PHYSICS

AAKASH INSTITUTE ENGLISH

THERMODYNAMICS

Example

1. When are the two bodies in thermal equilibrium?

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2. State true or false, internal energy of a gaseous system depends upon thermodynamic process.

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3. For a gaseous system find change in internal energy if the heat supplied to the system is 50 J and work done by the system is 16 J.

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4. Value of C_p for monatomic gas is $\frac{5}{2}R$. Find C_V.

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5. Change in internal energy in an isothermal process for ideal gas is

A. Zero

B. (+) ve

C. (-) ve

D. Cannot be predicted

Answer: A

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6. In an adiabatic process

A. $\Delta T = 0$

B. $\Delta Q = 0$

C. $\Delta P = 0$

D. $\Delta U = 0$

Answer: B

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7. State true or false. Work done by an ideal gas in adiabatic expansion is less than that in isothermal process (for same temperature range)

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8. The work done in an ischoric process is

A. 0

B. $+$ ve

C. (-) ve

D. Any of these

Answer: A

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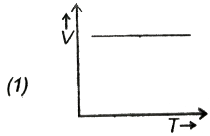
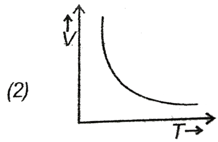
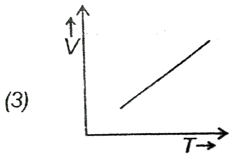
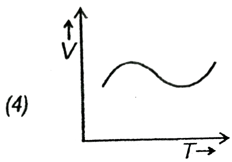
9. Which of the following is a V-T curve for isobaric process?

A. 

B. 

C. 

D. 

Answer: C

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10. A carnot engine has efficiency of 60%. If the source is at $527^\circ C$, then find the temperature of sink.

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11. Find the efficiency of a carnot engine whose source and sink are $327^\circ C$ and $27^\circ C$?

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12. A mass of dry air at N.T.P. is compressed to $\frac{1}{32}$ th of its original volume suddenly. If $\gamma = 1.4$ find the final pressure of the gas if initial pressure is P.

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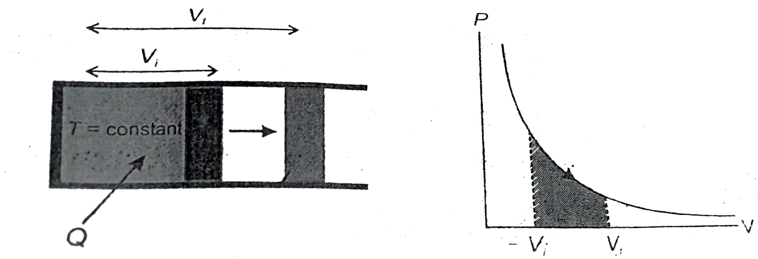
13. A cylinder contains 0.50 mol of an ideal gas at temperature of 310 K. as the gas expands isothermally from an initial volume of 0.31 m^3 to a final volume of 0.45 m^3, find the amount of heat that must be added to the gas in order to maintain a constant temperature.



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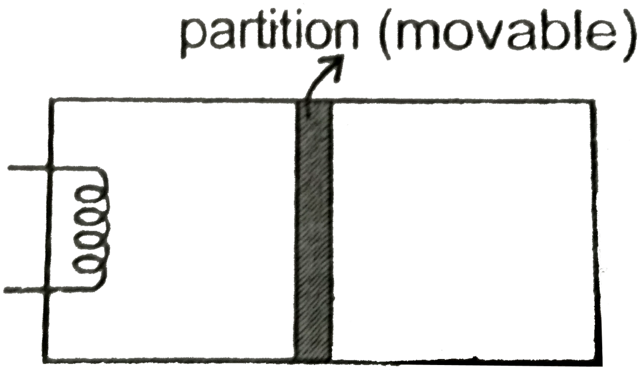
14. A rectangualr box (shown in figure) has a movable and smooth portition which can slide along the length of the box. Both chambers contains 1 mole of monoatomic gas (

$\gamma = \frac{5}{3}$) at a pressure walls of box and partition are thermally insulated. Due to heating, gas in left chamber expands until pressure in both chambers become $32P_0$ determine

(a) The final temperature of gas in each chamber

(b) The work done by the gas in the right chamber.



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15. An ideal gas is made to undergo a process $T = T_0 e^{\alpha V}$ where T_0 and α are constants. Find the molar specific heat capacity of the gas in the process if its molar specific heat capacity at constant volume is C_v. Express your answer as a function of volume (V).

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16. Find the relatio between volume and temperature of a gas in a process, in which the molar heat capacity C varies with temperature T as $C = C_V + \alpha T$. [α is a constant] .

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17. An ideal monoactomic gas undergoes a process ini which its internal energy depends upon its volume as $U = a\sqrt{V}$ [where a is a constant]

(a) find work done by a gas and heat transferred to gas to increse its internal energy by 200 J.

(b) find molar specific heat of gas for this process.

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18. An ideal gas undergoes a cyclic process as shown. Part of the process ab is isothermal expansion and work done by the gas in this expansion is 700 J. in adiabatic expansion be it again does 400 J work. If it rejects 100 J heat when it returns to a from c via b then find efficiency of the cycle.

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19. A cyclic process involves three processes: A to B, B to C, C to A, heat exchanges during processes are:

$Q_{AB} = +40J$

$Q_{BC} = +20J$

$Q_{CA} = -10J$

Find net work done and efficiency.

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20. Find the possible efficiency of a cycle working between $27^\circ C$ and $127^\circ C$.

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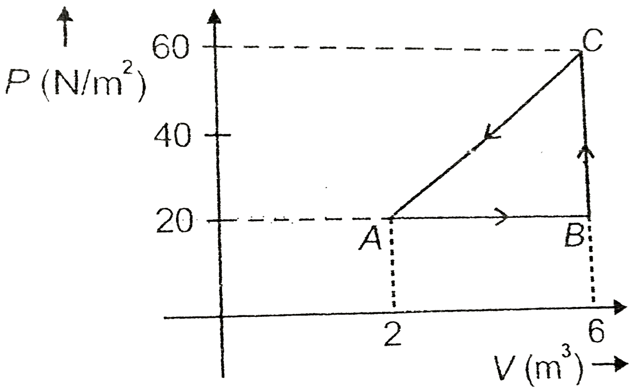
21. An ideal gas follows a cyclic process as shown in figure. Internal energy of gas at point A is 10 J while at B is 70 J. the heat absorbed by gas in BC is 120 J.

(a) How much heat is absorbed in process AB?

(b) Find heat energy rejected or absorbed by gas in process CA.



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22. What is the essential condition for thermodynamic equilibrium?

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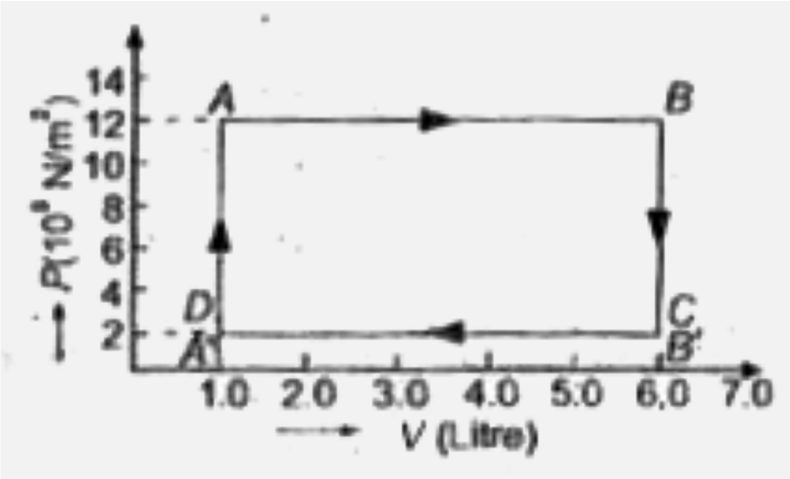
23. The figure shows a P.V graph of the thermodynamic behavious of an ideal gas. Find out form this graph (i) work done by the gas in the process $A \rightarrow B, B \rightarrow C, C \rightarrow D$ and $D \rightarrow A$. (ii) work done by the gas in complete cycle $A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$.



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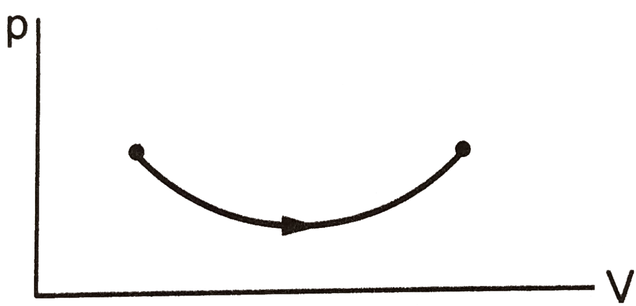
24. Consider the process on a system as shown in the figure. During the process, the work done by the system



A. Continuously increases

B. Continuously decreases

C. First increases then decreases

D. First decreases then increases

Answer:

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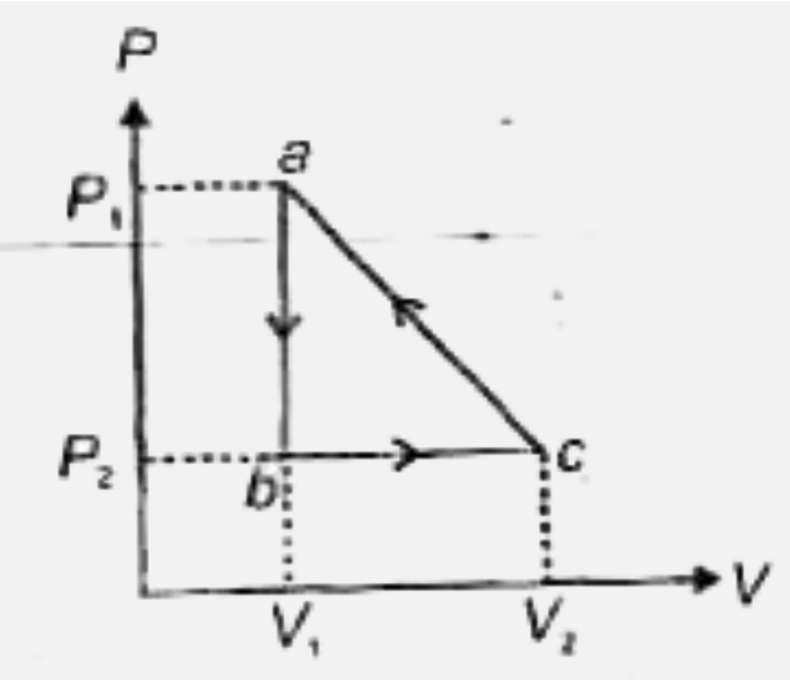
25. Find the net work done during the cycle abc.



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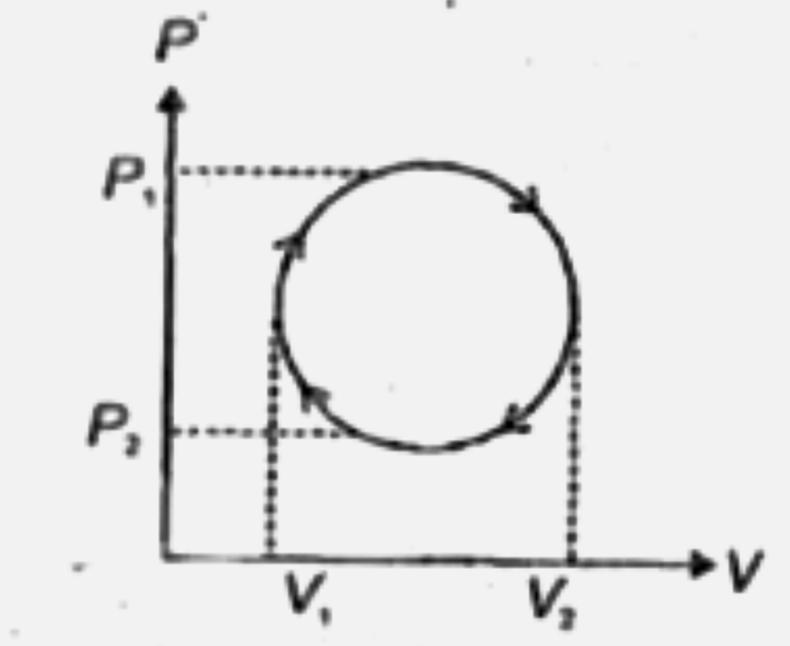
26. Find the work done during the perfectly circular cyclic process as shown in the diagram.



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27. For a gaseous system find change in internal energy if the heat supplied to the system is 50 J and work done by the system is 16 J.

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28. Value of C_p for monatomic gas is $\frac{5}{2}R$. Find C_V.

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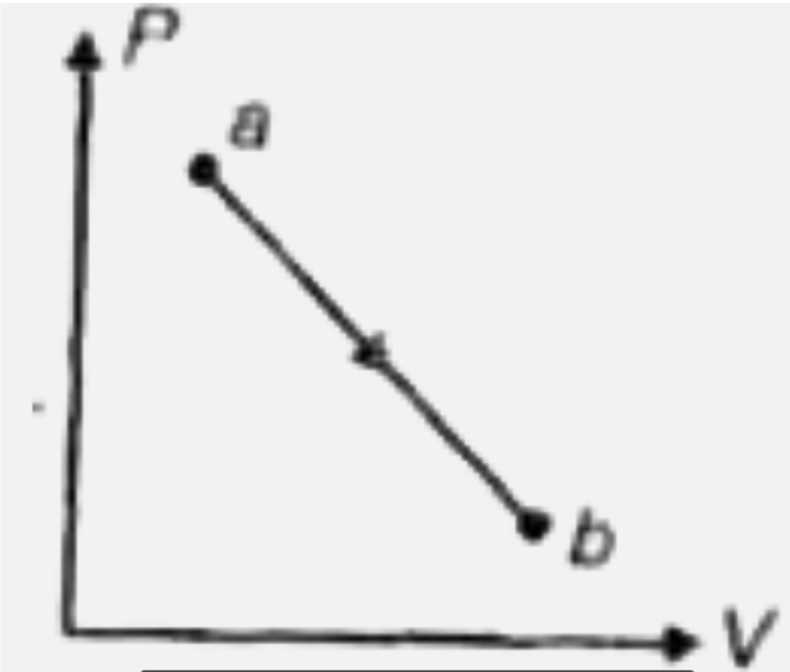
29. A gas undergoes expansion in such a mannerthat its p-V diagram plot is a downward sloping straight line as shown in the figure below. What happens to the temperature during the process ?



A. It increases first then decreases

B. It decreases first then increases

C. It continuously decreases

D. Data insuffcient

Answer:

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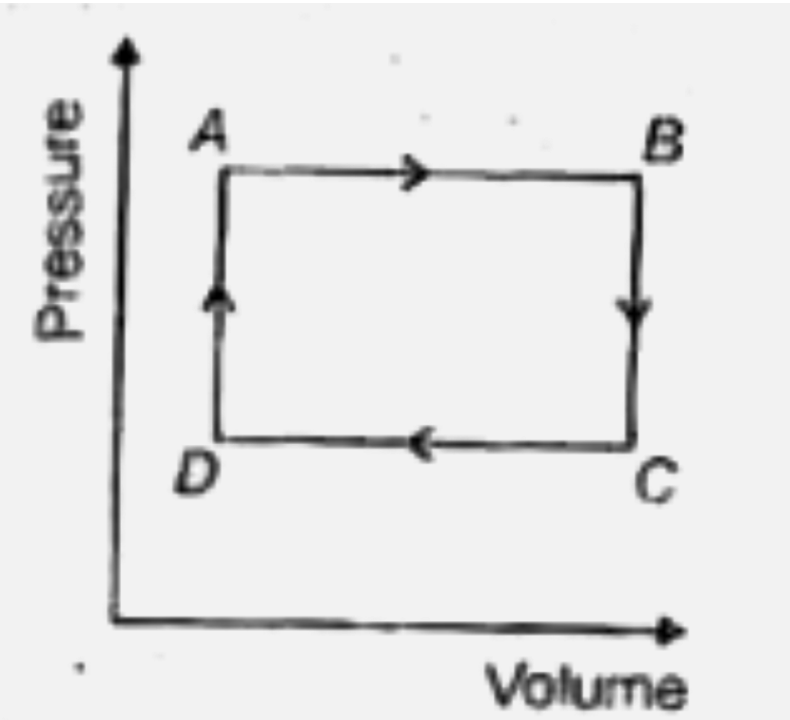
30. The pressure and volume of a gas are changed as shown in the p-V diagram in the figrue ahead. The thmperature of the gas



A. increases as if goes from A to B

B. Increases as it goes from B to C

C. Remains constant during these changes

D. Decreases as it goes from D to A

Answer:

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31. The pressure $(10^5 Nm^{-2})$ of air filled in a vessel is decreased adiabatically so as to increase its volume three times. Calculate the pressure of air. Given $\gamma -$ for air = 1.4

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32. A tyre pumped to a pressure $3.375 atm \text{at} 27^{\circ} C$ suddenly bursts. What is the final temperature $(\gamma = 1.5)$?

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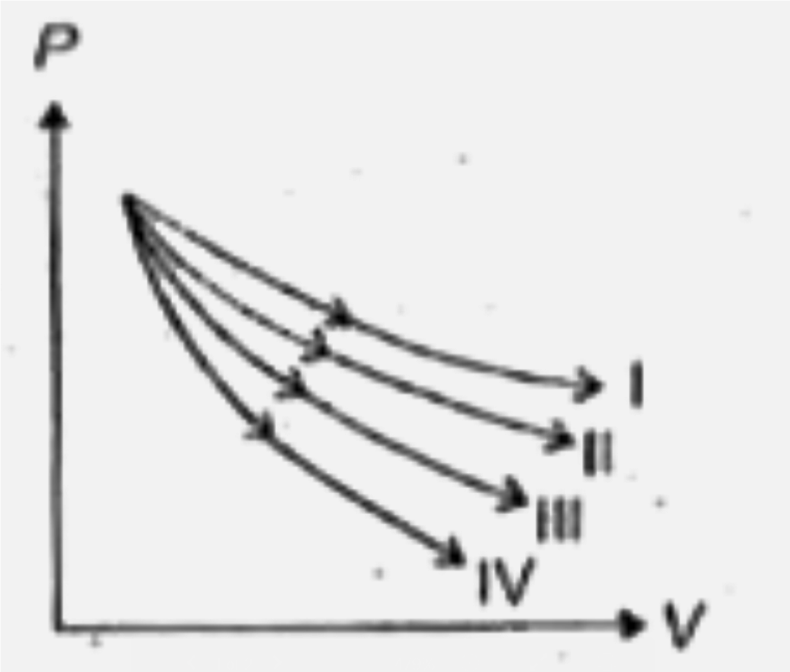
33. In the following plots match I,II, III,Iv with (a) isothermal process and Adiabatic process for (b) monatomic, (c) diatomic and (d) triatomic gases respectively.



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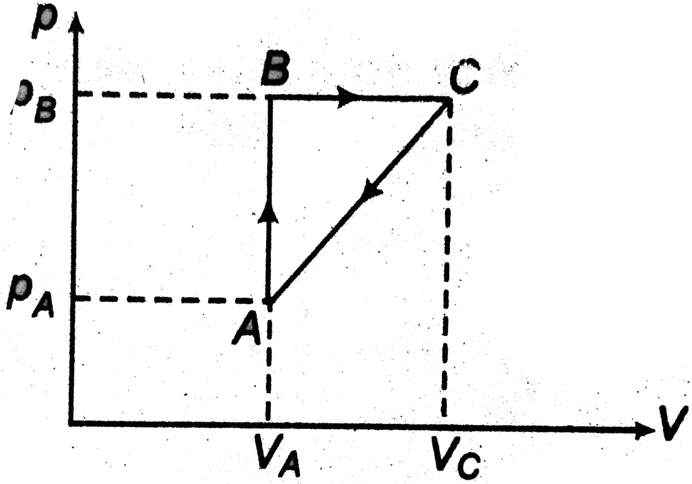
34. A thermodynamical process is shown in the figure with $p_A = 3 \times p_{atm}$, $V_A = 2 \times 10^{-4} m^3$, $p_B = 8 \times p_{atm}$, $V_C = 5 \times 10^{-4} m^3$. In the process AB and BC, 600J and 200J heat are added to the system. Find the change in internal energy of the system in the process CA.

