PHYSICS

BOOKS - CENGAGE PHYSICS (ENGLISH)

THERMODYNAMICS

1

1. One mole of an ideal gas is warmed slowly so that it goes form the PV state (P_iV_i) to $(3P_i, 3V_i)$ in such a way that the pressure of the gas is directly proportional to the volume.

(a) How much work is done on the gas in the process?

(b) How is the temperature of the gas related to its volume during this process?

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2. 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 adiabatic process

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

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

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

Answer:

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3. Two moles a monatomic gas in state A having critical pressure P_0 and temperature $3T_0$ is taken to a state B having pressure $3P_0$ and temperature $T_0/3$ by the process of equation P^2T = constant. Then state B is taken to state C keeping the volume constant and it comes back to initial state A keeping temperature constant.

a. Plot a P and T graph. (P on the y-axis and T on the x-axis).

Find the net work done and heat supplied to the gas during the complete cycle.

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2

1. An ideal gas is taken through a quasi-static process described by $P = \alpha V^2$, with $\alpha = 5.00 atm / m^6$. The gas is expanded to twice its original volume of $1.00 m^3$. How much work is done by the gas in expanding gas in this process?

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2. When heat in given to a gas in an isobaric process, then

A. the work is done by the gas

B. internal energy of the gas increases

C. both (a) and (b)

D. none from (a) and (b)

Answer:

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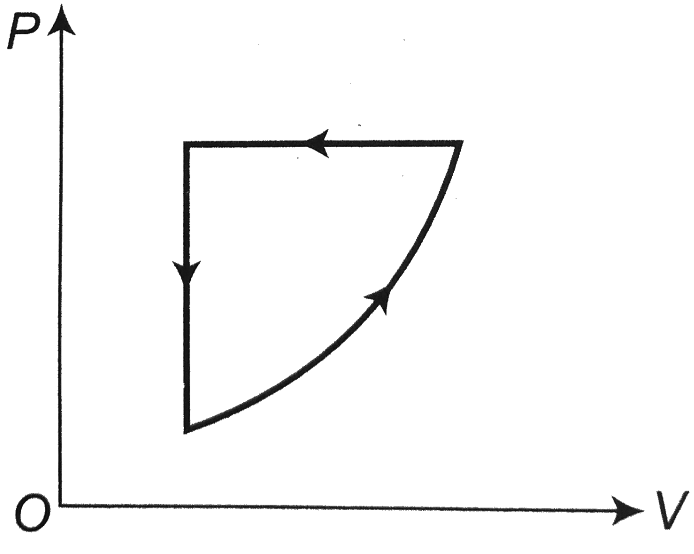
3. For one complete cycle of a thermodynamic process gas as shown in the P-V diagram, which of following correct?



A. $\Delta E_{\text{int}} = 0, Q < 0$

B. $\Delta E_{\text{int}} = 0, Q > 0$

C. $\Delta E_{\text{int}} > 0, Q < 0$

D. $\Delta E_{\text{int}} < 0, Q > 0$

Answer: A

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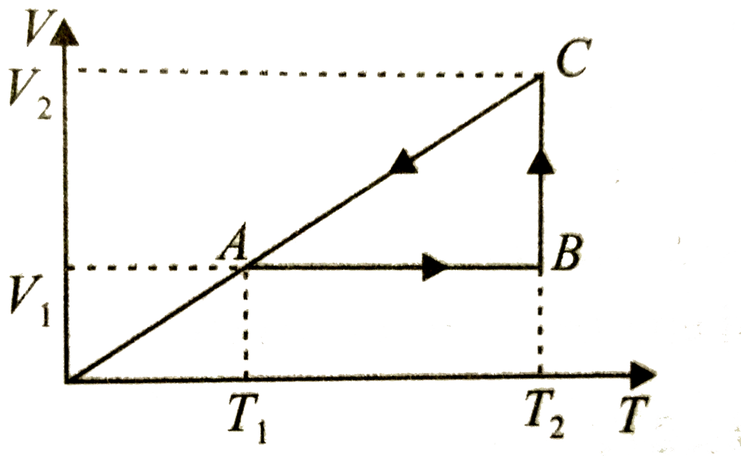
3

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



A. $O, \mathrm{RT}_2 \ln\left(\frac{V_1}{V_2}\right), R(T_1 - T_2)$

B. $R(T_1 - T_2), 0, \mathrm{RT}_1 \ln \frac{V_1}{V_2}$

C. $0, \mathrm{RT}_2 \ln\left(\frac{V_2}{V_1}\right), R(T_1 - T_2)$

D. $0, \mathrm{RT}_2 \ln\left(\frac{V_2}{V_1}\right), R(T_2 - T_1)$

Answer: D

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2. Which of the following is correct in terms of increasing work done for the same initial and final volume?

A. Adiabatic $<$ Isothermal $<$ Isobaric

B. Isobaric $<$ Adiabatic $<$ Isothermal

C. Adiabatic $<$ Isobaric $<$ Isothermal

D. None of these

Answer: d

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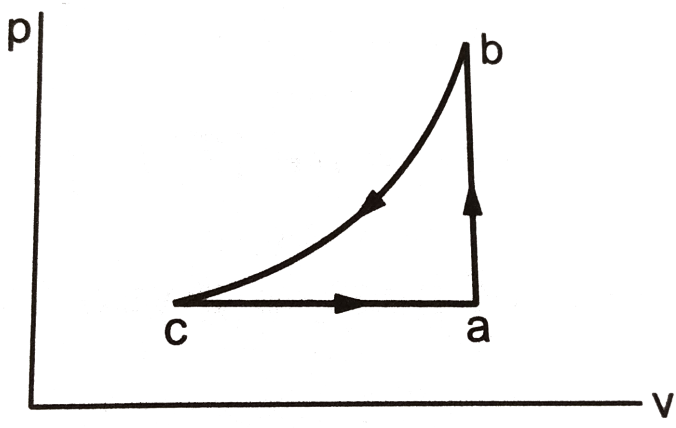
3. A sample of an ideal gas is taken through the cyclic process $abca$. It absorbs $50J$ of heat during the part ab, no heat during bc and rejects $70J$ of heat during ca. $40J$ of work is done on the gas during the part bc.

(a) Find the internal energy of the gas at b and c if it is $1500J$ at a.

(b) Calculate the work done by the gas during the part

ca.



