PHYSICS

BOOKS - NCERT FINGERTIPS PHYSICS (HINGLISH)

THERMODYNAMICS

Zeroth Law Of Thermodynamics

1. Zeroth law of thermodynamics gives the concept of

A. internal energy

B. heat content

C. pressure

D. temperature

Answer: D

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2. Two systems in thermal equilibrium with a third system separately are in thermal equilibrium with each other. The above statement is

A. First law of thermaodynamics

B. Second law of thermodynamics

C. Third law of thermodynamics

D. Zeroth law of thermodynamics

Answer: D

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Heat Internal Energy And Work

1. Internal energy of an ideal gas depends upon

A. Temperature only

B. volume only

C. both voume and temperature

D. neither volume no temperature

Answer: A

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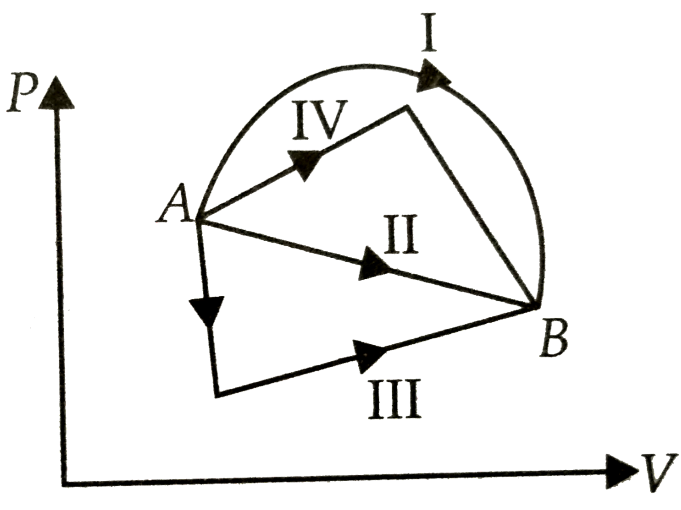
2. An ideal gas undergoing a change of state from A to B through four different paths I, II,III and IV as shown in the P-V diagram that lead to the same change of state tyhen the change in internal energy is



A. same in I and II but not in III and IV

B. same in III and IV but not I I and II

C. same in I, II and III but not I IV

D. same in all the four cases

Answer: D

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First Law Of Thermodynamics

1. Which of the following is not a path function

?

A. ΔQ

B. $\Delta Q + \Delta W$

C. ΔW

D. $\Delta Q - \Delta W$

Answer: D

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2. Air is expanded from 50 litres to 150 litres at 2 atomospheric pressure . The external work done is (Give , 1 atm=$10^5 N^{-}2$)

A. $2 \times 10^{-8} J$

B. $2 \times 10^{4} J$

C. $200 J$

D. $2000 J$

Answer: B

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3. An electric heater supplies heat to a system at a rate of 120 W. if system performs work at a rate of 80 JS^{-1}, the rate of increase in internal energy is

A. $30 JS^{-1}$

B. $40 JS^{-1}$

C. $50 JS^{-1}$

D. $60 JS^{-1}$

Answer: B

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4. 1 kg of water is heated from $40^\circ C$ to $70^\circ C$, If its volume remains constant, then the change in internal energy is (specific heat of water = $4148 J kg^{-1} K^{-1}$)

A. $2.44 \times 10^5 J$

B. $1.62 \times 10^5 J$

C. $1.24 \times 10^5 J$

D. $2.62 \times 10^5 J$

Answer: C

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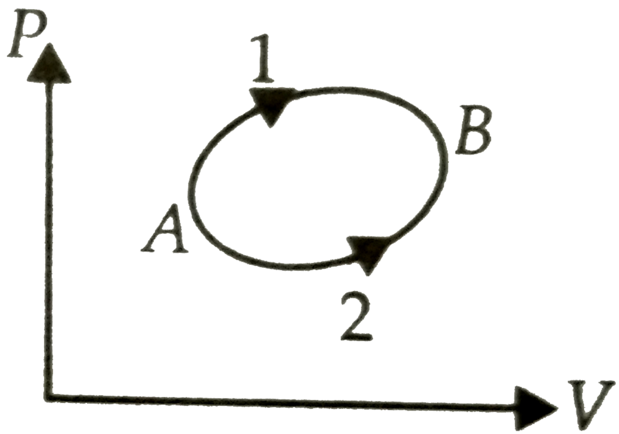
5. A system goes from A to B by two different paths in the P-V diagram as shown in figure Heat given to the system in path 1 is 1100 j, the work done by the system along path 1 is more than path 2 by 150 J. The heat exchanged by the system in path 2 is



A. 800 J

B. 750 J

C. 1050 J

D. 950 J

Answer: D

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Specific Heat Capacity

1. a geyser heats water flowing at the rate of 4 litrre per minute from $30^{\circ} \text{to} 85^{2} C$. If the geyser operates on a gas burner then the amount of heat used per minute is

A. $9.24 \times 10^{5} J$

B. $6.24 \times 10^{7} J$

C. $9.24 \times 10^{7} J$

D. $6.24 \times 10^{5} J$

Answer: A

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2. Mayer's kformula for the relation between two principla specific heats $C_p \text{and} \ C_V$ of a gas is given by

A. $C_V - C_P = R$

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

C. $C_P - C_V = R$

D. $\frac{C_V}{C_P} = R$

Answer: C

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3. The ratio $\frac{C_p}{C_v} = \gamma$ for a gas. Its molecular weight is M. Its specific heat capacity at constant pressure is

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

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

C. $\frac{\gamma R}{M}(\gamma - 1)$

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

Answer: C

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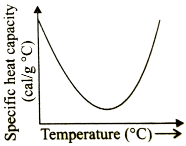
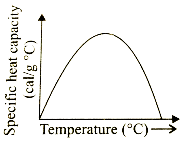
4. Which one of the following graphs represents variation of specific heat capacity of water with temperature?

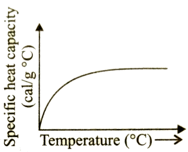
A. (a)



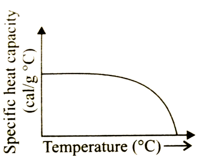
B. (b)



C. (c)



D. (d)



Answer: A

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5. An ideal gas having molar specific heat capaicty at constatnt volume is $\frac{3}{2}$R, the molar specific heat capacities at constant pressure is

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

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

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

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

Answer: B

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6. For nitrogen $C_p - C_V = x$ and for argon $C_P - C_V = y$.The relation between x and y is given by

A. x=y

B. x=7y

C. y=7x

D. $x = \frac{1}{2}y$

Answer: A

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7. Two moles of oxygen are mixed with eight moles of helium. The effective specific heat of the mixture at constant volume is

A. 1.3 R

B. 1.4R

C. 1.7R

D. 1.9R

Answer: C

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8. One mole of an ideal monoatomic gas at temperature T_0 expands slowly according to the law $\frac{p}{V}$ = constant. If the final temperature is $2T_0$, heat supplied to the gas is

A. $2RT_0$

B. RT_0

C. $\frac{3}{2}RT_0$

D. $\frac{1}{2}RT_0$

Answer: A

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9. The amount of heat supplied to 4×10^{-2} kg of nitrogen at room temperature to rise its temperature by $50^{\circ}C$ at constant pressure is (Molecular mass of nitrogen is 28 and $R = 8.3 J mol^{-1} K^{-1}$

A. 2.08 KJ

B. 3.08 KJ

C. 4.08 KJ

D. 5.08 KJ

Answer: A

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10. A sample of ideal gas $(\gamma = 1.4)$ is heated at constant pressure. If an amount of 100 J heat is supplied to the gas, the work done by the gas is

A. 28.57 J

B. 56.54 J

C. 38.92 J

D. 65.38 J

Answer: A

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11. What amount of heat must be supplied to 35 g of oxygen at room temperature to raise its temperature by $80^{\circ}C$ at constant volume (molecular mass of oxygen is 32 and R= 8.3 $jmol^{-1}K^{-1}$

A. 1.52 KJ

B. 3.23 KJ

C. 1.81 KJ

D. 1.62 KJ

Answer: C

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12. 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. $7 : 5 : 2$

C. $2 : 3 : 5$

D. $2 : 5 : 7$

Answer: B

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13. Calculate the change in internal energy when 5g of air is heated from 0° to $4^\circ C$. The specific heat of air at constant volume is $0.172 cal g^{-1} . ^\circ C^{-1}$.

A. 28.8 J

B. 14.4 J

C. 7.2 J

D. 3.51 J

Answer: B

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14. If $R =$ universal gas constant, the amount of heat needed to raise the temperature the temperature of $2mol$ of an ideal monatomic gas from $273K$ to $373K$ when no work is done is

A. 100R

B. 150R

C. 300R

D. 500R

Answer: C

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Thermodynamic State Variables

1. Which one of the following is not a thermodynamical coordinate ?

A. Gas constant(R)

B. Pressure (P)

C. Volume(V)

D. Temperature (T)

Answer: A

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2. Which is an intensive property?