$\left[1 p_{atm} = 10^5 N/m^2\right]$



A. 560 J

B. 800 J

C. 600 J

D. 640 J

Answer:

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35. Heat is supplied at constant pressure to diatomic gas. The part of this heat which goes to increase its internal energy will be

A. $\frac{5}{7}$

B. 3

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

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

Answer:

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36. 70 calories of heat required to raise the temperature of 2 moles of an ideal gas at constant pressure from $30^\circ C \to 35^\circ C$. The amount of heat required (in calories) to raise the temperature of the same gas through the same range $(30^\circ C \to 35^\circ C)$ at constant volume is:

A. 30 cal

B. 50 cal

C. 370 cal

D. 90 cal

Answer:

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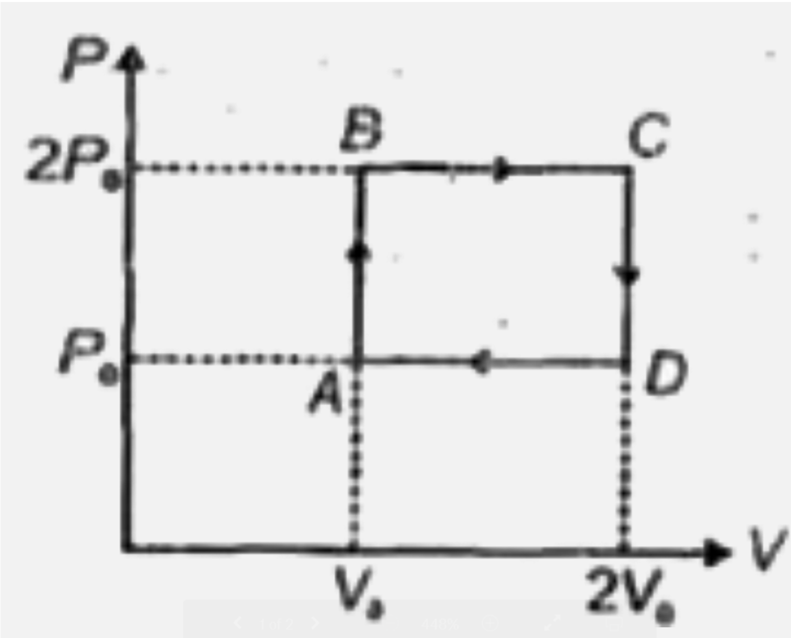
37. N moles of a monotomic gas is carried round the reversible rectangular cycle ABCDA as shown in the diagram. The temperature at A is T_{σ}. The thermodynamic efficiency of the cycle is



A. 0.15

B. 0.5

C. 0.2

D. 0.25

Answer:

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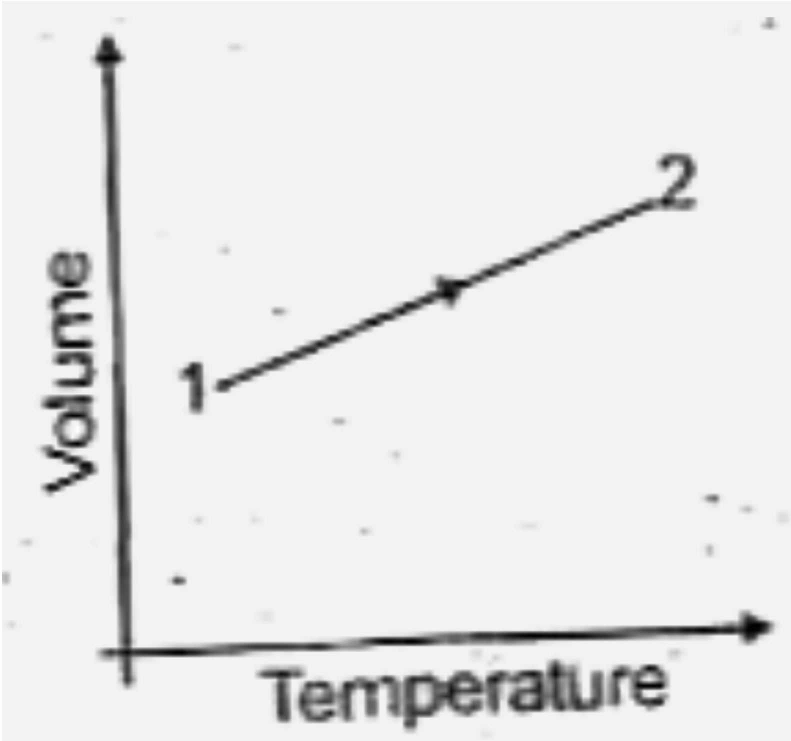
38. On a volume-temperature diagram a process 1-2 is an upward sloping straight line having the tendency to ct the volume axis as shown in the figure ehead. During this process the preseure



A. Remains constant

B. Continuously increases

C. Continuously decreases

D. Data insufficient

Answer:

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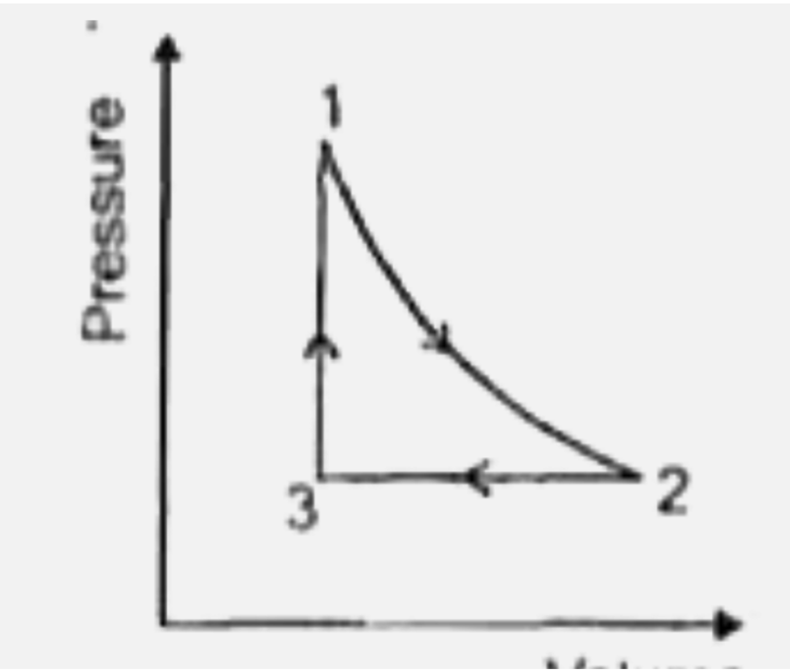
39. Given here is a cyclic process on P -V diagram. Process 1-2 is isothermal, 2-3 is isobaric and 3-1 is an isochoric process. Plot this T - P diagram.



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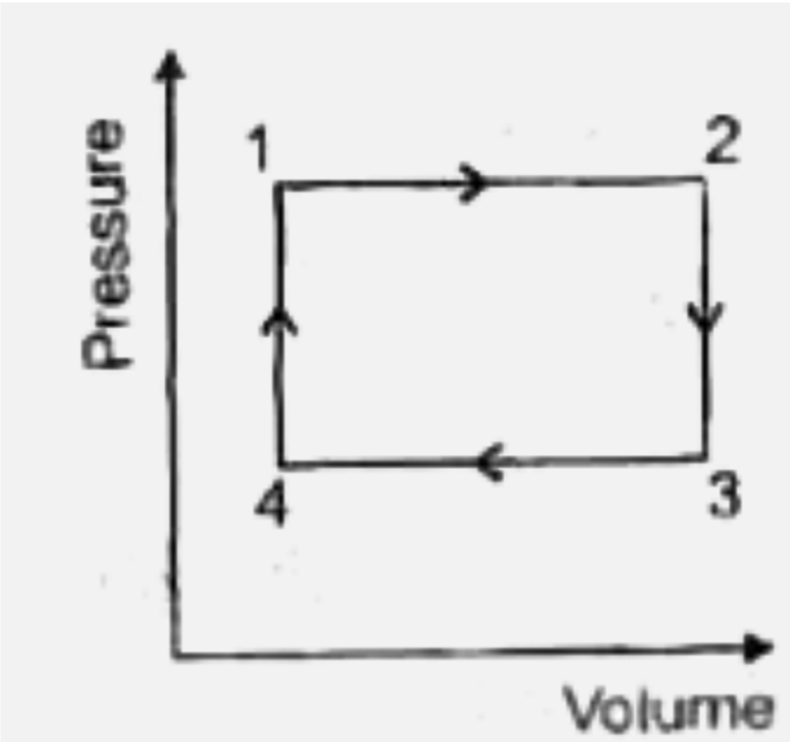
40. A particular cyclic process on a P-V diagram is a rectangle as shown below. Plot it on (a) T-V and P-T diagram.



41. A carnot engine takes in 3000 kcal of heat from a reservoir at $627^{\circ} C$ and gives a part of 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:

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42. A scientist chaims to have developed 60% effcient engine while working between$27^\circ C$ and $327^\circ C$. Does he claim right ?

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43. The efficiency of a Carnot's engine at a particular source and sink temperature is $\frac{1}{2}$ .When the sink temperature is reduced by $100^\circ C$, the engine efficiency, becomes $\frac{2}{3}$. Find the source temperature.

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44. An ideal refrigerator runs between $-23^{\circ}C$ and $27^{\circ}C$. Find the heat regected to atomosphere for every joule of work input.

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Try Youself

1. What are the conditions for thermodynamic equilibrium?

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2. If a body A is in thermal equilibrium with three different bodies B, C and D then

A. B is in thermal equilibrium with C

B. C is in thermal equilibrium with D

C. D is in thermal equilibrium with B

D. All of these

Answer: D

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3. An ideal gas is compressed in a closed container its U

A. Increases

B. Decreases

C. Remains same

D. Both (1) & (2)

Answer: A

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4. if work is done by the system then W is

A. (+)ve

B. (-)ve

C. Zero

D. Depends upon the thermodynamic process.

Answer: A

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5. For a gaseous system, change in internal energy and work done on the system are respectively 17 J and 41 J. find heat supplied / evolved from the system.

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6. Find $\frac{C_p}{C_v}$ for monatomic ideal gas.

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7. In an isothermal expansion change in internal energy and work done by the gas are respectively

A. (-) ve, (-) ve

B. 0, (+) ve

C. 0, (-) ve

D. (+) ve, (-) ve

Answer: B

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8. Draw at P-T curve for isochoric process.

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9. Draw at P-T curve for isobaric process.

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10. Why is the work done in isobaric process not zero always?

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11. A carnot engine has efficiency of 80%. If its sink is at $127^\circ C$, the find the temperature of source.

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12. Find the efficiency of carnot engine whose source and sink are at $927^\circ C$ and $27^\circ C$.

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13. The carnot cycle of a reversible heat engine consist of

A. one isothermal and two adiabatic processes

B. Two isobaric and one adiabatic processes

C. Two isothermal and two adiabatic processes

D. Two isobraic and two isothermal processes

A. one isothermal and two adiabatic processes

B. Two isobaric and one adiabatic processes

C. Two isothermal and two adiabatic processes

D. Two isobraic and two isothermal processes

Answer:

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Assignment Section A Objective Type Questions One Option Is Correct

1. In the SI system, the unit of temperature is

A. Kelvin

B. celcius

C. fahrenheit

D. reaumur

Answer: A

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2. SI unit of heat is

A. calories

B. joule

C. watt hour

D. kilojoule

Answer: B

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3. Two bodies A and B are said to be in thermal equilibrium with each other if they have same

A. pressure

B. volume

C. temperature

D. Area

Answer: C

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

A. Free expansion

B. Isothermal expansion

C. Isothermal compression

D. Adiabatic expansion

Answer: D

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5. Blowing air with open mouth is an example of

A. Isochoric process

B. Isobaric process

C. Isothermal process

D. Adiabatic process

Answer: B

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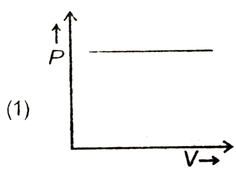
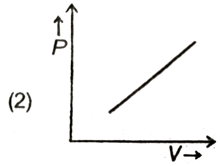
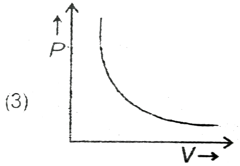
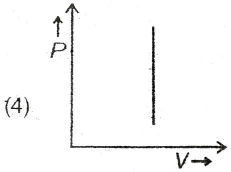
6. Which of the following P-V curve best represents. As isothermal process?

A. 

B. 

C. 

D. 

Answer: C

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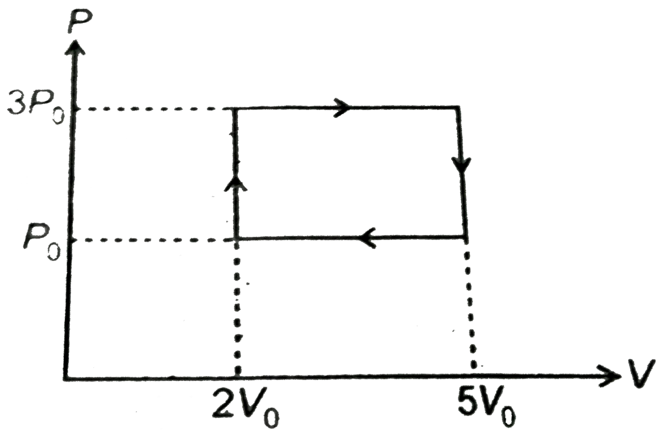
7. Work done in given cyclic process is



A. P_0V_0

B. $3P_0V_0$

C. $6P_0V_0$

D. $5P_0V_0$.

Answer: C

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8. In a carnot engine, for $\eta = 1$, which of the following is true? (Symbols have their usual meaning)

A. $T_1 = T_2$

B. $T_1 = 0$

C. $T_2 = 0$

D. η is independent of T_1 and T_2.

Answer: C

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9. Indicator Diagram

A. P-T curve

B. P-V curve

C. V-T curve

D. Q-T curve

Answer: B

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10. $\Delta U + \Delta W = 0$is valid for

A. Adiabatic process

B. Isochoric process

C. Isobaric process

D. Isothermal process

Answer: A

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11. During an isochoric process

A. V remains constant

B. T remains constant

C. Q remains constant

D. P remains constant

Answer: A

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12. In an isothermal process for an ideal gas

A. $\Delta Q = 0$

B. $\Delta W = 0$

C. $\Delta U = 0$

D. $\Delta V = 0$

Answer: C

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13. When gas in a vessel expands, it thermal energy decreases. The process involved is

A. Isobaric

B. Isochoric

C. Isothermal

D. Adiabatic

Answer: D

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14. The thermodynamic process in which no work is done on or by the gas is

A. Isothermal process

B. Isochoric process

C. Adiabatic process

D. Isobaric process

Answer: B

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15. heat flows between two bodies due to difference in their

A. Volume

B. Pressure

C. temperature

D. All of these

Answer: C

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16. Which of the following laws of thermodynamics defines the term internal energy?

A. Zeroth law

B. First law

C. Second law

D. Third law

Answer: B

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17. Select the incorrect statement

A. For isothermal process of ideal gas, $\Delta U = 0$

B. For isochoric process, W=0

C. For Adiabatic process, $\Delta U = - \Delta W$

D. For cyclic process, $\Delta U = - \Delta W$

Answer: D

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18. In transition from the liquid to the vapour phase, most of the heat goes to increase the

A. Internal energy

B. Temperature

C. Potential energy

D. Both (1) & (2)

Answer: D

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19. Water has maximum density at

A. 273K

B. 373K

C. 277K

D. 369K

Answer: C

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20. On heating water from $0^\circ C$ to $100^\circ C$ its volume

A. Increases at each $.^\circ C$

B. First increases till $4^\circ C$ and then decreases

C. First decreases till $4^\circ C$ and then increases

D. Remains same

Answer: C

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21. isotherm is a

A. P-V curve at constant temperature

B. P-T curve at constant volume

C. V-T curve at constant pressure

D. P-V at constant internal energy

Answer: A

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22. Which of the followig is extensive variable?

A. Internal energy

B. Temperature

C. Pressure

D. Density

Answer: A

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23. 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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24. The maximum amount of work done, which can be obtained by supplying 400 cal of heat will be

A. 1 kJ

B. 1.2 kJ

C. $1.76 kJ$

D. $1.68 kJ$

Answer: D

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25. If a gas of volume 10 L is expanded to quadruple its volume at 4 atm pressure, the external work done is

A. 3 kJ

B. 6 kJ

C. 12 kJ

D. 18 kJ

Answer: C

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26. In adiabatic process

A. PV^{γ}=constant

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

C. $P^{\gamma}V$ = constant

D. Both (1) & (2)

Answer: D

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27. A sample of gas expands from volume V_1 to V_2. The amount of work done by the gas is greater when the expansion is

A. Isobaric process

B. Isothermal process

C. Adiabatic process

D. Same in each process

Answer: A

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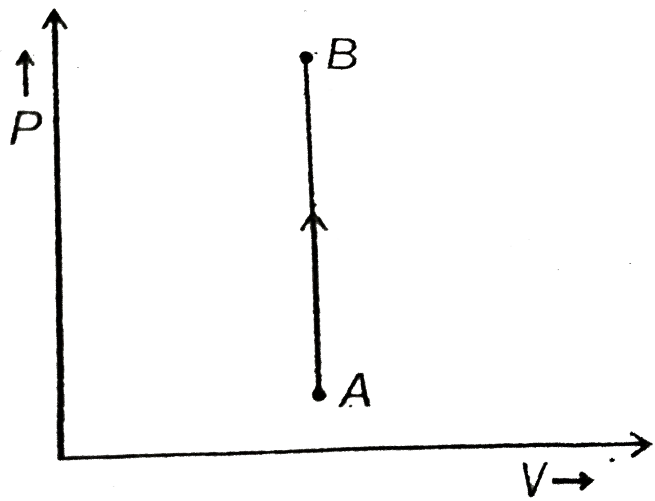
28. The following graph represents



A. $\Delta P = 0$

B. $\Delta W = 0$

C. $\Delta T = 0$

D. $\Delta Q = 0$

Answer: B

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29. What is the work done by 0.2 mole of a gas at room temperature to double its volume during isobaric process? (Take R=2 cal $mol^{-1}. ^{\circ} C^{-1}$)

A. 30 cal

B. 40 cal

C. 120 cal

D. 160 cal

Answer: C

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30. If the slope for isotherm is X and the slope for adiabat is Y then

A. X=γY

B. $Y = \gamma X$

C. X=Y

D. $X^{\gamma} = Y$

Answer: B

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31. The value of η may lie between

A. 0 to 1

B. 1 to ∞

C. -1 to +1

D. 0 to ∞

Answer: A

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32. If a carnot engine works between $127^{\circ}C$ and $527^{\circ}C$ then its efficiency is

A. 0.25

B. 0.375

C. 0.5

D. 0.75

Answer: C

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33. If the temperature of sink is at absolute zero, then the efficiency of carnot engine will be

A. 0

B. 1

C. -50%

D. 0.75

Answer: B

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34. A carnot engine has efficiency of 50% when its sink is at $227^\circ C$. What is the temperature of source

A. $727^\circ C$

B. $454^\circ C$

C. $113.5^\circ C$

D. $500^\circ C$.

Answer: A

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35. In a carnot engine, when heat is absorbed from the source, its temperature

A. Increases

B. Decreases

C. Remains same

D. Cannot be predicted

Answer: C

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36. A carnot engine whose sink is at 300 K has an efficiency of 50. by how much should the temperature of source be increased so as the efficiency becomes 70% ?

A. 100 K

B. 200 K

C. 300 K

D. 400 K

Answer: D

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37. Choose the correct relation

A. $\eta = \frac{1-\beta}{\beta}$

B. $\beta = \frac{1-\eta}{\eta}$

C. $\eta = \frac{\beta}{1-\beta}$

D. $\beta = \frac{\eta}{1-\eta}$

Answer: B

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38. A carnot engine takes 6000 cal of heat from a reservoir at $627^\circ C$ and gives it to a sink at $27^\circ C$. The work done by the engine is

A. 2 kcal

B. 3 kcal

C. 4 kcal

D. 8 kcal

Answer: C

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39. A process can be reversible if

A. it is quasi-static

B. non-dissipative

C. Both (1) and (2)

D. Neither (1) nor (2)

Answer: C

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40. Adiabatic expansion of a gas causes

A. Cooling

B. Heating

C. No temperature change

D. Zero work done

Answer: A

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41. The internal energy of non-ideal gas depends on

A. Temperature

B. Pressure

C. Volume

D. All of these

Answer: D

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42. In practise, all heat engines have efficiency less than that of a carnot engine because

A. Carnot engine is irreversible

B. A reversible process can never be attained in a real world

C. Irreversible engine has higher efficiency than reversible engine

D. Efficiency of carnot engine is always one

Answer: B

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43. The effiency of reversible engine is__the irreversible engine.

A. Less than

B. Greater than

C. Equal to

D. Negligible than

Answer: B

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44. A carnot cycle consists of

A. Two stages

B. Four stages

C. Six stages

D. Eight stages

Answer: B

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45. The internal energy of an ideal gas increases when it

A. Expands

B. Is compressed

C. Is first expanded and then compressed

D. None of these

Answer: D

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46. Find the change in internal energy if heat supplied to the gaseous system is 100 J and work done by the system is 80 J.