A. 1590J

B. 1620J

C. 1540J

D. 1570J

Answer: A

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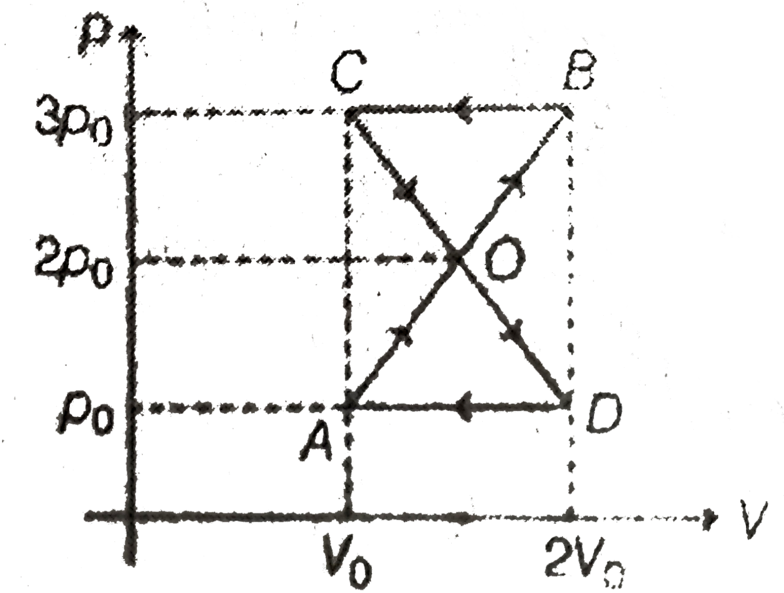
1. A thermodynamic system undergoes cyclic process ABCDA as shown in figure. The work done by the system is



A. P_0V_0

B. $2P_0V_0$

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

D. Zero

Answer: D

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

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

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

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

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

Answer: d

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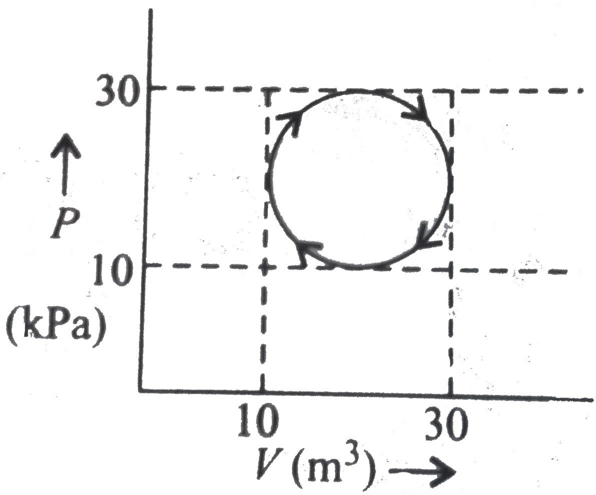
3. Which one is not correct for a cyclic process as shown in the figure ?



A. (a)25 %

B. (b)12.5%

C. (c)50%

D. (d)$\frac{100}{13}\%$

Answer: D

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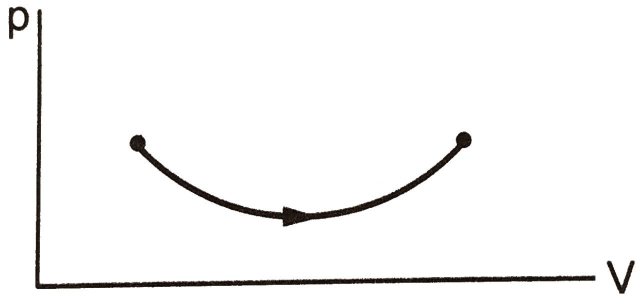
5

1. 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: A

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

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

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

C. $\frac{10}{3}$R

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

Answer: a

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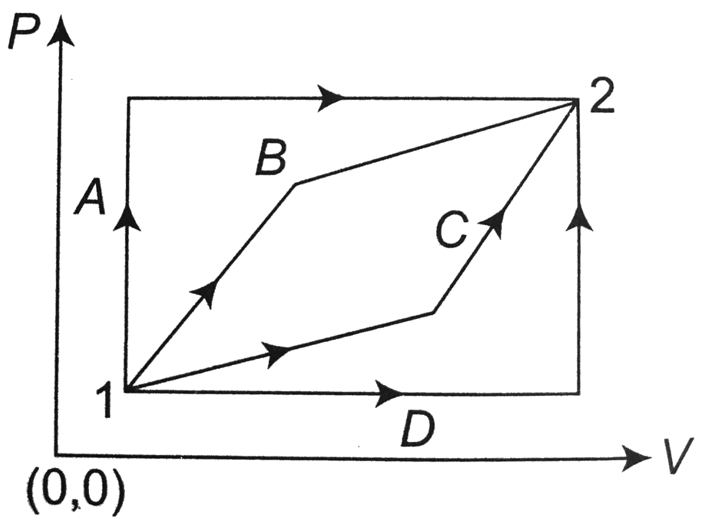
3. An ideal gas is taken from state 1 to state 2 through optional path A, B, C and D as shown in the PV diagram. Let Q, W and U represent the heat supplied, work done and change in internal energy of the gas respectively.

Then,



A. $Q_A - Q_D = W_A - W_D$

B. $Q_B - W_B > Q_C - W_C$

C. $W_A < W_B < W_C < W_D$

D. $Q_A < Q_B < Q_C < Q_D$

Answer: A

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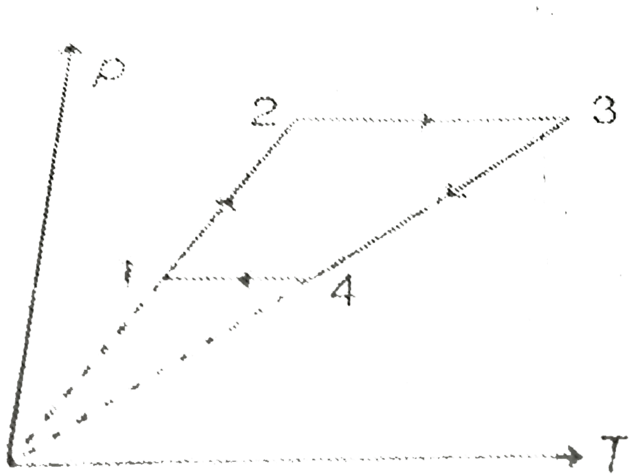
6

1. Three moles of an ideal monoatomic gas performs a cyclic process as shown in the figure. The temperatures in different states are $T_1 = 400K$, T_(2)=800K, T_(3)=2400K and T_(4)=1200K

$. Deter \min ethew \text{ or } kdo \neq bythegasdur \in gthecyc \leq .$

["Given R"=8.31"J-mol"^(-1)K^(-1)]`



A. 20 kJ

B. 30 kJ

C. 40 kJ

D. 60 kJ

Answer: C

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2. An insulator container contains 4 moles of an ideal diatomic gas at temperature T. Heat Q is supplied to this gas, due to which 2 moles of the gas are dissociated into atoms but temperature of the gas remains constant. Then

