PHYSICS

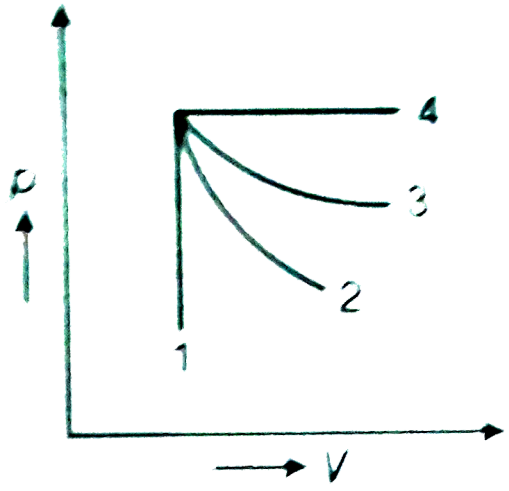
BOOKS - NCERT PHYSICS (HINGLISH)

THERMODYNAMICS

Multiple Choice Questions

1. An ideal gas undergoes for different processes from the same initial state (figure). Four processes are adiabatic, isothermal,

isobaric and isochoric. Out of 1, 2, 3 and 4 which one is adiabatic ?



A. 4

B. 3

C. 2

D. 1

Answer: C

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

A. 0.25 kg

B. 2.25 kg

C. 0.05 kg

D. 0.20 kg

Answer: A

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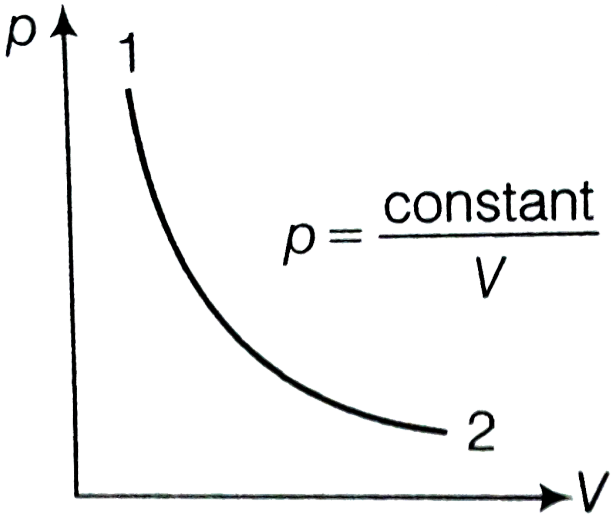
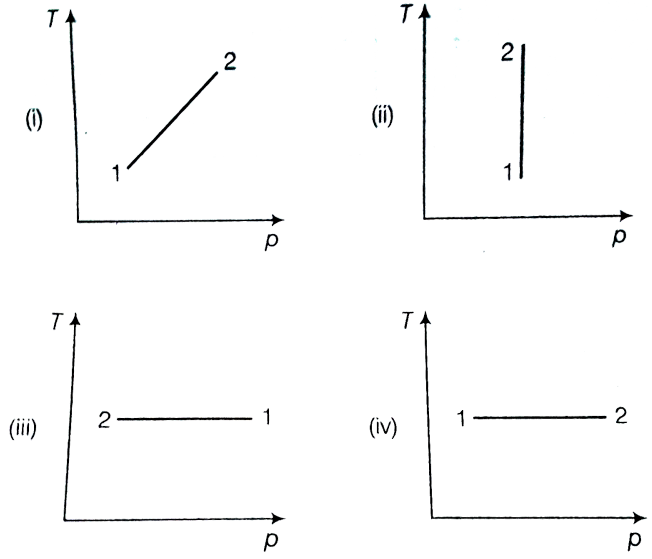
3. Consider p-V diagram for an ideal gas shown in figure.



