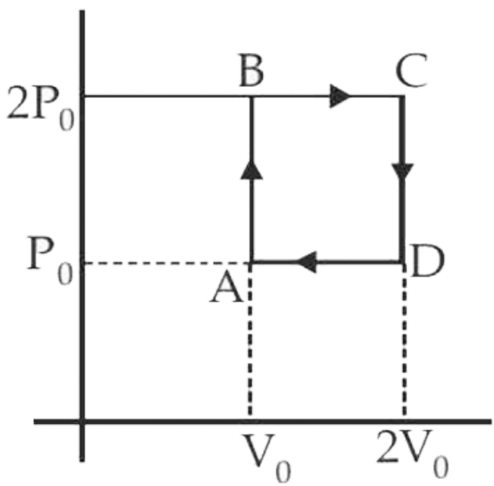
71. Helium gas goes through a cycle ABCDA (consisting of two isochoric and isobaric lines) as shown in figure Efficiency of this cycle is nearly: (Assume the gas to be close to ideal gas)



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72. A Carnot engine, whose efficiency is 40%, takes in heat from a source maintained at a temperature of 500K. It is desired to have an engine of efficiency 60%. Then, the intake temperature for the same exhaust (sink) temperature must be:

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73. A diatomic ideal gas is used in a Carnot engine as the working substance. If during the adiabatic expansion part of the cycle the volume of the gas increase from V to 32V, the efficiency of the engine is

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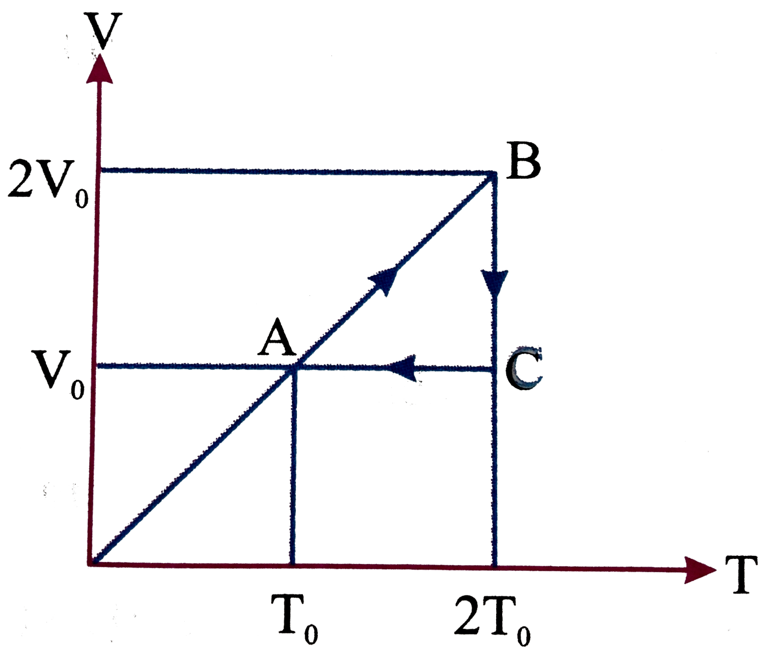
74. An ideal monoatomic gas undergoes a cyclic process $ABCA$ as shown in the figure. The ratio of heat absorbed during AB to the work done on the gas during BC id



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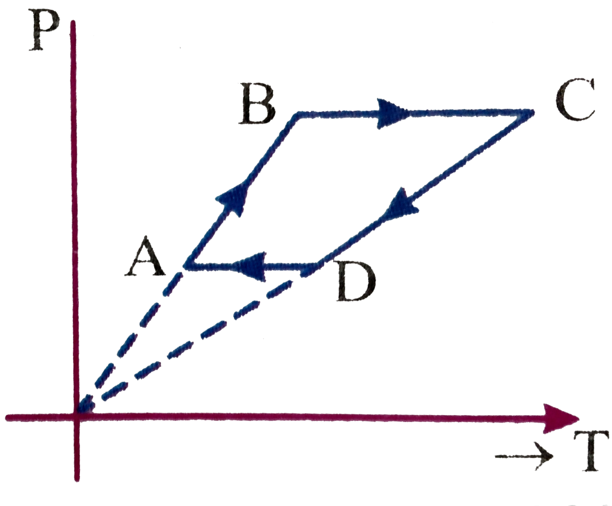
75. 3 moles of an ideal mono atomic gas performs a cycle as shown in fig. If gas temperature $T_A = 400K$

$T_B = 800K, T_C = 2400K$, and $T_D = 1200K$. Then total work done by gas is



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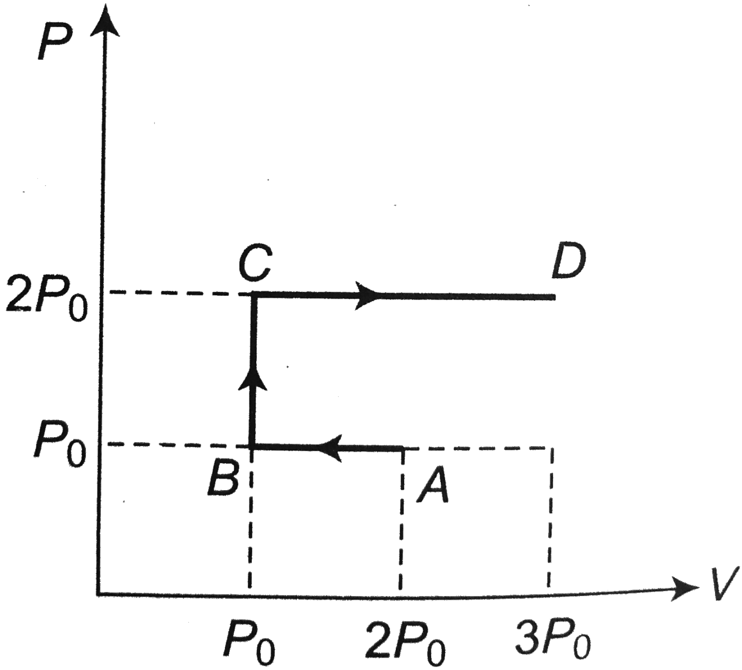
76. $P - V$ diagram of an ideal gas is as shown in figure. Work done by the gas in process $ABCD$ is



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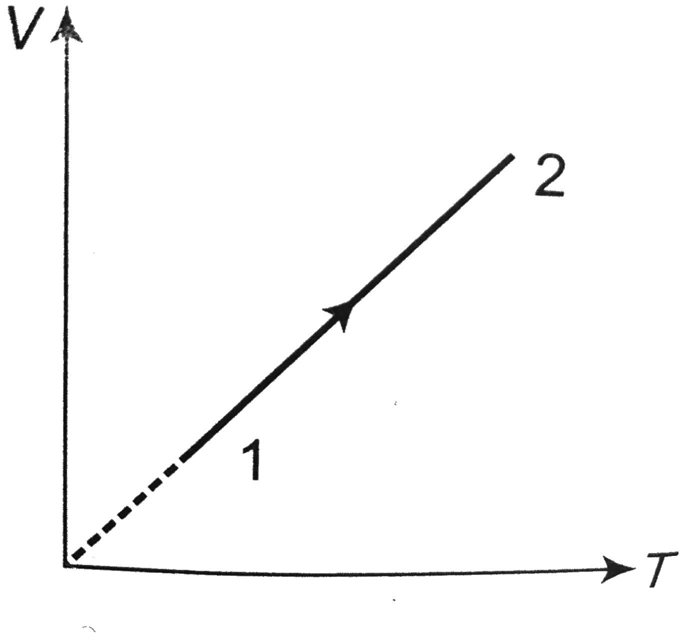
77. Volume versus temperature graph of two moles of helium gas is as shown in figure. The ratio of heat absorbed and the work done by the gas in process $1-2$ is



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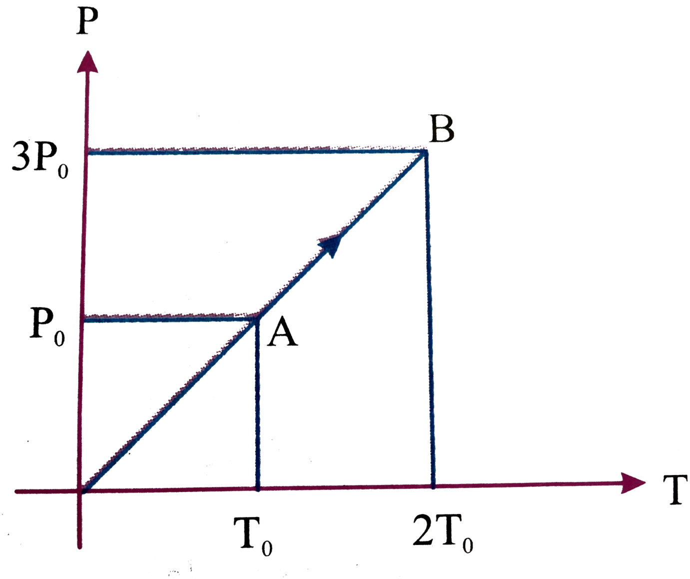
78. Pressure versus temperature graph of an ideal gas is shown in figure. Density of the gas at point A is ρ_0. Density at B will be



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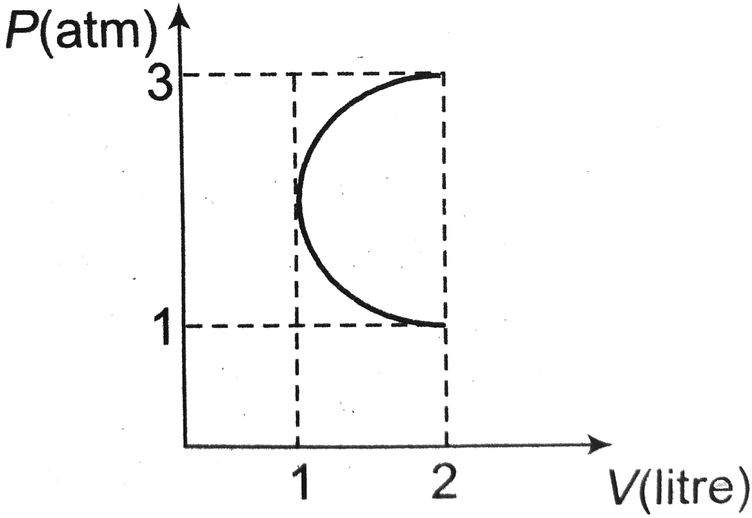
79. In the $P-V$ diagram shown in figure ABC is a semicircle.

The work done in the process ABC is



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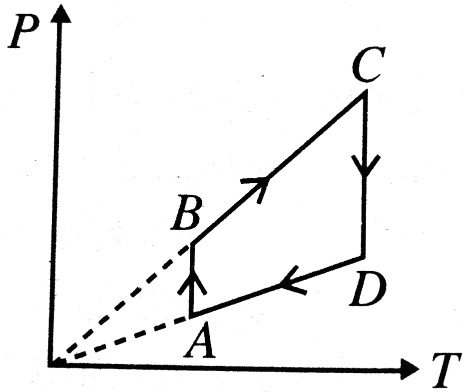
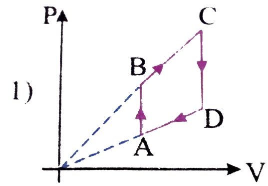
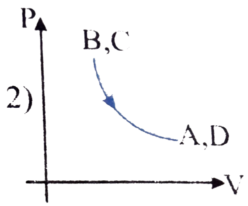
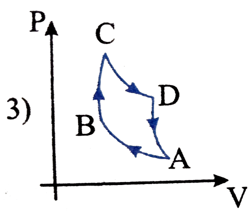
80. Pressure versus temperature graph of an ideal gas as shown in Fig.

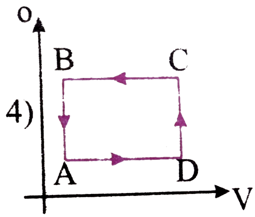
Corresponding density (ρ) versus volume (V) graph will be



A. 

B. 

C. 

D. 

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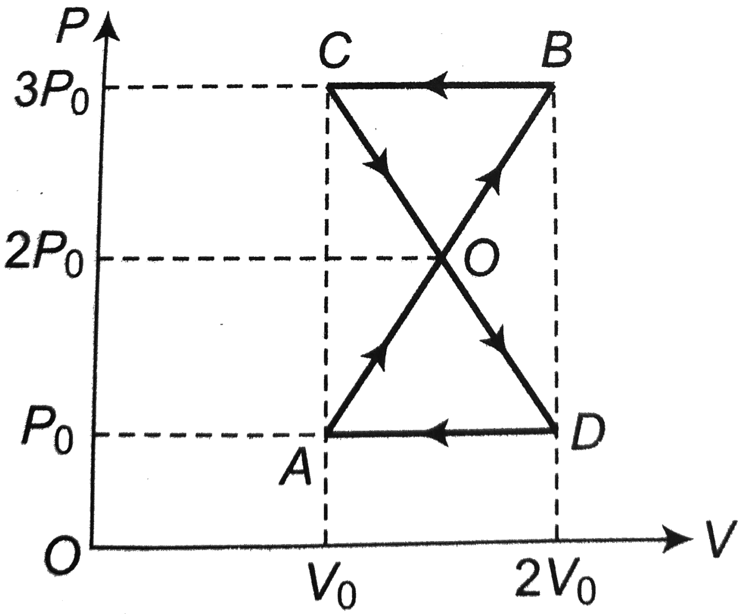
81. A thermodynamic system undergoes cyclic process $ABCDA$ as shown in figure. The work done by the system is



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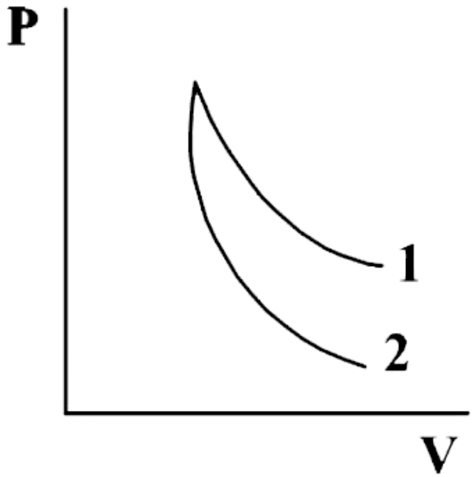
82. P-V plots for two gases during adiabatic processes are shown in the figure. Plots 1 and 2 should corresponds respectively to



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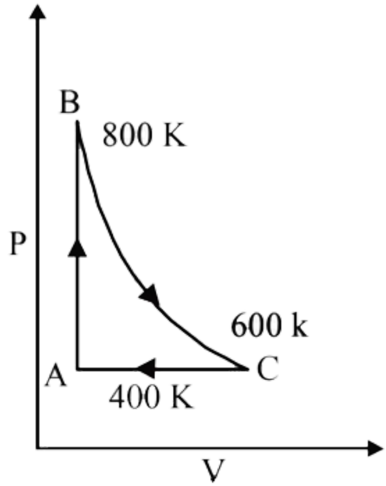
83. One mole of a diatomic ideal gas undergoes a cyclic process ABC as shown in figure. The process BC is adiabatic. The temperature at A,B and C are 400K, 800K and 600K respectively.