A. $Q = 2RT$

B. $Q = RT$

C. $Q = 3RT$

D. $Q = 4RT$

Answer: c

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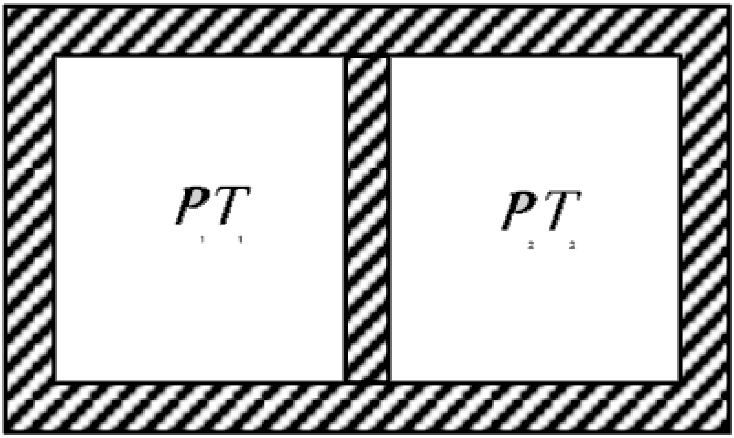
3. Following figure shows on adiabatic cylindrical container of volume V_0 divided by an adiabatic smooth piston (area of cross-section = A) in two equal parts. An ideal gas $\left(C_p / C_y = \lambda\right)$ is at pressure P_1 and temperature T_1 in left part and gas at pressure P_2 and temperature T_2 in right part. The piston is slowly displaced and released at a position where it can stay in equilibrium. The final pressure of the two parts will be

(Suppose x = displacement of the piston)



A. P_2

B. P_1

C. $\dfrac{P_1\left(\frac{V_0}{2}\right)^{\gamma}}{\left(\frac{V_0}{2}+Ax\right)^{\gamma}}$

D. $\dfrac{P_2\left(\frac{V_0}{2}\right)^{\gamma}}{\left(\frac{V_0}{2}+Ax\right)^{\gamma}}$

Answer: C

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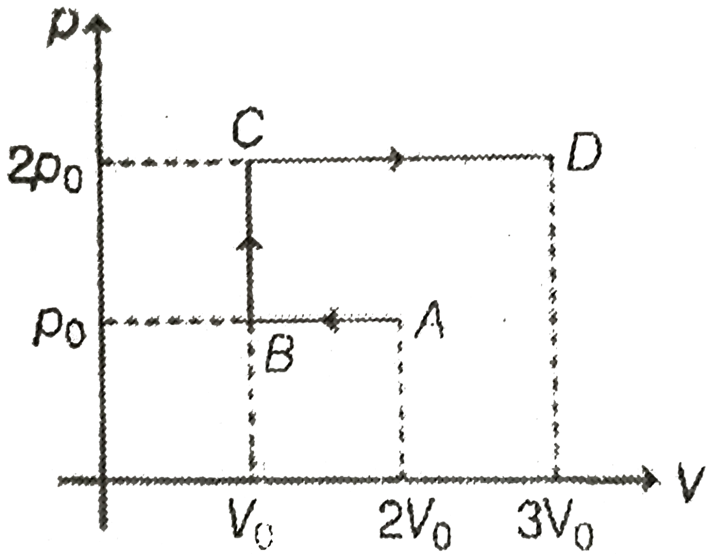
7

1. p-V diagram of an ideal gas is as shown in figure. Work done by the gas in the process ABCD is



A. $4P_0V_0$

B. $2P_0V_0$

C. $3P_0V_0$

D. P_0V_0

Answer: C

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2. Which one of the following gases possesses the largest internal energy

A. 2 moles of helium occupying 1 m^3 at 300 K

B. 56 kg of nitrogen at $10^7 Nm^{-2}$ and 300 K

C. 8 grams of oxygen at 8 atm and 300 K

D. 6×10^{26} molecules of argon occupying $40m^3$ at 900 K

Answer: c

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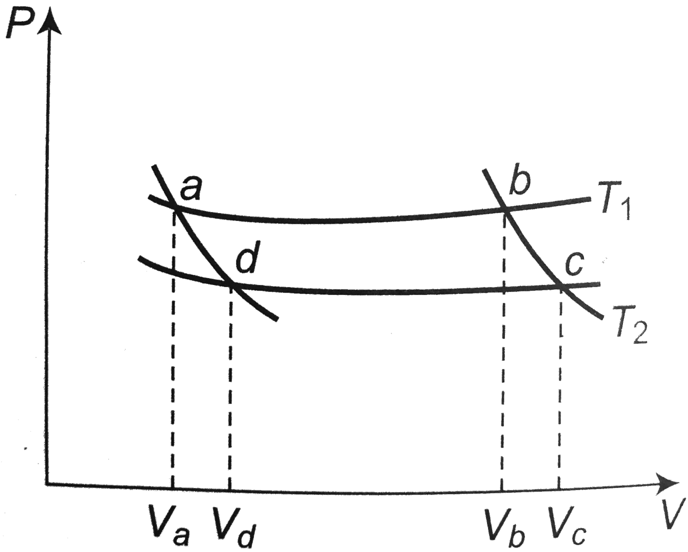
3. In the following P-V diagram two adiabatics cut two isothermals at temperature T_1 and T_2 (fig). The value of

$\frac{V_a}{V_d}$ will be



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

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

C. $\frac{V_d}{V_a}$

D. $V_b V_c$

Answer: A

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8

1. A gas expands with temperature according to the relation $V = kT^{2/3}$. What is the work done when the temperature changes by $30^{\circ}C$?

A. $10R$

B. $20R$

C. $30R$

D. $40R$

Answer: B

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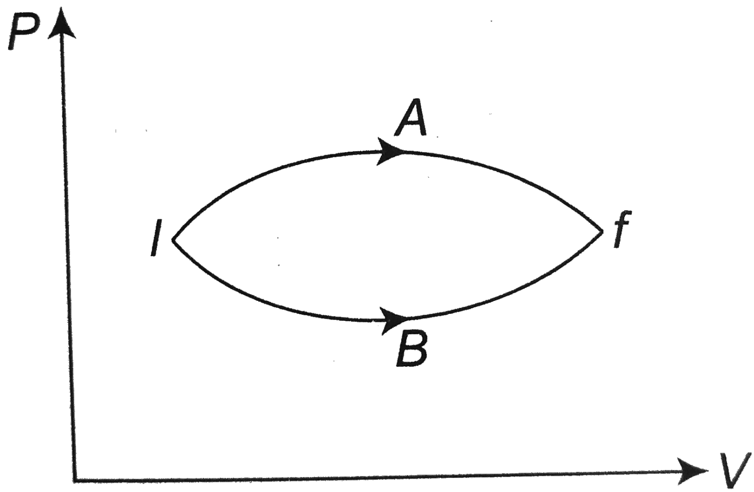
2. In the figure given two processes A and B are shown by which a thermodynamic system goes from initial state I to final state F. if ΔQ_A and ΔQ_B are respectively the heats supplied to the systems then