A. Volume

B. Mass

C. Refractive index

D. Weight

Answer: C

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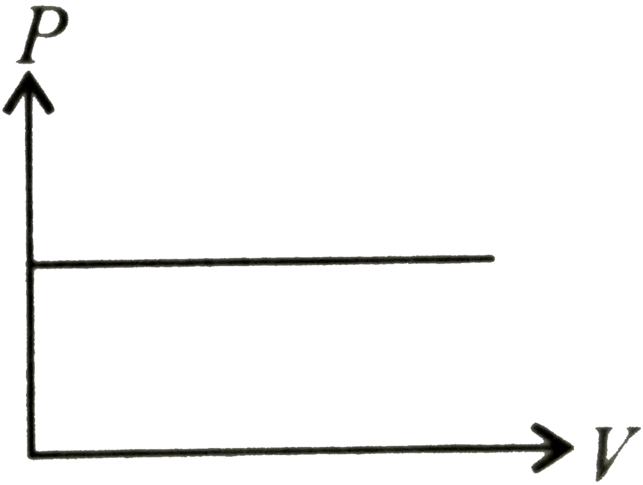
Thermodynamic Process

1. Which of the following process is correct for given P-V diagram.



A. Adiabatic process

B. Isothermal process

C. Isobaric process

D. Isochoric process

Answer: C

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2. Match the column I with columnII

A. (A)-(s),(B)-(R),(C)-(q),(D)-(p)

B. (A)-(p),(B)-(s),(C)-(r),(D)-(q)

C. (A)-(q),(B)-(r),(C)-(p),(D)-(s)

D. (A)-(r),(B)-(p),(C)-(q),(D)-(s)

Answer: A

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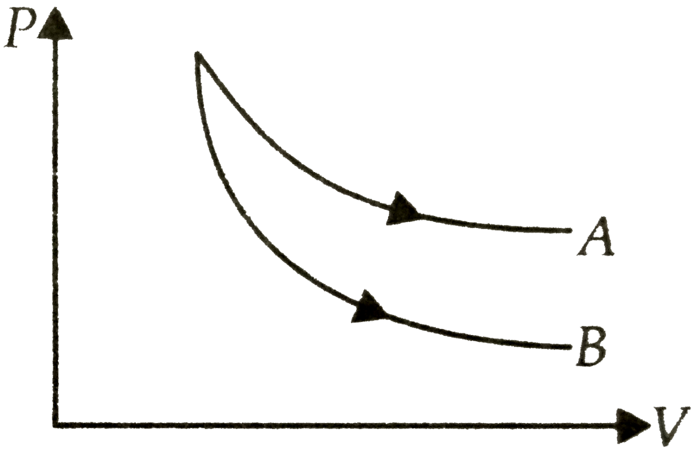
3. The given P-V diagram expansion of a gs which one of the following statement is true?



A. A is isothermal and B is adiabatic process

B. A is adiabatic and B is isothermal process

C. Both are isothemal process

D. Both are adiabatic process

Answer: A

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4. The possibility of increase in the temperature of gas without adding heat to it happens in

A. Adiabatic exapansion

B. isothermal expansion

C. adiabatic compression

D. isothermal compression

Answer: C

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5. The ideal gas equation for an adiabatic process is

A. PV^{γ}=constant

B. $TV^{\gamma+1}$=constant

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

D. $P^{\gamma+1}$T=constant

Answer: A

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

A. dU=dQ

B. dU=-dW

C. dU=0

D. dU=dW

Answer: C

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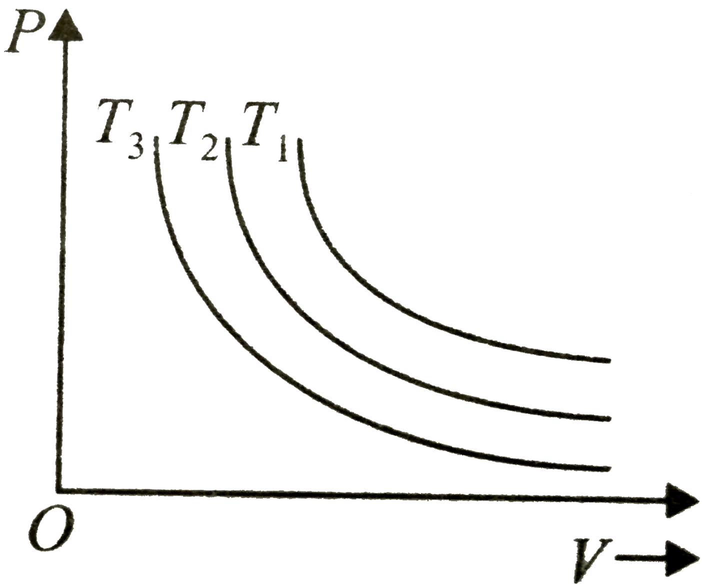
7. The isothermal diagram of a gas at three different temperatures $T_1, T_2 \text{ and } ^-(3),$ is show in the given figure .Then



A. $T_1 < T_2 < T_3$

B. $T_1 < T_2 > T_3$

C. $T_1 > T_2 > T_3$

D. $T_1 > T_2 < T_3$

Answer: C

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8. The relation between the slope of isothemal curve and slope of adiabatic curve

A. slope of adiabatic curve $=\gamma$ times slope of isotharmal curve

B. slope of isothermal curve $=\gamma$ times slope of adiabatic curve

C. slope of adiabatic curve $=\gamma^2$ times slope of isothermal curve

D. slope of isothermal curve $=\gamma^2$ times slope of adiabatic curve

Answer: A

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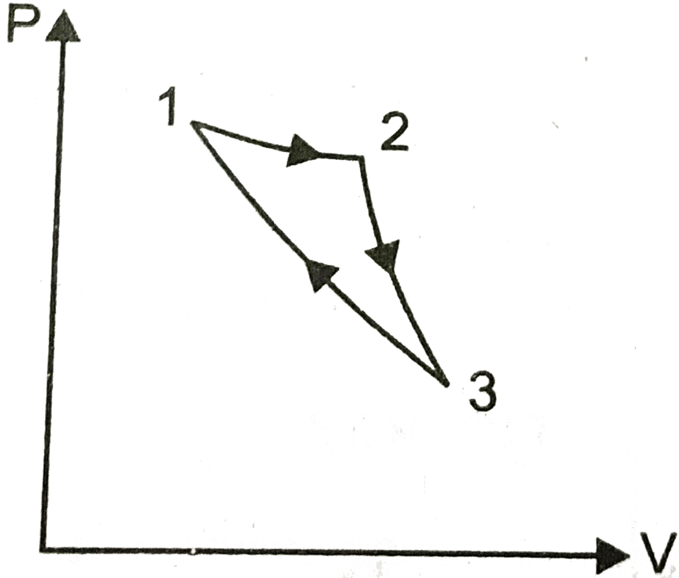
9. Consider a cycle followed by an engine, (figure)



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 in such a process which is not possible

B. mechanical energy is completely converted to hjeat in this proces , which is not possible

C. curves representign two adiabatic process can intersect

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

Answer: A

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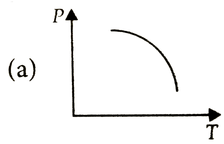
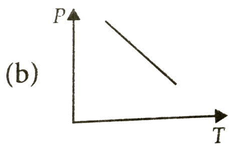
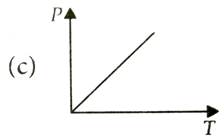
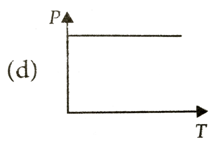
10. Which of the following P-V diagram represent the graph of isometric process?

A. 

B. 

C. 

D. 

Answer: C

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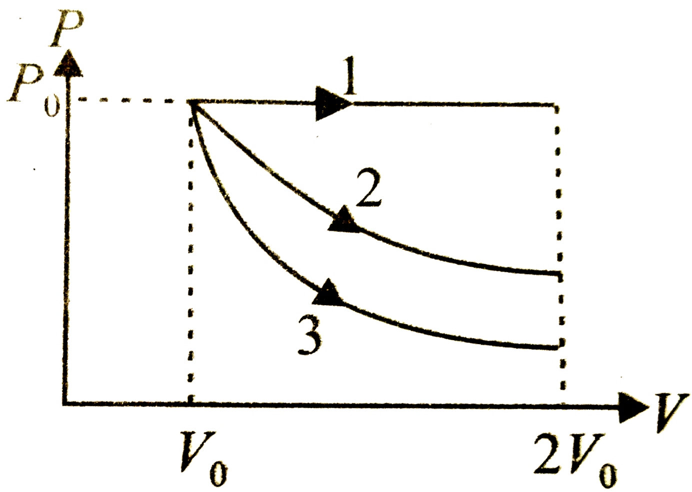
11. A gas is expanded form volume $V_0 \to 2V_0$ under three different processes as shown in the figure . Process 1 is isobaric process process 2 is isothermal and and process 3 is adiabatic .

