PHYSICS

BOOKS - DISHA PHYSICS (HINGLISH)

THERMODYNAMICS

Physics

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

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

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

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

Answer:

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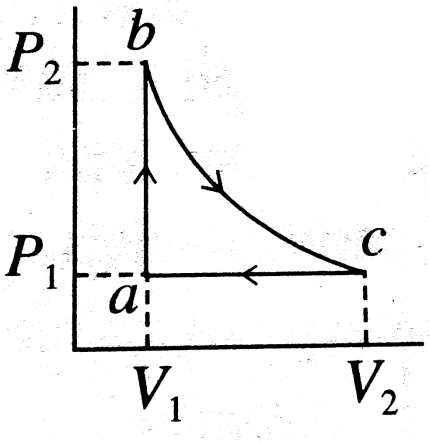
2. Carbon monoxide is carried around a closed cyclic processes abc, in which bc is an isothermal process, as shown in Fig. The gas absorbs $7000J$ of heat as its temperature is increased from $300K$ to $1000K$ in going from a to b. The quantity of heat ejected by the gas during the process ca is



A. 4200 J

B. 5000 J

C. 9000 J

D. 9800 J

Answer:

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3. 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

A. 100 J

B. 99 J

C. 90 J

D. 1 J

Answer:

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4. 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?

A. 2 joule

B. 18 joule

C. 42 joule

D. 58 joule

Answer:

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5. A closed gas cylinder is divided into two parts by a piston held tight. The pressure and volume of gas in two parts respectively are (P, 5V) and (10P, V). If now the piston is left free and the system undergoes isothermal process, then the volumes of the gas in two parts respectively are

A. 2V,4V

B. 3V,3V

C. 5v,V

D. $\frac{10}{11}V\frac{20}{11}V$

Answer:

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6. A mass of diatomic gas$(\gamma = 1.4)$ at a pressure of 2 atomphere is compressed adiabitically so that its temperature rises from

$27^\circ C$ to $927^\circ C$. The pressure of the gas in the final state is

A. 28atm

B. 68.7atm

C. 256 atm

D. 8atm

Answer:

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7. 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

A. 0.5

B. 0.75

C. 0.99

D. 0.25

Answer:

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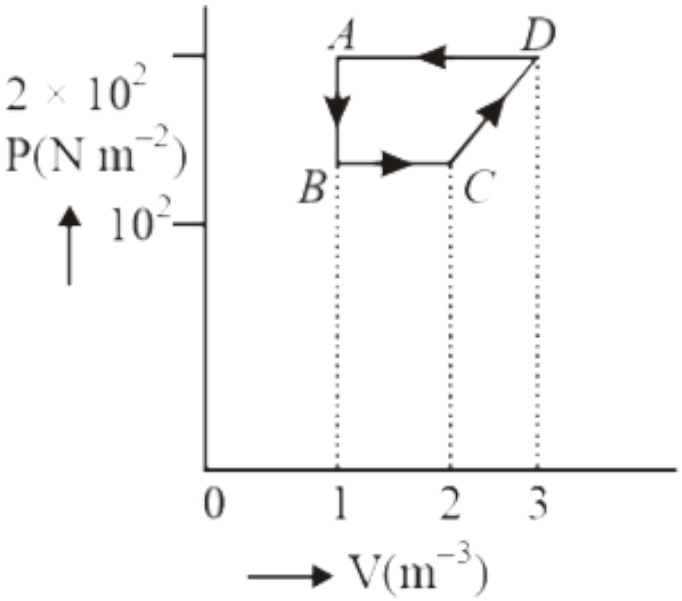
8. The P-V diagram of a gas system undergoing cyclic process is shown here. The work done during isobaric compression is



A. 100 J

B. 200 J

C. 600 J

D. 400 J

Answer:

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9. During an adiabatic process of an ideal gas, if P is proportional to $\frac{1}{V^{1.5}}$, then the ratio of specific heat capacities at constant pressure to that at constant volume for the gas is

A. 1.5

B. 0.25

C. 0.75

D. 0.4

Answer:

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10. The work of 146 kJ is performed in order to compress one kilo mole of a gas adiabatically and in this process the temperature of the gas

increases by $7^\circ C$. The gas is $\left(R = 8.3 ml^{-1} J mol^{-1} K^{-1}\right)$

A. diatomic

B. triatomic

C. a mixture of monoatomic and diatomic

D. monoatomic

Answer:

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11. 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. $T \propto \frac{1}{R}$

B. $T \propto \frac{1}{R^3}$

C. $T \propto e^{-R}$

D. $T \propto e^{-3R}$

Answer:

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12. 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

A. equal to 0.002 kJ

B. greater than 0.148 kJ

C. between 0.148 kJ and 0.028 kJ

D. less than 0.028 kJ

Answer:

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13. 5.6 liter of helium gas at STP is adiabatically compressed to 0.7 liter. Taking the initial temperature to be T_1, the work done in the process is

A. $\frac{9}{8}RT_1$

B. $\frac{3}{2}RT_1$

C. $\frac{15}{8}RT_1$

D. $\frac{9}{2}RT_1$

Answer:

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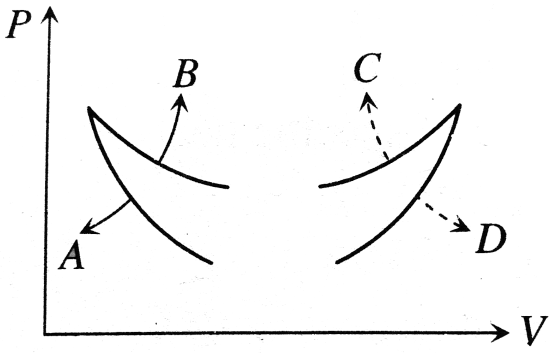
14. Four curves A, B, C and D are drawn in Fig. for a given amount of gas. The curves which represent adiabatic and isothermal changes



A. C and D respectively

B. D and c respectivelty

C. A and B respectively

D. B and A respectively

Answer:

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15. In a adiabatic process pressure is increased by $2/3\,\%$ if $C_P/C_V = 3/2$. Then the volume decreases by about

A. `(4)/(9)%

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

C. 1%

D. $\frac{4}{9}\%$

Answer:

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16. A reversible engine converts one-sixth of the heat input into work. When the temperature of the sink is reduced by $62^{\circ}C$,

the efficiency of the engine is doubled. The temperatures of the source and sink are

A. 99 C, 37 C

B. 80 C, 37 C

C. 95 C, 37 C

D. 90 C, 37 C

Answer:

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17. A diatomic ideal gas is compressed adiabatically to 1/32 of its initial volume. If the initial temperature of the gas is T_i (in Kelvin) and the final temperature is a T_i, the value of a is

A. 8

B. 4

C. 3

D. 5

Answer:

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18. When the state of a gas adiabatically changed from an equilibrium state A to another equilibrium state B an amount of work done on the stystem is 35 J. If the gas is taken from state A to B via process in which the net heat absorbed by the system is 12 cal, then the net work done by the system is (1 cal = 4.19 J)

A. 13.2 J

B. 15.4 J

C. 12.6 J

D. 16.8 J

Answer:

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19. Calculate the work done when one mole of a perfect gas is compressed adiabatically. The initial pressure and volume of the gas are $105N/m^2$ and 6 litres respectively. The final

volume of the gas are 2 litre. Molar specific heat of the gas at constant volume is $3R/2$.

A. $-957J$

B. $+957J$

C. $-805J$

D. $+805J$

Answer:

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20. 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. 900K

B. 600K

C. 700K

D. 800K

Answer:

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21. One kg of water at $373K$ is converted into steam at the same temperature. The volume $1cm^3$ of water becomes $1671cm^3$ on boiling. Calculate the change in internal energy of the system , if heat of vaporisation is $540calg^{-1}$. Given standard atmospheric pressure $= 1.013 \times 10^5 Nm^{-2}$.

A. $\approx 167cal$

B. 500cal

C. 540cal

D. 581cal

Answer:

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22. One mole of an ideal gas at temperature T was cooled isochorically till the gas pressure fell from P to $\frac{P}{n}$. Then, by an isobaric process, the gas was restored to the initial temperature. The net amount of heat absorbed by the gas in the process is

A. nRT

B. $\frac{RT}{n}\Big)$

C. $RT\left(1-n^{-1}\right.$

D. RT(n-1)

Answer:

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23. 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

A. 99 J

B. 90J

C. 1 J

D. 100 J

Answer:

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24. One litre of ideal gas is conpressed isothermally at 0.72m of Hg-column so that its volume becomes 0.9 litre. Find its stress, if the mercury is $13.6 \times 10^3 kg/m^3$.