A. $\Delta Q_A = \Delta Q_B$

B. $\Delta Q_A \geq \Delta Q_B$

C. $\Delta Q_A < \Delta Q_B$

D. $\Delta Q_A > \Delta_B$

Answer: b

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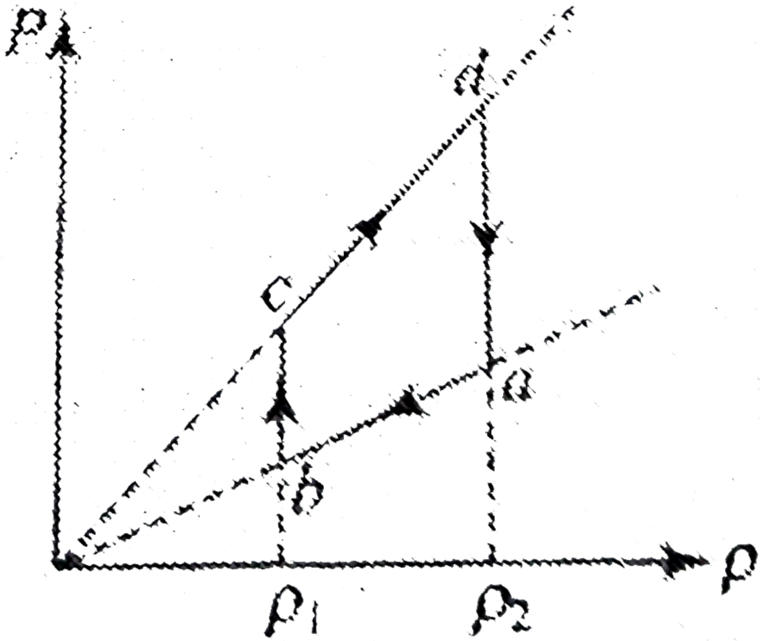
3. An ideal gas undergoes a cyclic process abcda which is shown by pressure-density curve,



A. (a)Work done by the gas in the process 'bc' is zero

B. (b)Work done by the gas in the process 'cd' is negative

C. (c)Internal energy of the gas at point 'a' is greater than at state 'c'

D. (d)Net work done by the gas in the cycle is negative.

Answer: A,B,D

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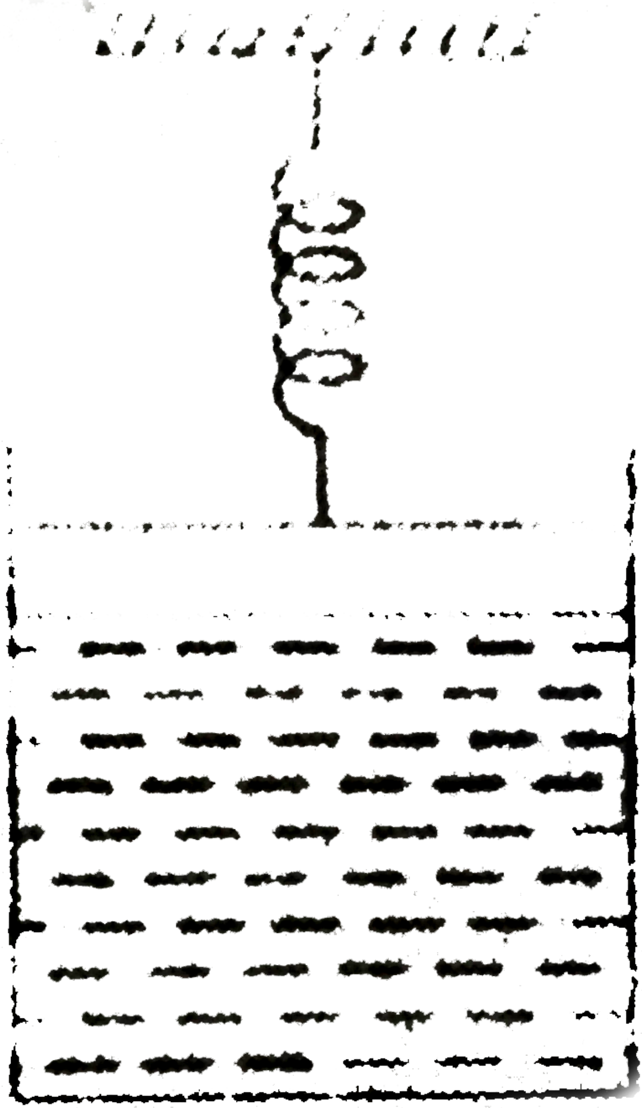
9

1. One mole of an ideal gas is kept enclosed under a light piston (area $= 10^{-1}m^2$) connected by a compressed spring (spring constant 100 N/m). The volume of gas is $0.83m^3$ and its temperature is 100K. The gas is heated so that it compresses the spring further by $0.1m$. The work done by the gas in the process is : (Take R $=8.3$J/K-mole and suppose there is no atmosphere).



A. $3J$

B. $6J$

C. $9J$

D. $1.5J$

Answer: D

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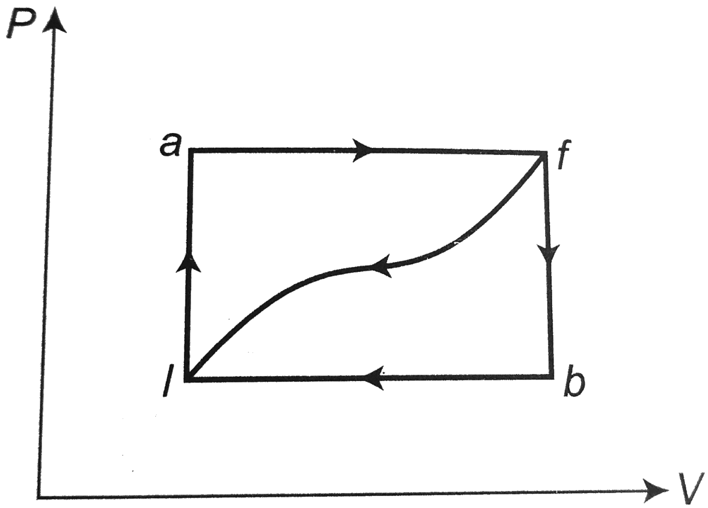
2. When a system is taken from state f along path $iaf, Q = 50J$ and $W = 20J$. Along path $ibf, Q = 35J$. If $W = -13J$ for the curved return path fI, Q for this path is