Let $\Delta U_1, \Delta U_2$ and ΔU_3 be the change in internal energy of the gs in these three processes then



A. $\Delta U_1 > \Delta U_2 > \Delta U_3$

B. $\Delta U_1 < \Delta U_2 < \Delta U_3$

C. $\Delta U_1 < \Delta U_2 < \Delta U_3$

D. $\Delta U_1 < \Delta U_2 < \Delta U_3$

Answer: A

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12. Two identical containers A and B with frictionless pistons contain the same ideal gas at the same temperature and the same velocity V. The mass of the gas in A is $m_A,$ and that in B is m_B. The gas in each cylinder is now allowed to expand isothermally to the same final volume 2V. The changes in the pressure in A and B are found to be ΔP and $1.5\Delta P$ respectively. Then

A. $4m_A = 9m_B$

B. $3m_A = 3m_B$

C. $3m_A = 2m_B$

D. $9m_A = 4m_B$

Answer: C

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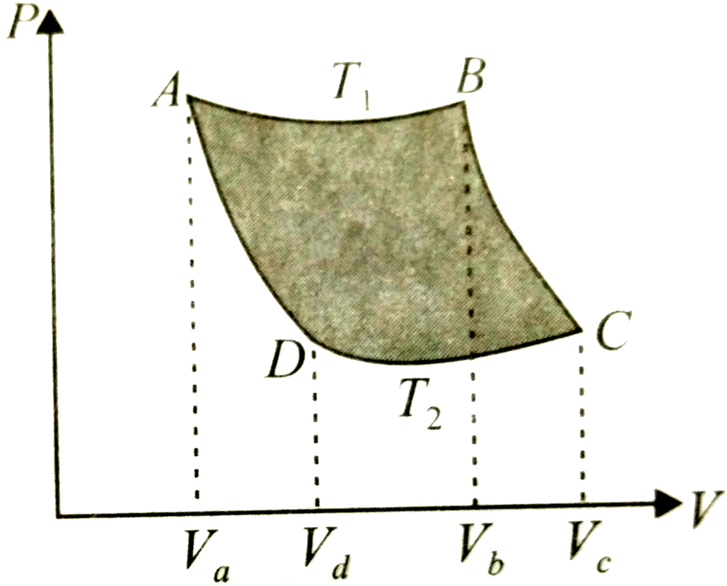
13. Two different adiabatic parts for the same gas intersect two isothermals at $T_1 \text{and} T_2$ shown in P-V diagram . Then the ratio of $\frac{V_a}{V_b}$

will be



A. $\frac{V_c}{V_d}$

B. $\frac{V_d}{V_c}$

C. $\gamma\frac{V_d}{V_c}$

D. $\frac{1}{\gamma}\frac{V_d}{V_c}$

Answer: B

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14. A heat insulating cylinder with a movable piston contains 5 moles of hydrogen at standard temperature and pressure if the gas is compressed to quarter of its original volume then the pressure of the gas is increased by $(\gamma = 1.4)$

A. $(2)^{1.4}$

B. $(3)^{1.4}$

C. $(4)^{1.4}$

D. $(5)^{1.4}$

Answer: C

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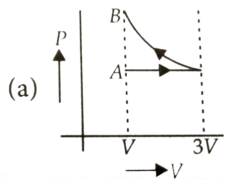
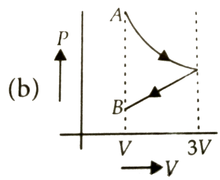
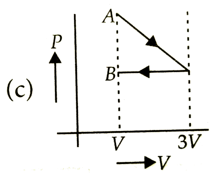
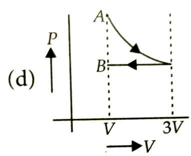
15. One mole of an ideal gas goes from an initial state A to final state B via two processss : It first undergoes isothermal expansion from volume V to $3V$ and then its volume is reduced from

$3V$ to V at constant pressure. The correct $P-V$ diagram representing the two process in (figure)

A. 

B. 

C. 

D. 

Answer: D

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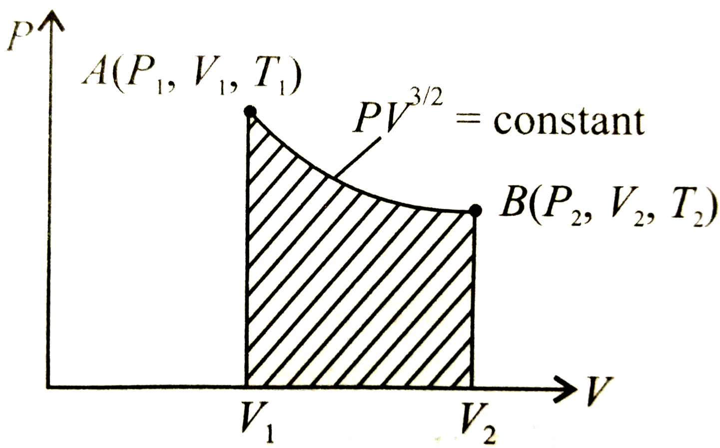
16. The P-V diagram of path followed by one mole of perfect gas in a cylindrical container is hsown in figure, the work done when the gas is taken from state A to state B is



A. $nRTIn\frac{V_2}{V_1}$

B. $nRTIn\frac{V_1}{V_2}$

C. $2nRTIn\frac{V_2}{V_1}$

D. $2nRTIn\frac{V_1}{V_2}$

Answer: B

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17. An ideal gs at pressure P is adiabatically compressed so that its density becomes n times the initial vlaue The final pressure of the gas will be $\left(\gamma = \frac{C_P}{C_V}\right)$

A. $n\gamma P$

B. $(n - \gamma)P$

C. $n(\gamma - 1)P$

D. $n(1 - \gamma)P$

Answer: A

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18. The work done in adiabatic process is given by

A. $\frac{nR(T_1) - T_2}{\gamma}$

B. $\frac{nR(T_1) - T_2}{\gamma - 1}$

C. $(nR(T_1) - T_2)R$

D. $\frac{\gamma(T_1) - T_2R}{n}$

Answer: B

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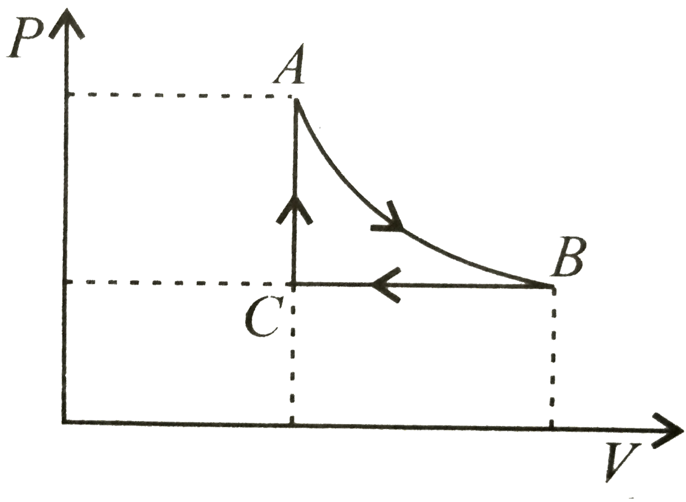
19. The cycle in the figure followed by an engine made of an ideal gas in ca cylinder with a piston, the heat exchanged by the engine with the surroundings for adiabatic section AB of cycle is $\left(C_V = \frac{3}{2}R\right)$



A. $\frac{3}{2}(P_B - P_A)V_A$

B. $\frac{5}{2}P_A(V_A - V_B)$

C. $\frac{1}{2}(P_A - P_B)(V_A - V_B)$

D. Zero

Answer: D

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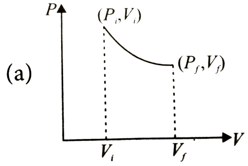
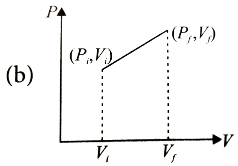
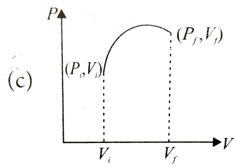
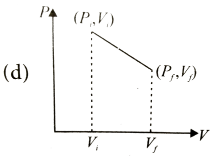
20. The initial state of certain gas $(P_i V_i T_i)$.It undergoes expansion till its volume becomes V_f at constant temperature T. The correct plot of P-V diagram for it is

A. 

B. 

C. 

D. 