A. 8cm of Hg

B. 7cm Hg

C. 6cm of Hg

D. 4cm of Hg

Answer:

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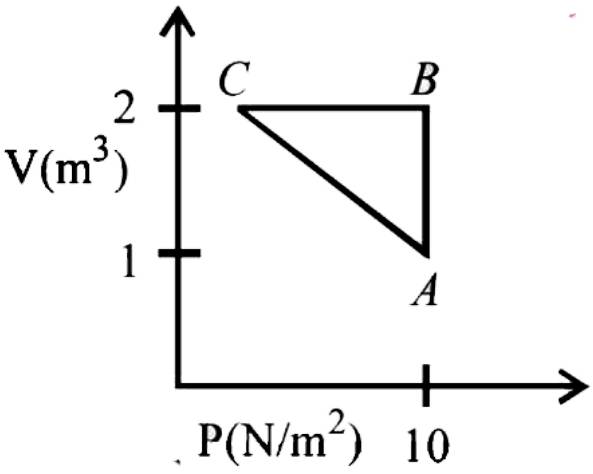
25. An ideal gas is taken through the cycle $A \rightarrow B \rightarrow C \rightarrow A$, as shown in the figure, If the net heat supplied to the gas in the cycle is 5J, the work done by the gas in the process CtoA is



A. $-5J$

B. $-10J$

C. $-15J$

D. $-20J$

Answer:

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26. An ideal gas undergoing adiabatic change has the following pressure-temperature relationship

A. $p\gamma^{-1}T^{\gamma} = \text{consatant}$

B. $p\gamma^{-1}T^{\gamma-1} = \text{consatant}$

C. $p\gamma^{-1}T^{-1\gamma} = \text{consatant}$

D. $p^{1-\gamma}T^{\gamma} = \text{consatant}$

Answer:

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27. 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?

A. 2 joule

B. 18 joule

C. 42 joule

D. 58 joule

Answer:

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28. The cofficient of performance of a refrigerator is 5. If the temperature inside freezer is $-20^{\circ}C$, the temperature of the surroundings to which it rejects heat is :

A. $41^{\circ}C$

B. $11^{\circ}C$

C. $21^{\circ}C$

D. $31^{\circ}C$

Answer:

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29. Two gases have the same initial pressure, volume and temperature. They expand to the same final volume, one adiabatically and the other isothermally

A. the greatest for the polyatomic gas

B. the greatest for the monatomic gas

C. the greatest for the diatomic gas

D. the question is irrelevant, there is no meaning of slow adiabatic expansion

Answer:

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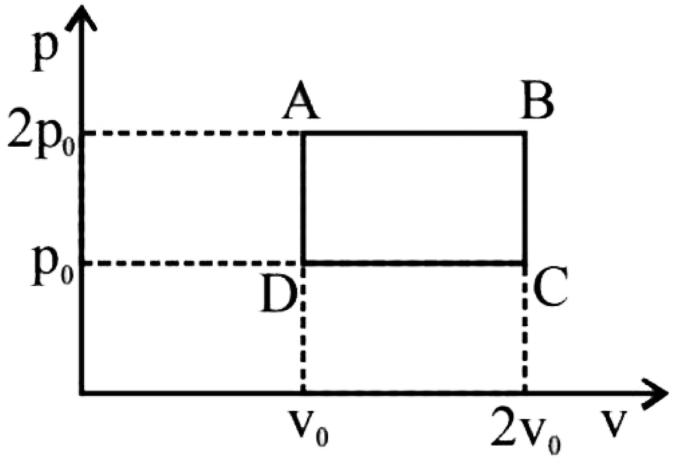

30.

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

A. $p_0 v_0$

B. $\left(\frac{13}{2}\right) P_0 v_0$

C. $\left(\frac{11}{2}\right) P_0 v_0$

D. $4 P_0 v_0$

Answer:

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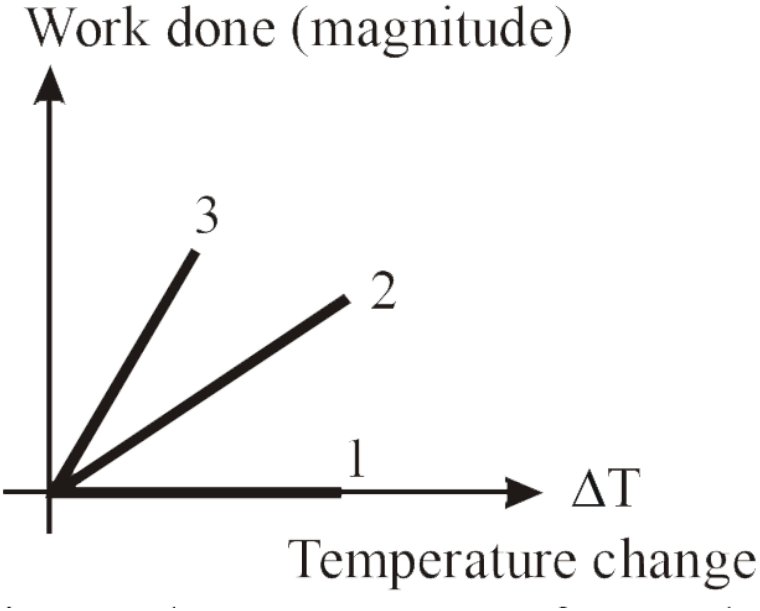
31. For an ideal gas graph is shown for three processes. Process 1, 2 and 3 are respectively