Choose the correct statement:



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C.U.Q

1. The root mean square speed of gas molecules

A. is same for all gases at the same temperature

B. depends on the mass of the gas molecule and its temperature

C. is independent of the density and pressure of the gas

D. depends only on the temperature and volume of the gas

Answer: B

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

A. 1/T

B. $\sqrt{T}$

C. T

D. T^2

Answer: C

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3. The mean square speed of the molecules of a gas at absolute temperature T is proportional to

A. 1/T

B. $\sqrt{T}$

C. T

D. T^2

Answer: B

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4. The following four gases are at the same temperature. In which gas do the molecules have the maximum root mean square speed?

A. Hydrogen

B. Oxygen

C. Nitrogen

D. Carbon dioxide

Answer: A

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5. The mean transitional kinetic energy of a perfect gas molecule at absolute temperature T is (k is the Boltzmann constant)

A. kT/2

B. 3 k T/4

C. k T

D. 3kT/2

Answer: D

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6. E_0 and E_n respectively represent the average kinetic energy of a molecule of oxygen and hydrogen. If the two gases are at the same temperature, which of the following statements is true?

A. $E_0 > E_k$

B. $E_0 = E_n$

C. $E_0 < E_h$

D. Nothing can be said about the magnitude of E_0 and E_h as the information given is insufficient.

Answer: B

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7. Choose the correct statement from the following:

A. The average kinetic energy of a molecule of any gas is the same at the same temperature.

B. The a average kinetic energy of a molecule of a gas is independent of its temperature.

C. The average kinetic energy of 1g of any gas is the same at the same temperature.

D. The average kinetic energy of 1g of a gas is independent of its temperature.

Answer: A

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8. The root mean square speed of the molecules of an enclosed gas is 'v'. What will be the root mean square speed if the pressure is doubled, the temperature remaining the same?

A. v/2

B. v

C. 2v

D. 4v

Answer: B

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9. Choose the only correct statement from the following:

A. The pressure of a gas is equal to the total kinetic energy of the molecuels in a unit volume of the gas.

B. The product of pressure and volume of a gas is always constant.

C. The averge kinetic energy of molecules of a gas is proportional to its absolute temperature.

D. The average kinetic energy of molecuels of a gas is proportional to the square root of its absolute temperature.

Answer: C

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10. A vessel contains a mixture of one mole of oxygen and two moles of nitrogen at 300K. The ratio of the average rorational kinetic energy per O_2 molecules to that per N_2 molecules is

A. $1:1$

B. $1:2$

C. $2:1$

D. depends on the moment of inertia of the two molecules

Answer: A

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11. Which of the following pehnomena gives evidence of the molecule motion ?

A. Brownian movement

B. Diffusion

C. Evaporation

D. All the above

Answer: D

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12. Choose the correct statement . When the temperature of a gas is increased

A. the kinetic energy of its molecules increase

B. the potential energy of its molecules increase

C. the potential energy decreases and the kinetic energy increases, the total energy remaining unchanged.

D. the potential energy increases, he kinetic energy decreases and the total energy remaining unchanged

Answer: A

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13. The number of molecules per unit volume (n) of a gas is given by

A. $\frac{P}{kT}$

B. $\frac{kT}{P}$

C. $\frac{P}{kT}$

D. $\frac{RT}{P}$

Answer: A

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14. The number of molecules of N_2 and O_2 in a vessel are same. If a fine hole is made in the vessel then which gas escapes out more rapidly?

A. N_2

B. O_2

C. both equally

D. sometimes N_2 and sometimes O_2

Answer: A

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15. The mean kinetic energy per unit volume of gas (E) is related to average pressure P, exerted by the gas is

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

B. P

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

D. 2P

Answer: C

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16. Two vessels have equal volums. One of them contains hydrogen at one atmosphere and the other helium at two atmosphere. If both the samples are at the same temperature, the rms velocity of the hydrogen molecules is

A. equal to that of helium

B. twice that of helium

C. half of helium

D. $\sqrt{2}$ times that of helium

Answer: D

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17. At a given volume and temperature the pressure of a gas

A. varies inversely as its mass

B. varies inversely as the square of its mass

C. varies linearly as its mass

D. is independent of its mass

Answer: C

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18. If the Avogadro's number was to tend to infinity the phenomenon of Brownian motion would

A. remain completely unaffected

B. become more vigorous than that observed we present finitc values of Avogadro's number, for sizes of the Brownian particles

C. become more vigorouos that that observed with the present finite value of Avodadro's number only for relatively large Brownian particles.

D. become practically unobservable as that another, for practicallly all sizes of Brownian particle another, for practically, all sizes of Brwonian particle.

Answer: D

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19. The root mean square speed of a group of gas moecules, having speeds $v_1, v_2, ... v_N$ is

A. $\frac{1}{N}\sqrt{(V_1 + V_2 + ... + V_N)^2}$

B. $\frac{1}{N}\sqrt{(V_1^2 + V_2^2 + ... + V_N^2)}$

C. $\sqrt{\frac{1}{N}(V_1^2 + V_2^2 + .. + V_N^2)}$

D. $\sqrt{(V_1 + V_2 + ... + V_N)^2}$

Answer: C

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20. v_{rms}, v_{av} and v_{mp} are root mean square average and most probable speeds of molecules of a gas obeying Maxwellian velocity distribution. Which of the following statements is correct ?

A. $v_{mp} > v_{avg} > v_{rms}$

B. $v_{rms} > v_{avg} > v_{mp}$

C. $v_{avg} > v_{mp} > v_{rms}$

D. $v_{mp} > v_{rms} > v_{avg}$

Answer: B

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21. The relation between rms velocity, v_{rms} and the most probable velocity, v_{mp}, of a gas is

A. $v_{rms} = v_{mp}$

B. $v_{rms} = \sqrt{\frac{3}{2}}mp$

C. $v_{rms} = \frac{2}{3}v_{mp}$

D. $v_{rms} = \frac{2}{3}v_{mp}$

Answer: B

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22. Which of the following methods will enable the volume of an ideal gas to be made four times

A. Quarter the pressure at constant temperature

B. Quarter the temperature at constant pressure

C. Half the temperature, double the pressure

D. Double the temperature, double the pressure

Answer: A

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23. 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 300K

B. 300K remains unchanged

C. remain unchanged

D. becomes unsteady

Answer: C

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24. At absolute zero temperature, the kinetic energy of the molecules

A. becomes zero

B. becomes maximum

C. becomes minimum

D. remains constant

Answer: A

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25. The average energy for molecules in one degree of reedom is

:

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

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

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

D. kT

Answer: B

Watch Video Solution

26. Two ballons are filled, one with pure He gas and other by air, repectively. If the pressure and temperature of these ballons are same then the number of molecules per unit volume is:

A. more in the He filled balloon

B. same in both balloons

C. more in air filled balloon

D. in the ratio of 1:4

Answer: B

Watch Video Solution

27. If gas molecules undergo, inelastic collision with the walls of the container

A. the temperature of the gas will decrease

B. the pressure of the gas will increse

C. neither the temperature nor the pressure will change

D. the temperature of the gas will increase

Answer: C

Watch Video Solution

28. On colliding in in a closed container the gas molecules

A. transfer momentum to the walls

B. momentum becomes zero

C. move in opposite directions

D. perform Brownian motion

Answer: D

Watch Video Solution

29. At upper atmosphere, an astronaut feels

A. exteremely hot

B. slightly hotter

C. extreely cool

D. slightly cooler

Answer: D

Watch Video Solution

30. The average distance travelled by a molecule of gas at temperature T between two successive collisions is called its mean free path which can be expressed by (P is pressure of gas, K is Boltzmann cosntant, d diameter of molecule)

A. $\frac{1}{\sqrt{2}\pi d^2 p}$

B. $\frac{P}{\sqrt{2}\pi d^2 T}$

C. $\dfrac{KT}{\sqrt{2}\pi d^2 P}$

D. $\dfrac{KP}{\sqrt{2}\pi d^2 T}$

Answer: C

Watch Video Solution

31. Which of the following statements about kinetic theor of gases is wrong?

A. The molecules of a gas are in continous random motion

B. The molecules continoulsy undergo ineleastic collisions

C. The molecules do not interact with each other except during collisions

D. The collisions amongst the molecules are of short duration

Answer: B

Watch Video Solution

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

A. $\frac{1}{3}p(\bar{c})^2$

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

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

D. $\frac{1}{3}\rho(c^{-2}-v)$

Answer: A

Watch Video Solution

33. At a given temperature if V_{rms} is the root mean square velocity of the molecules of a gas and V_s be the velocity of sound in it, then these are related as $\left(\gamma = \frac{C_p}{C_v}\right)$

A. $v_{rms} = v_s$

B. $v_{rms} = \sqrt{\frac{3}{\gamma}} \times v_s$

C. $v_{rms} = \sqrt{\frac{\gamma}{3}} \times v_s$

D. $v_{rms} = \left(\frac{3}{\gamma}\right) \times v_s$

Answer: B

Watch Video Solution

34. On any planet, the presence of atmosphere implies ($C_{rms} =$ root mean square velocity of molecules and $v_s =$ escape velocity)

A. $C_{rms} < v_s$

B. $C_{rms} > v_s$

C. $C_{rms} = v_s$

D. $C_{rms} = 0$

Answer: A

Watch Video Solution

35. 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 the gas is monoatomic

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

C. 3/2 PV if the gas is diatomic

D. 3/2 PV in all cases

Answer: D

Watch Video Solution

36. If the pressure in a closed vessel is reduced by drawing out some gas, the mean free path of the molecules

A. decreases

B. increases

C. remains unchanged

D. increases or decreases according to the nature of the gas

Answer: B

Watch Video Solution

37. The temperature of a gas is raised while its volume remains constant, the pressure exerted by the gas on the walls of the container increases because its molecules

A. lose more kinetic energy to the wall

B. are in contact with the wall for a shorter time

C. strike the wall more often with higher velocities

D. collide with each other with less frequency.

Answer: C

Watch Video Solution

38. Which of the following statements are true regarding the kinetic theory of gases?

A. The pressure of the gas is directly proportional to the average speed of the molecules

B. The root mean square speed of the molecules directly proportional to the pressure

C. The rate of diffusion is directly proportional average speed of the molecules

D. The average kinetic energy per molecule is inverse proportional to the absolute temperature.

Answer: C

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39. Water is used in car radiators as coolant because

A. its density is more

B. high specific heat

C. high thermal conductivity

D. free availability

Answer: B

Watch Video Solution

40. Of the following specific heat is maximum for

A. mercury

B. Copper

C. Water

D. Silver

Answer: C

Watch Video Solution

41. Heat is

A. Kinetic energy of molecules

B. potential and kinetic enrgy of molecules

C. energy in transtis

D. work done on the system.

Answer: C

Watch Video Solution

42. Which of the following parameters does not characterize the thermodynamic state of matter?

A. Volume

B. Temperature

C. Pressure

D. work done on the system.

Answer: D

Watch Video Solution

43. The thermal motion means

A. motion due to heat engine

B. disorderly motion of the body as a whole

C. motion of the body that generate heat

D. random motion of molecules

Answer: D

Watch Video Solution

44. Heat required to raise the temperature of one gram of water through $1^\circ C$ is

A. 0.001 K cal

B. 0.01 K cal

C. 0.1 K cal

D. 1.0 K cal

Answer: A

Watch Video Solution

45. If specific heat of a substance is infinite, it means

A. heat is given out

B. heat is taken in

C. no change in temperature whether heat is taken in (or) given out

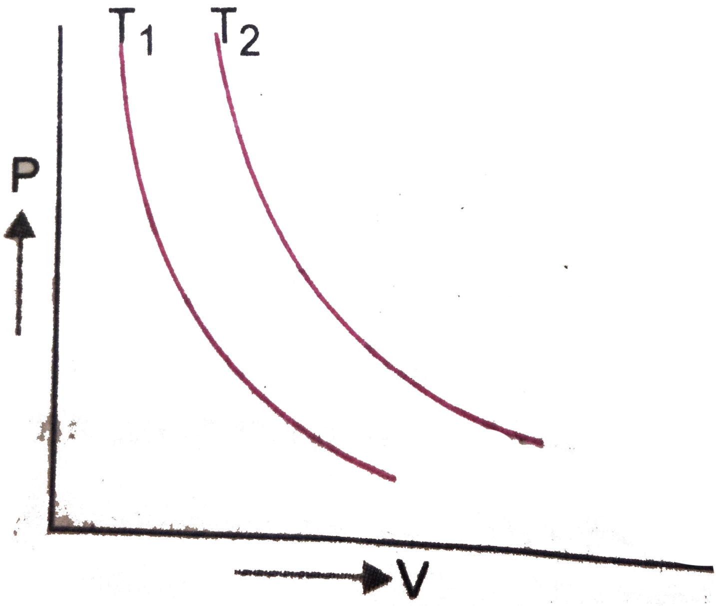
D. all of the above

Answer: C

Watch Video Solution

46. Isothermal curves for a given mass of gas are shown at two different temperture T_1 and T_2 in Fig. State whether

$T_1 > T_2$ or $T_2 > T_1$. Justify your answer.