Answer: A

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21. An ideal gas system undergoes an isothermal process, then the work done during the process is

A. $nRTIn\frac{V_2}{V_1}$

B. $nRTIn\frac{V_1}{V_2}$

C. $2nRTIn\frac{V_2}{V_1}$

D. $2nRTIn\frac{V_1}{V_2}$

Answer: A

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22. Pressure P, volume V and temperature T for a certain gas are related by $P=\frac{AT-BT^2}{V}$, where A and B are constants .The work done by the gas as its temperature change from T_1 to T_2 while pressure remaining constant is

A. $A-\frac{B}{2}(R_2-T_1)$

B. $A(T_2-T_1)-B\left(T_2^2-T_1^2\right)$

C. $\frac{A}{2}\left(T_2^2-T_1^2\right)-\frac{B}{3}\left(T_2^3-T_1^3\right)$

D. $A(T_2-T_1)-\frac{B}{3}(T_2-T_1)^3$

Answer: B

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23. A quantity of a substance in a closed system is made to undergo a reversibel process from an initial volume of $3m^3$ and initial pressure $10^5 N/m^2$ to a final volume of $5m^3$. If the pressure is proportional to the squre of the volume $\left(i.\ e, P = AV^2\right)$, the work done by the substance will be

A. $3.6 \times 10^2 J$

B. $7.4 \times 10^3 J$

C. $2.2 \times 10^4 J$

D. $3.6 \times 10^5 J$

Answer: D

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24. 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 system 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. 13.2J

B. 15.4 J

C. 12.6 J

D. 16.8 J

Answer: B

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25. If a gas is comprssed adiabatically by doing work of 150 J the change in internal energy of the gas is

A. 100 J

B. 150 J

C. 200 J

D. 250 J

Answer: B

26. In changing the state of a gas adiabatically from an equilibrium state A to another equilibrium state B an amount of work equal to 22.3 J is done on the system.If the gas is taken from state A to B via a process in which the net heat absorbed by the system is 9.35 cal then the net work done by the system in latter case is

(Take 1 case =4.2 J)

A. 15 J

B. 16 J

C. 17 J

D. 18 J

Answer: C

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27. A monatomic gas is compressed adiabatically to $\frac{1}{(4)^{th}}$ of its original volume , the final pressure of gas in terms of initial pressure P is

A. 7.08 P

B. 8.08 P

C. 9.08 P

D. 10.08 P

Answer: D

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28. $1g$ mole of an ideal gas at STP is subjected to a reversible adiabatic expansion to double its volume. Find the change in internal energy $(\gamma = 1.4)$

A. 1169 J

B. 769 J

C. 1373 J

D. 969 J

Answer: B

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29. If at 60° and 80 cm of mercury pressure a definite masss of a gas is compressed slowly, then the final pressure of the gas if the final volume is half of the initial volume $\left(\gamma = \frac{3}{2}\right)$ is

A. 120 cm of Hg

B. 140 cm of Hg

C. 160 cm of Hg

D. 180 cm of Hg

Answer: C

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30. During an isothermal expansion, a confined ideal gas does $-150J$ of work aginst its surroundings. This implies that

A. 150 J of heat has been removed from the gs

B. 300 J of heat has been added to the gas

C. no heat is transferred because the process is isothermal

D. 150 J of heat has been added to the gas

Answer: D

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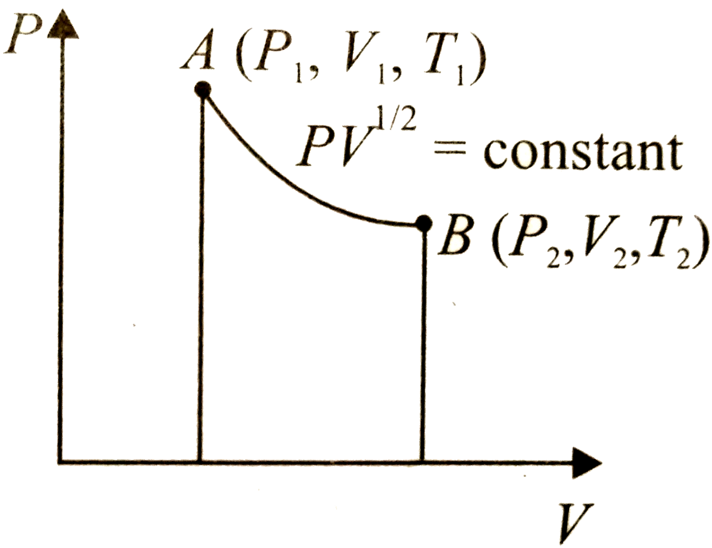
31. 1 mole of an ideal gas in a cylindrical container have the P-V diagram as shown in figure.If $V_2 = 4V_1$ then the ratio of temperatures $\frac{T_1}{T_2}$ will be



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

B. $\frac{1}{4}$

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

D. $\frac{3}{4}$

Answer: A

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32. 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

A. $2:1:\sqrt{2}$

B. $2\sqrt{2}:1:2$

C. $\sqrt{2}:1:2$

D. $\sqrt{2}:2:1$

Answer: B

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33. Two moles of an ideal monoatomic gas occupy a volume 2V at temperature 300K, it expands to a volume 4V adiabatically, then the final temperature of gas is

A. 179 K

B. 189 K

C. 199 K

D. 219 K

Answer: B

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34. The pressure P_1 and density d_1 of a diatomic gas $\left(\gamma = \frac{7}{5}\right)$ change to P_2 and d_2 during an adiabatic operation .If $\frac{d_2}{d_1} = 32, then \frac{P_2}{P_1}$ is

A. 76

B. 128

C. 168

D. 298

Answer: B

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35. The fall in temperature of helium gas initially at 20° when it is suddenly expanded to 8 times its original volume is $\left(\gamma = \frac{5}{3}\right)$

A. 70.25 K

B. 71.25 K

C. 72.25 K

D. 73.25 K

Answer: D

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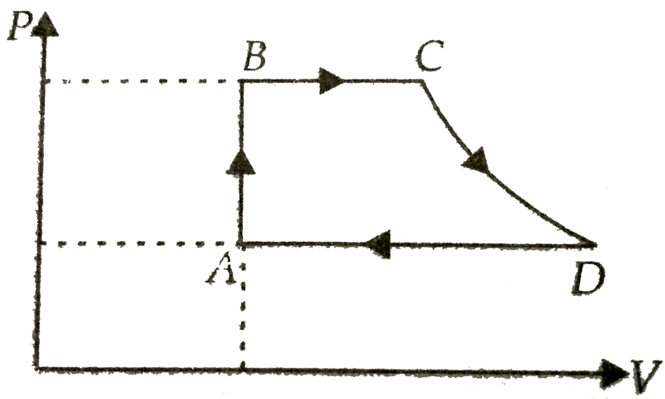
36. A cycle followed an engine (made of one mole of an ideal gas in a cylinder with a piston) is shown in figure The heat exchanged by the engine with the surroundings at constant volume is (Take $C_V = \frac{3}{2}R\Big)$



A. $(P_B - P_A)V_A$

B. $\frac{1}{2}(P_B - P_A)V_A$

C. $\frac{3}{2}(P_B - P_A)V_A$

D. $\frac{5}{2}(P_B - P_A)V_A$

Answer: C

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37. In the question number 61, the heat exchanged by the engine with the surrounding for path D to A is (at constant pressure)

A. $\frac{5}{2}P_A(V_D - V_A)$

B. $\frac{5}{2}P_A(V_A - V_D)$

C. $\frac{3}{2}P_A(V_D - V_A)$

D. $\frac{1}{2}P_A(V_D - V_A)$

Answer: B

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38. A one mole of an ideal gas expands adiabatically at a constant pressure such that its temperature $T \propto \frac{1}{\sqrt{V}}$ .The value of the adiabatic constant gas is

A. 1.3

B. 1.5

C. 1.67

D. 2

Answer: B

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39. A gas is suddenly compressed to $\frac{1}{4}th$ of its original volume. Caculate the rise in temperature when original temperature is $27^{\circ}C. \gamma = 1.5.$

A. 222.33 K

B. 233.33 K

C. 244.33 K

D. 255.33 K

Answer: A

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40. 1 mole of gas expands isothermally at $37^{\circ} C$. The amount of heat is absorbed by it until its volume doubled is $\left(R = 8.31 J mol^{-1} K^{-1}\right)$

A. 411.25 cal

B. 418.50 cal

C. 420.25 cal

D. 425.40 cal

Answer: D

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41. The temperature of n moles of an ideal gas is increased from T to 4T through a process for which pressure PaT^{-1} where a is a constant .Then the work done by the gas is

A. nRT

B. 4nRT

C. 2nRT

D. 6nRT

Answer: D

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42. A gas expands with temperature according to the relation $V = KT^{\frac{2}{3}}$.Work done when the temperature changes by 60K is.

A. 10R

B. 30R

C. 40R

D. 20R

Answer: C

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43. 50g of oxygen at NTP is compressed adiabatically to a pressure of 5 atmosphere. The work done on the gas, if $\gamma = 1.4$ and $R = 8.31 J mol^{-1} K^{-1}$ is

A. $-5173 J$

B. $1131 J$

C. $-1364 J$

D. $5673 J$

Answer: A

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44. In a cyclic process, which of the following statement is correct?