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



(i)

A. (iv)

B. (ii)

C. (iii)

D. (i)

Answer: C

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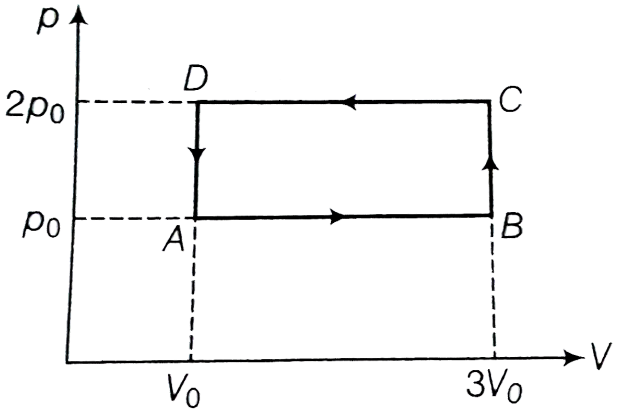
4. An ideal gas undergoes cyclic process $ABCDA$ as shown in givend $p-V$ diagram.

The amount of work done by the gas is



A. $6p_0V_0$

B. $-2p_0V_0$

C. $+2p_0V_0$

D. $+4p_0V_0$

Answer: B

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

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

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

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

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

Answer: A

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6. Three copper blocks of masses M_1, M_2 and M_3 kg respectively are brought into thermal contact till they each equilibrium. Before contact, they were at

$T_1, T_2, T_3 (T_1 > T_2 > T_3)$. Assuming there is no heat loss to the surroundings, the equilibrium temperature T is (s is specific heat of copper)

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

B. $T = \frac{M_1 T_1 + M_2 T_2 + M_3 T_3}{M_1 + M_2 + M_3}$

C. $T = \frac{M_1 T_1 + M_2 T_2 + M_3 T_3}{3(M_1 + M_2 + M_3)}$

D. $T = \frac{M_1 T_1 s + M_2 T_2 s + M_3 T_3 s}{M_1 + M_2 + M_3}$

Answer: B

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Multiple Choice Questions More Than One Options

1. Which of the processes described below are irreversible ?

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

B. A gas in a small container at a temperature T_1 is brought in contact with a big reservoir at a higher

temperature T_2 which increases the temperature of the gas

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

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

Answer: A::B::D

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2. An idel gas undrgoes isothermal process from some initial state i to final state f. Choose the correct alternatives.

A. $dU = 0$

B. $dQ = 0$

C. $dQ = dU$

D. $dQ = dW$

Answer: A::D

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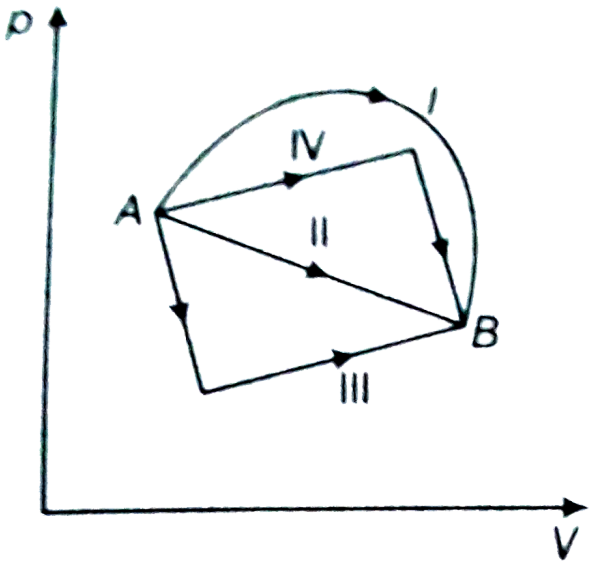
3. Figure shows the $p - V$ diagram of an ideal gas undergoing a change of state from A to B. Four different parts I, II, III and IV as shown in the figure may lead to the same change of