A. 5 J

B. 30 J

C. 10 J

D. 20 J

Answer: D

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47. Specific heat capacity of water is

A. 4.186 J $g^{-1}K^{-1}$

B. 4186 J $g^{-1}K^{-1}$

C. 41.86 kJ $g^{-1}K^{-1}$

D. 4186 kJ $g^{-1}K^{-1}$

Answer: A

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48. The value of C_V for monatomic gas is $\frac{3}{2}R$, then C_P will be

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

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

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

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

Answer: C

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49. Adiabatic exponent of a gas is equal to

A. $C_P \times C_V$

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

C. $C_P - C_V$

D. $C_P + C_V$

Answer: B

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50. A carnot engine is working in such a temperature of sink that its efficiency is maximum and never changes with any non-zero temperature of source. The temperature of sink will most likely to be

A. 0 K

B. $0^\circ C$

C. $0^\circ F$

D. Data insufficient

Answer: A

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Assignment Section B Objective Type Questions One Option Is Correct

1. A sample contains N moles of a diatomic gas at temperature T. Molecules of gas get dissociated into atoms temperature remaining constant, find change in internal energy of gas

A. NRT

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

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

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

Answer: C

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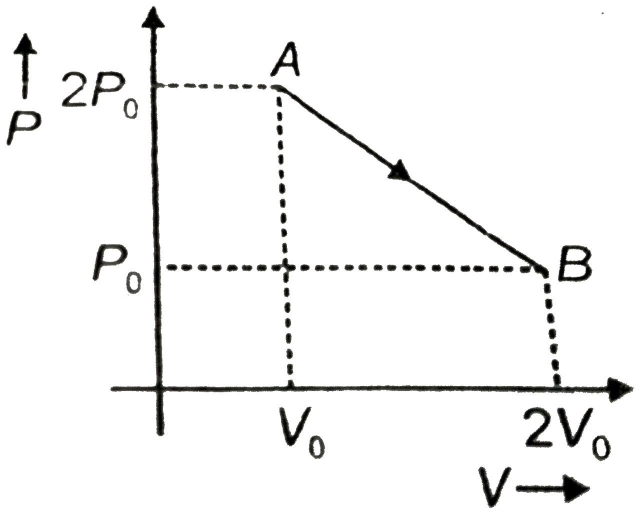
2. A sample of gas follows process AB, then which of the following is incorrect about AB?



A. $\Delta U = 0$

B. $W > 0$

C. $Q = W$

D. $\Delta U < 0$

Answer: D

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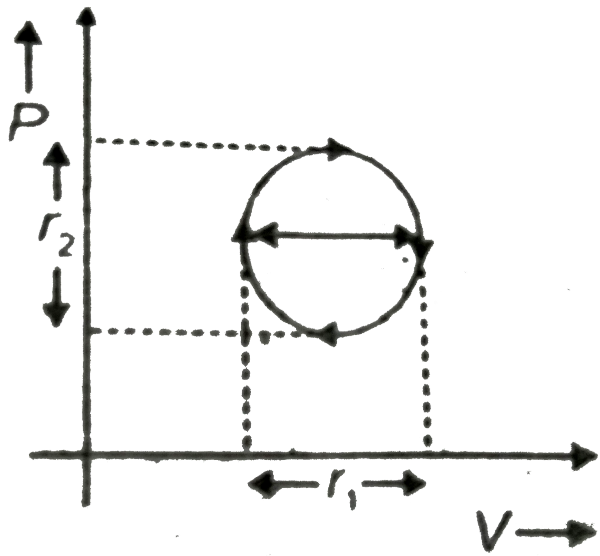
3. A sample of gas is going through cyclic process, work done by gas is



A. $\pi r_1 r_2$

B. πr_2^2

C. $\frac{\pi}{4}(r_1 r_2)$

D. Both (1) & (2) are correct

Answer: C

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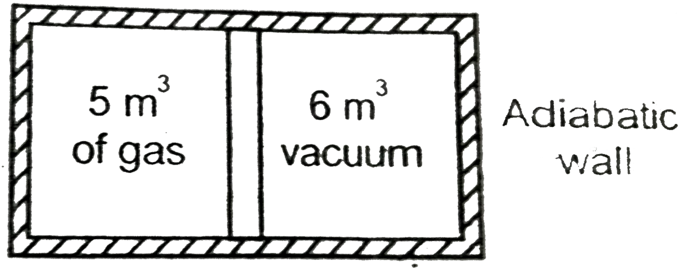
4. A movable piston separates a sample of gas from vacuum. In this state, pressure of gas is P, then find pressure after piston is released



A. P

B. $6P$

C. $\frac{5P}{11}$

D. Pressure is not defined because it is a free expansion

Answer: C

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5. A container is closed by a movable piston. We supply heat to gas inside container. Due to heating, piston is displaced by 5 cm. cross section area of cylinder is 40 cm^2 and heat supplied to gas is 40 joules. The change in internal energy is

A. a. 20 J

B. b. $-20J$

C. c. $0J$

D. d. $+40J$

Answer: A

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6. For a process, relation between temperature and volume is TV^3=constant. If a monoatomic gas follows this process, find molar specific heat for this process

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

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

C. $\frac{11R}{6}$

D. Zero

Answer: A

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7. In a thermodynamic process on an ideal diatomic gas, work done by the gas is η times the heat supplied $(\eta < 1)$. The molar heat capacity of the gas for the process is

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

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

C. $\frac{5R}{2(1-\eta)}$

D. $\frac{5R(1-\eta)}{2}$

Answer: C

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8. An open container is placed in atmosphere. During a time interval, temperature of atmosphere increase and then decreases. The internal energy of gas in container

A. First increases then decreases because internal energy depends upon temperature

B. First decreases then increases

C. Remains constant

D. Is inversely proportional to temperature

Answer: C

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9. Which of the following statements is correct?

A. Two isothermal curves may intersect

B. Two adiabatic curves may intersect

C. Two different states of gas can be connected by an isothermal process as well as an adiabatic process on a P-V diagram.

D. An isothermal curve may intersect an adiabatic curve

Answer: D

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10. Total kinetic energy of molecules of a gas sample varies

$K.E. = \frac{7}{4}nRT$. This sample contains

A. a. Monatomic gas

B. b. Mixture of amonatomic and diatomic gas

C. c. Mixture of monatomic and polyatomic gas

D. d. Both (2) & (3) are possible

Answer: D

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11. A sample of diatomic gas is heated at constant pressure. If an amount of 280 J of heat is supplied to gas, find ratio of work done by gas and change in internal energy

A. $5:2$

B. $2:5$

C. $2:3$

D. $3:2$

Answer: B

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12. 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

A. 4R

B. 2.5 R

C. 3R

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

Answer: C

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13. A cyclic process contains four steps AB,BC,CD and DA. Heat involved in different processes is given as $Q_{AB} = +200J, Q_{BC} = +600J, Q_{CD} = -300J, Q_{DA} = 0$, then efficiency of process is

A. $\frac{5}{8}$

B. $\frac{3}{8}$

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

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

Answer: A

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14. A monatomic ideal gas is heated at constant volume until its pressure is doubled. It is again heated at constant pressure, until its volume is doubled. Find molar specific heat for the whole process.

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

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

C. $\frac{13R}{6}$

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

Answer: C

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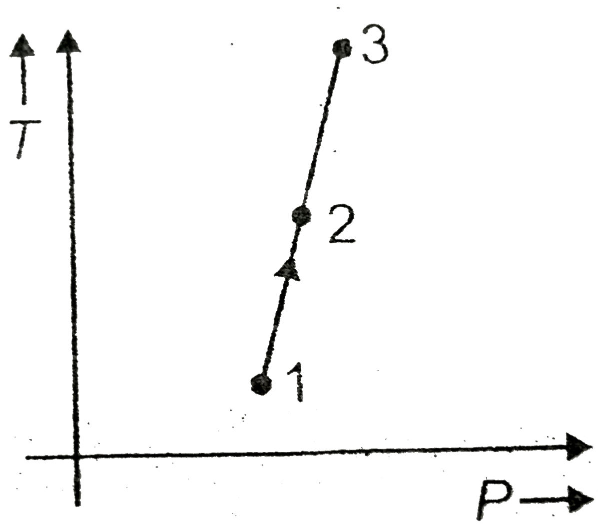
15. A sample of gas goes through a process shown in graph. Arrange the volume of given points in increasing order



A. $V_1 > V_2 > V_3$

B. $V_1 > V_2 = V_3$

C. $V_3 > V_2 > V_1$

D. $V_3 > V_2 = V_1$

Answer: C

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Assignment Section C Objective Type Questions More Than One Option Are Correct

1. 4 moles of a monoatomic gas are filled in a rigid container. Temperature of the gas increases from $27^\circ C$ to $127^\circ C$ by heating. Let Q, ΔU and W represent heat, change in internal energy and work done, then

A. Q=600R

B. Q=1000R

C. $\Delta U = 600R$

D. $\Delta U = 800R$

Answer: A::C

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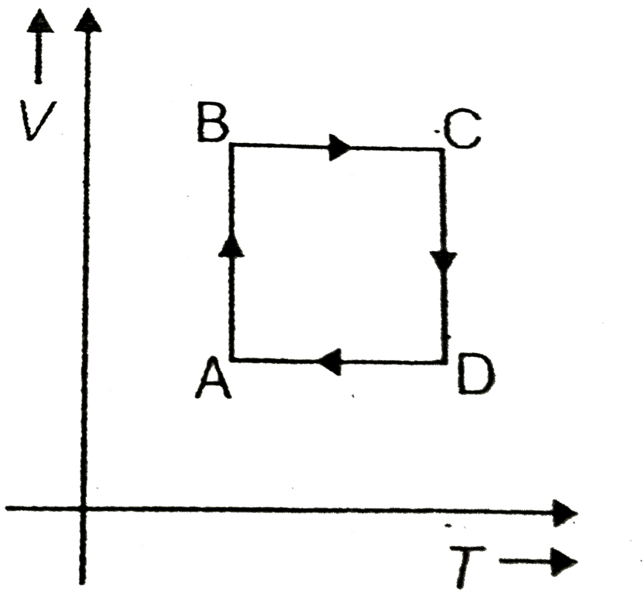
2. A cyclic process ABCDA is shown in figure



Which of the following statement is correct?

A. Net work done by gas is negative

B. net work done by gas is positive

C. Above process represents a cycle usable for engine

D. Above process represents a cycle usable for a refrigerator

Answer: A::D

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3. A closed bottle contains some liquid. We shake bottle vigorously for some time. It is found that temperature of liquid is increased (neglect expansion on heating). If Q, ΔU and W represent heat, change in internal energy and work done, then

A. $Q = 0$

B. W is negative

C. ΔU is positive

D. We cannot apply $Q = \Delta U + W$ on liquids

Answer: A::B::C

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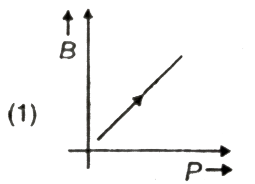
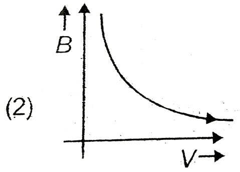
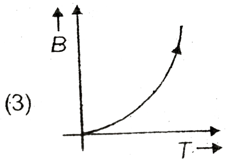
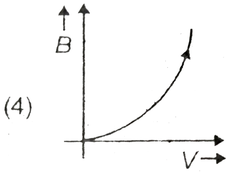
4. A sample of gas follow process represented by PV^2 = constant . Bulk modulus for this process is B, then which of the following graph is correct ?

A. 

B. 

C. 

D. 

Answer: A::B::C

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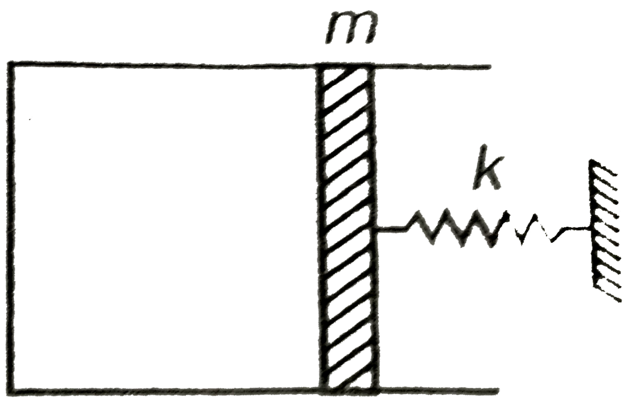
5. An ideal gas is enclosed in a thermally insulated container. Container is covered by an insulating piston which is connected with spring. Small displacement is given to piston as shown in figure. Which of the following statements is correct? Neglect friction everywhere.



A. Motion of piston is oscillatory

B. Motion of piston is S.H.M. for small displacement

C. Motion of piston can not be S.H.M.

D. Piston will not oscillate at all

Answer: A::B

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6. During the melting of a slab of ice at 273K at atmospheric pressure,

A. Work done by atmosphere on system is positive

B. Work done by atmosphere on system is negative

C. Change in internal energy is equal to mL (m=mass, L=latent heat)

D. Change in internal energy is greater than mL

Answer: A::D

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

A. $\sum W = 0$

B. $\sum Q = 0$

C. $\sum Q_{+ve} > \sum W$

D. $\sum \Delta U = 0$

Answer: C::D

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8. A thermally insulated vessel containing diatomic gas of molar mass M is moving with velocity v. the temperature of gas is T. if it is suddenly stopped, then

A. Internal energy of gas is equal to $\frac{5nRT}{2}$ when vessel is moving

B. There is no change in temperature if vessel is suddenly stopped

C. There is rise in temperature if vessel is suddenly stopped

D. Temperature increase is due to heat input

A. a. Internal energy of gas is equal to $\frac{5nRT}{2}$ when vessel is moving

B. b. There is no change in temperature if vessel is suddenly stopped

C. c. There is rise in temperature if vessel is suddenly stopped

D. d. Temperature increase is due to heat input

Answer: A::C

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9. A monatomic gas is expanded adiabatically and due to expansion volume becomes 8 times, then

A. a.Pressure becomes $\frac{1}{32}$ times

B. b.Total K.E. of gas molecules becomes $\frac{1}{4}$ times

C. c.Ratio of translational and roational kinetic energy changes with variation in temperature

D. d.None of These

Answer: A::B

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10. One mole of argon is expanded according to process equation $PV^{1.5} =$ constant and its temperature falls by 26 K, then

A. Heat exchanged is 108 J

B. Heat exchanged is zero

C. Work done by gas is 432 J

D. Work done by gas is 39 J

Answer: A::C

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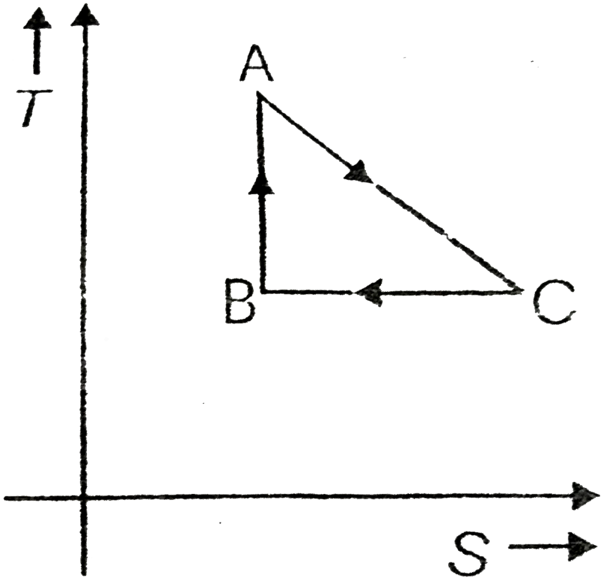
11. As area under P-V diagram represent work done by gas in a thermodynamic process, area under temperature (T) entropy (S) graph represents heat supplied to the thermodynamic system. Consider the following graph



A. Process AB is isochoric

B. Process BC is isothermal

C. Process AB is adiabatic

D. heat is absorbed by the gas during the process

ACBA

Answer: B::C::D

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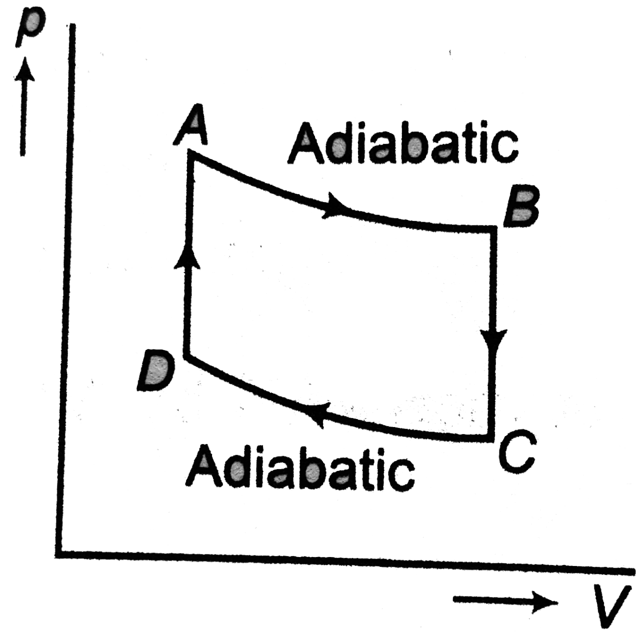
Assignment Section D Linked Comprehension Type Questions

1. One mole of a monoatomic ideal gas is taken through the cycle ABCDA as shown in the figure.

$T_A = 1000K$ and $2p_A = 3p_B = 6p_C$



$$\left[Assume\left(\frac{2}{3}\right)^{0.4} = 0.85 \text{ and } R = \frac{25}{3} JK^{-1}mol^{-1}\right]$$

The temperature at B is

A. 350 K

B. 1175 K

C. 850 K

D. 577 K

Answer: C

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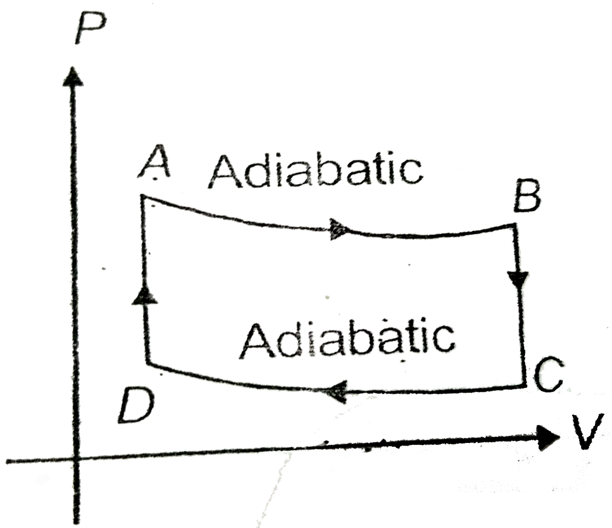
2. One mole of a monoatomic ideal gas is taken through the cycle ABCDA as shown in the figure.

$T_A = 1000K$ and $2p_A = 3p_B = 6p_C$



$$\left[Assume\left(\frac{2}{3}\right)^{0.4}=0.85 \text{ and } R=\frac{25}{3}JK^{-1}mol^{-1}\right]$$

Work done by the gas in the process $A \rightarrow B$ is

A. a. 5312.5 J

B. b. 1875 J

C. c. Zero

D. d. 8854J

Answer: B

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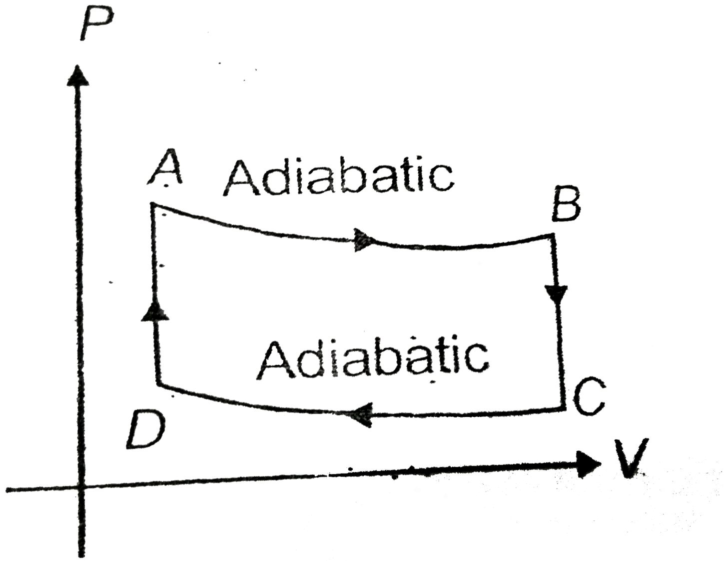
3. One mole of a monoatomic ideal gas is taken through the cycle ABCDA as shown in the figure.

$T_A = 1000K$ and $2p_A = 3p_B = 6p_C$



$$\left[Assume\left(\frac{2}{3}\right)^{0.4} = 0.85 \text{ and } R = \frac{25}{3} JK^{-1} mol^{-1}\right]$$

Heat lost by the gas in the process $B \rightarrow C$ is

A. a. 5312.5 J

B. b. 1875 J

C. c. Zero

D. d. 8854J

Answer: A

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Assignment Section E Assertion Reason Type Questions

1. Statement-1: Work and Heat are two equivalent form of energy.

Statement-2: Work is transfer of mechanical energy irrespective of temperature-differene whereas heat is transfer of thermal energy because of temperature difference only.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is NOT a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false

D. Statement-1 is false, statement-2 is true

Answer: A

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2. Statement-1: The internal energy of a system does not change when there is not change in temperature

Statement-2: The internal energy of a gaseous system is state function.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is NOT a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false

D. Statement-1 is false, statement-2 is true

Answer: D

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3. Statement-1: A refrigerator transfers heat from lower temperature to higher temperature.