A. Isobaric, adiabatic, isochoric

B. Adiabatic, isobaric, isochoric

C. Isochoric, adiabatic, isobaric

D. Isochoric, isobaric, adiabatic

Answer:

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32. During an adiabatic process an object does 100J of work and its temperature decreases by 5K. During another process it does 25J of work and its temperature decreases by 5K. Its heat capacity for 2^{nd} process is

A. 20J/k

B. 24 J/K

C. 15J/k

D. 100J/K

Answer:

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33. A refrigerator works between $4^{\circ}C$ and $30^{\circ}C$. It is required to remove $600cal$ or ies of heat every second in order to keep the temperature of the refrigerator space

constant.The power required is (Take $1cal \text{ or } ie = 4.2J$)

A. 2.365W

B. 23.65W

C. 236.5W

D. 2356W

Answer:

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34. A perfect gas goes from a state A to another state B by absorbing 8 × 105 J of heat and doing 6.5 × 105 J of external work. It is now transferred between the same two states in another process in which it absorbs 105 J of heat. In the second process

A. work done by gas is $10^5 J$

B. work done on gas is $10^5 J$

C. Workdone by the gas 0.5×10^5

D. Work done on the gas 0.5×10^5

Answer:

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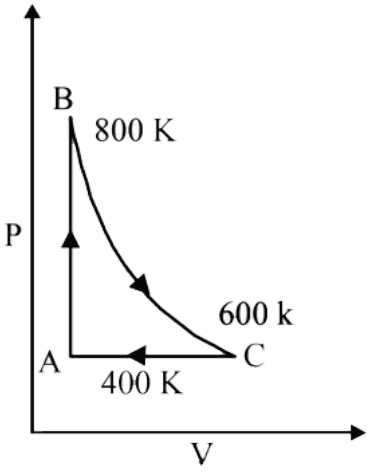
35. One mole of a diatomic ideal gas undergoes a cyclic process ABC as shown in figure. The process BC is adiabatic. The temperature at A,B and C are 400K, 800K and 600K respectively. Choose the correct

statement:



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

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

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

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

Answer:

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36. Two Carnot engines A and B are operated in series. The engine A receives heat from the source at temperature T_1 and rejects the heat

to the sink at temperature T. The second engine B receives the heat at temperature T and rejects to its sink at temperature T_2. For what value of T the efficiencies of the two engines are equal?

A. $\frac{T_1 + T_2}{2}$

B. $\frac{T_1 - T_2}{2}$

C. $T_1 T_2$

D. $\sqrt{T_1 T_2}$

Answer:

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37. An ideal gas is initially at P_1, V_1 is expands to P_2, V_2 and then compressed adiabatically to the same volume V_1 and pressure P_3. If W is the net work done by the gas in complete process which of the following is true.

A. $W > 0, P_3 > P_1$

B. $W < 0, P_3 > P_1$

C. $W > 0, P_3 < P_1$

D. $W < 0, P_3 < P_1$

Answer:

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38. Which of the following statements is correct for any thermodynamic system

A. The change in entropy can never be zero

B. Internal energy and entropy are state functions

C. The internal energy changes in all processes

D. The work done in an adiabatic process is always zero.

Answer:

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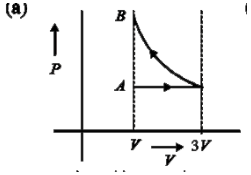
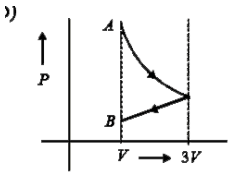
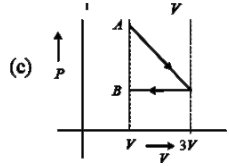
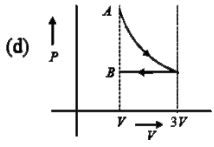
39. One mole of an ideal gas goes from an initial state A to final state B via two processs : It first undergoes isothermal expansion from

volume V to $3V$ and then its volume is reduced from $3V$ to V at constant pressure. The correct $P-V$ diagram representing the two process in (figure)

A. 

B. 

C. 

D. 