A. Change in internal energy is not zero

B. The system returns to its initial stae and it is reversible

C. the total heat absorbed by the system is not equal to work donw by the system

D. Change in internal energy is zero

Answer: D

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45. Which one of the following is not possible in a cyclic process?

A. Work done by the system is positive

B. Heat added to the system is positiv e

C. Wok done on the system is positive

D. Heat removed from the system is negative

Answer: C

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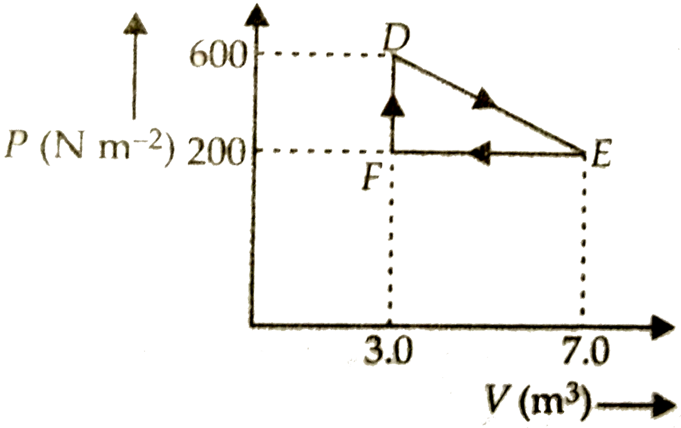
46. A thermodynamic process is carried out from an original state D to an intermediate state E by the linear process shown in figure. The total work is done by the gas from D to E to

F is



A. 100 J

B. 800 J

C. 300 J

D. 250 J

Answer: B

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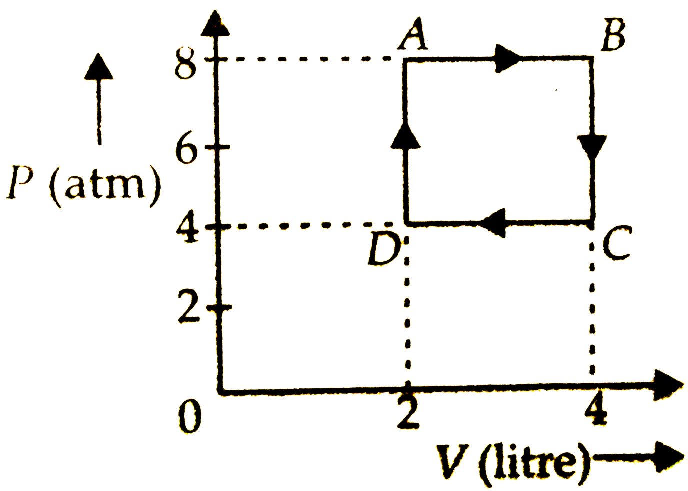
47. One mole of an ideal gas undergoes a cyclic process ABCDA as shown in the P-V diagram, The net work done in the process is

$(1 atm = 10^6$ dyne $cm^{-2})$



A. 500 J

B. 700 J

C. 800 J

D. 900 J

Answer: C

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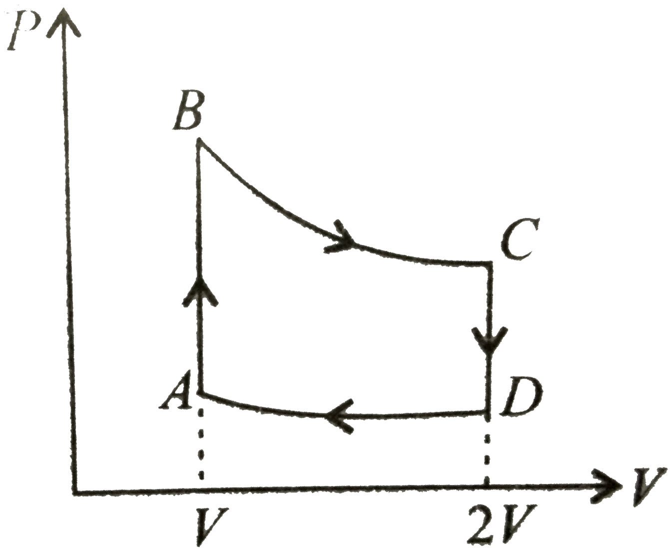
48. The cycle is shown in figure is made of one mole of perfect gas in a cylinder with a piston . The processes A to B and C to D are isochoric wheras process B to C and D to A are adiabatic, the work done in one cycle is

$(V_A = V_B = V, V_C = V_D = 2V \text{and} \ \ \gamma = 5/3)$



A. $\left[1 - \frac{4^3}{2}\right](P_B - P_A)V$

B. $\frac{3}{2}\left[1 - \frac{3^2}{3}\right](P_B - P_A)V$

C. $\frac{3}{2}\left[1 - \frac{2^{-2}}{3}\right](P_B - P_A)V$

D. $\frac{5}{2}\left[1 - \frac{2^{-2}}{3}\right](P_B - P_A)V$

Answer: C

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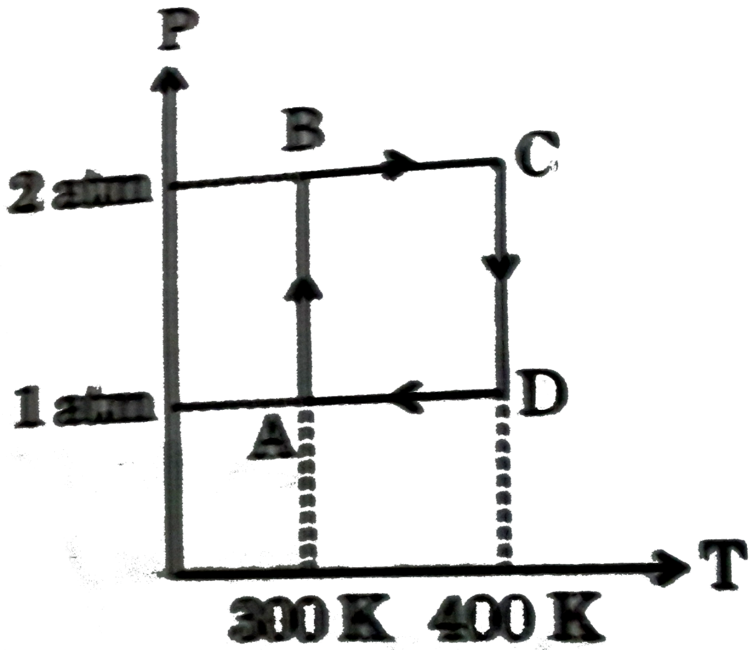
49. Two moles of Helium gas undergo a reversible cyclic process as shown in figure. Assuming gas to be ideal, what is the net work involved in the cyclic process ?



A. 200 Rln2

B. 100 Rln2

C. 300 Rln2

D. 400 Rln2

Answer: A

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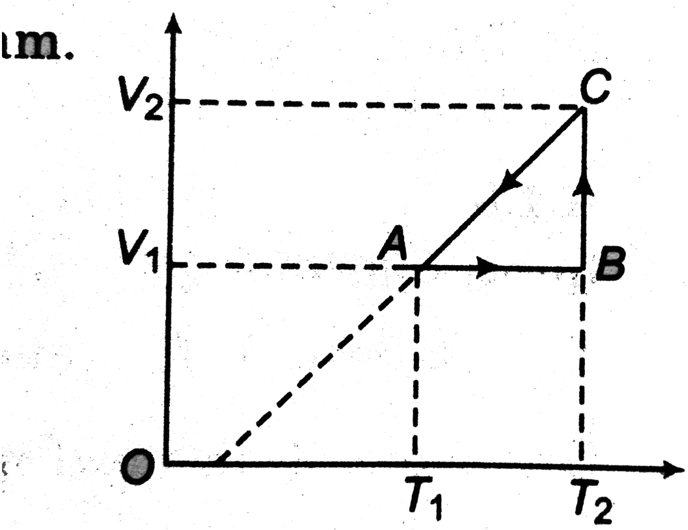
50. The cyclic process for 1 mole of an ideal gas is shown in the V-T diagram. The work done in AB, BC and CA respectively is



A. $0, RT_1 \ln\left(\frac{V_1}{V_2}\right), R(T_1 - T_2)$

B. $R, (T_1 - T_2)R, RT_1 In\left(\frac{V_1}{V_2}\right)$

C. $0, RT_2 \ln\left(\frac{V_2}{V_1}\right), \frac{RT_1}{V_1}(V_1 - V_2)$

D. $0, RT_2 \frac{\ln(V_1)}{V_2}, R(T_1 - T_2)$

Answer: C

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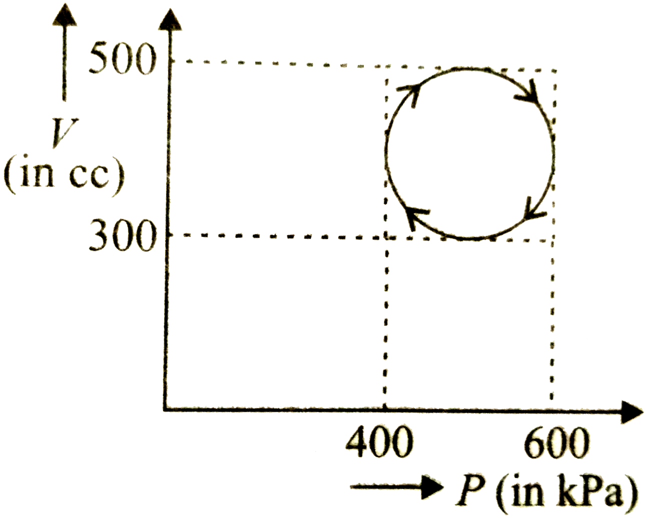
51. The heat absorbed by the system in going through the cyclic process as shown in figure is