Statement-2: Heat can be transferred from lower temperature to higher temperature by itself according to first law of thermodynamics.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is NOT a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false

D. Statement-1 is false, statement-2 is true

Answer: B

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4. Statement-1: For a gaseous system C_p is always greater than C_v

Statement-2: Work done by a gas at constant volume is zero.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is NOT a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false

D. Statement-1 is false, statement-2 is true

Answer: A

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5. Statement-1: Specific heat for adiabatic compression is negative.

Statement-2: Specific heat capacity for a gaseous system can have infinite values.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is NOT a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false

D. Statement-1 is false, statement-2 is true

Answer: D

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6. Statement-1: Two gases at same pressure, volume & temperature are compressed to same volume. The first isothermally and second adiabatically, greater work is done on the gas for an adiabatic process.

Statement-2: Final temperature for gas going under isothermal process is more than gas going under adiabatic process.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is NOT a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false

D. Statement-1 is false, statement-2 is true

Answer: C

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7. Assertion : Efficiency of a Carnot engine increase on reducing the temperature of sink. Reason : The efficiency of a Carnot engine is defined as ratio of net mechanical work done per cycle by the gas to the amount of heat energy absorbed per cycle from the source.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is NOT a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false

D. Statement-1 is false, statement-2 is true

Answer: B

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8. Assertion : The ratio C_P/C_v is more for helium gas than for hydrogen gas.

Reason : Atomic mass of helium is more than that of hydrogen.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is NOT a correct explanation for statement-1

C. Statement-1 is true, statement-2 is false

D. Statement-1 is false, statement-2 is true

Answer: B

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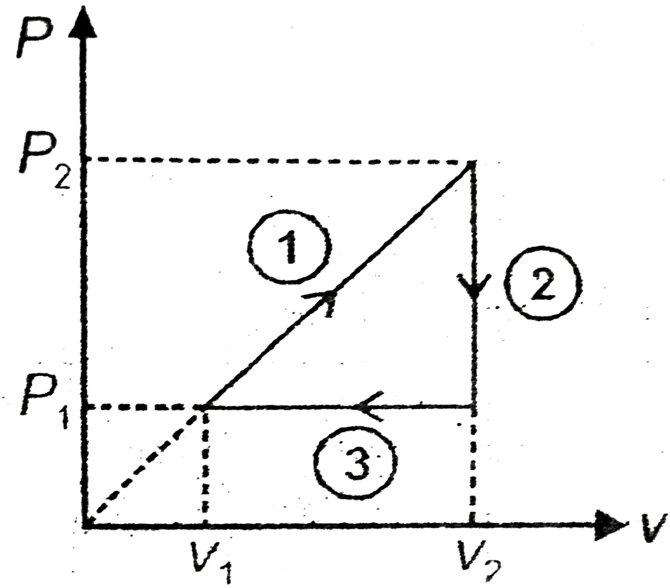
Assignment Section F Matrix Match Type Question

1. Consider cyclic process as depicted in figure. Match column-I and column-II for questions.



Q. Match the following

Column-I	Column-II
(A) ΔU_1	(p) Positive
(B) ΔU_2	(q) Negative
(C) ΔU_3	(r) Zero
(D) W during cycle	(s) Infinite

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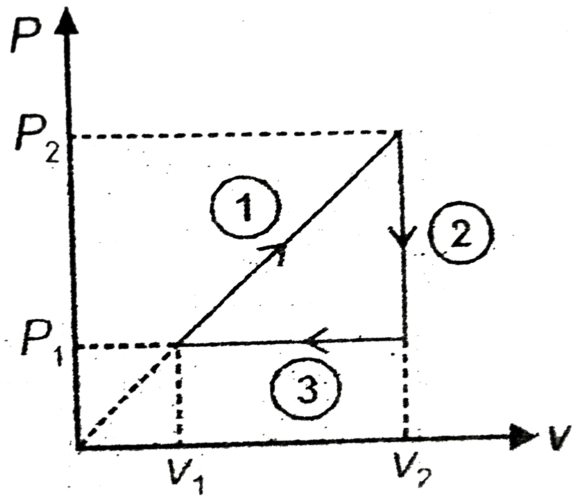
2. Consider cyclic process as depicted in figure. Match column-I and column-II for questions.



Q. Match the following

Column-I	Column-II
(A) Positive	(p) Q_1, W_1
(B) Negative	(q) Q_2
(C) Zero	(r) W_2
(D) Sign can't be predicted	(s) Q_3, W_3

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3. Match the following

Column-I	Column-II
(A) Free expansion of a gas	(p) $\Delta T = 0$
(B) Adiabatic compression	(q) Zero work done
(C) Isothermal compression	(r) $Q = 0$
(D) In a process initial and final volume is same	(s) Temperature increases
	(t) Work done by the gas is negative

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4. Match the following

Column-I	Column-II
(A) Isothermal expansion	(p) Internal energy Increases
(B) Adiabatic expansion	(q) Internal energy remains constant
(C) Isobaric expansion	(r) Change in internal energy, zero
(D) Isochoric expansion	(s) Internal energy decrease
(E) Cyclic Process	(t) Work done is zero

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5. Match the following

Column-I	Column-II
(A) Isothermal Compression	(p) $dQ = dw$
(B) Adiabatic process	(q) $dU = mL$
(C) Isochoric Process	(r) $dQ = dU$
(D) Cyclic Process	(s) $dQ < 0$
(E) Melting Process	(t) $\overline{dU} = -dW$

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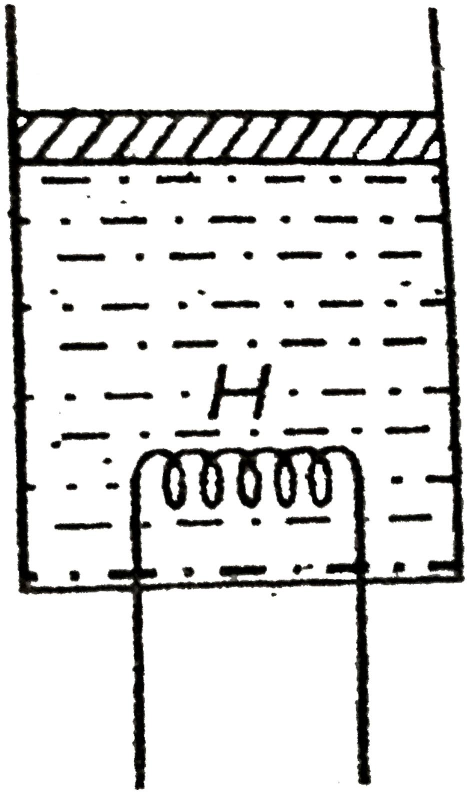
Assignment Section G Integer Answer Type Questions

1. 2 moles of a diatomic gas are enclosed in a cylinder piston arrangment. The area of cross section and mass of the piston are $1cm^2$ and 1 kg respectively. A heater is supplying heat to the gas very slowly. Find heat supplied (in joule) by the heater is the piston moves through a distance of 10 cm.



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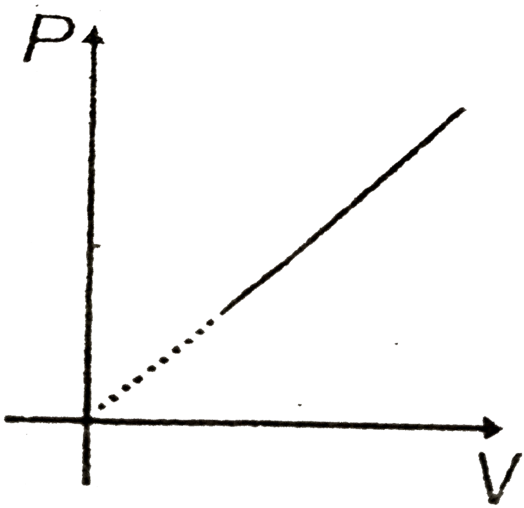
2. The variation of pressure versus volume is shown in the figure. The gas is diatomic and the molar specific heat capacity for the process is found to xR. Find the value of x.



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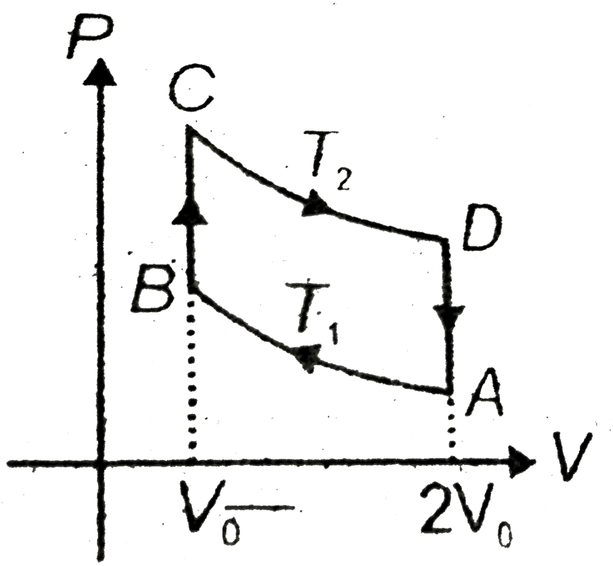
3. 4 millimoles of an ideal monoatomic gas is taken through a cyclic process ABCDA, is shown in the figure, AB and CD are two isothermal curves having temperature 300 K and 600 K respectively. The total work done by the gas during the cyclic process is $\frac{xR\log_e 2}{5}$. find the value of x



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Assignment Section H Multiple True False Type Question

1. Statement-1: Temperature of a system can be increased without supplying heat.

Statement-2: If the initial volume of system is equal to final volume in a process then work done is necessarily zero.

Statement-3: If an adiabatic curve for a gas intersect with an isothermal curve for the same gas then at the point of intersection, the ratio of slope of the adiabatic and the isothermal curve is γ.

A. FTF

B. TFT

C. TFF

D. TTT

Answer: B

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2. Statement-1: If the pressure and temperature of a gas sample are doubled then the volume of the gas will remain unchanged.

Statement-2: Molar specific heat for an adiabatic process is zero.

Statement-3: Heat energy is a path function.

A. FTF

B. TFT

C. TFF

D. FTT

Answer: D

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Assignment Section I Subjective Type

1. Two moles of an ideal gas are contained in a vertical cylinder with a frictionless piston. The piston is slowly displaced so that expansionin gas is isothermal at temperature $T_0 = 400$K. find the amount of work done in increasing the volume to 3 times.t ake atmospheric pressure $= 10^5 N / m^2$

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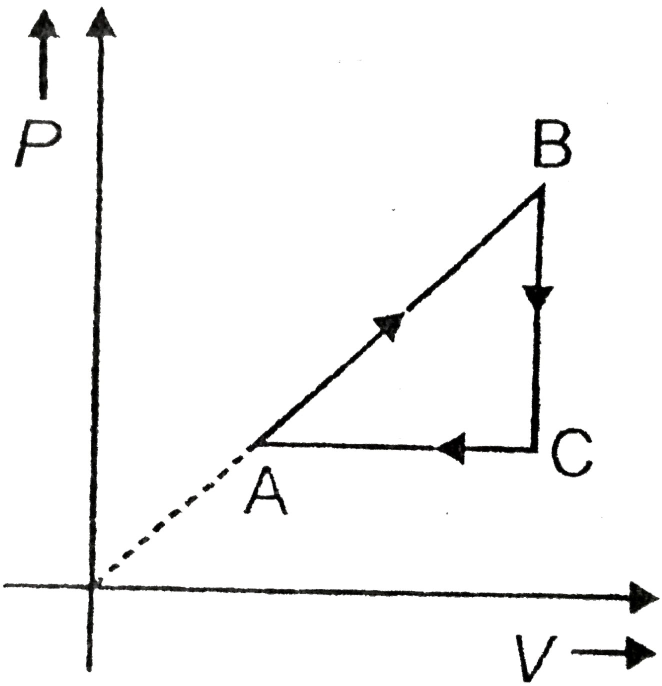
2. An ideal monoatomic gas goes through a cyclic process. Ratio of maximum temperature and minimum temperature is 2. find efficiency of cycle.



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3. One mole of an ideal monoatomic gas undergoes the process $T = T_0 + 4V$, where T_0 is initial temperature. Find

(i) Heat capacity of gas as function of its volume.

(ii) The amount of heat transferred to gas if its volume increases from V_0 to $4V_0$.

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4. Two moles of a certain gas at a temperature $T_0 = 300K$ were cooled isochorically so that the pressure of the gas got reduced 2 times. Then as a result of isobaric process, the gas is allowed to expand till its temperature got back to the initial value. Find the total amount of heat absorbed by gas in this process.

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5. The volume of one mole of an ideal gas with the adiabatic exponent γ is changed according to the relation $V = \frac{a}{T}$, where a is a constant . Find the amount of heat absorbed by the gas in the process, if the temperature is increased by ΔT.

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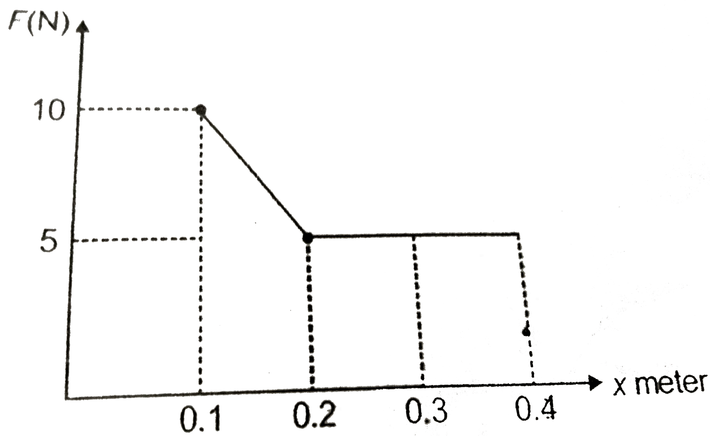
Assignment Section J Aakash Challengers Questions

1. The given figrue shows the variation of force exerted on the piston by an ideal gas (enclosed in a piston-cylinder arrangement) that undergoes a process during which piston position changes from 0.1 to 0.4 m. if the initial internal energy of the system is 3.25 J then find the net heat (in joule) absorbed during the process.



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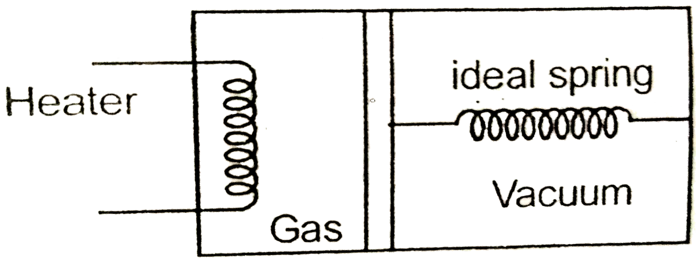
2. Consider a gas filled in a part of thermally insulated vessel with frictionless insulated piston (connected to a massless spring). Natural length of the spring equals length of the vessel. For 30 J of heat supplied, internal energy of gas increases by 25 J. find the number of atoms in one molecule.



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3. A cylinderical vessel made of thermally isulating material is divided into two equal parts by an insulating (moveable & smooth) piston. Both parts hae same ideal gas $\left(\frac{V_p}{C_v} = \frac{3}{2}\right)$. The gas in left part is supplied heat such that volume of right part becomes one fourth of initial value.

(PVT, PVT)

(1) In right part, the pressure becomes eight times of its inital value

(2) In right part, the temperature becomes two times

(3) In right part, work done by gas =3PV

(4) In right part, work done by gas=-2PV

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4. A polyatomic ideal gas with linear structure is being supplied that Q in a polytropic process. The work done upon gas is $\frac{Q}{N}$. The molar specific heat of the gas for the process is $\frac{N'NR}{2[N+1]}$. Then find the value of N' (here N is a constant).

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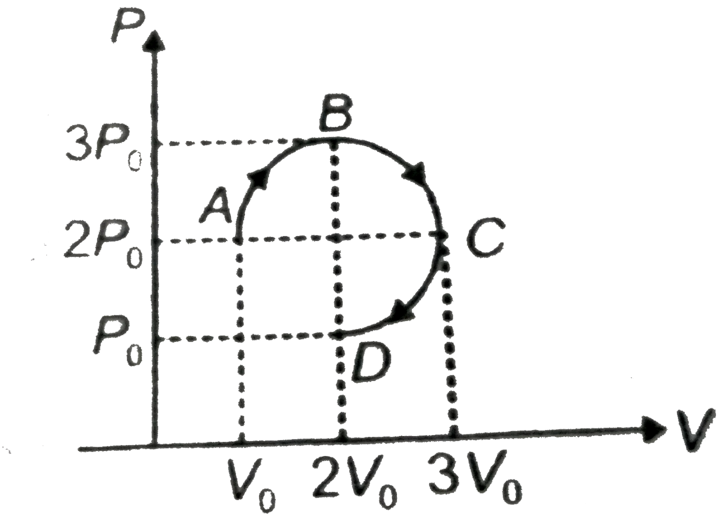
5. Helium gas is taken along the path $A \rightarrow B \rightarrow C \rightarrow$ D as shown the indicator diagram. Assume the gas to be ideal and take quantity 1 mole. The heat supplied to the gas is $\Delta Q = \frac{3\pi P_0 V_0}{x} + 2P_0V_0$ then find the value of x.



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6. Let F_1 be the magnitude of the gravitational force exerted on the Sun by Earth and F_2 be the magnitude of the force exerted on Earth by the Sun. Then:

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Try Yourself

1. What is the essential condition for thermodynamic equilibrium?

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2. If a body A is in thermal equilibrium with three different bodies B, C and D then

A. B is in thermal equilibrium with C

B. C is in thermal equilibrium with D

C. D is in thermal equilibrium with B

D. All of these

Answer: D

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3. An ideal gas is compressed in a closed container its U

A. increases

B. Decreases

C. Remains same

D. Both (1) & (2)

Answer: A

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4. if work is done by the system then W is

A. Positive

B. Negative

C. Zero

D. Depends upon the thermodynamic process

Answer: A

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5. For a gaseous system, change in internal energy and work done on the system are respectively 17 J and 41 J. find heat supplied / evolved from the system.

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6. Find $\frac{C_p}{C_v}$ for monatomic ideal gas.

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7. In an isothermal expansion change in internal energy and work done by the gas are respectively

A. (-)ve, (-) ye

B. 0, (+)ve

C. 0,(-)ve

D. (+) ve, (-) ve

Answer: B

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8. Draw at P-T curve for isochoric process.

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9. Draw at P-T curve for isobaric process.

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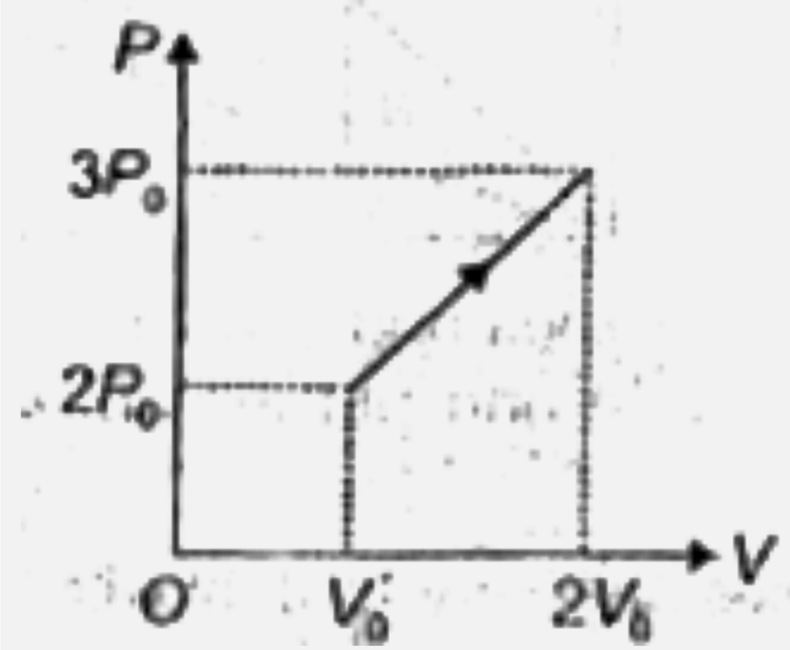
10. The PV-graph for a monatomic gas is shown in figure. Find the energy absorbed by the gas during this process.



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11. A carnot engine has efficiency of 80%. If its sink is at $127^\circ C$, the find the temperature of source.

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12. Find the efficiency of carnot engine whose source and sink are at $927^{\circ} C$ and $27^{\circ} C$.