A. $T_1 = T_2$

B. $T_1 > T_2$

C. $T_1 <^2$

D. $T_1 \geq T_2$

Answer: C

Watch Video Solution

47. Certain amount of heat supplied to an ideal gas under isothermal conditions will result in

A. rise in temperature q

B. doing external work and a change in temperature

C. doing external work

D. an increase in the internal energy of the gas

Answer: C

Watch Video Solution

48. The temperature range in the definition of standard calorie is

A. 14.5^0C to 15.5^0C

B. $15.5^{0}C$ to $16.5^{0}C$

C. $1^{0}C$ to $2^{0}C$

D. $13.5^{0}C$ to $14.5^{0}C$

Answer: A

Watch Video Solution

49. The pressure p for a gas is plotted against its absolute temperature T for two different volumes V_1 and V_2. If p is plotted on $y-$ axis and T on $x-$ axis, then

A. the curve for V_1 has greater slope than the curve for V_2

B. the curve for V_2 has greater slope than the curve for V_1

C. the curve must intersect at some point other than T=0

D. the curves have the same slope and do not intersect

Answer: B

Watch Video Solution

50. dU+dW=0 is valid for

A. adiabatic process

B. isothermal process

C. isobaric process

D. isochoric process

Answer: A

Watch Video Solution

51. In a given process on an ideal gas, $dW = 0$ and $dQ < 0$. Then for the gas

A. temperature-increases

B. volume-decreases

C. pressure-decreases

D. pressure-increases

Answer: C

Watch Video Solution

52. A piece of ice at $0^{\circ} C$ is dropped into water at $0^{\circ} C$. Then ice will

A. melt

B. be converted into water

C. not melt

D. partially melt

Answer: C

Watch Video Solution

53. The temperature determines the direction of net change of

A. gross kinetic energy

B. intermolecular kinetic energy

C. gross potential enrgy

D. intermolecular potential energy

Answer: B

Watch Video Solution

54. The direction of flow of heat between two bodies is determined by

A. average kinetic enrgy

B. total energy

C. internal energy

D. potential energy

Answer: A

Watch Video Solution

55. Heat is absorbed by a body. But its temperature does not raised. Which of the following statement explains the phenomena?

A. only K.E. of vibration increases

B. Only P.E. of inter molecular force change

C. No increases in internal energy takes place

D. Increase in K.E. is blanced by decrease in P.E.

Answer: B

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56. Zeroth law of thermodynamics gives the concept of

A. pressure

B. volume

C. temperature

D. heat

Answer: C

Watch Video Solution

57. We need mechanical equivalent of heat because

A. in C.G.S system, heat is not measured in the units of work

B. in SI system, heat is measured in the units of work

C. of some reason other than those mentioned in the units of work

D. of some reason other than those mentioned above.

Answer: B

Watch Video Solution

58. If an electric fan be switched on in a closed room, will the air of the room be cooled? If not, why do we feel cold?

A. increases

B. decreases

C. remains unchanged

D. may increase or decrease depending on the speed of rotation of the fan.

Answer: A

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59. Which type of motion of the molecules is responsible for internal energy of a monoatomic gas?

A. translational

B. rotational

C. vibrational

D. Isothermal

Answer: A

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60. The internal energy of a perfect monoatomic gas is

A. complete kinetic

B. complete potential

C. sum of potential and kinetic energy of the molecules

D. difference of kinetic and potential energies of the molecules.

Answer: A

Watch Video Solution

61. The internal energy of a perfect monoatomic gas is

A. complete kinetic

B. complete potential

C. sum of potential and kinetic energy of the molecules

D. difference of kinetic and potential energies of the molecules.

Answer: A

Watch Video Solution

62. Which of the following is constant in an isochoric process?

A. Pressure

B. Volume

C. Temperature

D. Mass

Answer: B

Watch Video Solution

63. How does the internal energy change when the ice and wax melt at their normal melting points?

A. Increases for ice and decreases for wax

B. Decreases for ice and increases for wax

C. Decreases both for ice and wax

D. Increases both for ice and wax

Answer: A

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64. In the free expansion of a gas, its internal energy

A. remains constant

B. increases

C. Decreases both for ice and wax

D. sometimes increases, sometimes decreases

Answer: A

Watch Video Solution

65. The internal energy of an ideal gas depends upon

A. only its pressure

B. only its volume

C. only its temperature

D. its pressure and volume

Answer: C

Watch Video Solution

66. On compressing a gas suddenly, its temperature

A. increases

B. decreases

C. remains constant

D. all the above

Answer: A

Watch Video Solution

67. When heat is added to a system at constant temperature, which of the following is possible.

A. Internal energy of system increases

B. Work is done by the system

C. Neither internal energy increases nor work done by the system

D. Internal energy increaes and work is done by the system

Answer: B

Watch Video Solution

68. The first law of thermodynamics is based on the law of conservation of

A. energy

B. mass

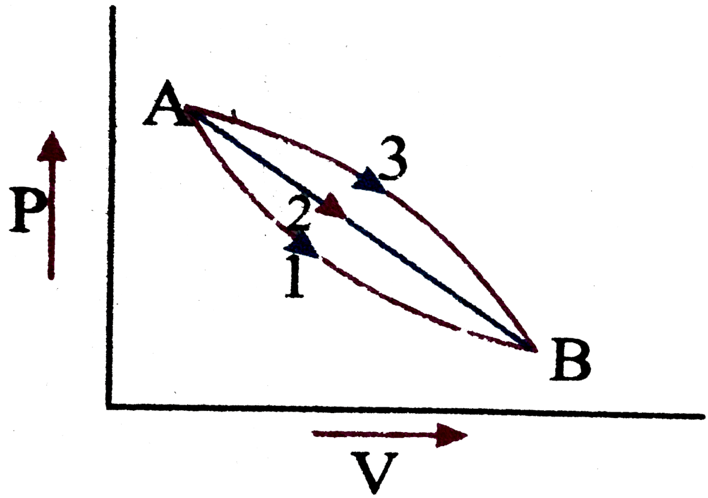
C. momentum

D. pressure

Answer: A

Watch Video Solution

69. A given mass of a gas expands from the state A to the state B by three paths 1,2 and 3 as shown in the figure, If W_1, W_2 and W_3 respectively be the work done by the gas along the three paths then



A. $W_1 > W_2 > W_3$

B. $W_1 < W_2 < W_3$

C. $W_1 = W_2 = W_3$

D. $W_1 < W_2 = W_3$

Answer: B

Watch Video Solution

70. A given system undergoes a change in which the work done by the system equals to the decrease in its internal energy. The system must have undergone an

A. isothermal change

B. adiabatic change

C. isobaric change

D. isochoric change

Answer: B

Watch Video Solution

71. A closed vessel contains some gas at a given temperature and pressure. If the vessel is given a very high velocity, then the temperature of the gas

A. increases

B. decreases

C. may increase or decrease depending upon the nature of the gas

D. does not change

Answer: D

Watch Video Solution

72. Unit mass of liquid of volume V_1 completely turns into a gas of volume V_2 at constant atmospheric pressure P and temperature T. The latent heat of vaporization is "L". Then the change in internal energy of the gas is

A. L

B. $L + P(V_2 - V_1)$

C. $L - P(V_2 - V_1)$

D. Zero

Answer: C

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73. Find the ratio of $\frac{\Delta Q}{\Delta U}$ and $\frac{\Delta Q}{\Delta W}$ in an isobaric process. The ratio of molar heat capacities $\frac{C_p}{C_V} = \gamma$.

A. $\Delta Q : \Delta U = 1 : 1$

B. $\Delta Q : \Delta U = 1 : \gamma - 1$

C. $\Delta Q : \Delta U = \gamma - 1 : 1$

D. $\Delta Q : \Delta U + \gamma - 1$

Answer: D

Watch Video Solution

74. Find the ratio of $\frac{\Delta Q}{\Delta U}$ and $\frac{\Delta Q}{\Delta W}$ in an isobaric process. The ratio of molar heat capacities $\frac{C_p}{C_V} = \gamma$.

A. $\Delta Q : \Delta W = 1 : 1$

B. $\Delta Q : \Delta W = \, : \gamma - 1$

C. $\Delta Q : \Delta W = \gamma - 1 : \gamma$

D. $\Delta Q : \Delta W = \gamma - 1$

Answer: B

Watch Video Solution

75. A gas is contained in a metallic cylinder fitted with a piston.The piston is suddenly moved in to compress the gas and is maintained at this position. As time passes the pressure of the gas in the cylinder

A. The pressure decreases

B. The pressure incrases

C. The pressure remains the same

D. The pressure may increase or decreaes depending upon the nature of the gas

Answer: A

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76. The gases have two principal specific heats but solids and liquied have only one specific heat. Why ?

A. Solid

B. Gas

C. Liquid

D. Plasma

Answer: B

Watch Video Solution

77. What is specific heat of gas in isothermal changes?

A. infinity

B. zero

C. negative

D. remains constant

Answer: A

Watch Video Solution

78. At a given temperature, the specific heat of a gas at constant pressure is always greater than its specific heat at constant volume.

A. There is greater inter molecular atraction at constant pressure

B. At constnat pressure molecular oscillations are more violent

C. External work need to be done for allowing expansion of gas at constant pressure.

D. Due to more reason other than those mentioned in the above

Answer: C

Watch Video Solution

79. The ratio $[C_p / C_v]$ of the specific heats at a constant pressure and at a constant volume of any perfect gas

A. can't be greater than 5/4

B. can't be greater than 3/2

C. can't be greater than 5/3

D. can have any value

Answer: C

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80. Which of the following formula is wrong?

A. $C_v = \frac{R}{\gamma - 1}$

B. $\frac{C_P}{C_V} = \gamma$

C. $C_P = \frac{\gamma R}{\gamma - 1}$

D. $C_P - C_V = 2R$

Answer: D

Watch Video Solution

81. Two identical samples of gases are allowed to expand to the same final volume (i) isothermally (ii) adiabatically. Work done is

A. more in the isothermal process

B. more in the adiabatic process

C. equivalent in both processes

D. equal in all processes

Answer: A

Watch Video Solution

82. Which of the following is true in the case of a reversible process?

A. There will be enrgy loss due to friction

B. System and surroundings will not be in thermodynamic equilibrium

C. Both system and surroundings retains their initial states

D. 1 and 3

Answer: C

Watch Video Solution

83. The ratio of the relative rise in pressure for adiabatic compression to that for isothermal compression is

A. γ

B. $\frac{1}{\gamma}$

C. $1-\gamma$

D. $\frac{1}{1-\gamma}$

Answer: A

Watch Video Solution

84. Ratio of isothermal elasticity of gas to the adiabatic elasticity is

A. γ

B. $\frac{1}{\gamma}$

C. $1-\gamma$

D. $\frac{1}{1-\gamma}$

Answer: B

Watch Video Solution

85. The conversion of water into ice is and

A. isothermal proces

B. isochoric process

C. isobaric process

D. entropy process

Answer: A

Watch Video Solution

86. For the Boyle's law to hold good, the necessary condition is

A. Isobaric

B. Isothermal process

C. isobaric process

D. entropy process

Answer: B

Watch Video Solution

87. An isothermal process is a

A. slow process

B. quick process

C. very quick process

D. both 1 & 2

Answer: A

Watch Video Solution

88. Two sample A and B of a gas initially at the same pressure and temperature are compressed from volume V to $V/2$ (A isothermally and B adiabatically). The final pressure of A is

A. A and B will be same

B. A will be more than in B

C. A will be less than in B

D. A will be double that in B

Answer: C

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89. In which of the following processes all three thermodynamic variables, that is pressure volume and temperature can change

A. Isobaric

B. Isothermal process

C. Isochoric

D. Adiabatic

Answer: D

Watch Video Solution

90. During adiabatic expansion the increase in volume is associated with

A. increase in pressure and temperature

B. increase in pressure and decrease in temperature

C. Decrease in pressure and increase in temperature

D. decrease in pressure and temperature

Answer: B

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91. A gas is being compressed adiabatically. The specific heat of the gas during compression is

A. zero

B. infinite

C. finite but non zero

D. undefined

Answer: A

Watch Video Solution

92. The gas equation $PV/T =$ constant is true for a constant mass of an ideal gas undergoing

A. isothermal change only

B. adiabatic chagne only

C. Both isothermal $\&$ adiabatic changes

D. neither isothermal nor adiabatic change

Answer: C

Watch Video Solution

93. During adiabatic compression of a gas, its temperature

A. falls

B. raises

C. remains constant

D. becomes zero

Answer: B

Watch Video Solution

94. The work done on the system in an aidabatic compression depends on

A. the increase in internal energy of the system

B. the decrease in internal energy

C. the change in volume of the system

D. all the above

Answer: A

Watch Video Solution

95. The ratio of slopes of adiabatic and isothermal curves is

A. γ

B. $\frac{1}{\gamma}$

C. γ^2

D. γ^3

Answer: A

Watch Video Solution

96. Two steam engines 'A' and 'B', have their sources respectively at 700K and 650 K and their sinks at 350 K and 300K. Then

A. A' is more efficient than 'B'

B. B' is more efficient than 'A'

C. both A and B are equally efficient

D. depends on fuels used in A and B

Answer: B

Watch Video Solution

97. If the temperature of the sinkis decreased, then the efficiency of heat engine

A. first increases then decrease

B. increases

C. decreses

D. remains unchanged

Answer: B

Watch Video Solution

98. An ideal heat engine can be 100% efficient if its sink is at

A. 0K

B. 273K

C. $0^{\circ}C$

D. $0^{\circ}F$

Answer: A

Watch Video Solution

99. If the temperature of a source increases, then the efficiency of a heat engine

A. increases

B. decreases

C. remains unchanged

D. none of these

Answer: A

Watch Video Solution

100. When heat is added to a system then the following is not possible?

A. Internal energy of the system increases

B. Work is done by the system

C. Neither internal energy increases nor work is done by the system

D. Internal energy increases and also work is done by the system

Answer: C

Watch Video Solution

101. A sink, that is a system where heat is rejected, is essential for the conversion of heat into work. From which law the above inference follows?