A. (a)33 J

B. (b)23 J

C. (c)$-7J$

D. (d)$-43J$

Answer: d

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3. An ideal gas can be expended from an initial state to a certain volume through two different processes

(i) $pV^2 =$ constant and (ii) $p = KV^2$ where K is a positive constant. Then

A. Final temperature in (i) will be greater than in (ii)

B. Final temperature in (ii) will be greater then in (i)

C. Total heat given to the gas in (i) case is greater than in (ii)

D. Total heat is given to the gas in (ii) case is greater than in (i)

Answer: B,D

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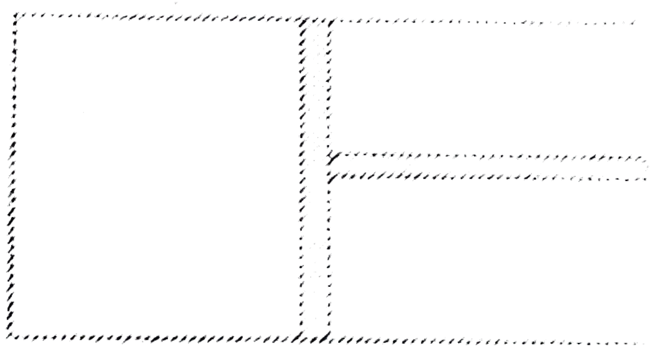
10

1. n moles of a gas filled in a container temperature T is in thermodynamic equilibrium initially. If the gas is compressed slowly and isothermally to half its initial volume volume the work done by the atmosphere on the piston is :



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

B. $-\frac{nRT}{2}$

C. $nRT\left(\ln 2 - \frac{1}{2}\right)$

D. $-nRT\ln 2$

Answer: A

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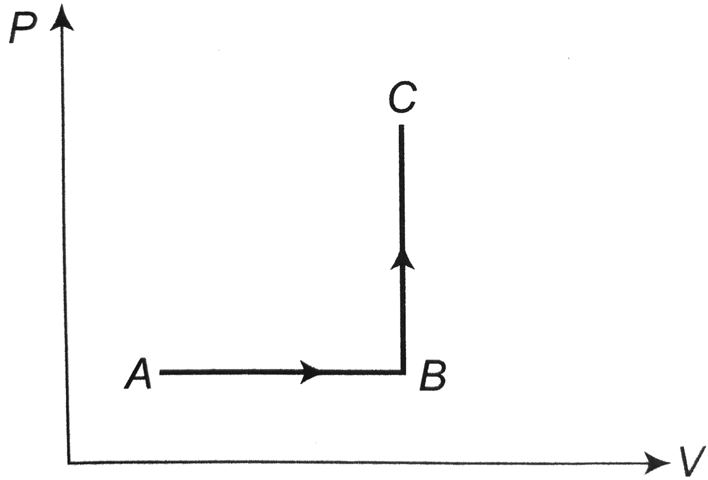
2. The $P-V$ diagram of a system undergoing thermodynamic transformation is shown in figure. The work done by the system in going from $A \rightarrow B \rightarrow C$ is $30J$ and $40J$ heat is given to the system. The change in internal energy between A and C is



A. 10 J

B. 70 J

C. 84 J

D. 134 J

Answer: a

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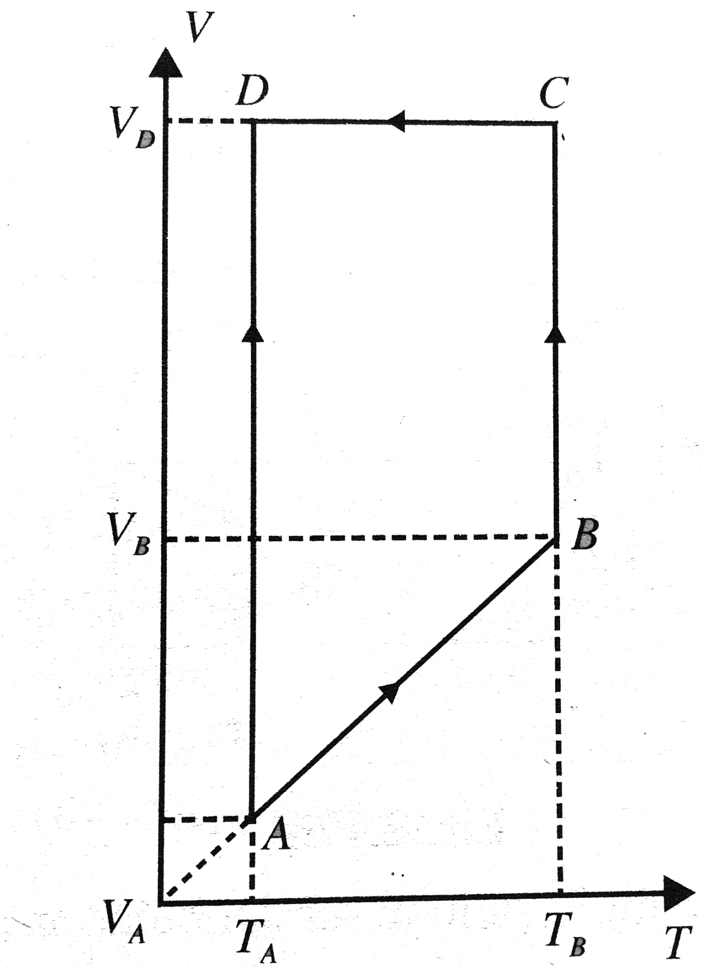
3. A monatomic idea gas of $2mol$ is taken through a cyclic process starting from A as shown in figure. The volume ratio are $V_B/V_A = 2$ and $V_D/V_A = 4$. If the temperature T_A at A is $27^\circ C$, and gas constant is R. Calculate.