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Exercise

1. When are the two bodies in thermal equilibrium?

A. Pressure

B. Volume

C. Temperature

D. Area

Answer: C

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2. Which of the following P-V curve best represents. As isothermal process?

A.

B.

C.

D.

Answer: C

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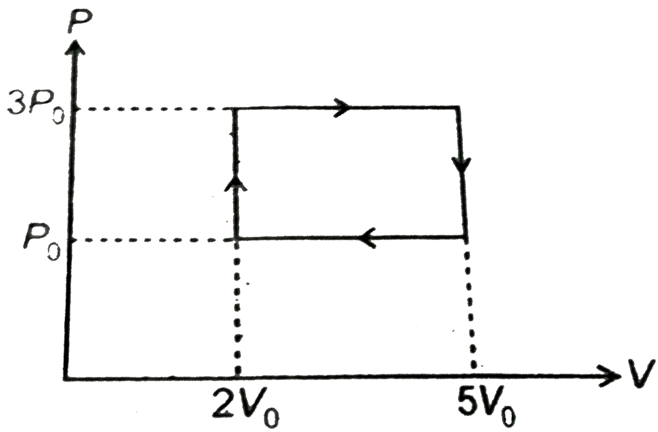
3. Work done in given cyclic process is



A. P_0V_0

B. $3P_0V_0$

C. $6P_0V_0$

D. $5P_0V_0$

Answer: C

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4. INDICATOR DIAGRAM

A. P -T curve

B. P - V curve

C. V - T curve

D. Q -T curve

Answer: B

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5. In an isothermal process for an ideal gas

A. $\Delta Q = 0$

B. $\Delta W = 0$

C. $\Delta U = 0$

D. $\Delta V = 0$

Answer: C

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6. When gas in a vessel expands, it internal energy decreases. The process involved is

A. Isobaric

B. Isochoric

C. Isothermal

D. Adiabatic

Answer: D

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7. Which of the following laws of thermodynamics defines the term internal energy?

A. Zeroth law

B. First law

C. Second law

D. Third law

Answer: B

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8. Select the incorrect statement

A. For isothermal process of ideal gas, $\Delta U = 0$

B. For isochoric process, $W = 0$

C. For adiabatic process, $\Delta U = -\Delta W$

D. For cyclic process, $\Delta W = 0$

Answer: D

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9. Which of the following is not a path function ?

A. ΔQ

B. $\Delta Q + W$

C. W

D. ΔU

Answer: D

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10. What is the work done by 0.2 mole of a gas at room temperature to double its volume during isobaric process? (Take R=2 cal $mol^{-1}.^{\circ}C^{-1}$)

A. 30 cal

B. 40 cal

C. 120 cal

D. 160 cal

Answer: C

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11. The value of η may lie between

A. 0 to 1

B. 1 to ∞

C. $-1 \text{ to } +1$

D. 0 to ∞

Answer: A

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12. If a Carnot engine works between $127^{\circ}C$ and $727^{\circ}C$, then its efficiency is

A. 0.6

B. 0.4

C. 0.5

D. 0.75

Answer: A

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13. If the temperature of sink is at absolute zero, then the efficiency of carnot engine will be

A. 0

B. 1

C. 0.5

D. 0.75

Answer: B

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14. A carnot engine whose sink is at 300 K has an efficiency of 50%. by how much should the temperature of source be increased so as the efficiency becomes 70% ?

A. 100K

B. 200K

C. 300K

D. 400K

Answer: D

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15. A Carnot engine takes 9000 cal of heat from a reservoir at 627° C and gives it to a sink at $27^\circ C$. The work done by the angine is

A. 6 kcal

B. 3 kcal

C. 4 kcal

D. 8 kcal

Answer: A

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16. A process can be reversible if

A. It is quasi-static

B. Non-dissipative

C. Both (1) & (2)

D. Neither (1) nor (2)

Answer: C

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17. In practise, all heat engines have efficiency less than that of a carnot engine because

A. Carnot engine is ineversible

B. A reversible process can never be attained in a real world

C. irrveversible engine has higher efficiency than reversible engine has higher efficiency than reversible engine

D. Efficiency of Carnot engine is always one

Answer: B

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18. The effiency of reversible engine is___the irreversible engine.

A. Less than

B. Greater than

C. Equal to

D. Negligible than

Answer: B

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19. A carnot cycle consists of

A. Two stages

B. Four stages

C. Six stages

D. Eight stages.

Answer: B

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20. A carnot engine is working in such a temperature of sink that its efficiency is maximum and never changes with any non-zero temperature of source. The temperature of sink will most likely to be

A. 0 K

B. $0^{\circ} C$

C. $0^{\circ} F$

D. Data insufficient

Answer: A

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Assignment Section A Objective Type Questions

1. If W si work done by the system $(-ve)$, the mathematical respresentation of the first law of thermodynamics is//are

A. Work done

B. Thermal equilibrium

C. Entropy

D. Diffusion

Answer: B

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2. In a cylic process, ______.

A. $\Delta U = 0$

B. $\Delta Q = 0$

C. $W = 0$

D. Both (1) & (3)

Answer: A

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3. Select the incorrect relation. (Where symboles have their usual meanings):-

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

B. $C_P - C_V = R$

C. $\Delta U = \dfrac{P_f V_f - P_i V_i}{1-\gamma}$

D. $C_v = \dfrac{R}{\gamma - 1}$

Answer: C

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4. The internal energy of non-ideal gas depends on

A. Temperature

B. Pressure

C. Volume

D. All of these

Answer: D

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5. For an adiabatic expansion of an ideal gas the fractional change in its pressure is equal to

A. $-\gamma \frac{V}{dV}$

B. $-\frac{dV}{\gamma V}$

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

D. $-\gamma \frac{dV}{V}$

Answer: D

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6. Which of the following laws of thermodynamics defines the term internal energy?

A. Zeroth law

B. Second law

C. First law

D. Third law

Answer: C

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7. Select the correct statement for work, heat and change in internal energy

A. Heat supplied and work done depend on initial and final states

B. Change ininternal energy depends on the initial and final states only

C. Heat and work depend on the path between the two points

D. All of these

Answer: D

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8. Morning breakfast gives 5000 cal to a 60 kg. person. The efficiency of person is 30%. The height upto which the person can climb up by using energy obtained from breakfast is

A. 5m

B. 10.5m

C. 15 m

D. 16.5 m

Answer: B

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9. Select the incorrect statement about the specific heat of a gaseous system :

A. Specific heat no exchange condition, $C_A = 0$

B. Specific heat at constant temperature , $C_7 = \infty$

C. Specific heat at constant pressure, $C_p = \dfrac{\gamma R}{\gamma - 1}$

D. Specific heat at constant volume, $C_v = \dfrac{R}{\gamma}$

Answer: D

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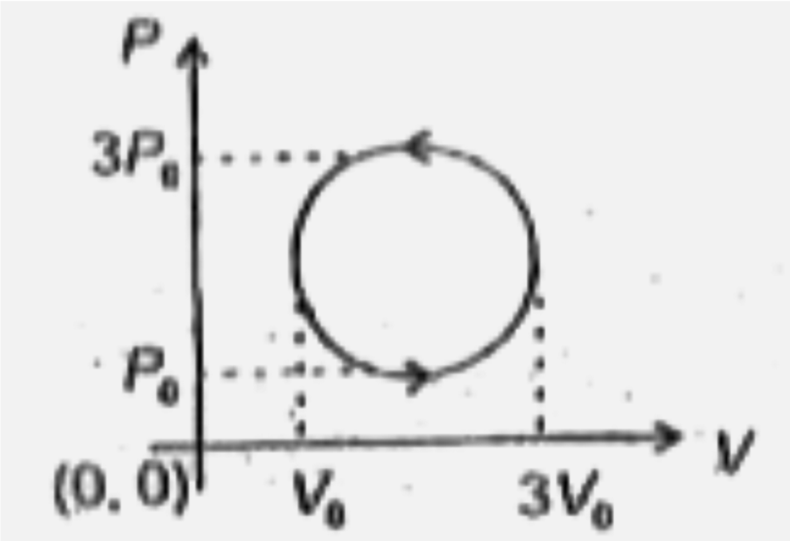
10. Work done in the cyclic process shown in figure is



A. $4P_0V_0$

B. $-4P_0V_0$

C. $-\frac{22}{7}P_0V_0$

D. $-13P_0V_0$

Answer: C

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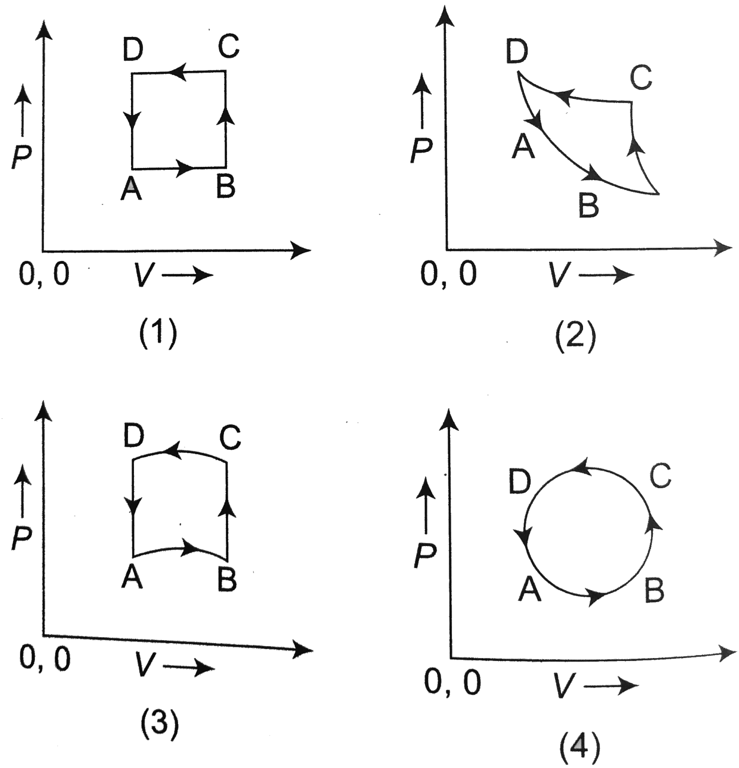
11. In following figs. Variation of volume by change of pressure is shown in Fig. A gas is taken along the path $ABCDA$. The change in internal energy of the gas will be:



A. Positive in all cases from (a) to (d)

B. Positive in cases (a), (b) and (c) but zero in case (d)

C. Negative in cases (a), (b) and (c) but zero in case (d)

D. Zero in all the four cases

Answer: D

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12. 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. 2J

B. 18J

C. 42J

D. 58J

Answer: B

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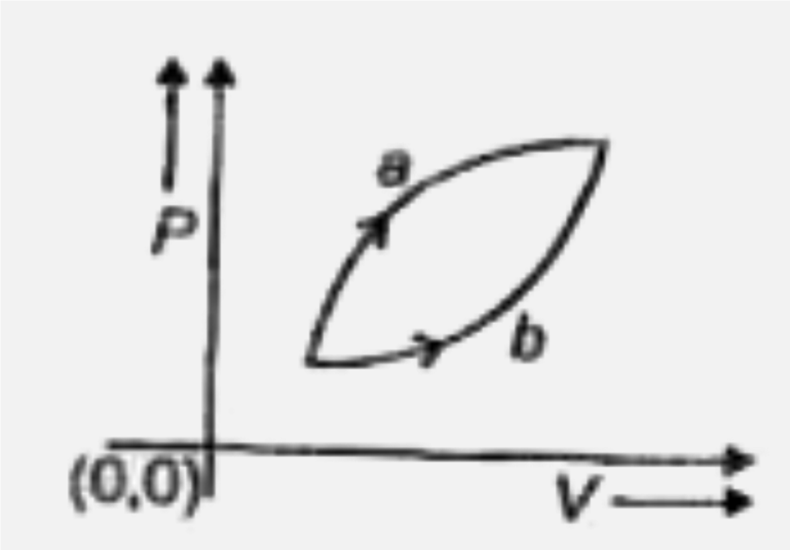
13. Figure shows two processes a and b for a given sample of gas. If $\Delta Q_1, \Delta Q_2$ are the amount of heat absorbed by the systemin the two cases , and $\Delta U_1, \Delta U_2$ are changes ininternal energy respeclively, then



A. $\Delta Q_1 = \Delta Q_2, \Delta U_1 = \Delta U_2$

B. $\Delta Q_1 > \Delta Q_2, \Delta U_1 > \Delta U_2$

C. $\Delta Q_1 < \Delta Q_2, \Delta U_1 < \Delta U_2$

D. $\Delta Q_1 > \Delta Q_2, \Delta U_1 = \Delta U_2$

Answer: D

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14. A gas undergoes a change at constant temperature. Which of the following quantities remain fixed ?

A. Pressure

B. Entropy

C. Heat exchanged with the system

D. All the above may change

Answer: D

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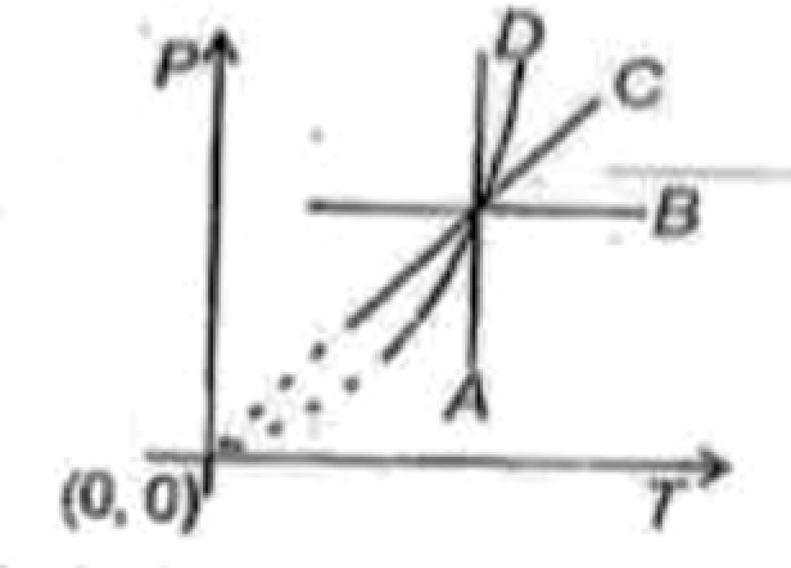
15. Following figure shows P-T graph for four processes A, B, C and D.Select the correct alternative



A. A - Isobaric process

B. B - Adiabatic process

C. C - Isochoric process

D. D - Isothermal process

Answer: C

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16. An ideal gas with adiabatic exponent γ is heated at constant pressure. It absorbs Q amount of heat. Fraction of heat absorbed in increasing the temperature is

A. γ

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

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

D. 2γ

Answer: B

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17. If $\overrightarrow{a}$ and $\overrightarrow{b}$ are two unit vectors and θ is the angle between them, then the unit vector along the angular bisector of $\overrightarrow{a}$ and $\overrightarrow{b}$ will be given by

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

B. $2T_0$

C. $\frac{T_0}{2}$

D. $\frac{5}{3}T_0$

Answer: D

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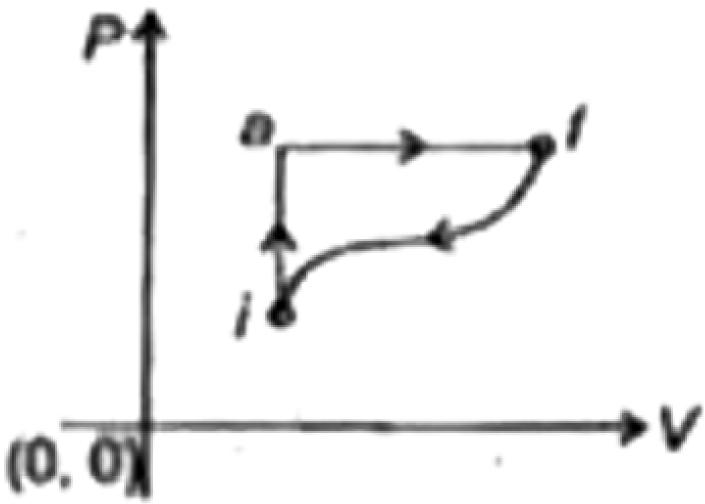
18. In the diagram shown $Q_{iaf} = 80$ cal and $W_{iaf} = 50$cal.

If W = - 30 cal for the curved path fi,value of Q for path fi,

will be



A. 60 cal

B. 30 cal

C. $-30cal$

D. $-60cal$

Answer: D

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19. A mass of dry air at N.T.P. is compressed to $\frac{1}{32}$ th of its original volume suddenly. If $\gamma = 1.4$ find the final pressure of the gas if initial pressure is P.

A. 32 atm

B. 128 atm

C. $\frac{1}{32}$ atm

D. 150 atm

Answer: B

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20. 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. $P_A > P_B$

B. $P_A = P_B$

C. $P_A > P_B$

D. $P_A = 2P_B$

Answer: C

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21. The adiabatic elasticity of hydrogen gas $(\gamma = 1.4)$ at NTP

A. Zero

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

C. $1.4 \times 10^5 N / m^2$

D. $2.75 \times 10^5 N / m^2$

Answer: C

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22. For an isomertric process

A. $\Delta W - \Delta U$

B. $\Delta Q = \Delta U$

C. $\Delta Q = \Delta W$

D. $\Delta Q = -\Delta U$

Answer: B

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23. A mixture of gases at NTP for which $\gamma = 1.5$ si suddenly compressed to $\frac{1}{9}th$ of its original volume. The final temperature of mixture is

A. $300^\circ C$

B. $546^\circ C$

C. $420^\circ C$

D. $872^{\circ} C$

Answer: B

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24. In which process P-V diagramis a stright line parallel to the volume axis ?

A. Iochoric

B. Isobaric

C. Isothermal

D. Adiabatic

Answer: B

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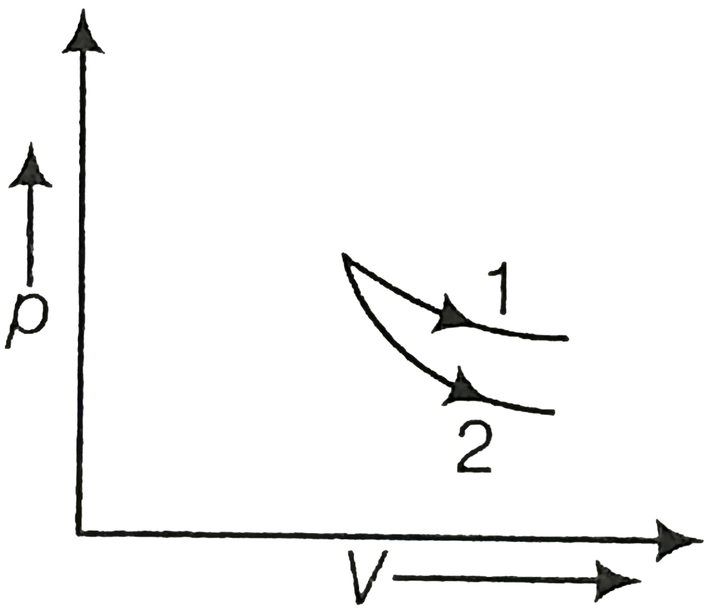
25. p-V plots for two gases during adiabatic process as shown in figure plots 1 and 2 should correspond respectively to



A. O_2 and He

B. He and O_2

C. O_2 and CO

D. N_2 and O_2

Answer: A

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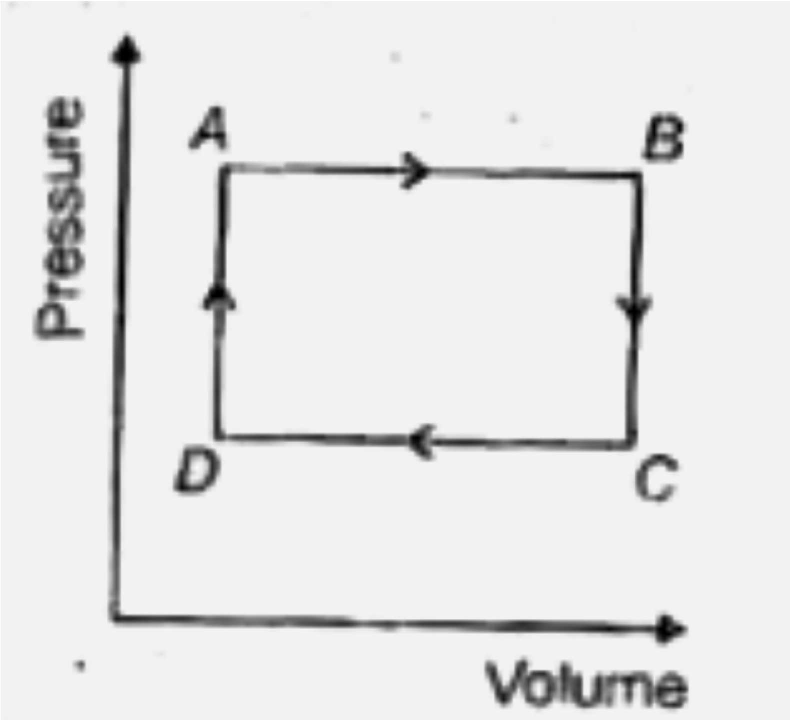
26. The pressure and volume of a gas are changed as shown in the p-V diagram in the figrue ahead. The thmperature of the gas



A. Increase as it goes from A to B

B. Increase as it goes from B to C

C. Remain constant during these changes

D. Decrease as it goes from D to A

Answer: A

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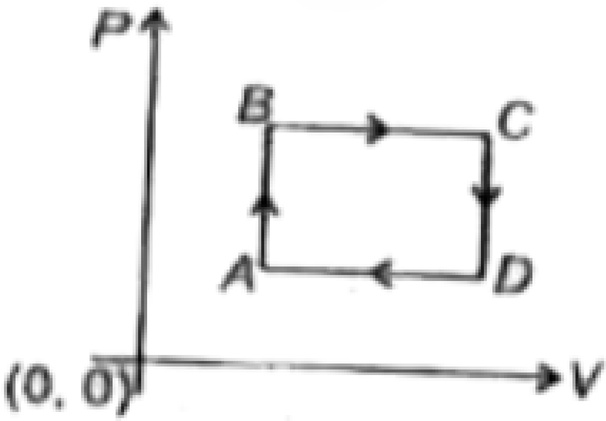
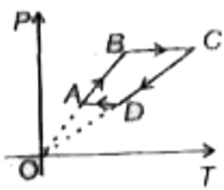
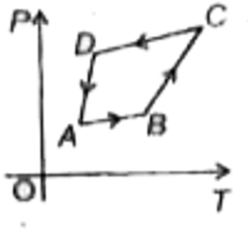
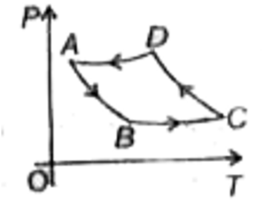
27. The figure shows P-V diagram of a thermodynamic cycle. Which corresponding curve is correct ?