A. Zeroth

B. First

C. Second

D. Both 1 & 2

Answer: C

Watch Video Solution

102. The efficiency of a Carnot heat engine

A. is independent of the temperature of the source and the sink.

B. is undependent of the working substance

C. can be 100%

D. is not effected by the thermal capacity of the source or the sink.

Answer: B

Watch Video Solution

103. An ideal heat engine working between temperature T_H and T_L has efficiency η. If both the temperature are raised by $100K$ each the new efficiency of heat engine will be

A. equal to η

B. greater than η

C. less than η

D. greater or less than η depending upon the nature of the working substance

Answer: C

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104. The efficiency of the reversible heat engine is η_r and that of irreversible heat engine is η_l. Which of the following relations is correct?

A. $\eta_r > \eta_1$

B. $\eta_r < n_1$

C. $\eta_r \geq \eta_1$

D. $\eta_r > 1$ and $\eta_1 < l$

Answer: C

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105. In a heat engine, the temperature of the working substance at the end of the cycle is

A. equal to that at the beginning

B. more than that at the beginning

C. less than that at the beginning

D. determined by the amount of heat rejected to the sink.

Answer: A

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106. The adiabatic and isothermal elasticities B_ϕ and B_θ are related as

A. $\frac{B_\phi}{B_\theta} = \gamma$

B. $\frac{B_\theta}{B_\phi} = \gamma$

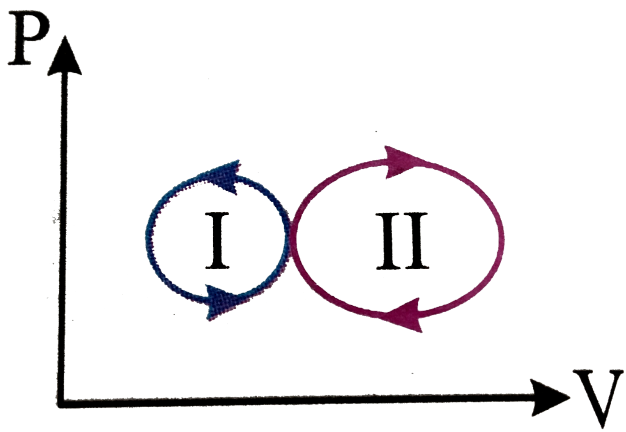
C. $B_\phi - B_\theta = \gamma$

D. $B_\phi - B_\phi = \gamma$

Answer: A

Watch Video Solution

107. For the indicator diagram given below, select wrong statement?



A. Cycle-II is heat engine cycle

B. Net work is done on the gas in cycle-I

C. Work done is positive for cycle-I

D. Workdone is positive for cycle-II

Answer: C

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108. The door of a running refrigerator inside a room is left open. The correct statement out of the following ones is

A. you can cool the room to a certain degree

B. you can cool it to the temperature inside the refrigerator

C. you can ultimately warm the room slightly

D. you can neither cool nor warm the room

Answer: C

Watch Video Solution

109. Which of the following will extinguish the fire quickly?

A. Water at $100^{\circ}c$

B. Steam at $100^{\circ}C$

C. Water at $0^{\circ}C$

D. Ice at $0^{\circ}C$

Answer: A

Watch Video Solution

110. Which of the following is true in the case of molecules, when ice melts?

A. K.E. is gained

B. K.E. is lost

C. P.E. is gained

D. P.E. is lost

Answer: C

Watch Video Solution

111. When two blocks of ice are pressed against each other then they stick together (coalesce) because

A. cooling is produced q

B. heat is produced

C. increase in pressure will increase in melting point

D. increase in pressure will decrease in melting point

Answer: D

Watch Video Solution

112. A cubical box containing a gas with internal energy U is given velocity V, then the new internal energy of the gas

A. less than U

B. more than U

C. U

D. zero

Answer: C

Watch Video Solution

113. A cubical box containing a gas is moving with some velocity. If it is suddenly stopped, then the internal energy of the gas

A. decreaes

B. increases

C. remains constant

D. may increases or decreases depending on the time interval during which box comes to rest.

Answer: B

Watch Video Solution

114. Which one of the following is wrong statement.

A. During free expansion, temperature of ideal gas does not change.

B. During free expansion, temperature of real gas decrease.

C. During free expansion of real gas temperature does no change.

D. Free expansion is conducted in adiabatic manner.

Answer: C

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115. A common salt is first dissolved in water and extracted again from the water. In this process,

A. entropy decreases

B. entropy increases

C. entropy becomes zero

D. entorpy remains constant.

Answer: B

Watch Video Solution

116. A large block of ice is placed on a table when the surroundings are at $0^\circ C$.

A. ice melts at the sides

B. ice melts at the top

C. ice melts at the bottom

D. ice does not melt at all

Answer: C

Watch Video Solution

117. Which of the following at $100^{\circ}C$ produces most sever burns ?

A. Hot air

B. Water

C. Steam

D. Oil

Answer: C

Watch Video Solution

118. What enrgy transformation takes place when ice is converted into water

A. Heat energy to kinetic energy

B. kinetic energy to heat energy

C. Heat energy to latent heat

D. Heat energy to potential energy

Answer: D

Watch Video Solution

119. Which of the following laws of thermodynamics leads to the interference that it is difficult to convert whole of heat into work?

A. Zeroth

B. Second

C. First

D. both 1 $\&$ 2

Answer: B

Watch Video Solution

120. Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2. The amount of work done by the gas is greatest when the expansion is

A. isothermal

B. isobaric

C. adiabatic

D. equal in all cases

Answer: B

Watch Video Solution

121. The second law of thermodynamics implies

A. whole of heat can be converted into mechanical energy

B. no heat engine can be 100% efficient

C. every heat engine has an efficiency of 100%

D. a refrigerator can reduce the temperature to absolute zero.

Answer: B

Watch Video Solution

122. In the adiabatic compression the decrease in volume is associated with

A. increase in temperature and decrease in pressure

B. decrease in temperature and increase in pressure

C. decreae in temperature and decrease in pressure

D. increase in temperature and increae in pressure

Answer: D

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123. For adiabatic processes $\left(\gamma = \frac{C_p}{C_v}\right)$

A. $P^{1-\gamma} =$ constant

B. $P^{\gamma}T^{1-\gamma} =$ constant

C. $PT^{\gamma} =$ cosntant

D. $P^{\gamma}T =$ constant

Answer: A

Watch Video Solution

124. If an ideal gas is isothermally expanded its internal energy will

A. increase

B. decrease

C. remains same

D. decrease or increase depending on nature of the gas

Answer: C

Watch Video Solution

125. For an adiabatic process the relation between V and T is given by

A. $TV^{\gamma} =$ constant

B. $T^{\gamma}V =$ constant

C. $TV^{1-\gamma} =$ constant

D. $TV^{\gamma-1} =$ constant

Answer: D

Watch Video Solution

126. The temperature of the system decreases in the process of

A. free expansion

B. adiabatic expansion

C. isothermal expansion

D. isothermal compression

Answer: B

Watch Video Solution

127. Heat engine rejects some heat to the sink. This heat

A. converts into electrical energy.

B. converts into light energy.

C. converts into electromagnetic energy

D. is unavailable in the universe.

Answer: D

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128. For an adiabatic change in a gas, if P,V,T denotes pressure, volume and absolute temperature of a gas at any time and γ is the ratio of specific heats of the gas, then which of the following equation is true?

A. $T^{\gamma}P^{1-\gamma}=$ const.

B. $T^{1-\gamma}P^{\gamma}=$ const.

C. $T^{\gamma-1}V^{\gamma}=$ const.

D. $T^{\gamma}V^{\gamma}=$ const.

Answer: A

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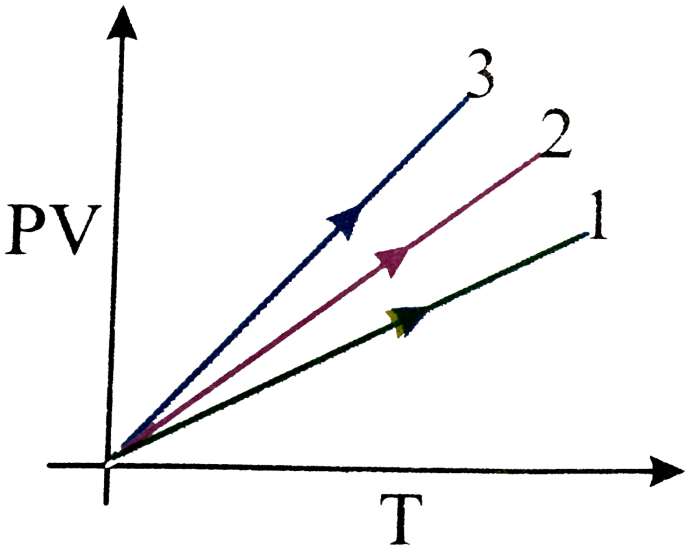
129. PV versus T graph of equal masses of H_2, He and CO_2 is shown in figure. Choose the correct alternative?



A. 3 corresponds to H_2, 2 to He and 1 to CO_2

B. 1 corresponds to He, 2 to H_2 and 3 to CO_2

C. 1 corresponds to He, 3 to H_2 and 2 to CO_2

D. 1 corresponds to CO_2, 2 to H_2 and 3 to He

Answer: A

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130. If the ratio of specific heat of a gas of constant pressure to that at constant volume is γ, the change in internal energy of the mass of gas, when the volume changes from V to $2V$ at constant pressure p is

A. $R/(\gamma - 1)$

B. PV

C. $PV/(\gamma - 1)$

D. $\gamma PV/(\gamma - 1)$

Answer: C

Watch Video Solution

131. Heat is added to an ideal gas and the gas expands. In such a process the temperature

A. must always increase

B. will remain the same if the work done is equal to the heat added

C. must always decrease

D. will remain the same if change in internal energy is equal to the heat added

Answer: B

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132. First law of thermodynamics states that

A. system can do work

B. system has temperature

C. system has pressure

D. heat is form of enrgy

Answer: A

Watch Video Solution

133. Which of the following has maximum specific heat?

A. mercury

B. water

C. hydrogen q

D. diamond

Answer: C

Watch Video Solution

134. The law obeyed by isothermal process is

A. Gay-Lussac's law

B. Charles law

C. Boyle,s law

D. Dalton's law

Answer: C

Watch Video Solution

135. Which law defines entropy in thermodynamics

A. zeroth law

B. First law

C. second law

D. Stefan's law

Answer: C

Watch Video Solution

136. For the conversion of liquid into a solid

A. orderliness decreaes and entropy decreases

B. both are not related

C. both are not related

D. orderliness increaes and entropy decreases

Answer: D

Watch Video Solution

137. Among the following the irreversibel process is

A. free expansion of a gas

B. extension or compression of a spring very slowly

C. motion of an object on perfectly frictionless surface

D. all of them

Answer: A

Watch Video Solution

138. Which of the following processes are reversible ?

A. Only a

B. Both b and d

C. Only c

D. All of the above

Answer: B

Watch Video Solution

139. Gas is taken through a cyclic process completely once. Change in the internal energy of the gas is

A. infinity

B. zero

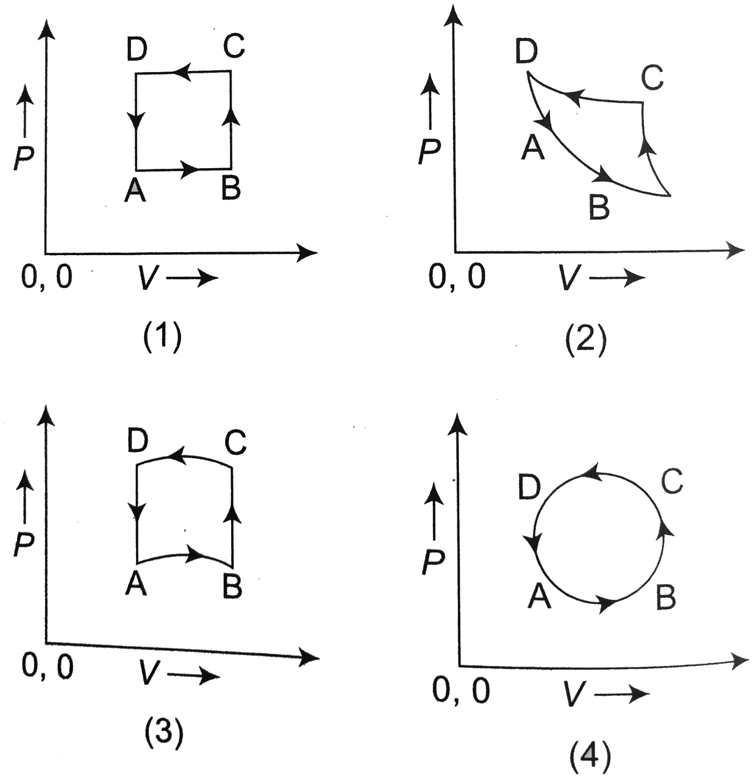
C. small

D. large

Answer: B

Watch Video Solution

140. In following figs. Variation of volume by change of pressure is shown in Fig. A gas is taken along the path $ABCDA$. The change in internal energy of the tgas will be:



A. $+ve$ in all cases

B. $-ve$ in all cases

C. $-ve$ in 1 and 3 and + ve in 2 and 4

D. zero in all cases

Answer: D

Watch Video Solution

141. Which of the following is incorrect regarding the first law of thermodynamics?

A. It introduces the concept of intermal enrgy

B. It introduces the concept of entropy

C. It is applicable to any process

D. It is a restatement of principle of conservation of energy.

Answer: B

Watch Video Solution

142. The temperature of the system decreases in the process of

A. free expansion

B. isothermal expansion

C. adiabatic expansion

D. isothermal compression

Answer: C

Watch Video Solution

143. The pressure p and volume V of an ideal gas both increase in a process.

A. It is not possible to have such a process

B. The workdone by the system is positive

C. The temperature of the sytem increases

D. 2 and 3

Answer: B

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144. The heat capcity of material depends upon

A. the structure of a matter

B. temperature of matter

C. density of matter

D. specific heat of matter.

Answer: D

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145. "Heat cannot by itself flow from a body at lower temperature to a body at higher temperature" is a statement or consequence of

A. 1^{st} law of thermodynamics

B. II^{nd} law of thermodynamics

C. conservation of momentum

D. conservation of mass

Answer: B

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146. For an isothermal process

A. $dQ = dW$

B. $dQ = dU$

C. $dW = dU$

D. $dQ = dU + dW$

Answer: A

Watch Video Solution

147. When thermodynamic system returns to its original state, which of the following is NOT possible?

A. The work done is Zero

B. The work done is positive

C. The work done is negative

D. The work done is independent of the path followed

Answer: D

Watch Video Solution

148. A thermos flask contains coffee. It is shaken vigorously. (i) Has any heat been added to it.

(ii) Has any work been done on it.