The temperature of the gas at point B

A. (a) 600K

B. (b) 450K

C. (c)400K

D. (d)900K

Answer: A

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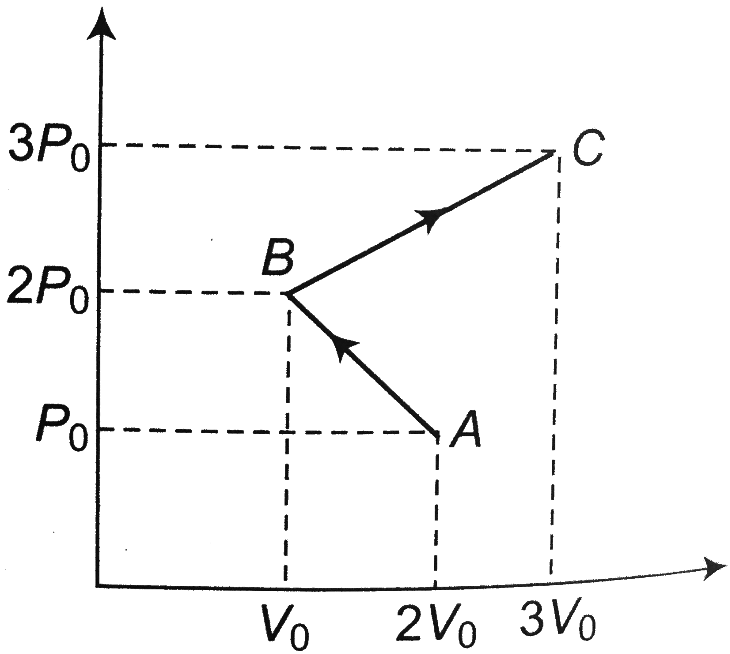
11

1. Find the work done by the gas in the process ABC.



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

B. $\frac{5}{2}P_0V_0$

C. $\frac{7}{2}P_0V_0$

D. $4P_0V_0$

Answer: C

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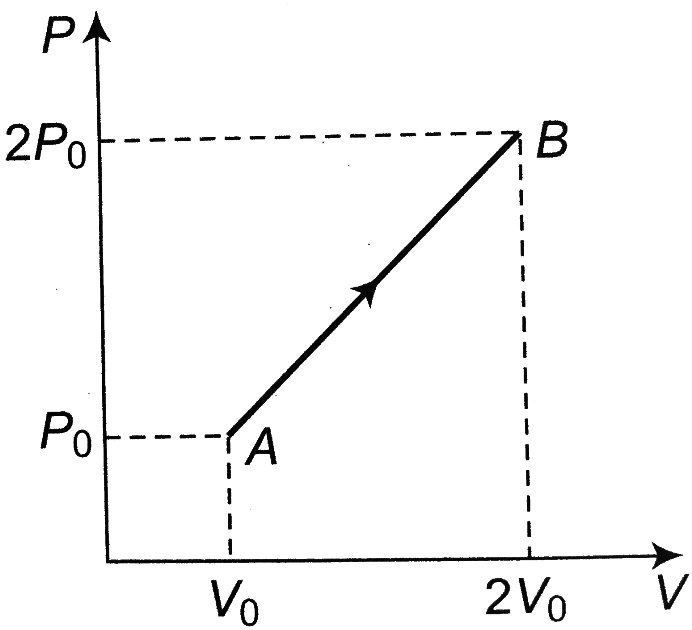
2. The $P - V$ diagram of 2 gm of helium gas for a certain process $A \rightarrow B$ is shown in the figure. What is the heat given to the gas during the process $A \rightarrow B$?



A. $4P_0V_0$

B. $6P_0V_0$

C. $4.5P_0V_0$

D. $2P_0V_0$

Answer: c

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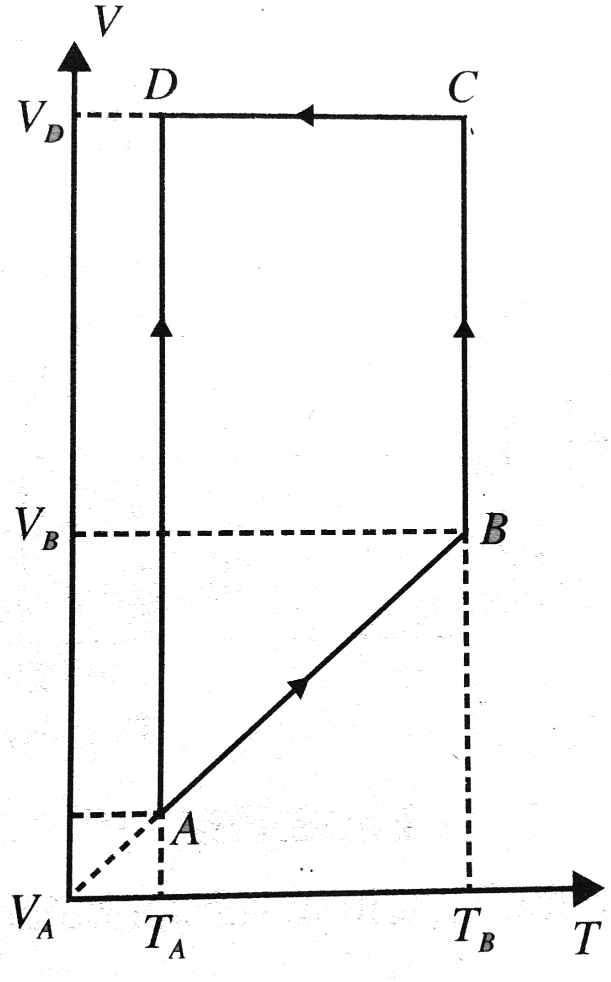
3. A monatomic ideal gas of $2mol$ is taken through a cyclic process starting from A as shown in figure. The volume ratio are $V_B / V_A = 2$ and $V_D / V_A = 4$. If the temperature T_A at A is $27^\circ C$, and gas constant is R. Calculate heat absorbed or released by the gas in process $B \rightarrow C$



A. 1200R

B. 1500R

C. 1400R

D. 1000R

Answer: B,D

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12

1. In an isothermal reversible expansion, if the volume of 96 gm of oxygen at $27^{\circ} C$ is increased from 70 litres to 140 litres , then the work done by the gas will be

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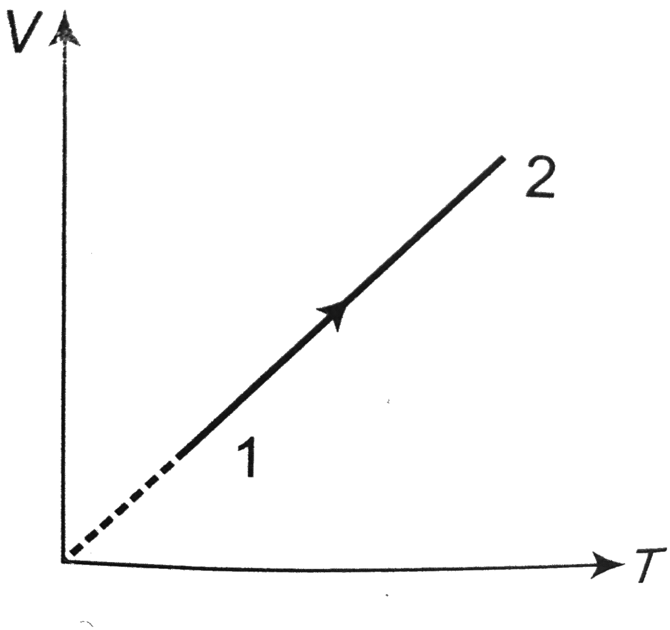
2. Volume versus temperature graph of two moles of helium gas is as shown in figure. The ratio of heat absorbed and the work done by the gas in process $1 - 2$ is