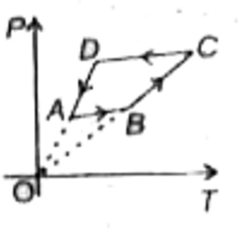




A.

B. 

C. 

D. 

Answer: A

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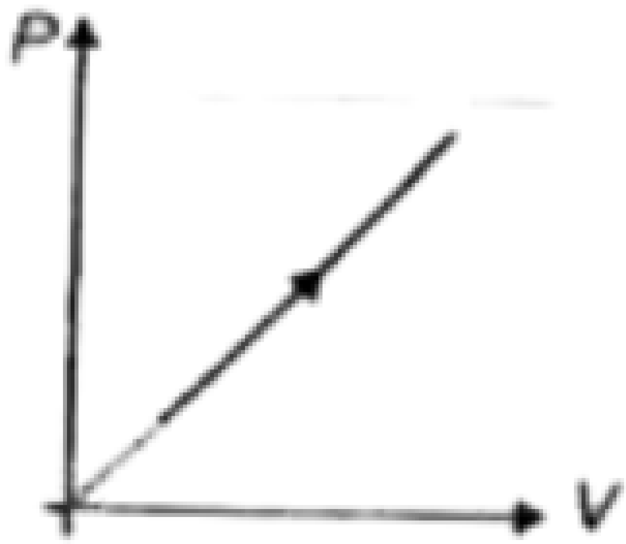
28. During the thermodynamic process shown in figure for an ideal gas



A. $\Delta T = 0$

B. $\Delta Q = 0$

C. $W < 0$

D. $\Delta U > 0$

Answer: D

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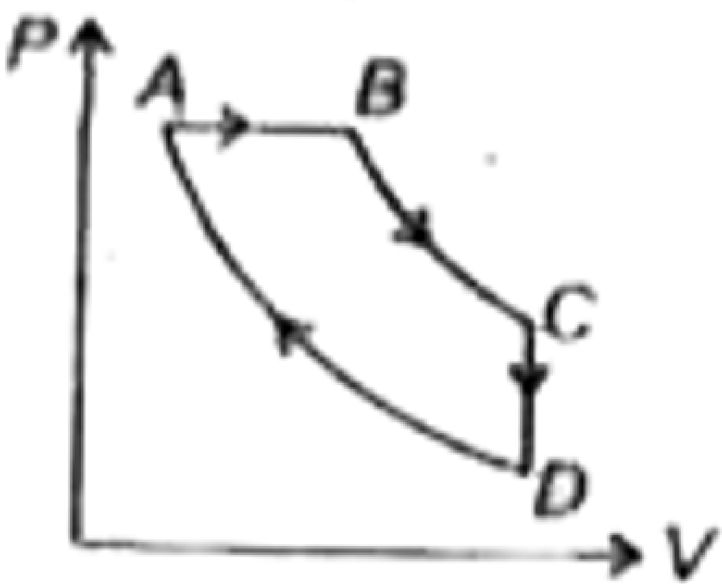
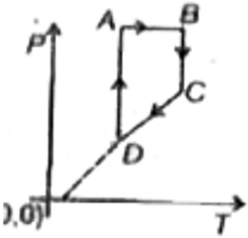
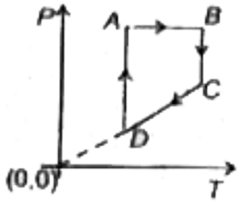
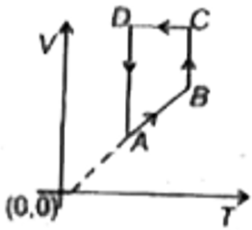
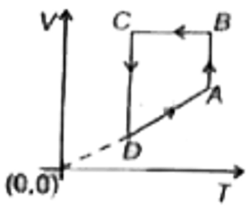
29. For P-V diagram of a thermodynamic cycle as shown in figure,process BC and DA are isothermal. Which of the corresponding graphs is correct?



A. 

B. 

C. 

D. 

Answer: B

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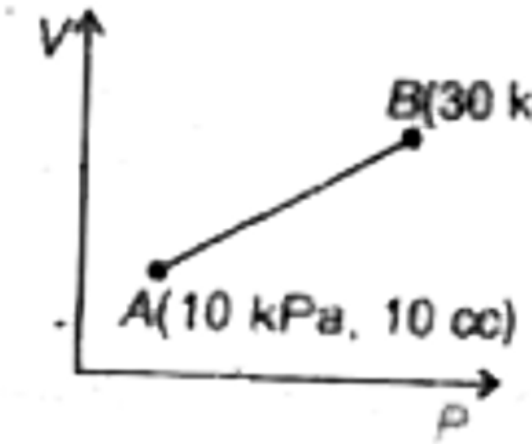
30. Work done for the process shownin the figure is



A. 1J

B. 1.5 J

C. 4.5J

D. 0.3J

Answer: D

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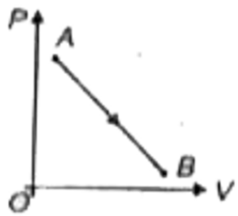
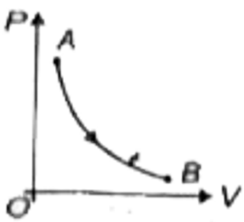
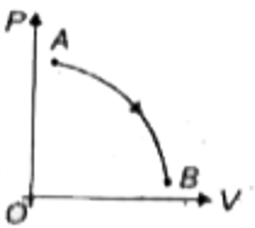
31. During which of the following thermodynamic process represented by PV diagram the heat energy absorbed by system may be equal to area under PV graph?



A.



B.



C.

D. All of these

Answer: D

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32. The specific heat of a gas in a polytropic process is given by-

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

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

C. $\frac{R}{\gamma-1}-\frac{R}{N-1}$

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

Answer: C

33. For a certain process, pressure of diatomic gas varies according to the relation $P = aV^2$, where a is constant. What is the molar heat capacity of the gas for this process ?

A. $\frac{17R}{6}$

B. $\frac{6R}{17}$

C. $\frac{13R}{6}$

D. $\frac{16R}{7}$

Answer: A

34. In a thermodynamic process two moles of a monatomic ideal gas obeys $PV^{-2} = cons\tan t.$ If temperature of the gas increases from 300 K to 400 K, then find work done by the gas (Where R = universal gas constant)

A. 200 R/3

B. $-200R$

C. $-100R$

D. $-400R$

Answer: A

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35. entropy of a system decreases

A. When heat is supplied to a system at constant temperature

B. When heat is taken out from the system at constant temperature

C. At equilibrium

D. In any spontaneous process

Answer: B

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36. During an adiabatic process, the pressure of gas is found to be proportional to the cube of its absolute temperature. The ratio of $(C_{p,m}/C_{v,m})$ for gas is :

A. 2

B. 1.5

C. 1.67

D. 2.1

Answer: A

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37. If the efficiency of a carnot engine is η,then the coefficient of performance of a heat pump working between the same temperatures will be

A. $1-\eta$

B. $\dfrac{1-\eta}{\eta}$

C. $\dfrac{1}{\eta}$

D. $1+\dfrac{1}{\eta}$

Answer: C

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38. In a carnot engine, when heat is absorbed from the source, its temperature

A. increases

B. Decreases

C. Remains constant

D. Cannot say

Answer: C

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39. A Carnot engine working between K 300 and 600 K has work output of 800 J per cycle. What is amount of heat energy supplied to the engine from source per cycle

A. 800 J

B. 1600 J

C. 3200 J

D. 6400J

Answer: B

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40. An ideal gas heat engine operates in a Carnot's cycle between $227^{\circ}C$ and $127^{\circ}C$. It absorbs $6 \times 10^{4} J$ at high temperature. The amount of heat converted into work is

A. 4.8×10^4 cal

B. 3.5×10^4 cal

C. 1.6×10^4 cal

D. 1.2 xx 10^4` cal

Answer: D

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41. The maxium possible efficiency of a heat engine is

A. 1

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

C. $\frac{T_1}{T_2} + 1$

D. Dependent upon the temperature of source (T_1)

Answer: D

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42. A frictionless heat engine can be 100% efficient only if its exhaust temperature is

A. Equal to its input temperature

B. Less than its input temperature

C. 0 K

D. $0^\circ C$

Answer: C

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43. The effiency of reversible engine is___the irreversible engine.

A. two engines are same

B. reversible engine is greater

C. Irreversible engine is greater

D. two engines cannot be compared

Answer: B

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44. Which of the following can be coefficient of perfomace refrigerator?

A. 1

B. 0.5

C. 9

D. All of these

Answer: D

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45. The temperature inside and outside a refrigerator are 273 K and 300 K respectively. Assuming that the refrigerator cycle is reversible. For every joule of work done heat delivered to the surrounding will be nearly :-

A. 11 J

B. 22 J

C. 33 J

D. 50 J

Answer: A

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46. By opening the door of a refrigerator placed inside a room you

A. Can cool the room to certain degree

B. Can cool it to the temperature inside the refrigerator

C. Ultimately warm the room slightly

D. Can neither cool nor warm the room

Answer: C

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47. A Carnot engine whose sink is at $300K$ has an efficiency of 40%. By how much should the temperature of source be increased so as to increase its efficiency by 50% of original efficiency.

A. 150 K

B. 250 K

C. 300 K

D. 450 K

Answer: B

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Assignment Section B Objective Type Questions

1. A container is filled with 20 moles of an ideal diatomic gas at absolute temperature T. When heat is supplied to gas temperature remains constant but 8 moles dissociate into atoms. Heat energy given to gas is

A. 4 RT

B. 6 RT

C. 3 RT

D. 5 RT

Answer: A

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2. Liquid oxygen at 50K is heated at 300K at constant pressure of 1at. The rate of heating is constant. Which one of the following graphs represents the variation of temperature with time?

A. 

B. 

C. 

D. 

Answer: C

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3. In an isobaric process, the ratio of heat supplied to the system (dQ) and work done by the system (dW) for diatomic gas is

A. γ

B. $\gamma - 1$

C. $\dfrac{\gamma}{\gamma + 1}$

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

Answer: D

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4. 3 moles of an ideal gas are contained within a cylinder by a frictionless piston and are initially at temperature T . The pressure of the gas remains constant while it is heated and its volume doubles . If R is molar gas constant , the work done by the gas in increasing its volume is

A. $\frac{3}{2}RT$ ln 2

B. $3RT$ ln 2

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

D. 3 RT

Answer: D

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5. Two moles of a gas at temperature T and volume V are heated to twice its volume at constant pressure. If $\frac{C_p}{C_v}=\gamma$ then increase in internal energy of the gas is-

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

B. $\frac{2RT}{\gamma - 1}$

C. $\frac{2RT}{3(\gamma - 1)}$

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

Answer: B

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6. A triatomic, diatomic and monoatomis gas is supplied same amount of heat at constant pressure then

A. Fractional energy used to change internal energy is maximum in monatomic gas

B. Fractional energy used to change internal energy is maximum in diatomic gas

C. Fractional energy used to change internal energy is maximum is triatomic gases

D. Fractional energy used to change internal energy is same in all the three gases

Answer: C

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7. 105 calories of heat is required to raise the temperature of 3 moles of an ideaol gas at constant pressure from $30^{\circ}C$ to $35^{\circ}C$. The amount of heat required in calories to raise the temperature of the gas though the range $(60^\circ C \text{ to } 65^\circ C)$ at constant volume is $\left(\gamma = \frac{C_p}{C_v} = 1.4\right)$

A. 50 cal

B. 75 cal

C. 70 cal

D. 90 cal

Answer: B

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8. To an ideal triatomic gas 800 cal heat energy is given at constant pressure . If vibrational mode is neglected , then energy used by gas in work done against surroundings is

A. 200 cal

B. 300 cal

C. 400 cal

D. 60 cal

Answer: A

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9. N moles of a diatomic gas in a cylinder are at a temperature T. Heat is supplied to the cylinder such that the temperature remains constant but n moles of the diatomic gas get converted into monoatomic gas. What is the change in the total kinetic energy of the gas?

A. $\frac{5}{2}(N-n)RT$

B. $\frac{5}{2}$ n RT

C. $\frac{1}{2}$ n RT

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

Answer: C

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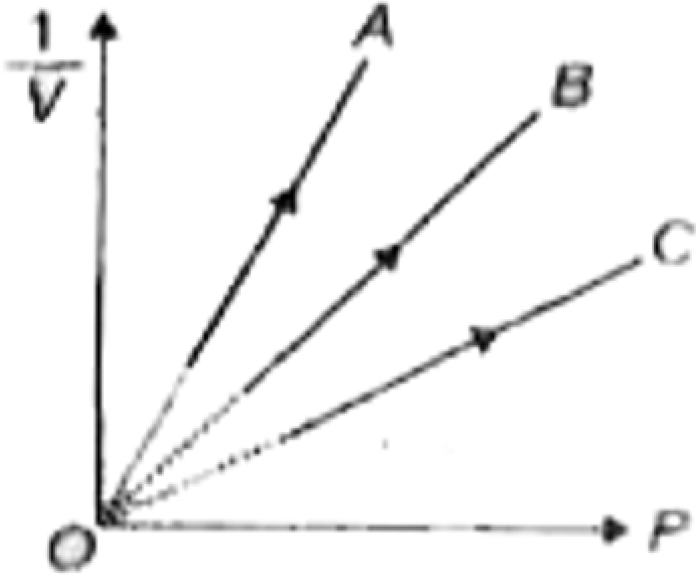
10. Figure shows the isotherms of a fixed mass of an ideal gas at three temperatures T_A, T_B and T_C , then



A. $T_A > T_B > T_C$

B. $T_A < T_B < T_C$

C. $T_B < T_A < T_C$

D. $T_A = T_B = T_C$

Answer: B

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11. An ideal monatomic gas at 300 K expands adiabatically to 8 times its volume . What is the final temperature ?

A. 75 K

B. 300 K

C. 560 K

D. 340 K

Answer: A

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12. Slope of isotherm for a gas (having $\gamma = \frac{5}{3}$) is $3 \times 10^5 N/m^2$. If the same gas is undergoing adiabatic change then adiabatic elasticity at that instant is

A. $3 \times 10^5 N/m^2$

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

C. $6 \times 10^5 N/m^2$

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

Answer: B

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13. A gas may expand either abiabatically or isothermally .A number of P-V curves are drawn for the two processes over different ranges of pressure and volume . It will be found that :

A. An adiabatic curve and an isothermal curve may intersect

B. Two adiabatic curves do not intersact

C. Two isothermal curves do not intersect

D. All of these

Answer: D

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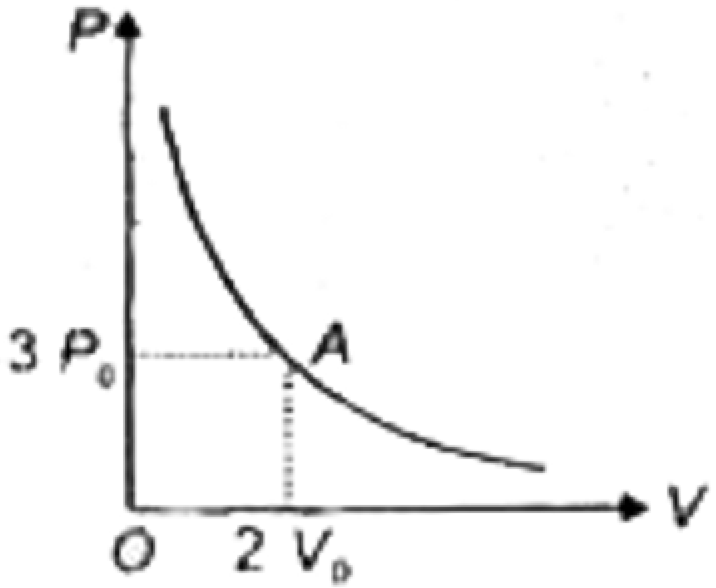
14. The variation of pressure P with volume V for an ideal monatomic gas during an adiabatic process is shown in figure . At point A the magnitude of rate of change of pressure with volume is



A. $\dfrac{3P_0}{6V_0}$

B. $\dfrac{5P_0}{3V_0}$

C. $\frac{3P_0}{2V_0}$

D. $\frac{5P_0}{2V_0}$

Answer: D

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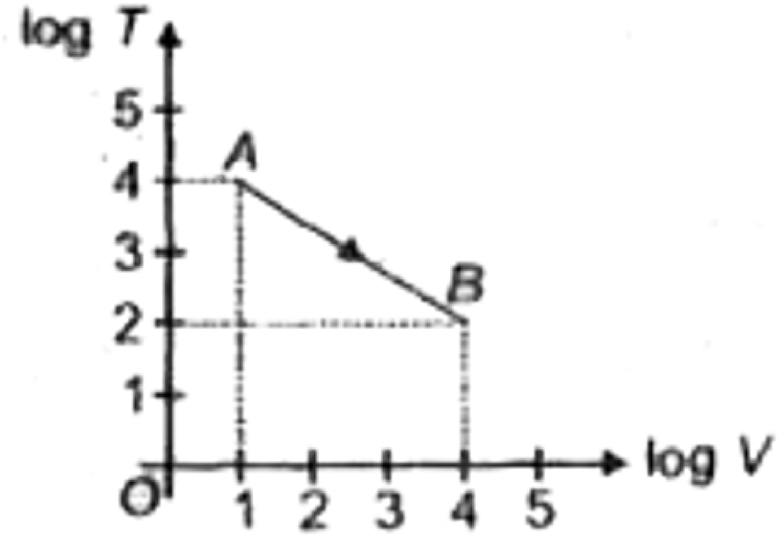
15. Figure shows , the adiabatic curve on log T and log V scale performed on ideal gas . The gas is



A. Monatomic

B. Diatomic

C. Polyatomic

D. Mixture of monatomic and diatomic

Answer: A

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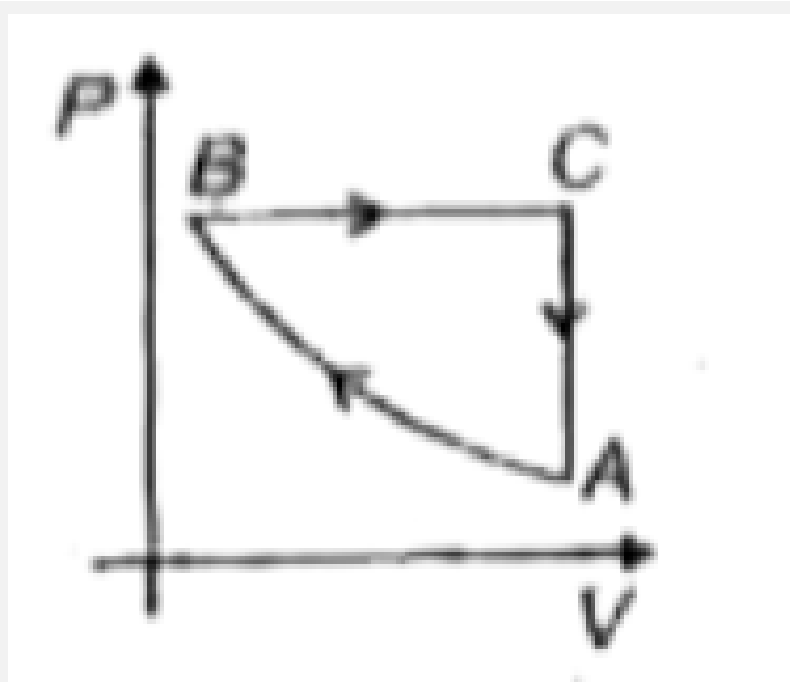
16. A cyclic process on an ideal monatomic gas is shown in figure . The correct statement is