(iii) Does it internal energy change?

(iv) Does its temp. rise?

A. is not altered

B. increases

C. Decreases both for ice and wax

D. none

Answer: B

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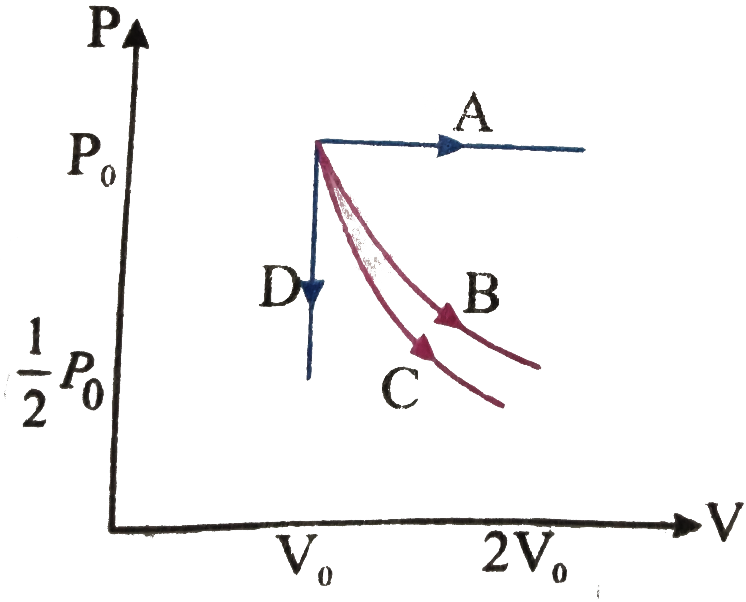
149. The PV diagram shows four different possible paths of a reversible processes performed on a monoatomic ideal gas. Path A is isobaric, path B is isothermal, path C is adiabatic and path D is isochoric. For which process does the temperature of the gas decrease?



A. Process A only

B. Process C only

C. Processes C & D

D. Processes B, C & D

Answer: C

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150. Two completely identical samples of the same ideal gas are in equal volume containers with the same pressure and temperature in containers labeled A and B. The gas in containers A performs non-zero positive work W on the surroundings during an isobaric process before the pressure is reduced isochorically to 1/2 of its initial amount. The gas in container B has its pressure reduced isochorically to 1/2 of its initial amount. The gas in container B has its pressure reduced isochorically to 1/2 of its initial value and then the gas performs same non-zero positive work W on the surroundings during an isobaric process. After the processes are performed on the gases in containers A and B, which is at the higher temperature?

A. The gas in contaienr A

B. The gas in container B

C. The gases have equal temperature

D. The value of the work W is necessary to answer this question.

Answer: B

View Text Solution

151. Which of the following conditions of the Carnot ideal heat engine can be realised in practice?

A. Infinite thermal capacity of the source

B. infinite thermal capacity of the sink

C. Perfectly non conducting stand

D. Less than 100% efficiency

Answer: D

Watch Video Solution

152. A heat engine works between a source and a sink maintaned at constant temperatures T_1 and T_2. For the efficiency to be greatest

A. T_1 and T_2 should be high

B. T_1 and T_2 should be low

C. T_1 should be high and T_2 should be low

D. T_1 should be low and T_2 should be high

Answer: C

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153. The heat engine would operate by taking heat at a particular temperature and

A. converting it all into work

B. converting some of it into work and rejecting the rest at lower temperature

C. converting some of it into work and rejecting the rest at same temperature

D. converting some of it into work and rejecting the rest at a higher temperature.

Answer: B

Watch Video Solution

LEVEL-I(C.W)

1. A piece of lead falls from a height of 100m on a fixed non-conducting slab which brings it to rest. If the specific heat of lead is 30.6 cal/kg $.^\circ C$, the increase in temperature of the slab immediately after collision is

A. $6.72^\circ C$

B. $7.62^\circ C$

C. $5.62^\circ C$

D. $8.72^\circ C$

Answer: B

Watch Video Solution

2. Hailstones fall from a certain height. If only 1% of the hailstones melt on reaching the ground, find the height from which they fall. $\left(g = 10ms^{-2}, L = 80cal \text{ or } ie/g\right.$ & $\left.J = 4.2\frac{J}{\text{calorie}}\right)$

A. 336m

B. 236m

C. 436m

D. 536m

Answer: A

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3. Two spheres A and B with masses in the ratio 2:3 and specific heat 2:3 fall freely from rest. If the rise in their temperature on reaching the ground are in the ratio 1:2 the ratio of their heights of fall is

A. $3:1$

B. $1:3$

C. $4:3$

D. $3:4$

Answer: B

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4. Two identical balls 'A' and 'B' are moving with same velocity. If velocity of 'A' is reduced to half and of 'B' to zero, then the rise in temperature of 'A' to that is reduced to half and of 'B' to zero, then the rise in temperature of 'A' to that of 'B' is

A. $3:4$

B. $4:1$

C. $2:1$

D. $1:1$

Answer: A

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5. A $50kg$ man is running at a speed of $18kmH^{-1}$ If all the kinetic energy of the man be uses to increase the temperature of water from $30^{\circ}C$.How much water can be heated with this energy?

A. 15g

B. 20g

C. 30g

D. 40g

Answer: A

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6. A man of 60kg gains 1000 cal of heat by eating 5 mangoes. His efficiency is 56%. To what height he can jump by using this energy?

A. 4m

B. 20m

C. 28m

D. 0.2m

Answer: A

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7. How much work to be done in decreasing the volume of an ideal gas by an amount of $2.4 \times 10^{-4} m^3$ at constant normal pressure of $1 \times 10^5 N/m^2$?

A. 28 joule

B. 27joule

C. 24joule

D. 25 joule

Answer: C

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8. Find the external work done by the system in keal, when 20 kcal of heat is supplied to the system and the increase in the internal energy is 8400J (J=4200 J//kcal)?

A. 16kcal

B. 18kcal

C. 20kcal

D. 19 kcal

Answer: B

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9. Air expands from 5 litres to 10 literes at 2 atm pressure. External workdone is

A. 10J

B. 1000J

C. 3000J

D. 300J

Answer: B

Watch Video Solution

10. Heat given to a system is 35 joules and work done by the system is 15 joules. The change in the internal energy of the system will be

A. $-50J$

B. $20J$

C. $30J$

D. 50J

Answer: B

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11. A gas is compressed at a constant pressure of $50N/m^2$ from a volume $10m^3$ to a volume of $4m^3$. 100J of heat is added to the gas then its internal energy is

A. Increases by 400J

B. Increases by 200J

C. Decreases by 400J

D. Decreases by 200J

Answer: A

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Watch Video Solution

12. Find the chagne in internal energy in joule when 10g of air is heated from $30^\circ C$ to $40^\circ C$ $(c_V = 0.172kcal/kg/kj = 4200j/kcal)$

A. $62.24J$

B. $72.24J$

C. $52.24J$

D. $82.24J$

Answer: B

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13. The temperature of $5 mol$ of gas which was held at constant volume was change from $100^{\circ} C$ to $120^{\circ} C$. The change in internal energy was found to ve $80 J$. The total heat capacity of the gas at constant volume will be equal to

A. 8

B. 4

C. 0.8

D. 0.4

Answer: B

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14. When an ideal diatomic gas is heated at constant pressure, the fraction of heat energy supplied which is used in doing work to maintain pressure constant is

A. $5/7$

B. $7/2$

C. $2/7$

D. $2/5$

Answer: C

Watch Video Solution

15. For a gas the differce between the two specific heat is $4150J/kgK$. What is the specific heat at constant volume of gas if the ratio of sepcific heat is 1.4

A. 8475

B. 5186

C. 1660

D. 10375

Answer: D

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16. The specific heat of air at constant pressure is 1.05kj//kg K and the specific heat of air at constant voume is $0.718KJ/kgK$. Find this specific gas constant.

A. 0.287 kJ/kgK

B. 0.21 kJ/kgK

C. 0.34 kJ/kg K

D. 0.19 kJ/kg K

Answer: A

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17. The specific heat of Argon at constant volume is 0.3122 kJ/kg/K. Find the specific heat of Argon at constant pressure if R=8.314 kJ/k mole K. (Molecular weight of argon=39.95)

A. 0.5203

B. 0.5302

C. 0.2305

D. 0.3025

Answer: A

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18. If the ratio of the specific heats of steam is 1.33 and R=8312 J/k mole k find the molar heat capacities of steam at constant pressure and constant volume.

A. 33.5 kJ/k mole.

B. 25.19 kJ/kg K

C. 25.19 kJ/K mole.

D. 24.12 kj/k mole 16.12kj/k mole

Answer: A

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19. One mole of an ideal gas undergoes an isothermal change at temperature 'T' so that its voume V is doubled. R is the molar gas constant. Work done by the gas during this change is

A. RT log4

B. RT log2

C. RTlog1

D. RT log3

Answer: B

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20. One mole of O_2 gas having a volume equal to 22.4 litres at $0^\circ C$ and 1 atmospheric pressure is compressed isothermally so that its volume reduces to 11.2 litres. The work done in this process is

A. 672.5 J

B. 1728 J

C. $-1728J$

D. $-1572.5J$

Answer: D

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21. A given quantity of a ideal gas is at pressure P and absolute temperature T. The isothermal bulk modulus of the gas is

A. P

B. γP

C. $P/2$

D. P/γ

Answer: A

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22. Diatomic gas at pressure 'P' and volume 'V' is compressed adiabatically to 1/32 times the original volume. Then the final pressure is

A. P/32

B. 32 P

C. 128P

D. P/128

Answer: C

Watch Video Solution

23. The pressure and density of a diatomic gas $(\gamma = 7/5)$ change adiabatically from (p,d) to (p^1, d^2). If $\frac{d^1}{d} = 32$, then $\frac{P^1}{P}$ should be

A. 1/128

B. 32

C. 128

D. none of the above

Answer: C

Watch Video Solution

24. An ideal gas at pressure of 1 atmosphere and temperature of $27^\circ C$ is compressed adiabatically until its pressure becomes 8 times the initial pressure, then the final temperature is $(\gamma = 3/2)$

A. $627^\circ C$

B. $527^\circ C$

C. $427^\circ C$

D. $327^\circ C$

Answer: D

Watch Video Solution

25. The volume of a gas is reduced adibatically to $(1/4)$ of its volume at $27^\circ C$. if $\gamma = 1.4$. The new temperature will be

A. $350 \times 4^{0.4} K$

B. $300 \times 4^{0.4} K$

C. $150 \times 4^{0.4} K$

D. None of these

Answer: B

Watch Video Solution

26. At $27^{\circ} C$ two moles of an ideal monoatomic gas occupy a volume V. The gas expands adiabatically to a volume 2V. Calculate (i) the final temperature of the gas, (ii) change in its internal energy, and (iii) the work done by the gas during this process.

A. $-2767.23 J$

B. $2767.23 J$

C. 2500J

D. $-2500J$

Answer: B

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27. A container of volume $1m^3$ is divided into two equal compartments, one of which contains an ideal gas at 300K. The oterh compartment is vaccum. The whole system is thermally isolated from its surroundings. The partition is removed and the gas expands to occupy the whole volume of the container. Its temperature now would be

A. 300K

B. 250K

C. 200K

D. 100K

Answer: A

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28. A gas at $10^\circ C$ temperature and 1.013xx10^5 Pa pressure is compressed adiabatically to half of its volume. If the ratio of specific heats of the gas is 1.4, what is its final temperature?

A. $103^\circ C$

B. $123^\circ C$

C. $93^\circ C$

D. $146^\circ C$

Answer: A

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29. Find the work done by a gas when it expands isothermally at $37^{\circ} C$ to four times its initial volume.

A. 3753J

B. 3573J

C. 7633J

D. 5375J

Answer: B

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30. A monatomic gas expands at constant pressure on heating. The percentage of heat supplied that increases the internal energy of the gas and that is involed in the expansion is

A. 100%,0

B. 60%,40%

C. 40%,60%

D. 75%,25%

Answer: B

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31. The efficiency of a heat engine if the temperature of source $227^{\circ} C$ and that of sink is $27^{\circ} C$ nearly?