A. 30.4 J

B. 31.4 J

C. 32.4 J

D. 33.4 J

Answer: B

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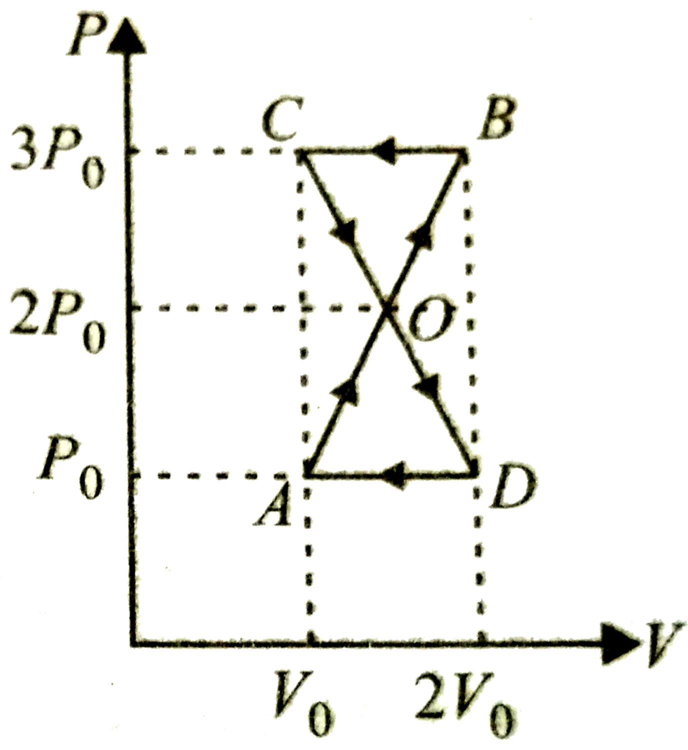
52. A thermodynamical system undergoes cyclic process ABCDA as shown in figure work done by the system is



A. zero

B. $2P_0V_0$

C. P_0V_0

D. $\frac{3}{2}P_0V_0$

Answer: A

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Heat Engines

1. A heat engine has an efficiency η. Temperatures of source and sink are each decreased by 100 K. The efficiency of the engine

A. increases

B. decreases

C. remains

D. becomes 1

Answer: A

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2. An engine has an efficiency of 0.25 when temperature of sink is reduced by $58^\circ C$, If its efficiency is doubled, then the temperature of the source is

A. $150^\circ C$

B. $222^\circ C$

C. $242^\circ C$

D. $232^\circ C$

Answer: D

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3. If a steam engine delivers $6.0 \times 10^8 J$ of work per minute and absorbs $5.4 \times 10^9 J$ of heat per minute from its boiler then the efficiency of the engine is

A. 0.11

B. 0.12

C. 0.13

D. 0.14

Answer: A

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4. In a heat engine, the temperature of the source and sink are 500 K and 375 K. If the engine consumes $25 \times 10^5 J$ per cycle, find(a) the efficiency of the engine, (b) work done per cycle, and (c) heat rejected to the sink per cycle.

A. $6.25 \times 10^5 J$

B. $3 \times 10^5 J$

C. $2.19 \times 10^5 J$

D. $4 \times 10^4 J$

Answer: A

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Refrigerators And Heat Pumps

1. When the door of a refrigerator is kept open then the room temperature starts

A. cool down

B. hot up

C. first cool down then hot up

D. neither cool down nor hot up

Answer: B

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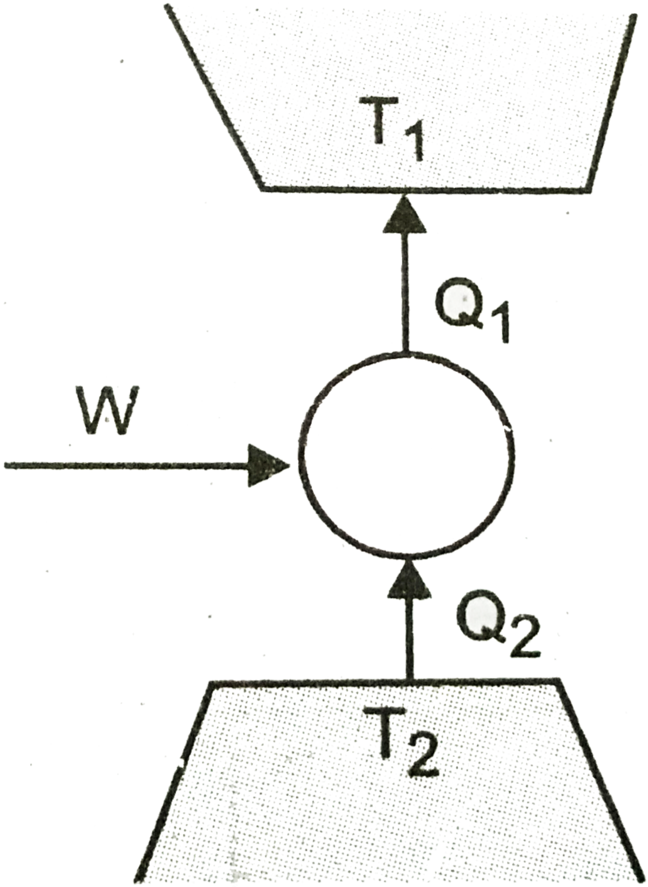
2. Consider a heat engine as shown in (figure). Q_1 and Q_2 are heat added to heat bath T_1 and heat taken from T_2 one cycle of engine. W is the mechanical work done on the engine.



If $W > 0$, then possibillities are:

A. (i) and (ii)

B. (i) and (iii)

C. (ii) and (iii)

D. (ii) and (iv)

Answer: B

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3. A refrigerator is to maintain eatables kept inside at $7^\circ C$. The coefficient opf performance of refrigerator if room temperature is $387^\circ C$ is

A. 15.5

B. 16.3

C. 20.1

D. 9.03

Answer: D

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4. The coefficient of performance of refrigerator, whose efficiencty is 25% is

A. 1

B. 3

C. 5

D. 7

Answer: B

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5. If the coefficient of performance of a refrigerator is 5 and operates at the room temperature $(27^\circ$ C), find the temperature inside the refrigerator.

A. 240 K

B. 250 K

C. 230 K

D. 260 K

Answer: B

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6. The temperature inside a refrigerator is $t_2^\circ C$.

The amount of heat delivered to the room for each joule of electrical energy consumed ideally

will be

A. $\frac{t_1}{t_1 - t_2}$

B. $\frac{t_1 + 273}{t_1 - t_2}$

C. $\frac{t_2 + 273}{t_1 - t_2}$

D. $\frac{t_1 + t_2}{t_1 + 273}$

Answer: B

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7. The reezer in a refrigeratror is located at the top section so that

A. the entire chamber of the refirgerator is cooled quickly due to convection

B. the motor is not heated

C. the heat gained from the environment is high

D. the heat gained from the environment is low

Answer: A

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8. A refrigerator with $COP = 1/3$ release $200J$ at heat to a reservoir. Then the work done on the working substance is

A. $\frac{100}{3}J$

B. 100 J

C. $\frac{200}{3}J$

D. 150 J of heat has been added to the gas

Answer: D

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9. A process is said to be reversible if

A. the system return to their original states

B. the surrounding return to their original states

C. both the system as well as the surroundings return to their original states

D. neither system nor surroundings return to their original states

Answer: C

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10. Which of the processes described below are irreversible ?