A. 3

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

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

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

Answer: B

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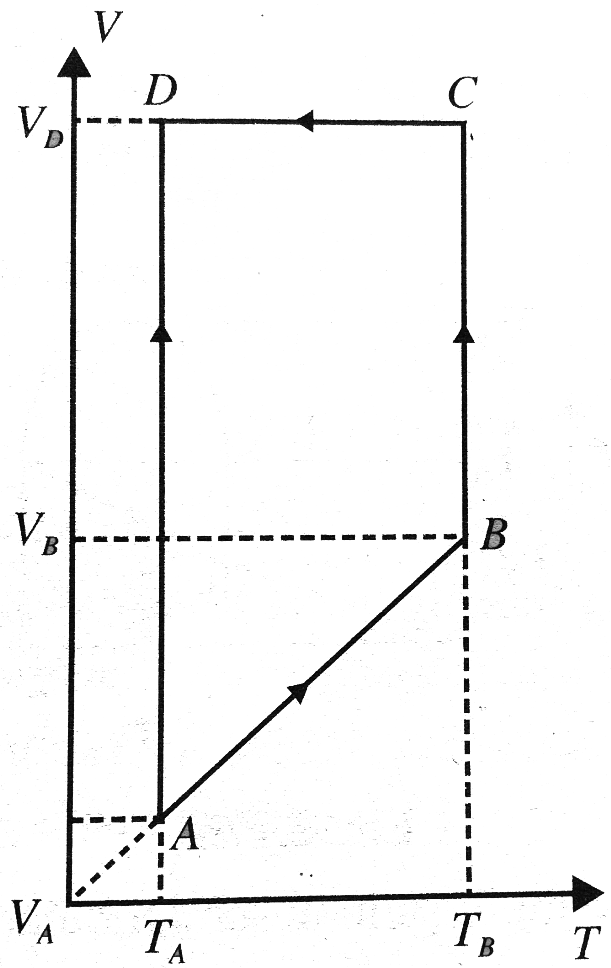
3. A monatomic idea gas of $2mol$ is taken through a cyclic process starting from A as shown in figure. The volume ratio are $V_B / V_A = 2$ and $V_D / V_A = 4$. If the temperature T_A at A is $27^\circ C$, and gas constant is R. Calculate.



The total work done by the gas during the complete cycle.

A. 1000R

B. 800R

C. 832R

D. 945R

Answer: C

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13

1. 540 calories of heat convert 1 cubic centimeter of water at $100^{o}C$ into 1671 cubic centimeter of steam at $100^{o}C$ at a pressure of one atmosphere. Then the work done against the atmospheric pressure is nearly

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2. Heat is supplied to a diatomic gas at constant pressure.

The ratio of $\Delta Q : \Delta U : \Delta W$ is a) 5: 3: 2 b) 7: 5: 2 c) 2: 3: 5 d) 2: 5: 7

A. $5:3:2$

B. $5:2:3$

C. $7:5:2$

D. $7:2:5$

Answer: C

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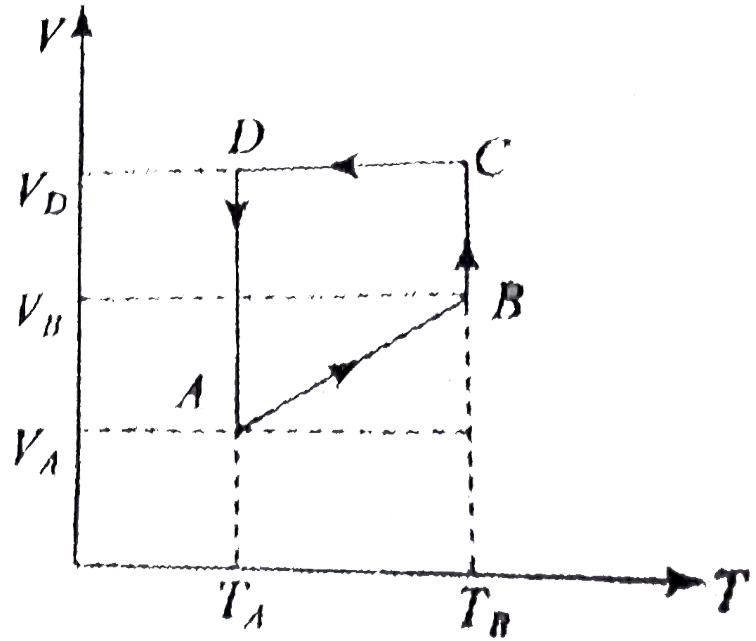
3. A monotomic ideal gas of two metal is taken through a cyclic process straining from A as shown $V_B / V_A = 2$ and $V_D / V_A = 4$ Temperature $T_A is 27^\circ C$

The work done during the process $C \rightarrow D$ is



A. 900R (absorbed)

B. 900R(released)

C. 1200R(absorbed)

D. 1200R(released)

Answer: B,D

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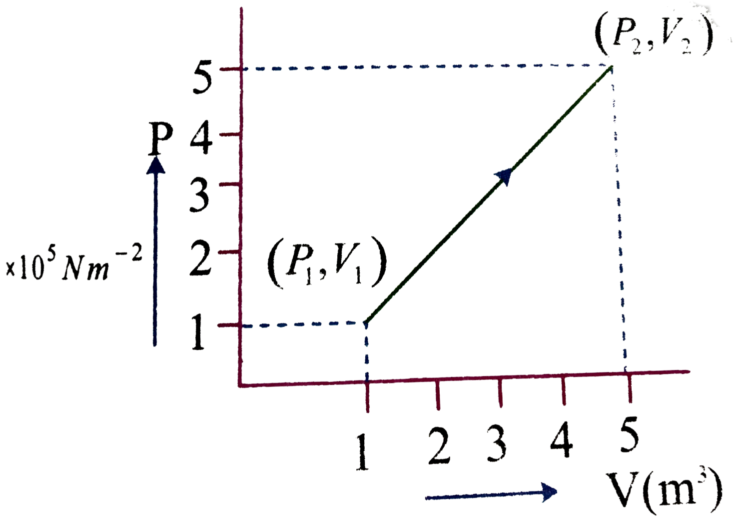
14

1. A system changes from the state (P_1, V_1) to (P_2, V_2) as shown in the diagram. The work done by the system is



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2. An insulator container contains 4 moles of an ideal diatomic gas at temperature T. Heat Q is supplied to this gas, due to which 2 moles of the gas are dissociated into atoms but temperature of the gas remains constant. Then