A. Work done by gas in process AB is more than that in the process BC

B. Net heat energy has been supplied to the system

C. Temperature of the gas is maximum at state B

D. In process CA , heat energy is absorbed by system

Answer: B

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17. A diatomic gas undergoes a process represented by $PV^{1.3}$= constant . Choose the incorrect statement

A. The gas expands by absorbing heat from the surroundings

B. The gas cools down during expansion

C. The work done by surrounding during expansion of the gas is negative

D. None of these

Answer: D

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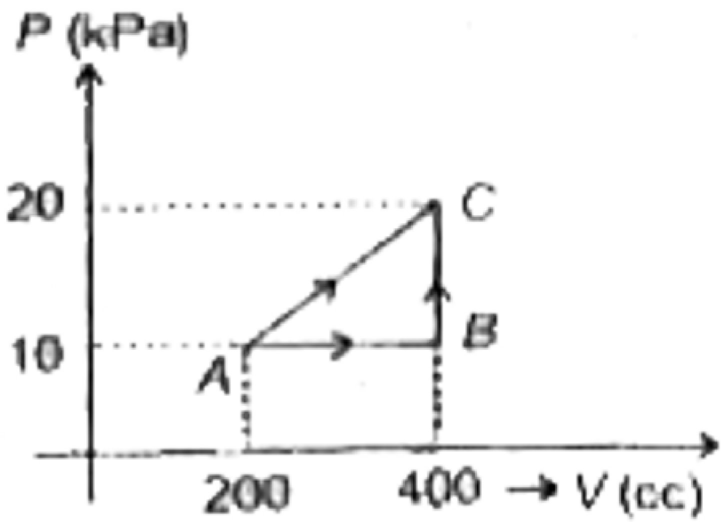
18. If a gas is taken from A to C through B then heat absorbed by the gas 8 J . Heat absorbed by the gas in taking it from A to C directly is



A. 8 J

B. 9 J

C. 11 J

D. 12 J

Answer: B

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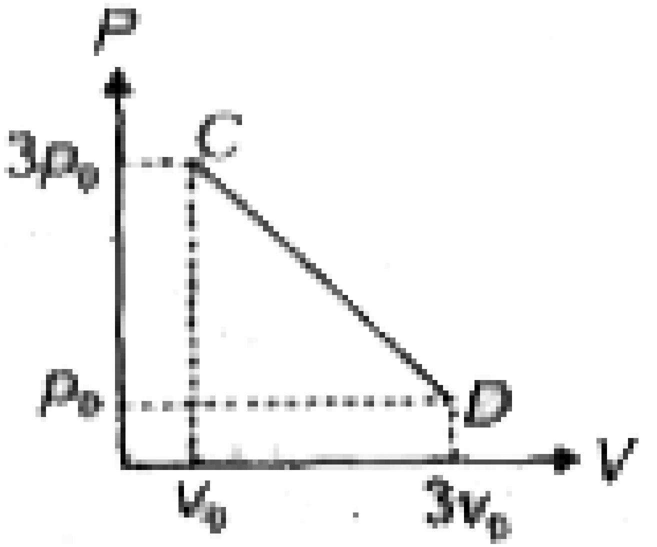
19. The process CD is shown in the diagram . As system is taken from C to D , what happens to the temperature of the system ?



A. Temperature first decreases and then increases

B. Temperature first increases and then decreases

C. Temperature decreases continuously

D. Temperature increases continuously

Answer: B

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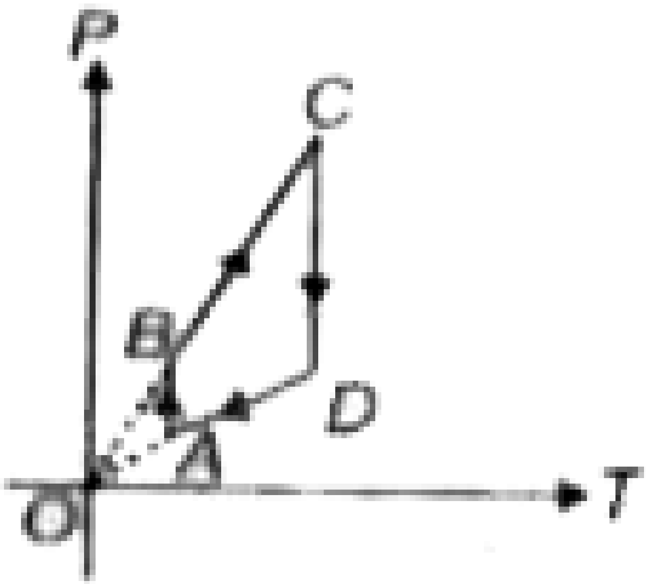
20. A. P . T graph is shown for a cyclic process . Select correct statement regarding the



A. During process CD , work done by gas is negative

B. During process AB , work done by the gas is positive

C. During process BC internal energy of system increases

D. During process BC internal energy of the system decreases

Answer: C

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21. A hydrogen cylinder is designed to withstand an internal pressure of 100 atm . At $27^{\circ}C$, hydrogen is pumped into the cylinder which exerts a pressure of 20 atm . At which temperature does the danger of explosion first sets in ?

A. 500 K

B. 1500 K

C. 1000 K

D. 2000 K

Answer: B

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22. An ideal gas of volume V and pressure P expands isothermally to volume 16 V and then compressed adiabatically to volume V . The final pressure of gas is [$\gamma = 1.5]$

A. P

B. 3P

C. $4P$

D. $6P$

Answer: C

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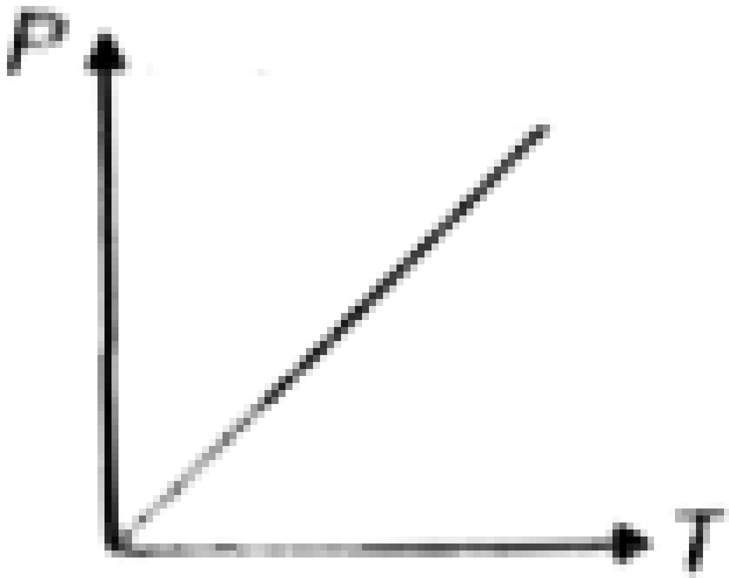
23. The pressure P of an ideal diatomic gas varies with its absolute temperature T as shown in figure . The molar heat capacity of gas during this process is [R is gas constant]



A. 1.7 R

B. 3.25 R

C. 2.5 R

D. 4.2 R

Answer: C

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24. An ideal gas expands according to the law P^2V = constant . The internal energy of the gas

A. Increases continuously

B. Decreases continuously

C. Remain constant

D. First increases and then decreases

Answer: A

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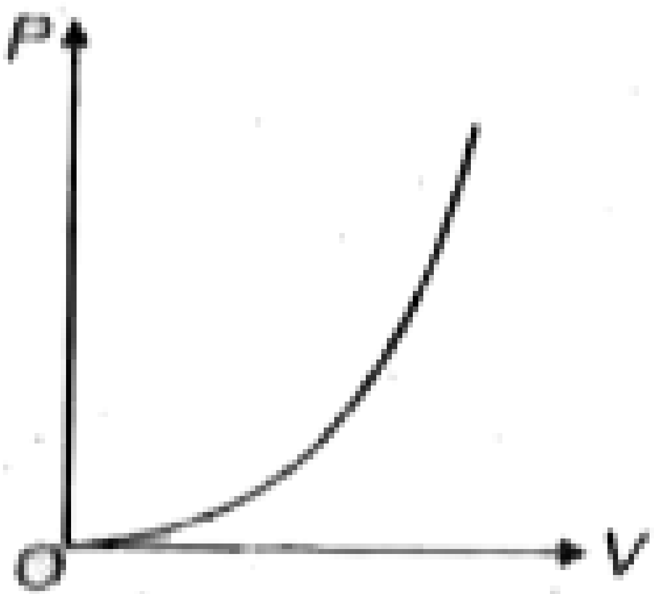
25. The variation of pressure P with volume V for an ideal diatomic gas is parabolic as shown in the figure . The molar species heat of the gas during this process is



A. $\frac{9R}{5}$

B. $\frac{17R}{6}$

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

D. $\frac{8R}{5}$

Answer: B

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26. Neon gas of a given mass expands isothermally to double volume . What should be the further fractional decreases in pressure , so that the gas when adiabatically compressed from that state , reaches the original state ?

A. $1 - 2^{-2/3}$

B. $1 - 3^{1/3}$

C. $2^{1/3}$

D. $3^{2/3}$

Answer: A

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27. When $1kg$ of ice at $0^{\circ}C$ melts to water at $0^{\circ}C$, the resulting change in its entropy, taking latent heat of ice to be $80cal/.^{\circ}C$, is

A. 293 cal/K

B. 273 cal/K

C. 8×10^{4} cal/K

D. 80 cal/K

Answer: A

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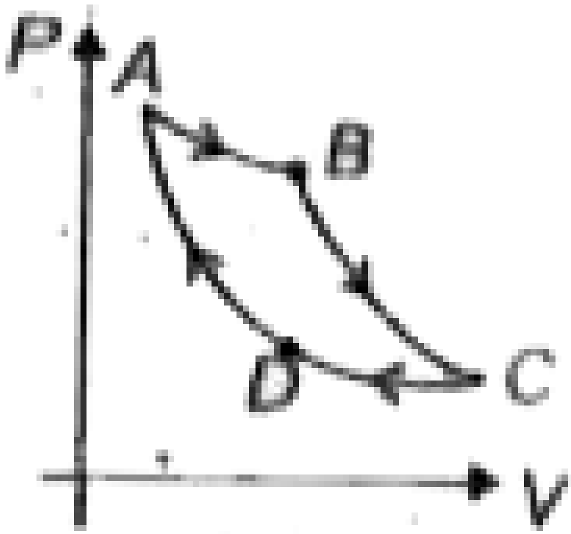
28. Carrot cycle is plotted in P-V graph . Which portion represents an isothermal expansion ?



A. AB

B. BC

C. CD

D. DA

Answer: A

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29. Efficiency of a heat engine working between a given source and sink is 0.5 . Coefficient of performance of the refrigerator working between the same source and the sink will be

A. 1

B. 0.5

C. 1.5

D. 2

Answer: A

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30. A heat engine rejects 600 cal to the sink at $27^{\circ}C$. Amount of work done by the engine will be

(Temperature of source is $227^{\circ}C$ & J = 4.2 J/cal)

A. 1680 J

B. 840 J

C. 2520 J

D. None of these

Answer: A

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Assignment Section C Previous Year Questions

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

A. 1 J

B. 90 J

C. 99 J

D. 100 J

Answer: B

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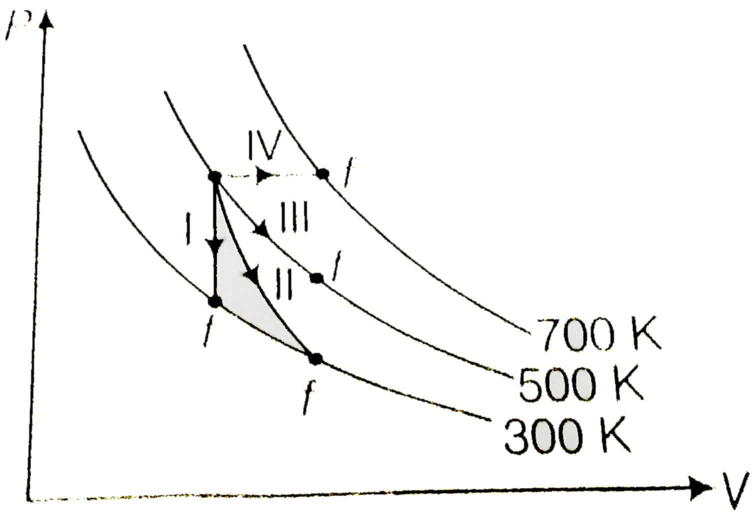
2. Thermodynamic processes are indicated in the following diagram



Match the following :

	Column-I		Column-II
P.	Process I	a.	Adiabatic
Q.	Process II	b.	Isobaric
R.	Process III	c.	Isochoric
S.	Process IV	d.	Isothermal

A. $P \to a, Q \to C, R \to d, S \to b$

B. $P \to c, Q \to a, R \to d, S \to b$

C. $P \to c, Q \to d, R \to b, S \to a$

D. $P \to d, Q \to b, R \to a, S \to c$

Answer: B

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3. One mole of an ideal monatomic gas undergoes a process descrbed by the equation $pV^3 =$ constant. The heat capacity of the gas during this process is

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

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

C. 2 R

D. R

Answer: D

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4. The temperature inside a refrigerator is t2 C and the room temperature is t1 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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5. A refrigerator works between $4^\circ C$ and $30^\circ C$. It is required to remove 600 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power requiredd is

(Take, 1 cal = 4.2 Joules)

A. 2365 W

B. 2.365 W

C. 23.65 W

D. 236.5 W

Answer: D

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

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

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

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

Answer: C

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7. 4.0 g of a gas occupies $22.4L$ at NTP. The specific heat capacity of the gas at constant volume is $50KJ^{-1}$. If the speed of sound in this gas at NTP is $952ms^{-1}$, then the heat capacity at constant pressure is

(Take gas constant $R = 8.3 JK^{-1} mol^{-1}$)

A. $8.5 JK^{-1} mol^{-1}$

B. $8.0 JK^{-1} mol^{-1}$

C. $7.5 JK^{-1} mol^{-1}$

D. $7.0 JK^{-1} mol^{-1}$

Answer: B

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8. the coefficient of performance of a refrigerator is 5. If the temperature inside freezer is $-20^{\circ} C$, the temperature of the surrounding to which it rejects heat is

A. $21^\circ C$

B. $31^\circ C$

C. $41^\circ C$

D. $11^\circ C$

Answer: B

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9. An ideal gas is compressed of half its initial volume by means of several process. Which of the process results in the maximum work done on the gas ?

A. Isothermal

B. Adiabatic

C. Isobatic

D. Isochoric

Answer: B

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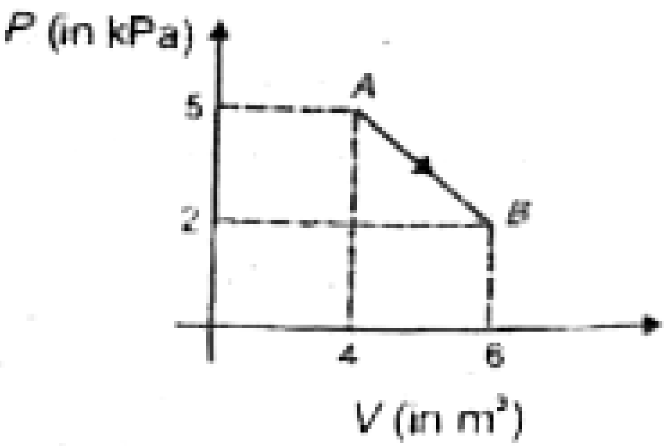
10. One mole of an ideal diatomic gas undergoes a transition from A to B along a path AB as shown in the figure



The change to internal energy of the gas during the transition is

A. $-12kJ$

B. $20kJ$

C. $-20kJ$

D. $20J$

Answer: C

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

A. $1J$

B. $100J$

C. $99J$

D. $90J$

Answer: D

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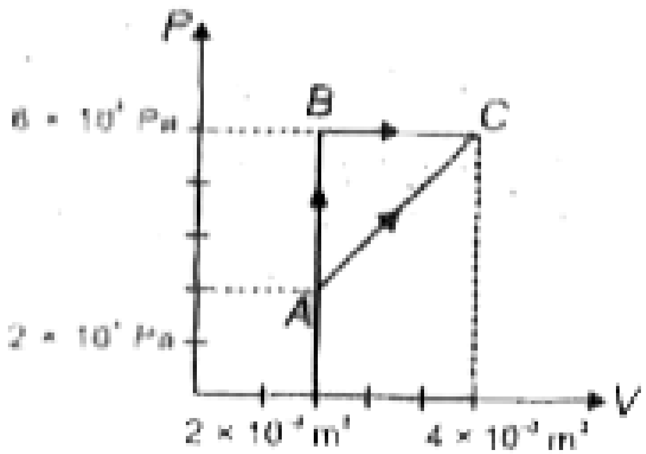
12. Figure below shows two paths that may be taken by a gas to go from a state A to a state C . In process AB , 400 J of heat is added to the system and in process BC , 100 J of heat is added to the system . The heat absorbed by the system in the process AC will be



A. 300 J

B. 380 J

C. 500 J

D. 460 J

Answer: D

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13. A monatomic gas at a pressure P, having a volume V expands isothermally to a volume 2 V and then adiabatically to a volume 16 V. The final pressure of the gas is (take $\gamma = \frac{5}{3}$)

A. 64 P

B. 32 P

C. $P/64$

D. 16 P

Answer: C

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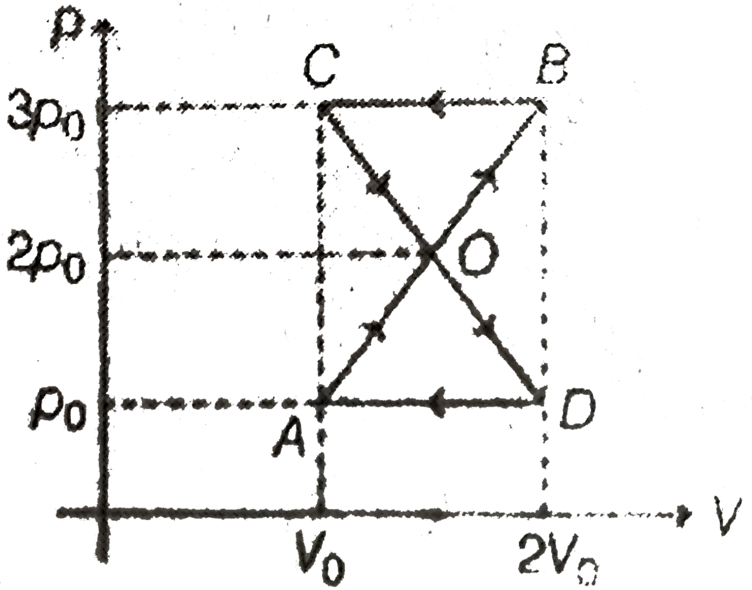
14. A thermodynamic system undergoes cyclic process ABCDA as shown in figure. The work done by the system is



A. $P_0 V_0$

B. $2P_0 V_0$

C. $\frac{P_0 V_0}{2}$

D. Zero

Answer: D

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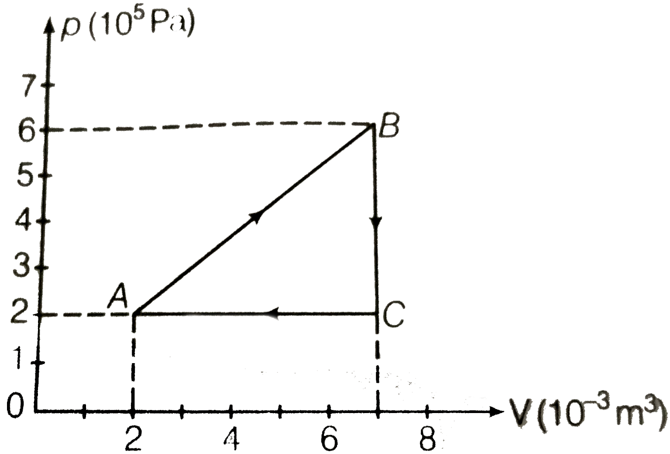
15. A gas is taken through the cycle $A \to B \to C \to A$, as shown. What is the net work done by the gas ?