A. the increase in temperature of an iron rod by hammering it

B. A gas in a small container at a temperature T_1 is brought in contact with a big reservioir at a higher temperature T_2 which increasses the temperature of the gas

C. An idel gas is enclosed in a piston cylinder arrangement with adiabatic walls

D. All of above

Answer: D

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Carnot Engine

1. Carnot engine is

A. reversible engine

B. operating between two temperatures T_1 (source) and T_2 (sink) have maximum efficiency

C. consisting of two isothermal processes connected by two adiabatic processes

D. all of these

Answer: D

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2. The efficiency of carnot's heat engine is 0.5 when the temperature of the source is T_1 and that of sink is T_2 .The efficiency of another carnot's heat engine is also 0.5.the temperature of source and sink of the second engine are respectively

A. $2T_1, 2T_2$

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

C. $T_1 + 5, T_2 - 5$

D. $T_1 + 10, T_2 - 10$

Answer: A

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3. 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:

A. 1200K

B. 750 K

C. 600 K

D. 800 K

Answer: B

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4. A Carnot engine absorbs 750 J of heat energy from a reservoir at $137^{\circ} C$ and rejects 500 J of heat during each cycle then the temperature of sink is

A. $0.25^{\circ} C$

B. $0.34^{\circ} C$

C. $0.44^{\circ} C$

D. $0.54^\circ C$

Answer: B

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5. A carnot engine takes 900 Kcal of heat from a reservoir at $723^\circ C$ and exhausts it to a sink at $30^\circ C$ the work done by the engine is

A. $2.73 \times 10^6 cal$

B. $3.73 \times 10^6 cal$

C. $6.27 \times 10^5 cal$

D. $3.73 \times 10^5 cal$

Answer: C

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6. A Carnot's cycle operating betiween $T_1 = 600K$ and $T_2 = 300K$ Producing 1.5 KJ of mechanical work per cycle. The transferred to the engine by the reservoirs is

A. 2.5 KJ

B. 3 KJ

C. 3.5 KJ

D. 4 KJ

Answer: B

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7. Consider a carnot cycle operating between source tempeature 750 K and sink temperature 350 K producing 1.25 J KJ of mechanical work per cycle, the heat transferred to the engine by the reservers

A. 1.34 KJ

B. 2.34 KJ

C. 3.34 KJ

D. 4.34 KJ

Answer: B

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8. Efficiency of carnot engine working between ice point and steam point is

A. 0.249

B. 0.257

C. 0.268

D. 0.288

Answer: C

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9. The efficiencty of a carnot engine working between $127^{\circ}C$ and $77^{\circ}C$ is

A. 0.105

B. 0.115

C. 0.268

D. 0.135

Answer: C

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Higher Order Thinking Skills

1. A thermodynamic process of one mole ideal monoatomic gas is shown in figure. The efficiency of cyclic process $ABCA$ will be

A. 0.25

B. 0.125

C. 0.5

D. 0.077

Answer: D

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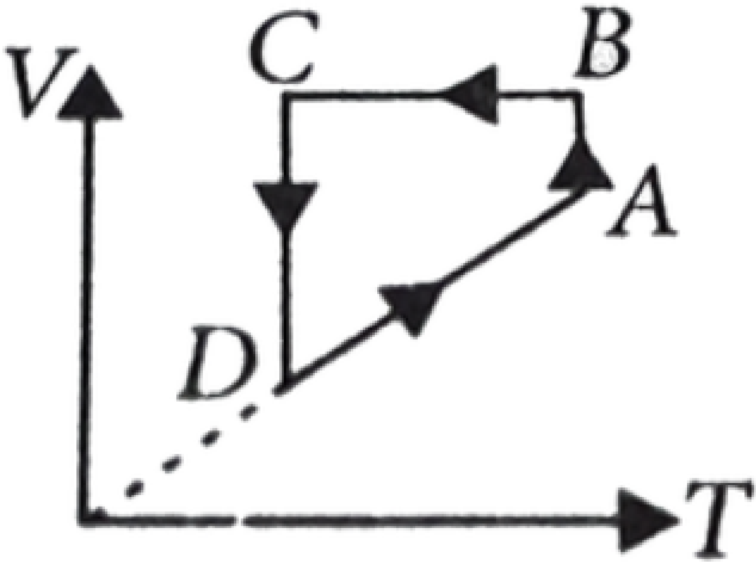
2. Some gas $(C_p / C_V = \gamma = 1.25)$ follows the cycle ABCDA as shown in the figure. The ratio of the energy given out by the gas to its surrounding durning the isochoric section of the cycle to the expansion work done during the isobaric section of the cycle is



A. 2

B. 0.04

C. 6

D. 0.08

Answer: B

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3. For an ideal gas the equation of a process for which the heat capacity of the gas varies with temperatue as $C = (\alpha / T(\alpha)$ is a constant) is given by

A. $V \ln T = cons \tan t$

B. $VT^{1/(\gamma-1)} \_ (e)^{\alpha/RT}$=constant

C. $\frac{V^1}{\gamma - 1} T^{\alpha/RT}$=constant

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

Answer: B

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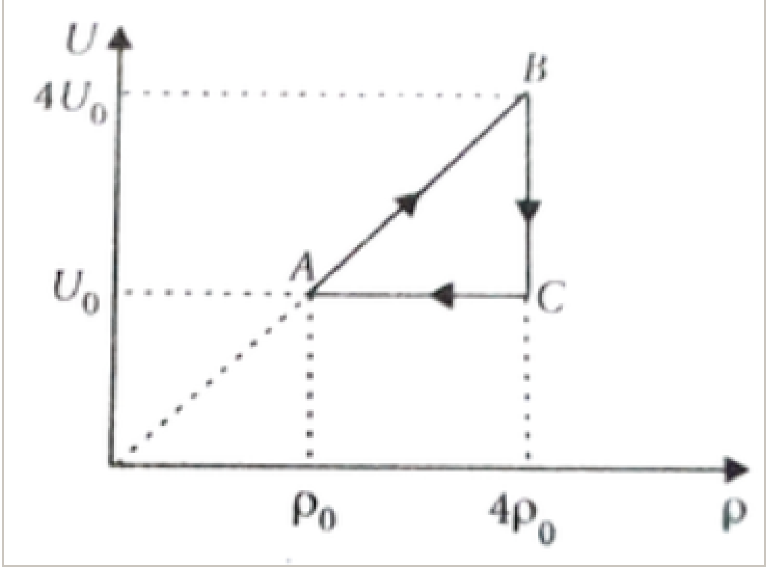
4. A monatomic ideal gas is following the cyclic proces ABCA. Then choose the incorrect option.



A. molar heat capacity for the process AB is

$\frac{R}{2}$

B. Heat is rejected by the system in path BC.

C. Molar heat capacity for the process BC is

$\frac{2}{3}R$

D. Work done by the system in the process CA is $\frac{2U_0}{3}\ln 4$

Answer: C

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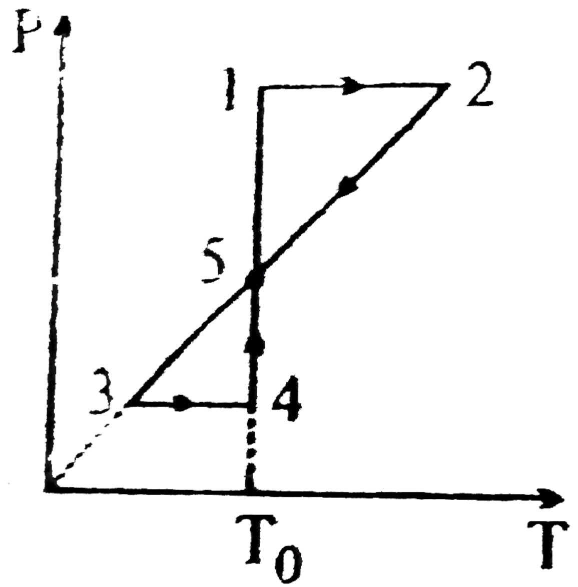
5. Consider PT graph of cyclic process shown in the figure. Maximum pressure during the cycle is twice the minimum pressure. The heat received by the gas in the process 1-2 is equal to the heat received in the process 3-4. The process is done on one mole of monoatomic gas.



Correct PV diagram for the process is-

A. 

B. 

C. 

D.

Answer: D

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6. In the question number 5, if the maiximum pressure is P then what is the pressur at the point 5? (in P-T diagram)

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

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

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

D. None of these.

Answer: C

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7. One mole of a monatomic ideal gas is taken through the cycle shown in figure

The pressures and temperatures at A,B etc, are denoted by P_A, T_A, P_B, T_Betc respectively.Given

$T_A = 1000K, P_B = (2/3)P_A$ and $P_C = (1/3)P_A$

Then choose the incorrect option.

A. The work done by the gas in the process A

$\rightarrow$ B is 1869.75J

B. The heat lost by the gas sin the process B

$\rightarrow$ C is -5297.25J

C. Temperature T_D is 500K

D. Work done from B $\rightarrow$ C is 40J

Answer: D

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8. A gaseous mixture enclosed in a vessel of volume V consists of one gram mole of gas A with $\gamma = \frac{C_P}{C_V} = \frac{5}{3}$an another gas B with $\gamma = \frac{7}{5}$ at a certain temperature T. The gram molecular weights of the gases A and B are 4 and 32 respectively. The gases A and B do not react with each other and are assumed to be ideal. The gaseous mixture follows the equation $PV^{19/13}$ = constant , in adiabatic process. Find the number of gram moles of the gas B in the gaseous mixture.