A. 0.4

B. 0.5

C. 0.6

D. 0.7

Answer: A

Watch Video Solution

32. A Carnot engine takes $3 \times 10^6 cal.$ of heat from a reservoir at $62^\circ C$, and gives it to a sink at $27^\circ C$. The work done by the engine is

A. $4.2 \times 10^6 J$

B. $8.4 \times 10^6 J$

C. $16.8 \times 10^6 J$

D. zero

Answer: B

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LEVEL-II(C.W)

1. A copper block of mass 1kg slides down one rough inclined plane of inclination 37° at a constant speed. Find the increase in the temperature of the block as it slides down temperature of the block as it slides down through 60cm assuming that the loss in mechanical energy goes into the copper block as thermal energy. (specific heat of copper=$420Jkg^{-1}K^{-1}, g=10ms^{-2}$)

A. $6.6 \times 10^{-3}.^\circ C$

B. $7.6 \times 10^{-3}.^\circ C$

C. $8.6 \times 10^{-3}.^\circ C$

D. $9.6 \times 10^{-3} . ^{\circ} C$

Answer: C

Watch Video Solution

2. A steel ball of mass 0.1 kg falls freely from a height of 10 m and bounces to a height of 5.4 m from the ground. If the dissipated energy in this process is absorbed by the ball, the rise in its temperature is (specific heat of steel $= 460K / kg^{\circ} / C, g = 10m / s^2)$

A. $0.01^{\circ} C$

B. $0.1^{\circ} C$

C. $1^{\circ} C$

D. $1.1^{\circ} C$

Answer: B

Watch Video Solution

3. A lead bullet (specific heat=0.032cal/gm $.^{\circ} C$) is completely stopped when it strikes a target with a velocity of 300m/s. the heat generated is equally shared by the bullet and the target. The rise in temperature of bullet will be

A. $16.7^{\circ} C$

B. $1.67^{\circ} C$

C. $167.4^{\circ} C$

D. $267.4^{\circ} C$

Answer: C

Watch Video Solution

4. A block of ice falls from certain height and completely melts. If only 3/4th of the enrgy is absorbed by the block. The height of the fall should be (L=363SI units and $g = 10ms^{-2}$)

A. 48.4m

B. 84.4m

C. 88.4m

D. 44.8m

Answer: A

Watch Video Solution

5. A lead bullet of mass 21g travelling at a speed of 100 ms^{-1} comes to rest in a wooden block. If no heat is taken away by the wood, the rise in temperature of the bullet in the wood nearly is

(Sp. Heat of lead 80cal/kg $.^\circ C$)

A. $25^\circ C$

B. $28^\circ C$

C. $33^\circ C$

D. $15^\circ C$

Answer: D

Watch Video Solution

6. When 20J of work was done on a gas, 40J of heat energy was released. If the initial internal enrgy of the gas was 70J, what is the final internal energy?

A. 50J

B. 60J

C. 90J

D. 110J

Answer: A

Watch Video Solution

7. A quantity of heat Q is supplied to a monoatomic ideal gas which expands at constant pressure. The fraction of heat that goes into work done by the gas $\left(\frac{W}{Q}\right)$ is

A. 43501

B. 43529

C. 43499

D. 1

Answer: A

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8. If for hydrogen $C_P - C_V = m$ and for nitrogen $C_P - C_V = n$, where C_P and C_V refer to specific heats per unit mass respectively at constant pressure and constant volume, the relation between m and n is (molecular weight of hydrogen = 2 and molecular weight or nitrogen = 14)

A. a=16b

B. b=16a

C. a=4b

D. a=b

Answer: D

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9. The H calories of heat is required to increase temperature of one mole of monoatomic gas from $20^\circ C$ to $30^\circ C$ at constant volume. The quantity of heat required to increase the temperature of 2 moles of a diatomic gas from $20^\circ C$ to $25^\circ C$ at constant volume is

A. $\frac{4H}{3}$

B. $\frac{5H}{3}$

C. $2H$

D. $\frac{7H}{3}$

Answer: B

Watch Video Solution

10. $(1/2)$ mole of helium is contained in a container at STP how much heat energy is needed to double the pressure of the gas, keeping the volume constant? Heat capacity of gas is $3Jg^{-1}K^{-1}$.

A. 3276 J

B. 1638J

C. 819J

D. 409.5J

Answer: B

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11. How much heat energy in joules must be supplied to 14gms of nitrogen at room temperature to rise its temperature by $40^{\circ}C$

at constant pressure? (Mol. Wt. of $N_2 = 28gm$, R=constant)

A. 50R

B. 60R

C. 70R

D. 80R

Answer: C

Watch Video Solution

12. The volume of 1kg of hydrogen gas at N.T.P. is $11.2m^3$. Specific heat of hydrogen at constant volume is 100.6J kg.$^{-1}K^{-1}$. Find the specific heat at constant pressure in $Jkg.^{-1}K^{-1}$?

A. 12.2

B. 142.2

C. 163.4

D. 182.3

Answer: B

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13. 3 moles of a monoatomic gas requires occur heat for $5^\circ C$ rise of temperature at constant volume, then heat required for 6 moles of same gas under constant pressure for $10^\circ C$ rise of temperature is (R=2cal/mol-K)

A. 200cal

B. 400cal

C. 100cal

D. 300cal

Answer: D

Watch Video Solution

14. If one mole of a monatomic gas $\left(\gamma = \frac{5}{3}\right)$ is mixed with one mole of a diatomic gas $\left(\gamma = \frac{7}{5}\right)$, the value of gamma for mixture is

A. 1.5

B. 1.54

C. 1.4

D. 1.45

Answer: A

Watch Video Solution

15. The triatomic gas is heated isothermally. What percentage of the heat energy is used to increase the internal energy?

A. 0

B. 0.14

C. 0.6

D. 1

Answer: A

Watch Video Solution

16. One mole of an ideal gas $(\gamma = 7/5)$ is adiabatically compressed so that its temperature rises from $27^{\circ}C$ to $35^{\circ}C$ the work done by the gas is (R=8.47J/mol-K)

A. $-160J$

B. $-168J$

C. 150J

D. 120J

Answer: B

Watch Video Solution

17. The tyre of a motor can contains air at $15^\circ C$ if the temperature increases to $35^\circ C$, the approximate percentage increase in pressure is (ignore be expansion of tyre)

A. 7

B. 9

C. 11

D. 13

Answer: A

Watch Video Solution

18. A given mass of a gas is compressed isothermally until its pressure is doubled. It is then allowed to expand adiabatically until its original voume is restored and its pressure is then found to be 0.75 of its initial pressure. The ratio of the specific heats of the gas is approximately.

A. 1.2

B. 1.41

C. 1.67

D. 1.83

Answer: B

Watch Video Solution

19. One mole of oxygen is heated at constant pressure starting at $0^{\circ}C$. How much heat energy must be added to the gas to double its volume ?

A. $2.5 \times 273 \times r$

B. $3.5 \times 273 \times R$

C. $2.5 \times 546 \times R$

D. $3.5 \times 546 \times R$

Answer: B

Watch Video Solution

20. The equation of a certain gas can be written as $\frac{T^{7/5}}{P^{2/5}} =$ cons $\tan 1$. Its specific at constant volume will be.

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

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

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

D. $2R$

Answer: B

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21. In a mechanical refrigerator the low temperature coils are at a temperature of $-23^\circ C$ and the compressed gas in the condenser has a temperature of $27^\circ C$. The theoretical coefficient of performance is

A. 5

B. 8

C. 6

D. 6.5

Answer: A

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22. A Carnot's engine whose sink is at temperature of 300K has an efficiency of 40% By how much should the temperature of the source be increased so as to increase the efficiency to 60%?

A. 250K

B. 275K

C. 300K

D. 325K

Answer: A

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23. A refrigerator placed in a room at 300K has inside temperature 200K. How many caslories of heat shall be delivered to the room for each 2 KiloCal of energy consumed by the refrigerator ideally?

A. 4K.cal

B. 2K.cal

C. 8K.cal

D. 6Kcal

Answer: D

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24. An ideal Carnot's engine whose efficiency 40% receives heat of 500K. If the efficiency is to be 50% then the temperature of sink will be

A. 600K

B. 800K

C. 1000K

D. 250K

Answer: D

Watch Video Solution

25. Two Carnot engines A and B are operated is succession. The first one A receives heat from a source at $T_1 = 800K$ and rejects to a sink at T_2K. The second engine B receives hence rejected by the first engine and rejects the another sink at T_3=300K. If the efficiencies of two engines are equal, then the value of T_2 is

A. 489.4K

B. 469.4K

C. 449.4K

D. 429.4K

Answer: A

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LEVEL-III(C.W)

1. An ice block is projected vertically up with a velocity 20 ms^{-1}. The amount of ice that melt when it reaches the ground and if the loss of P.E. is converted into heat energy if the mass of ice block is 4.2 kg

A. 2.5gm

B. 2.5kg

C. 0.25kg

D. 0.25gm

Answer: A

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2. How much will the temperature of 100g of water be rised by doing 4200 J of work in stirring the water?

A. $0.01^{\circ} C$

B. $0.1^{\circ} C$

C. $1^{\circ} C$

D. $10^{\circ} C$

Answer: D

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3. A lead ball moving with a velocity v strikes a wall and stops. If 50% of its energy is onverted into heat. The increase in temperature is (Specific heat of lead is S)

A. $2v^2 / JS$

B. $v^2 / 4JS$

C. $v^2 S / J$

D. $v^2 S / 2J$

Answer: B

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4. A steel drill is making 180 revolution per minute, under a constant forque of 5N-m. If it drills a hole in 7sec in a steel block of mass 600gm, rise in temperature of the block is $\left(S = 0.1 gm^{-1}.^{\circ} C^{-1}\right)$

A. $2.6^{\circ} C$

B. $1.3^{\circ} C$

C. $5.2^{\circ} C$

D. $3^{\circ} C$

Answer: A

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5. The time taken by an electric heater to rise the temperature of 100cc of water through $10^\circ C$ is 7s. If there is no loss in energy. Power of that motor is (J=4.2J/cal)

A. 420W

B. 42W

C. 4.2W

D. 0.6KW

Answer: D

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6. When 1 gm of water changes from liquid to vapour phase at constant pressure of 1 atmosphre, the volume increases from 1cc to 1671cc. The heat of vaporisation at his pressure is 540 cal/gm. Increase in internal energy of water is (1 atmosphre =1.01x 10^6 dyne/cm^2)

A. 4200J

B. 8200J

C. 1200J

D. 2100J

Answer: D

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7. One cubic meter of an ideal gas ia at a pressure at $10^5 N/m^2$ and temperature 300K. The gas is allowed to expand at constant pressure to twice its volume by supplying heat. If the change in internal energy in this process is $10^4 J$, then the heat supplied is

A. $10^5 J$

B. $10^4 J$

C. $11 \times 10^4 J$

D. $2.2 \times 10^5 J$

Answer: C

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8. When unit mass of water boils to become steam at $100^\circ C$, it absorbs Q amount of heat. The densities of water and steam at

$100^{\circ} C$ are ρ_1 and ρ_2 respectively and the atmospheric pressure is P_0. The increase in internal energy of the water is

A. Q

B. $Q + P_0\left(\frac{1}{\rho_1} - \frac{1}{\rho_2}\right)$

C. $Q + P_0\left(\frac{1}{\rho_2} - \frac{1}{\rho_1}\right)$

D. $Q - P_0\left(\frac{1}{\rho_1} + \frac{1}{\rho_2}\right)$

Answer: B

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9. Consider the melting of 1g of ice at $0^{\circ} C$ to was at $0^{\circ} C$ at atmospheric pressure. Then the change in internal energy of the system (density of ice is 920kg/m^3)?

A. 334J

B. 420J

C. 540J

D. 680J

Answer: A

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10. The equation of state for a gas is given by $PV = \eta RT + \alpha V$, where η is the number of moles and α a positive constant. The intinal pressure and temperature of 1 mol of the gas contained in a cylinder is P_0 and T_0, respectively. The work done by the gas when its temperature doubles isobarically will be

A. $\dfrac{P_0 T_0 R}{P_0 - \alpha}$

B. $\dfrac{P_0 T_0 R}{P_0 + \alpha}$

C. P_0T_0R in 2

D. P_0T_0R

Answer: A

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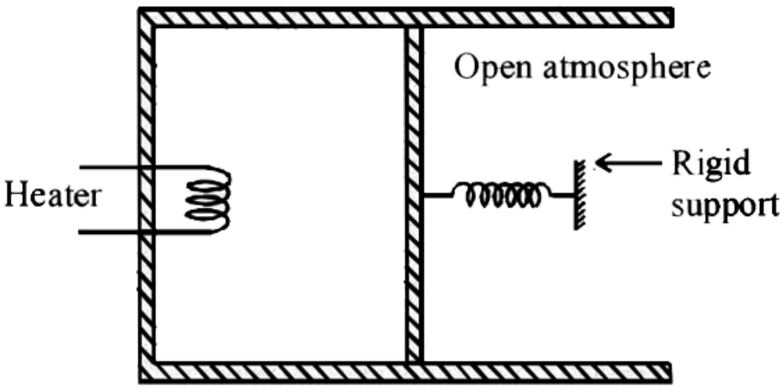
11. An ideal monoatomic gas is confined in a cylinder by a spring-loaded piston of cross-section $8.0 \times 10^{-3}m^2$. Initially the gas is at 300K and occupies a volume of $2.4 \times 10^{-3}m^3$ and the spring is in its relaxed (unstretched, unompressed) state, fig. The gas is heated by a small electric heater until the piston moves out slowly by 0.1m. Calculate the final temperature of the gas and the heat supplied (in joules) by the heater. The force constant of the spring is $8000N/m$, atmospheric pressure is $1.0 \times 10^5 Nm^{-2}$. The cylinder and the piston are thermally insulated. The piston is massless and there is no friction between the piston and the cylinder. Neglect heat loss through lead wires of the heater. The heat capacity of the heater coil is negligible. Assume the spring to be massless.