Answer:

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40. A sample of an ideal gas in a cyclinder is compressed adiabatically to $\frac{1}{3}rd$ of its volume. Will final pressure be more or less than $3\times$ the initial pressure?

A. Final pressure will be three times less than initial pressure

B. Final pressure will be three times more than initial pressure.

C. Change in pressure will be more than three times the initial pressure.

D. Change in pressure will be less than three times the initial pressure.

Answer:

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41. A gas is compressed isothermally to half its initial volume. The same gas is compressed separately through an adiabatic process untill its volume is again reduced to half. Then

A. Compressing the gas isothermally will require more work to be done.

B. Compressing the gas through adiabatic process will require more work to be done.

C. Compressing the gas isothermally or adiabatically will require the same amount of work.

D. Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas.

Answer:

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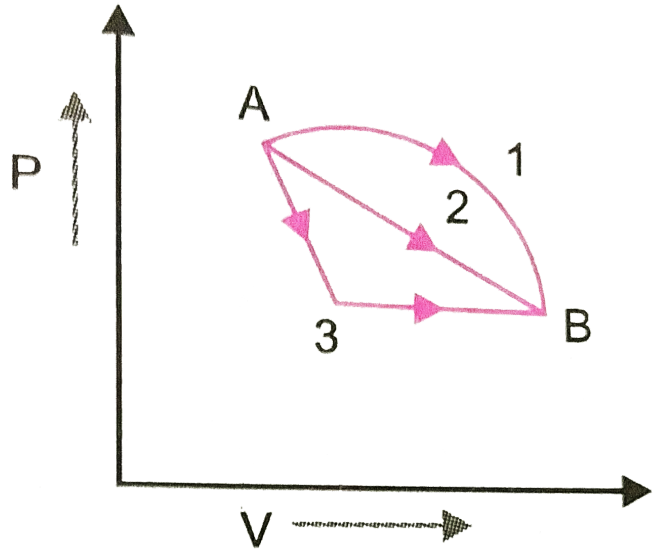
42. An ideal gas goes from State A to state B via three different process as indicate in the $P - V$ diagram.



If Q_2, Q_3 indicates the heat absorbed by the gas along the three processes and $\Delta U_1, \Delta U_2, \Delta U_3$ indicates the change in

internal energy along the three processes respectively, then

A.

$$Q_1 > Q_2 > Q_3 \text{ and } \Delta U_1 = \Delta U_2 = \Delta U_3$$

B.

$$Q_3 > Q_2 > Q_1 \text{ and } \Delta U_1 = \Delta U_2 = \Delta U_3$$

C.

$$Q_1 = Q_2 = Q_3 \text{ and } \Delta U_1 > \Delta U_2 > \Delta U_3$$

D.

$$Q_3 > Q_2 > Q_1 \text{ and } \Delta U_1 > \Delta U_2 > \Delta U_3$$

Answer:

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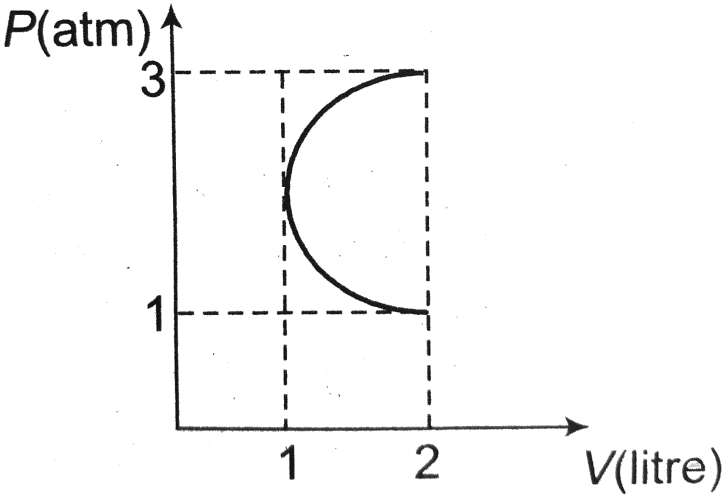
43. In the $P-V$ diagram shown in figure ABC is a semicircle. The work done in the process ABC is



A. 4J

B. $\frac{-\pi}{2}J$

C. $\frac{\pi}{2}J$

D. zero

Answer:

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44. For an isothermal expansion of a perfect gas, the value of $\frac{\Delta P}{P}$ is

A. $-\gamma^{1/2}\frac{\Delta V}{V}$

B. $-\frac{\Delta V}{V}$

C. $-\gamma\frac{\Delta V}{V}$

D. $-\gamma^{2}\frac{\Delta V}{V}$

Answer:

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