A. 2

B. 3

C. 4

D. 5

Answer: A

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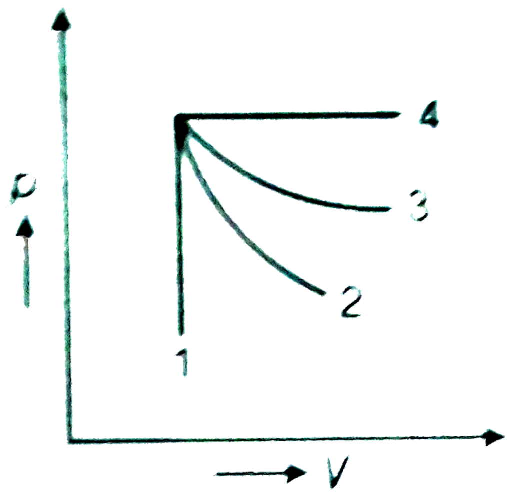
Mcqs

1. An ideal gas undergoes for different processes from the same initial state (figure). Four processes are adiabatic, isothermal, isobaric and isochoric. Out of 1, 2, 3 and 4 which one is adiabatic ?



A. 4

B. 3

C. 2

D. 1

Answer: C

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2. If an average jogs, he produces 14.5×10^3 cal/min. This is removed by the evaporation of sweat. The amount of sweat evaporated per minute (assuming 1 kg requires 580×10^3 cal for evaporation) is

A. 0.25 Kg

B. 2.25 Kg

C. 0.05 kg

D. 0.20 Kg

Answer: A

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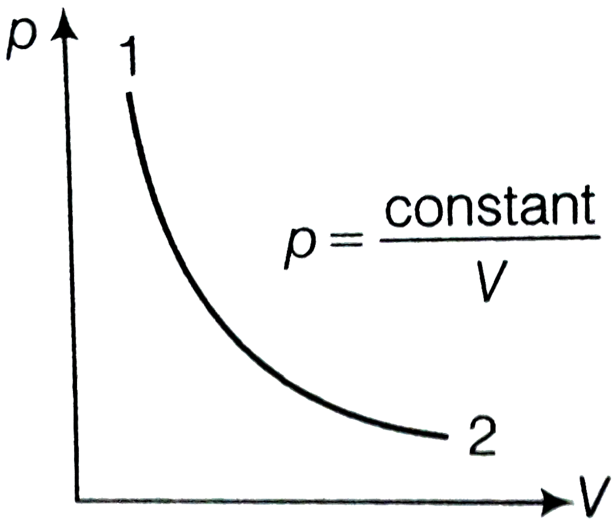
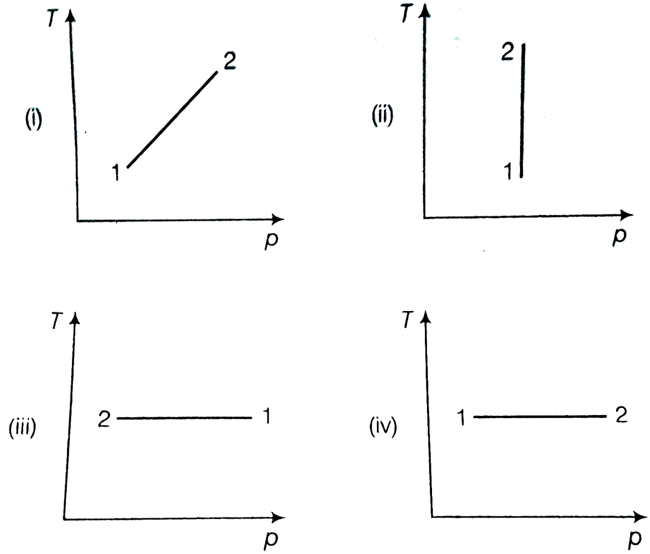
3. Consider p-V diagram for an ideal gas shown in figure.



Out of the following diagrams, which figure represents the $T - p$ diagram ?

(i)



A. (iv)

B. (ii)

C. (iii)

D. (i)

Answer: C

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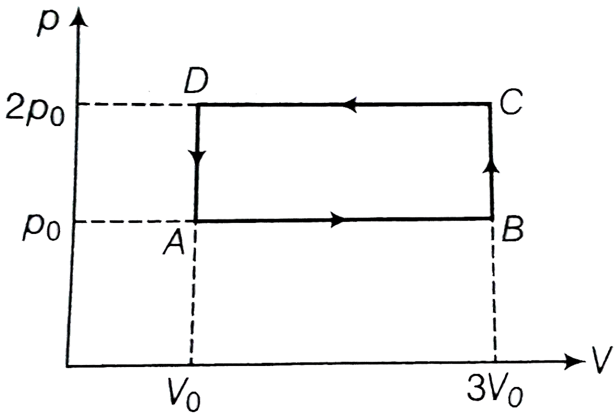
4. An ideal gas undergoes cyclic process $ABCDA$ as shown in givend $p - V$ diagram. The amount of work done by the gas is



A. $6P_0V_0$

B. $-2P_0V_0$

C. $+2P_0V_0$

D. $+4P_0V_0$

Answer: B

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5. 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. $\frac{1}{(2)^{\gamma - 1}}$

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

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

Answer: A

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6. Three copper blocks of masses M_1, M_2 and $M_3 kg$ respectively are brought into thermal contact till they reach equlibrium. Before contact, they were at $T_1, T_2, T)(3), (T_1 > T_2 > T_3)$. Assuming there is no heat loss to the surroundings, the equilibrium temperature T is $(sisspec \text{ if } icheatofcopper)$

A. $T = \dfrac{T_1 + T_2 + T_3}{3}$

B. $T = \dfrac{M_1T_1 + M_2T_2 + M_3T_3}{M_1 + M_2 + M_3}$

C. $T = \dfrac{M_1T_1 + M_2T_2 + M_3T_3}{3(M_1 + M_2 + M_3)}$

D. $T = \frac{M_1T_1 + M_2T_2 + M_3T_3}{M_1 + M_2 + M_3}$

Answer: B

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Assertion And Reason

1. Assertion: The zeroth law said that , when two systems A and B, are in thermal equilibrium, there must be a physical quantitiy that has the same value for both.

Reason : The physical quantity which is same for both system is temperature.

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

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2. Assetion :when a bullet is fired from a gun the bullet preces a wooden block and stops changing the temperature of the bullte and the surrounding layers opf ood.

Reason : Temperature is related to the energy of motion of the bullet as a whole.

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: C

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3. Assertion : First law of thermodynamics does not forbid flow of heat from lower temperature to higher temperature.

Reason : Heat supplied to a system always equal to the increase in its internal energy.

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of

assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: B

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4. Assertion:A constant volume gas thermometer, reads temperature in terms of pressure.

Reason : In this case a plot of ressure verus temperature gives a straight line.

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

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5. Assertion: The isothermal curves intersect each other at a certain point.

Reason: The isothermal changes takes place rapidly, so the isothermal curves have very little slope.

A. If both assetion and reason are true and reaasons is the correct expanation of

assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: D

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6. Assertion : In an isothemal expansion the gas absorbs heat and does work while in an gas by the enviroment and heat is relaeased.

Reason: In an isothermal process there is no change in internal energy of an ideal gas.

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of

assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

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7. Statement-1 : In an adiabatic process, change in internal energy of a gas is equal to work done on/by the gas in the process.

Statement-2 : This is because temp.of gas remains constant in an adiabatic process.

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: D

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8. Assetion : The temperature of a gas does not change when it undergoes on adiabatic process Reason: During adiabatic process , heat energy is exchanged between a system and surroundings.

A. If both assetion and reason are true and reaasons is the correct expanation of

assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: D

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9. Assertion : In an isolated system the entropy increases.

Reason : The processes in an isolated system are adiabatic.

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: B

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10. Assertion: A heat engine is the reverse of a refrigerator.

Reason : A refrigerator cannnot work without some external work done on the system

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

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11. Assertion : The efficiency of a heat engine can never be unity.

Reason : Efficiency of heat engine is fundamental limitation given by first law of thermodynamics.

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of

assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: C

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12. Assetion : A refrigerator transfers heat from a lower temperature to a higher temperature.

Reason: Heat cannot flow from a lower temperature to a higher temperature.

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: B

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13. Assetion : A quasi static isothermal expansion of an idel gas in a cylinder fitted with a frictionless movablepistonis a irreversible process.

Reason : A process is irreversible only if system remains in equilibrium with the surroundings at every stage.

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: D

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14. Assertion: Thermodynamics process in nature are irreversible.

Reason: Dissipative effects cannot be eliminated.

A. If both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: A

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15. Assetion : No engine can have efficiencyt greater than that of the carnot engine

Reason : The efficiencyt of a cornot engine is given by $\eta = 1 - \frac{T_2}{T_1}$

A. If both assetion and reason are true and reaasons is the correct expanation of assetion

B. If both assetion and reason are tur but reason is not the correct explanation of assetion

C. If assertion is true but reason is false

D. If both assertion and reason are false.

Answer: B

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