A. 300K

B. 800K

C. 500K

D. 1000K

Answer: B

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12. A cylinder of fixed capacity 67.2 liters contains helium gas at STP . Calculate the amount of heat required to rise the temperature of the gas by $15^{\circ}C$? $\left(R = 8.314 Jmol^{-1}k^{-1}\right)$

A. 520J

B. 560.9J

C. 620J

D. 621.2J

Answer: B

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13. $14 g of N_2$ gas is heated in a closed rigid container to increase its temperature from $23^\circ C$ to $43^\circ C$. The amount of heat supplied to the gas is

A. 25cal

B. 50cal

C. 100cal

D. 30cal

Answer: B

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14. 70 calories of heat required to raise the temperature of 2 moles of an ideal gas at constant pressure from $30^\circ C \rightarrow 35^\circ C$. The amount of heat required (in calories) to raise the temperature of the same gas through the same range $(30^\circ C \rightarrow 35^\circ C)$ at constant volume is:

A. 28J

B. 50Cal

C. 75J

D. Zero

Answer: B

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15. The relation between internal energy U, pressure P and volume V of a gas in an adiabatic process is $U = a + bPV$ where a and b are constants. What is the effective value of adiabatic constant γ ?

A. $\frac{a}{b}$

B. $\frac{b+1}{b}$

C. $\frac{a+1}{a}$

D. $\frac{b}{a}$

Answer: B

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16. If the ratio of specific heat of a gas of constant pressure to that at constant volume is γ, the change in internal energy of the mass of gas, when the volume changes from V to $2V$ at constant pressure p is

A. $\frac{PV}{\gamma-1}$

B. PV

C. $\gamma - 1$

D. $\frac{PV}{\gamma}$

Answer: A

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17. An ideal gas at $27^\circ C$ is compressed adiabatically to $8/27$ of its original volume. If $\gamma = 5/3$, then the rise in temperature is

A. $450^\circ C$

B. $375^\circ C$

C. $225^\circ C$

D. $402^\circ C$

Answer: B

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18. One mole of a gas expands with temperature T such thaht its volume, V=KT^2, where K is a constant. If the temperature of the gas changes by $60^\circ C$ then the work done by the gas is `120R

A. R ln 60

B. kR In 60

C. 60 kR

D. 120R

Answer: D

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19. A monoatomic ideal gas, initially at temperature T_1, is enclosed in a cylinder fitted with a friction less piston. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1 and L_2 are the length of the gas column before expansion respectively, then $\frac{T_1}{T_2}$ is given by

A. $\left(\frac{L_1}{L_2}\right)^{\frac{2}{3}}$

B. $\frac{L_1}{L_2}$

C. $\frac{L_2}{L_1}$

D. $\left(\frac{L_2}{L_1}\right)^{\frac{2}{3}}$

Answer: D

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20. Three samples of the same gas 'x','y' and 'z', for which the ratio of specific heats in $\gamma = 3/2$, have initially the same volume. The volumes of each sample is doubled, by adiabatic process in the case of 'x' by isobaric process in the case of 'y' and by isothermal process in the case of 'z'. If the initial pressures of the samples 'x','y' and 'z' are in the ratio $2\sqrt{2}:1:2$, then the ratio of theri final pressures is

A. $2:1:1$

B. $1:1:1$

C. $1:2:1$

D. $1:1:2$

Answer: B

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21. n moles of an ideal gas undergo a process in which the temperature changes with volume as $T = kv^2$. The work done by the gas as the temperature changes from 7_0 to 47_0 is

A. $3nRT_0$

B. $\left(\frac{5}{2}\right)nRT_0$

C. $\left(\frac{3}{2}\right)nRT_0$

D. Zero

Answer: C

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22. m' grams of a gas of a molecular weight M is flowing in a isolated tube with velocity 2v. If the gas flow is suddenly stopped the rise in its temperature is ($\gamma =$ ratio of specific heats, R=universal gas constant, J=Mechanical equivalent of heat)

A. $\dfrac{2Mv^2(\gamma - 1)}{RJ}$

B. $\dfrac{mv^2(\gamma - 1)}{M2RJ}$

C. $\dfrac{mv^2\gamma}{2RJ}$

D. $\dfrac{Mv^2\gamma}{2RJ}$

Answer: A

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23. Heat is supplied to a diatomic gas at constant pressure. The ratio of $\Delta Q : \Delta U : \Delta W$ is

A. $5:3:2$

B. $5:2:3$

C. $7:5:2$

D. $7:2:5$

Answer: C

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24. A given quantity of an ideal gas at pressure P and absolute temperature T obyes $P\alpha T^3$ during adiabatic process. The adiabatic bulk modulus of the gas is

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

B. P

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

D. $2P$

Answer: C

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25. An ideal gas is taken through a cyclic thermodynamic process through four steps. The amounts of heat involved in these steps are

$Q_1 = 5960 J, Q_2 = -5585 J, Q_3 = -2980 J \text{ and } Q_4 = 3645 J$

, respectively. The corresponding quantities of work involved are

$W_1 = 2200 J, W_2 = -825 J, W_3 = -1100 J \text{ and } W_4$

respectively.

(1) Find the value of W_4.

(2) What is the efficiency of the cycle

A. $1315 J, 10\%$

B. $275 J, 11\%$

C. $765J$, 10.82%

D. $675J$, 10.82%

Answer: C

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26. During an adibatic compression ,830 J of work is done on 2 moles of a diatomic ideal gas to reduce its volume by 50%. The change in its temperature is nearly:

A. 40K

B. 33K

C. 20k

D. 14K

Answer: C

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27. Consider a spherical shell of radius R at temperature T. The black body radiation inside it can be considered as an ideal gas of photons with internal energy per unit volume $u = \frac{U}{V} \propto T^4$ and pressure $P = \frac{1}{3}\left(\frac{U}{V}\right)$. If the shell now undergoes an adiabatic expansion the relation between T and R is :

A. $T a e^{-R}$

B. $T \alpha e^{-3} R$

C. $T = \frac{1}{R}$

D. $T \alpha \frac{1}{R^3}$

Answer: C

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28. An ideal gas under goes a quasi static, reversible process in which its molar heat capacity C remains constant. If during this process the relation of pressure P and volume V is given by $PV^n = cons\tan t$, then n is given by (Here C_P and C_V are molar specific heat at constant pressure and constant volume, respectively):

A. $n = \frac{C_P}{C_V}$

B. $n = \frac{C - C_P}{C - C_V}$

C. $n = \frac{C_P - C}{C - C_V}$

D. $n = \frac{C - C_V}{C - C_P}$

Answer: B

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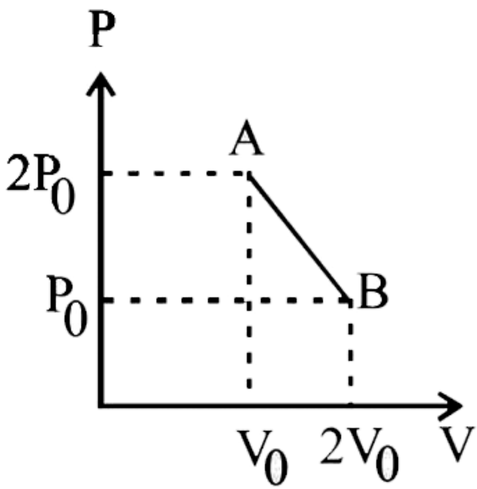
29. n' moles of an ideal gas undergoes a process $A \to B$ as shown in the figure. The maximum temperature of the gas during the process will be:



A. $\dfrac{9P_0V_0}{4nR}$

B. $\dfrac{3P_0V_0}{2nR}$

C. $\dfrac{9P_0V_0}{2nR}$

D. $\dfrac{9P_0V_0}{nR}$

Answer: A

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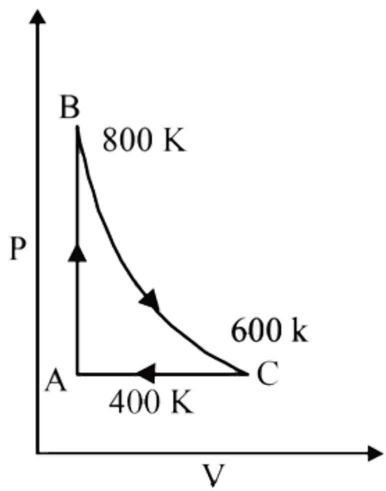
30. One mole of a diatomic ideal gas undergoes a cyclic process ABC as shown in figure. The process BC is adiabatic. The temperature at A,B and C are 400K, 800K and 600K respectively. Choose the correct statement:



A. The change in internal energy in whole cyclic process is 250R

B. The change in internal energy in the process CA is 700R.

C. The change in internal energy in the process AB is -350 R.

D. The change in internal energy in the process BC is-500R.

Answer: D

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

A. $\frac{3\gamma + 5}{6}$

B. $\frac{3\gamma - 5}{6}$

C. $\frac{\gamma + 1}{2}$

D. $\frac{\gamma - 1}{2}$

Answer: C

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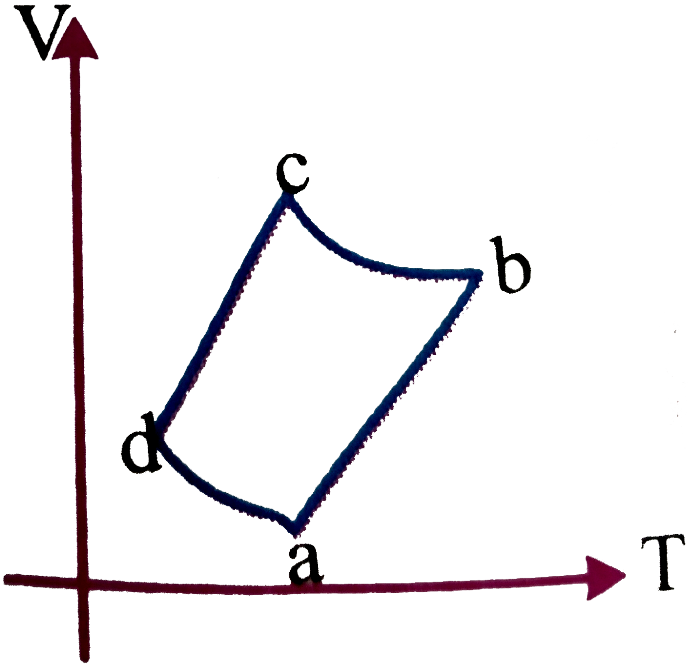
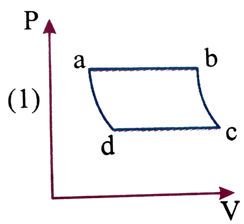
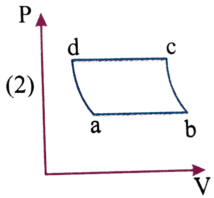
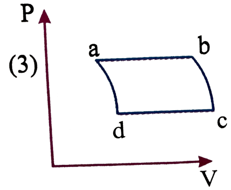
32. An ideal gas goes through a reversible cycle $a \to B \to c \to d$ has the V-T diagram shown below. Process $d \to a$ and $b \to c$ are adiabatic

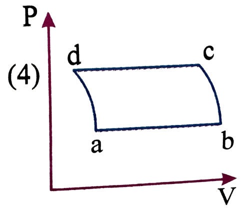


The corresponding P-V diagram for the process is(all figures are schematic and not drawn to scale)

A.


B.


C. 

D. 

Answer: B

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33. A Carnot's engine is made to work between $200^{\circ} C$ and $0^{\circ} C$ first and then between $0^{\circ} C$ and $-200^{\circ} C$. The ratio of efficiencies of the engine in the two cases is

A. $1:73:1$

B. $1:1:73$

C. $1:1$

D. $1:2$

Answer: B

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34. A scientist says that the efficiency of his heat engine which operates at source temperature $127^{\circ}C$ and sink temperature $27^{\circ}Cis26\%$, then

A. it is impossible.

B. it is possible but less probable

C. it is quite probable

D. data is incomplete

Answer: A

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35. Efficiency of a Carnot engine is 50% when temperature of outlet is $500K$. In order to increase efficiency up to 60% keeping temperature of intake the same what is temperature of outlet?

A. 200K

B. 400K

C. 600K

D. 800K

Answer: B

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36. An ideal refrigerator has a freezer at a temperature of $-13^{\circ} C$. The coefficient of performance of the engine is 5. The temperature of the air (to which heat is rejected) will be

A. $325^{\circ} C$

B. $325 K$

C. $39^{\circ} C$

D. $320^{\circ} C$

Answer: C

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37. The heat reservoir of an ideal carnot engine is at 800K and its sink is at 400K. The amount of heat taken in it in one second to produce useful mechanical work at the rate of 750J is

A. 2250J

B. 1125J

C. 1500J

D. 750J

Answer: C

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38. A Carnot engine workds between $200^\circ C$ and $0^\circ C$ and . $-200^\circ C$. In both caes the working substance absorbes 4 kilocalories of heat from the source. The efficiency of first engine will be

A. $\frac{100}{173}$

B. $\frac{200}{473}$

C. $\frac{173}{273}$

D. $\frac{273}{373}$

Answer: B

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39. In the above problem, the output of second engine is

A. 29.3×10^3 Cal

B. 12.3×10^3 Cal

C. 12.3×10^3 Joule

D. 2.93×10^3 joule

Answer: C

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40. In the above problem, the ratio of outputs of two engines is

A. 0.577

B. 0.377

C. 0.777

D. 0.177

Answer: A

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41. A carbot freezer takes heat from water at $0^{\circ} C$ inside it and rejects it to the room at a temperature of $27^{\circ} C$. The latent heat of ice is $336 \times 10^3 Jkg^{-1}$. If 5kg of water at $0^{\circ} C$ is converted into ice at $0^{\circ} C$ by the freezer, then the enrgy consummed by the freezer is close to :

A. $1.68 \times 10^6 J$

B. $1.71 \times 10^7 J$

C. $1.51 \times 10^5 J$

D. $1.67 \times 10^5 J$

Answer: D

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42. A carnot engine absorbs $1000J$ of heat energy from a reservoir at $127^{\circ} C$ and rejecs $600J$ of heat energy during each cycle. Calculate (i) efficiency of the engine, (ii) temperature of sink, (iii) amount of useful work done per cycle.