A. zero

B. $\frac{1}{2}nRT$

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

D. $\frac{3}{2}(N-n)RT$

Answer: B

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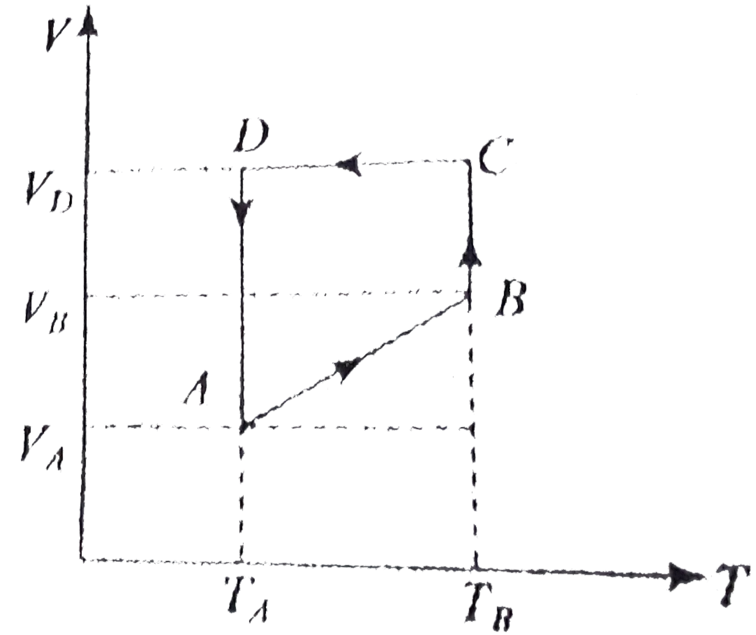
3. A monoatomic ideal gas of two mole is taken through a cyclic process starting from A as shown $V_B/V_A = 2$ and $V_D/V_A = 4$ Temperature $T_A is 27^{\circ}C$

The work done during the process $D \rightarrow A$ is



A. 900R (absorbed)

B. 900R(released)

C. 1200ln(2)R(absorbed)

D. 1200ln(2)R(released)

Answer: D

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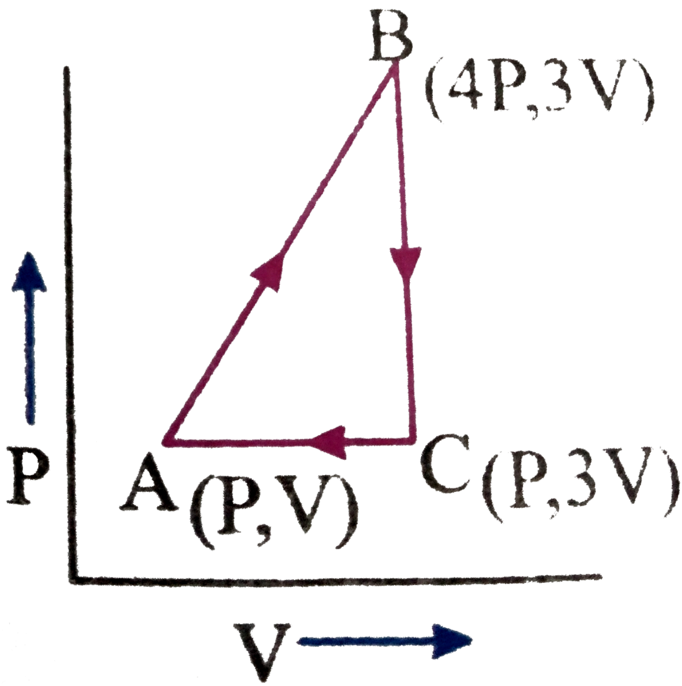
15

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



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2. In thermodynamic process, pressure of a fixed mass of a gas is changed in such a manner that the gas molecules gives out 20 J of heat and 10 J of work is done in the gas. If the initial internal energy of the gas was 40 J, then the final internal energy will be

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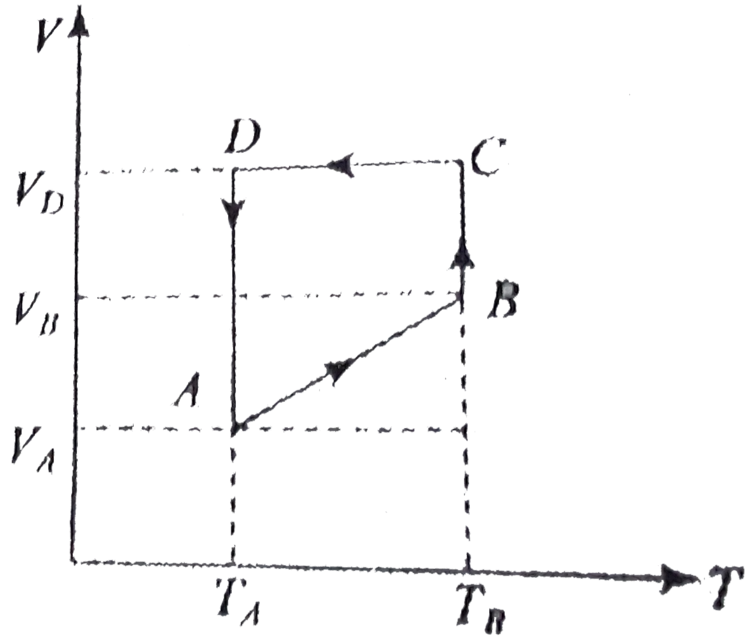
3. A monotomic ideal gas of two metal is taken through a cyclic process straining from A as shown $V_B / V_A = 2$ and $V_D / V_A = 4$ Temperature $T_A is 27^\circ C$

The temperature at B, T_B is



A. 400R

B. 600R

C. 450R

D. 800R

Answer: B

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16

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

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17

1. The specific heat of a gas in an isothermal process is

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18

1. A thermally insulated container is divided into two parts by a screen. In one part the pressure and temperature are P and T for an ideal gas filled. In the second part it is vacuum. If now a small hole is created in the screen, then the temperature of the gas will

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1. When an ideal gas in a cylinder was compreswsed isothermally by a piston, the work done on the gas found to be 1.5×10^4 cal. During this process about

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20

1. In an adiabatic expansion of ideal gas

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21

1. If an ideal gas at $27^{\circ}C$ is compresse suddenly to one fourth of its initial volume, then rise in its temperature is $\left(\gamma = \frac{7}{5}\right)$

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

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1. Two identical samples of a gas are allowed to expand (i) isothermally (ii) adiabatically. Work done is

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1. During the adiabatic expansion of 2 moles of a gas, the internal energy of the gas is found to decrease by 2 joules , the work done during the process on the gas will be equal to

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