A. 1000 J

B. Zero

C. $-2000J$

D. 2000 J

Answer: A

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16. The molar specific heats of an ideal gas at constant pressure and volume are denoted by C_p and C_v respectively. If $\gamma = \dfrac{C_p}{C_v}$ and R is the universal gas constant, then C_v is equal to

A. $\dfrac{R}{(\gamma - 1)}$

B. $\dfrac{(\gamma - 1)}{R}$

C. γR

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

Answer: A

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17. During an adiabatic process, the pressure of gas is found to be proportional to the cube of its absolute temperature. The ratio of $(C_{p,m}/C_{v,m})$ for gas is :

A. 2

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

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

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

Answer: C

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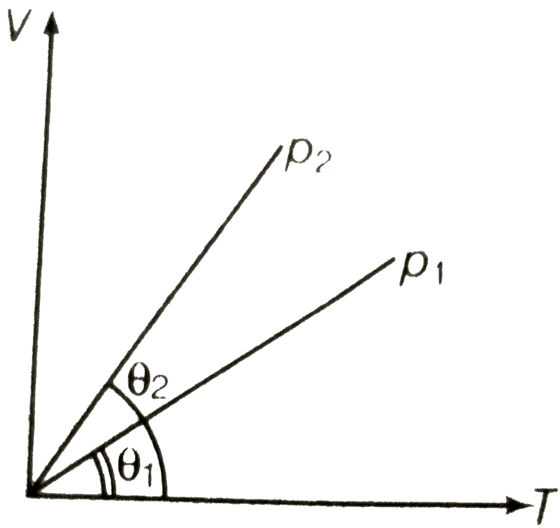
18. In the given $(V-T)$ diagram, what is the relation between pressures p_1 and p_2 ?



A. $P_2 > P_1$

B. $P_2 < P_1$

C. Cannot be predicted

D. $P_2 = P_1$

Answer: B

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19. One mole of an ideal gas goes form an initial stateA to final state B via two processes : It first undergoes iosthermal expansion from vluem V to 3V and then its volume is reduced from 3V to V at constatn pressure.The correct P-V diagram rpresenting the two processes is

A.

B.

C.

D.

Answer: B

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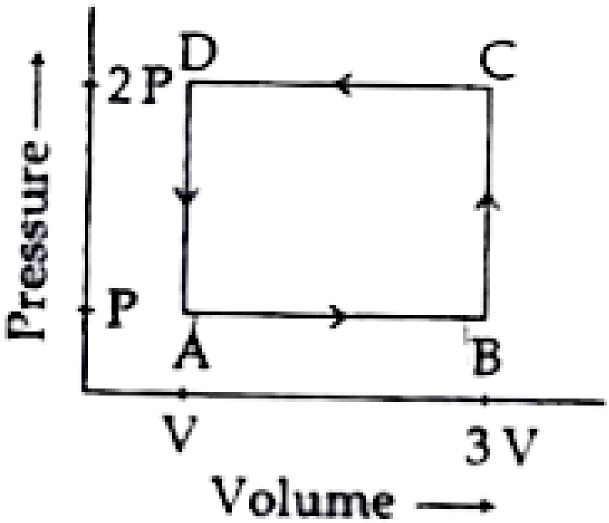
20. A thermodynamics system is taken trough the cycle ABCD as shown in figure. Heat rejected by the gas during the cycle is:



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

B. PV

C. 2 P V

D. 4 PV

Answer: C

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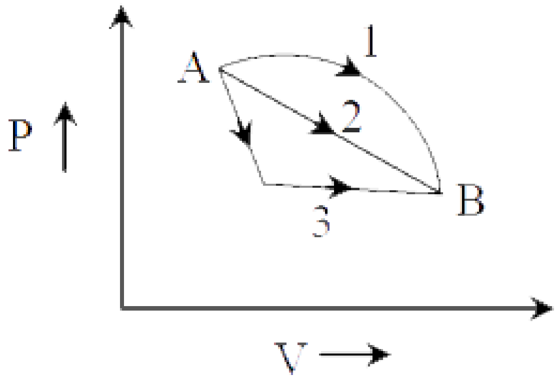
21. An ideal gas goes from state A to state B via three different processes as indicated in the P-V diagram -



If Q_1, Q_2, Q_3 indicate the heat absorbed by the gas along the three process and $\Delta U_1, \Delta U_2, \Delta U_3$, indicate the change in internal energy along the three processes respectively, then -

A. $Q_1 > Q_2 > Q_3$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$

B. $Q_3 > Q_2 > Q_1$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$

C. $Q_1 = Q_2 = Q_3$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$

D. $Q_3 > Q_2 > Q_1$ and $\Delta U_1 > \Delta U_2 \Delta U_3$

Answer: A

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

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

B. 150 J of heat has been removed from the gas

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

D. No heat is transferred because the process is isothermal

Answer: B

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23. A mass of diatomic gas (γ = 1.4) at a pressure of 2 atmosphere is compressed adiabatically so that its temperature rises from $27^{\circ}C$ to $927^{\circ}C$. The pressure of the gas in the final state is

A. 256 atm

B. 8 atm

C. 26 atm

D. 68.7 atm

Answer: A

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24. If ΔU and ΔW represent the increase in internal energy and work done by the sytem respectively in a thermodynamical process, which of the following is true ?

A. $\Delta U = -\Delta W$, in a isothermal process

B. $\Delta U = -\Delta W$ in a adiabatic process

C. $\Delta U = \Delta W$, in a isothermal process

D. $\Delta U = \Delta W$, in a adiabatic process

Answer: B

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25. If C_p and C_v denote the specific heats (per unit mass) of an ideal gas of molecular weight M.-

Where R is the molar gas constant

A. $C_P - C_V = R/M^2$

B. $C_P - C_V = R$

C. $C_P - C_V = R/M$

D. $C_P - C_V = MR$

Answer: C

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26. A monoatomic gas at pressure P_1 and volume V_1 is compressed adiabatically to $1/8^{th}$ its original volume. What is the final pressure of gas -

A. $64P_1$

B. P_1

C. $16P_1$

D. $32P_1$

Answer: D

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27. In thermodynamic processes which of the following statements is not true ?

A. In an isochoric process pressure remains constant

B. In an isothermal process the temperature remains constant

C. In an adiabatic process PV^{γ} = constant

D. In an adiabatic process the system is insulated from the surroundings

Answer: A

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28. The internal energy change in a system that has absorbed 2 kcal of heat and done 500 J of work is

A. 6400 J

B. 5400 J

C. 7900 J

D. 8900 J

Answer: C

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29. If Q, E and W denote respectively the heat added, change in internal energy and the work done in a closed process, then

A. Q = 0`

B. $W = 0$

C. Q = W = 0

D. E = 0

Answer: D

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30. At $10^\circ C$ the value of the density of a fixed mass of an ideal gas divided by its pressure is x. At $110^\circ C$ this ratio is

A. $\frac{283}{383}x$

B. x

C. $\frac{383}{283}x$

D. $\frac{10}{110}x$

Answer: A

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31. The efficiency of a heat engine is $1/6$Its efficiency double when the temperature of sink decrease by $62^{\circ}C$ its efficiency doubles.Then,What is the temperature of source?

A. $99^{\circ}C$

B. $124^{\circ}C$

C. $37^\circ C$

D. $62^\circ C$

Answer: A

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32. A Carnot engine whose sink is at $300K$ has an efficiency of 40%. By how much should the temperature of source be increased so as to increase its efficiency by 50% of original efficiency.

A. 275 K

B. 325 K

C. 250 K

D. 380 K

Answer: C

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33. The molar specific heat at constant pressure of an ideal gas is $\left(\frac{7}{2}\right)R$. The ratio of specific heat at constant pressure to that at constant volume is:-

A. $\frac{7}{5}$

B. $\frac{8}{7}$

C. $\frac{5}{7}$

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

Answer: A

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34. Which of the following processes is reversible

A. Transfer of heat by radiation

B. Electrical heating of a nichrome wire

C. Transfer to heat by conduction

D. Isothermal compression

Answer: D

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35. An ideal gas heat engine operates in Carnot cycle between $227^\circ C$ and $127^\circ C$. It absorbs 6×10^4 cal of heat at highter temperature. Amount of heat converted to work is

A. 2.4×10^4 cal

B. 6×10^4 cal

C. 1.2×10^4 cal

D. 4.8×10^4 cal

Answer: C

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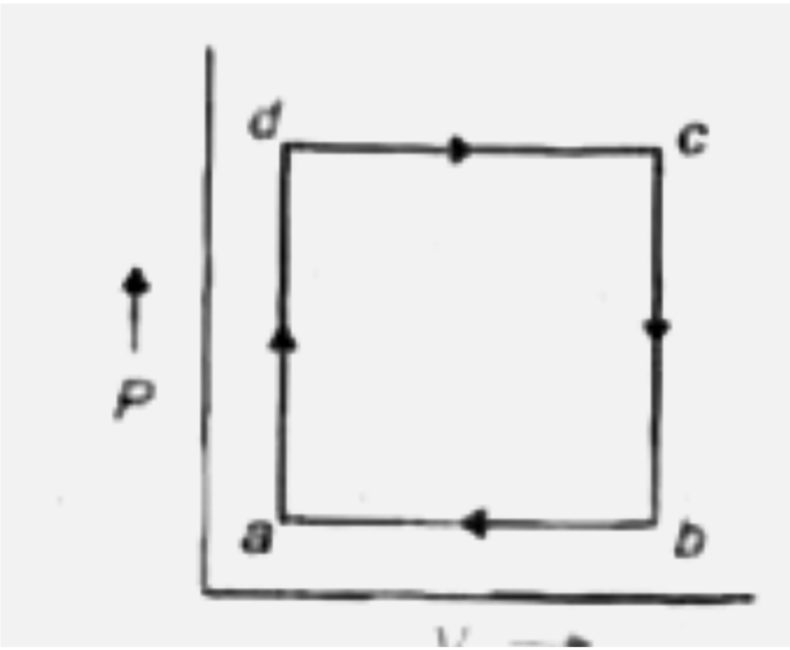
36. A system is taken from state a to state c by two paths abc and abc as shown in the figure. The internal energy at a is $U_a = 10J$. Along the path adc the amount of heat absorbed $\delta Q_1 = 50J$ and the work obtained $\delta W_1 = 20J$ whereas along the path abc the heat absorbed $\delta Q_2 = 36J$. The amount of work along the path abc is



A. 6J

B. 10 J

C. 12 J

D. 36 J

Answer: A

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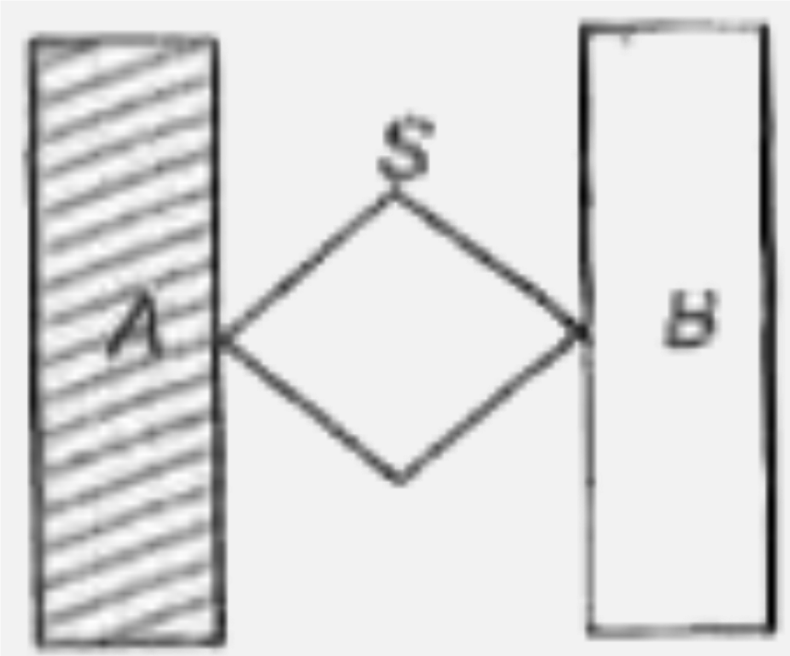
37. Consider two insulated chambers (A,B) of same volume connected by a closed knob ,S. 1 mole of perfect gas is confined in chamber A. What is the change in entropy of gas when knob S is opened ?



A. $1.46 J / K$

B. $3.46 J / K$

C. $5.46 J / K$

D. $7.46 J / K$

Answer: C

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38. A Carnot engine has efficiency 25%. It operates between reservoirs of constant temperatuers with temperature difference of $80^\circ C$. What is the temperature of the low -temperature reservoir ?

A. $-25^\circ C$

B. $25^\circ C$

C. $-33^\circ C$

D. $33^\circ C$

Answer: C

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39. In an adiabatic change the pressure and temperature of monoatomic gas are related as $P \propto T^c$ where C equal

A. $\frac{3}{5}$

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

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

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

Answer: D

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40. An ideal Carnot engine, whose efficiency is 40% receives heat at 500 K. If its efficiency is 50%, then the intake temperature for the same exhaust temperature is

A. 800 K

B. 900 K

C. 600 K

D. 700 K

Answer: C

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41. A diatomic gas initially at $18^\circ C$ is compressed adiabatically to one-eight of its original volume. The temperature after compression will be

A. 1164 K

B. 144 K

C. 18 K

D. 887.4 K

Answer: A

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42. An ideal gas underging adiabatic change has the following pressure-temperature relationship

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

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

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

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

Answer: B

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43. A sample of gas expands from volume V_1 to V_2. The amount of work done by the gas is greater when the expansion is

A. Adiabatic

B. Equal in all cases

C. Isothermal

D. Isobaric

Answer: D

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44. The efficiency of a Carnot engine operating between temperatures of $100^\circ C$ and $-23^\circ C$ will be

A. $\frac{373+250}{373}$

B. $\frac{373-250}{373}$

C. $\frac{100+23}{100}$

D. $\frac{100-23}{100}$

Answer: B

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45. We consider a thermodynamic system. If ΔU respresents the increase in its internal energy and W the work done by the system, which of the following statements is true ?

A. $\Delta U = -W$ in an isothermal process

B. $\Delta U = W$ in an isothermal process

C. $\Delta U = -W$ in an adiabatic process

D. $\Delta U = W$ in an adiabatic process

Answer: C

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

A. $\dfrac{PV}{(\gamma - 1)}$

B. PV

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

D. $\dfrac{\gamma PV}{(\gamma - 1)}$

Answer: A

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47. An ideal gas at $27^{\circ} C$ is compressed adiabatically to $\frac{8}{27}$ of its original volume. The rise in temperature is $\left(\gamma = \frac{5}{3}\right)$

A. 275 K

B. 375 K

C. 475K

D. 175K

Answer: B

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48. Two ideal Carnot engines operate in casade (all heat given up by one engine is used by the other engine to produce work) between temperatures, T_1 and T_2. The temperature of the hot reservoir of the first engine is T_1 and the temperature of cold reservoir of the second engine is T_2. T is temperature of the sink of first engine which is also the source for the second engine. How is T related to T_1 and T_2, if both the engines perform equal amount of work?

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

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

C. $T_1 T_2$

D. $\sqrt{T_1 T_2}$

Answer: D

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49. The (W/Q) for a Carnot engine is 1/6. Now the temperature of sink is reduced by $62^\circ C$, then this ratio becomes twice, therefore the initial temperatureof the sink and source are respectively

A. $33^\circ C, 67^\circ C$

B. $37^\circ C, 99^\circ C$

C. $67^\circ C, 33^\circ C$

D. $97K, 37K$

Answer: B

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50. The temperature of source and sink of a heat engine are $127^\circ C$ and $27^\circ C$ respectively. As inventor claims its efficiency to be 26%, then,

A. It is impossible

B. It is possible but less probable

C. It is quite probable

D. Date are incomplete

Answer: A

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51. The efficiency of carnot engine is 50% and temperature of sink is 500K. If temperature of source is kept constant and its efficiency raised to 60%, then the required temperature of the sink will be : -

A. 100 K

B. 600 K

C. 400 K

D. 500 K

Answer: C

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52. An ideal gas heat engine operates in a Carnot cycle between $27^{\circ} C$ and $127^{\circ} C$. It absorbs $6 kcal$ at the higher temperature. The amount of heat (in kcal) converted into work is equal to

A. 4.5

B. 3.5

C. 1.6

D. 1.2

Answer: D

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53. One mole of an ideal gas at an initial temperature of T K does 6 R joules of work adiabatically. If the ratio of specific heats of this gas at constant pressure and at constant volume is $\frac{5}{3}$, the final temperature of gas will be :-

A. $(T + 2.4)K$

B. $(T - 2.4)K$

C. $(T + 4)K$

D. $(T - 4)K$

Answer: D

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54. The amount of heat energy required to raise the temperature of 1 g of helium at NTP, from $T_1 K$ to $T_2 K$ is

A. $\frac{3}{2}N_a K_B(T_2 - T_1)$

B. $\frac{3}{4}N_a K_B(T_2 - T_1)$

C. $\frac{3}{4}N_a K_B\left(\frac{T_2}{T_1}\right)$

D. $\frac{3}{8}N_a K_B(T_2 - T_1)$

Answer: D

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55. Which of the following relations does not give the equation of an adiabatic process, where tems have their usual meaning ?

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

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

C. PV^{γ}= constant

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

Answer: A

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56. According to C.E van der Waal, the interatomic potential varies with the average interatomic distance (R) as

A. R^{-1}

B. R^{-2}

C. R^{-4}

D. R^{-6}

Answer: D

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57. A gas at pressure p_0 is contained in a vessel. If the masses of all the molecules are halved and their speeds doubled, the resulting pressure would be

A. 4P

B. 2P

C. P

D. P/2

Answer: B

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58. The mean free path of collision of gas melecules varies with its diameter (d) of the molecules as

A. d^{-1}

B. d^{-2}

C. d^{-3}

D. d^{-4}

Answer: B

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59. At $0K$, which of the following properties of a gas will be zero ?

A. volume

B. density

C. kinetic energy

D. protential energy

Answer: C

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60. The units of constant b used in van der Waals' equation are ....

A. $T_C = \frac{8a}{27Rb}$

B. $T_C = \frac{27a}{8Rb}$

C. $T_C = \frac{a}{2Rb}$

D. $T_C = \frac{a}{27Rb}$

Answer: A

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61. The degrees of freedom of a triatomic gas is

A. 6

B. 4

C. 2

D. 8

Answer: A

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62. To find out degree of freedom, the correct expression is:

A. $f = \dfrac{2}{\gamma - 1}$

B. $f = \dfrac{\gamma + 1}{2}$

C. $f = \dfrac{2}{\gamma + 1}$

D. $f = \dfrac{1}{\gamma + 1}$

Answer: A

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63. The equation of state for 5 g of oxygen at a pressure P and temperature T, when occupying a volume V, will be

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

B. $PV = 5RT$

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

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

Answer: A

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Assignment Section D Assertion Reason Type Questions

1. A : Work done by a gas in isothermal expension is more than the work done by the gas in the same expasion adiabatically.

R : Temperature remains constant in isothermal expansion and not in adiabatic expansion.

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

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

Answer: B

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2. A : Efficiency of heat engine can neve be 100%.

R : Second law of thermodynamics puts a limitaion of the efficiency of a heat engine.

A. If both Assertion & Reason are true and the reason is the correct explantion of the assertion, then mark(1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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3. A : Heat absorbed in a cyclic process is zero.

R : Work done in a cyclic process is zero.

A. If both Assertion & Reason are true and the reason is the correct explantion of the assertion, then mark(1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4)

Answer: D

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4. A : Coefficient of performanceof a refreigerator is always greater than 1.

R : Efficiencyof heat engine is greater than 1.

A. If both Assertion & Reason are true and the reason is the correct explantion of the assertion, then mark(1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4)

Answer: D

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5. A : Adiabatic expansion causes cooling.

R : In adiabatic expansion, internal energy is used up in doing work.

A. If both Assertion & Reason are true and the reason is the correct explantion of the assertion, then mark(1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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6. A : The specific heat of an ideal gas is zero in an adiabatic process.

R : Specific heat of a gas is process independent.

A. If both Assertion & Reason are true and the reason is the correct explantion of the assertion, then mark(1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4)

Answer: C

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7. A : The change in intermal energy does not depend on the path of process.

R : The internal energy of an ideal gas is independent to the configurationof its molecules.

A. If both Assertion & Reason are true and the reason is the correct explantion of the assertion, then mark(1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4)

Answer: B

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8. A : Heat supplied to a gaseous system in an isothermal process is used to do work against surroundings.

R : During isothermal process there is no change ininternal energy of the system.

A. If both Assertion & Reason are true and the reason is the correct explantion of the assertion, then mark(1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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9. Assertion: Thermodynamics process in nature are irreversible.

Reason: Dissipative effects cannot be eliminated.

A. If both Assertion & Reason are true and the reason is the correct explantion of the assertion, then mark(1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4)

Answer: A

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10. A : During a cyclic process work done by the system is zero.

R : Heat supplied to a system in the cyclic process converts into internal energy of the system.

A. If both Assertion & Reason are true and the reason is the correct explantion of the assertion, then mark(1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4)

Answer: D

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