A. 20% and $-43^\circ C$

B. 40% and $-33^\circ C$

C. 50% and $-20^\circ C$

D. 70% and $-10^\circ C$

Answer: B

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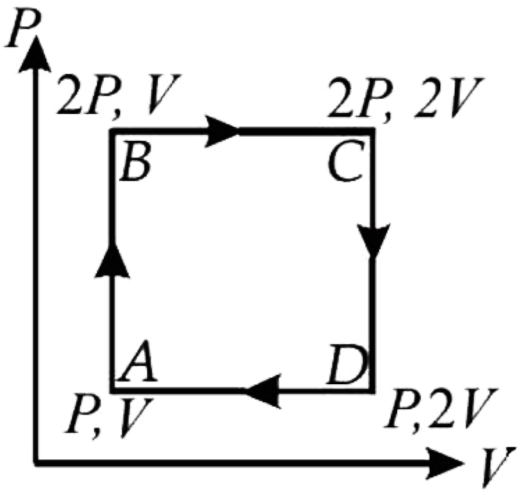
43. An ideal monoatomic gas is taken round the cycle ABCDA as shown in the P-V diagram. The work done during the cycle is



A. PV

B. 2PV

C. 3PV

D. 4PV

Answer: A

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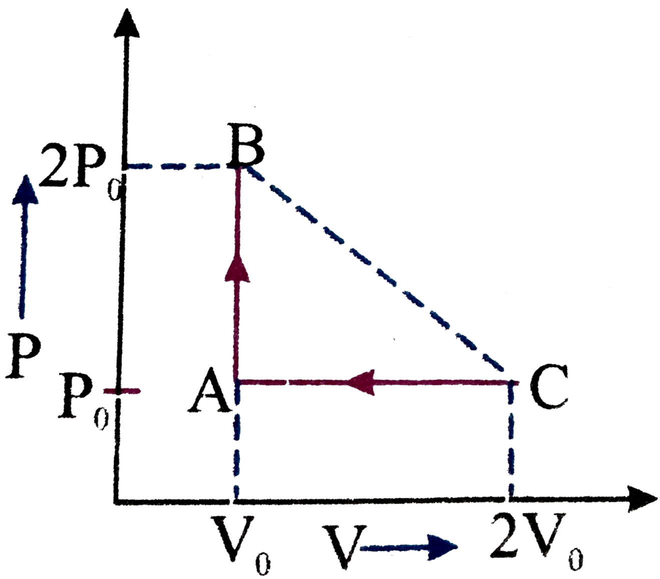
44. The figure shows P-V graph of an ideal on molegas undergone to cyclic process ABCD then the process $B \rightarrow C$ is



A. Isobaric

B. Adiabatic

C. Isochoric

D. Isothermal

Answer: D

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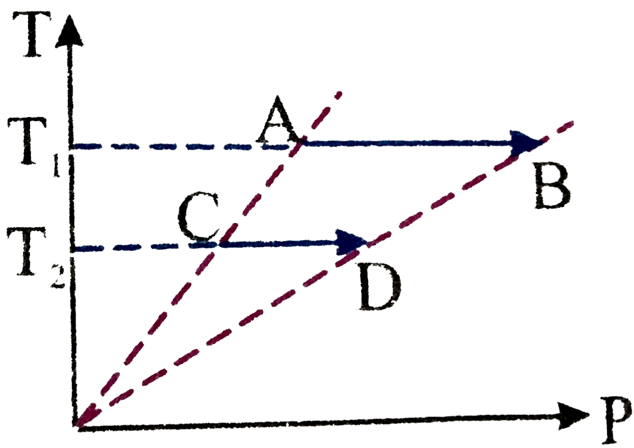
45. On a T-P diagram, two moles of ideal gas perform process AB and CD. If the work done by the gas in the process AB is two times the work done in the process CD then what is the value of $\frac{T_1}{T_2}$?



A. 1/2

B. 1

C. 2

D. 4

Answer: C

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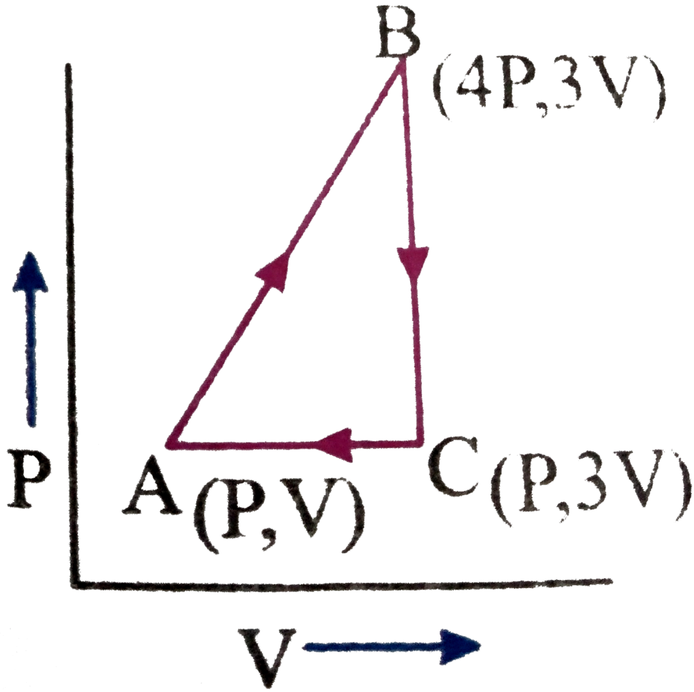
46. A sample of an ideal monoatomic gas is taken round the cycle ABCA as shown in the figure the work done during the cycle is



A. Zero

B. 3PV

C. 6PV

D. 9PV

Answer: B

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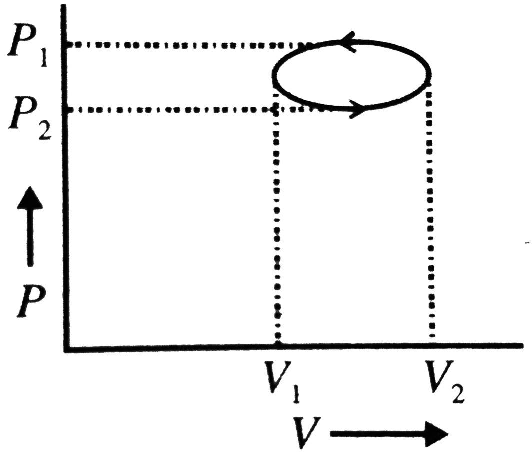
47. In the given elliptical $P - V$ diagram



A. The work done is positve

B. The change in internal energy is non-zero

C. The work done $= -\left(\frac{\pi}{4}\right)(P_2 - P_1)(V_2 - V_1)$

D. The work done $= (\pi)(V_2 - V_1)^2 = \pi(P_2P_1)^2$

Answer: C

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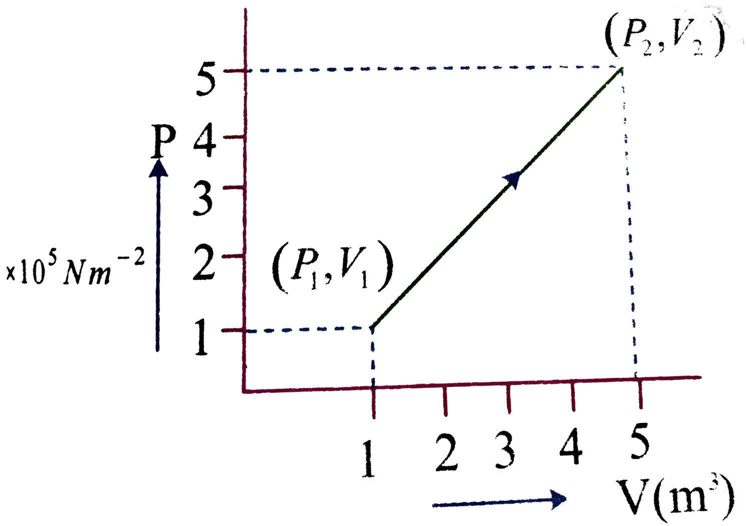
48. A system changes from the state (P_1, V_1) to $(P_2 V_2)$ as shwon in the diagram. The workdone by the system is



A. $12 \times 10^4 J$

B. $12 \times 10^8 J$

C. $12 \times 10^5 J$

D. $6 \times 10^4 J$

Answer: C

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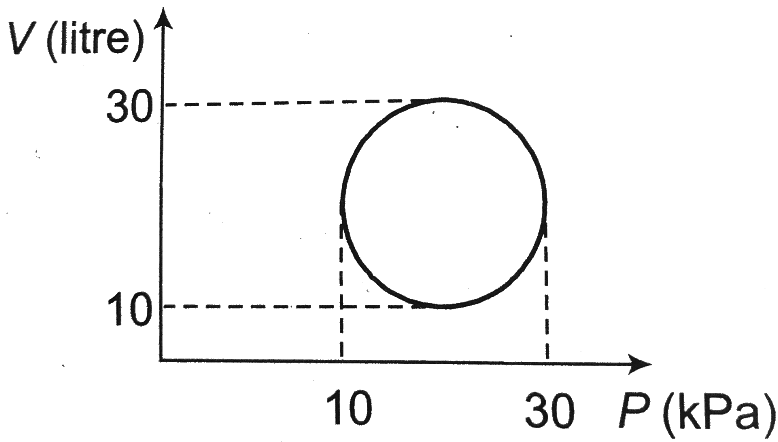
49. Heat energy abosrbed by a system in going through a cyclic process shown in figure is



A. $10^3 \pi J$

B. $10^3 \pi J$

C. $10^4 \pi J$

D. $10^7 \pi J$

Answer: B

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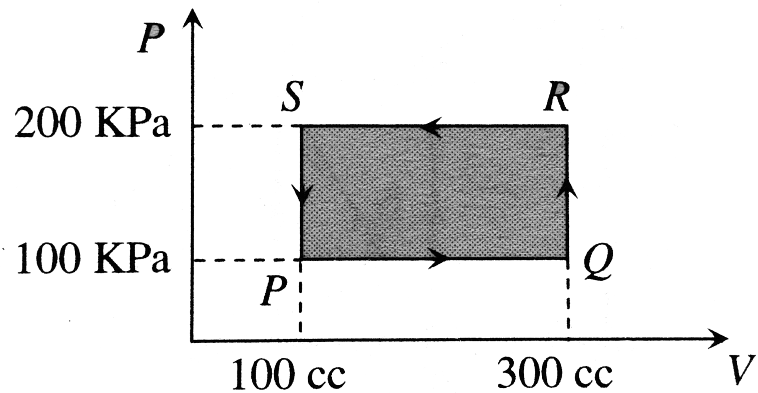
50. A thermodynamic system is taken through the cyclic $PQRSP$ process. The net work done by the system is



A. 20J

B. $-40J$

C. 400J

D. $-374J$

Answer: B

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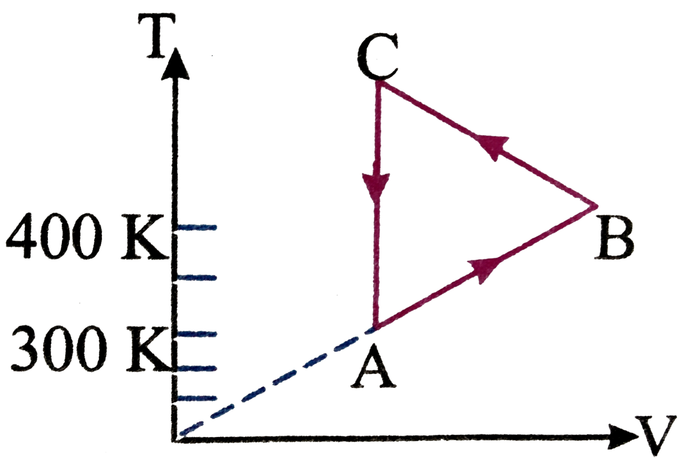
51. A cyclic process performed on one mole of an ideal gas. A total 1000 J of heat is withdrawn from the gas in a complete cycle. Find the work. Done by the gas druing the process $B \rightarrow C$.



A. $-1531J$

B. $-1631J$

C. $-1731J$

D. $-1831J$

Answer: D

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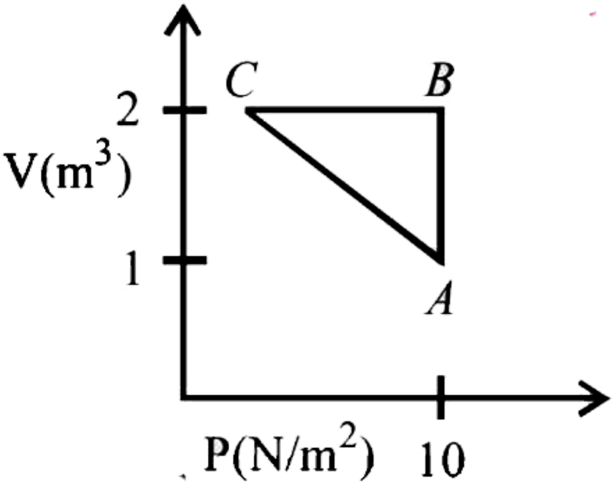
52. An ideal gas is taken through the cycle $A \rightarrow B \rightarrow C \rightarrow A$, as shown in the figure, If the net heat supplied to the gas in the cycle is 5J, the work done by the gas in the process CtoA is



A. -53

B. $-10J$

C. $-15J$

D. $-20J$

Answer: A

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