state. ltBrgt



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

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

C. Work done is maximum in case I

D. Work done in minimum in case II

Answer: B::C

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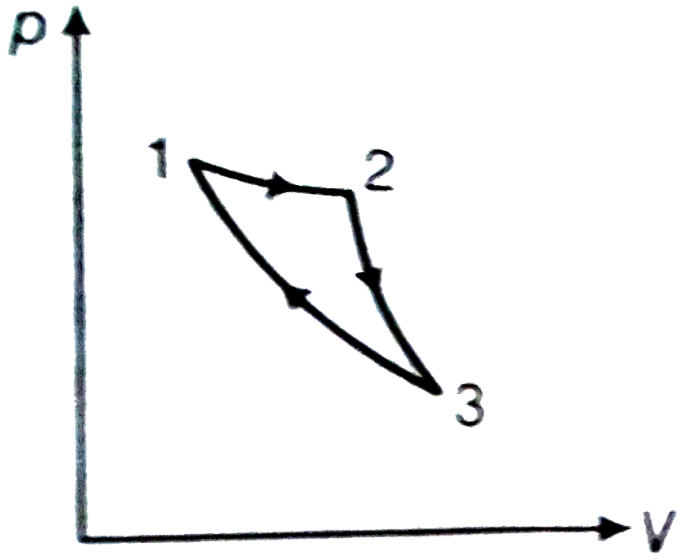
4. Consider a cycle followed by an engine (figure.)



1 or 2 is isothermal

2 to 3 is adiabatic

3 to 1 is adiabatic

Such a process does not exist, because

A. heart is completely converted to mechanical energy in such a process,

which is not possible

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

C. curves representing two adiabatic processes don't intersect

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

Answer: A::C

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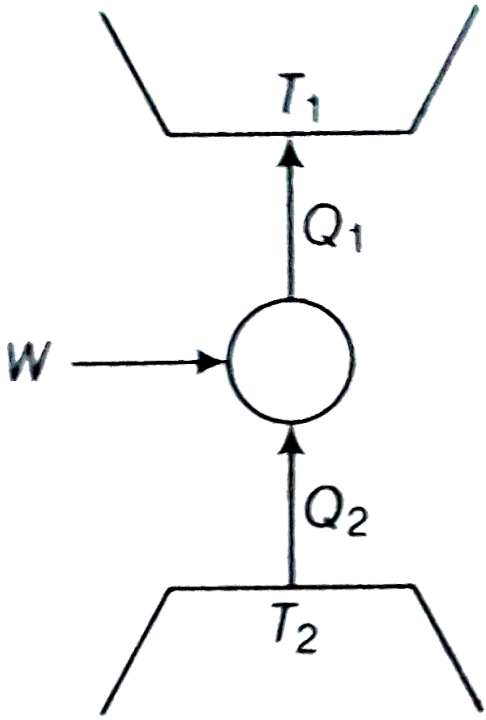
5. Consider a heat engine as shown in figure. Q_1 and Q_2 are heat added both to T_1 and heat taken from T_2 in one cycle of engine. W is the mechanical work done on the engine.



If $W > 0$, then possibilities are

A. $Q_1 > Q_2 > 0$

B. $Q_2 > Q_1 > 0$

C. $Q_2 < Q_1 < 0$

D. $Q_1 < 0, Q_2 > 0$

Answer: A::C

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Very Short Answer Type Questions

1. Can a system be heated and its temperature ramains constant ?

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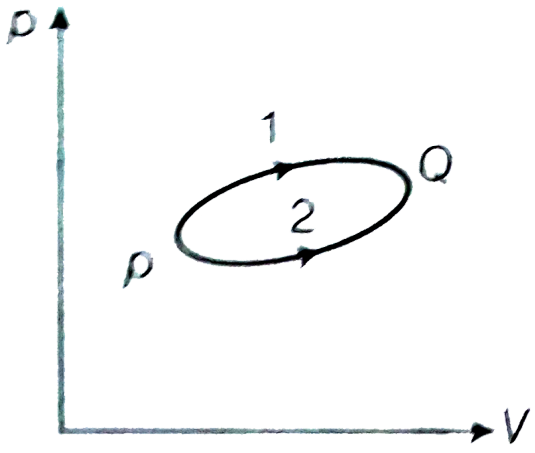
2. A system goes from P to Q by two different paths in the $p-V$ diagram as shown in figure. Heat given to the system in path 1 is 1000 J. The work done by the system along path 1 is more than path 2 by 100 J. What is the heat exchanged by the system in path 2 ?



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3. If a refrigerator's door is kept open, will the room become cool or hot ?

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4. Is it possible in increase the temperature of a gas without adding heat to it ? Explain.

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5. Air pressure in a car tyre increase during. Explain.

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Short Answer Type Questions

1. Consider a Carnot's cycle operating between T_1=500 K and T_2 = 300 K producing 1 kJ of mechanical work per cycle. Find the heat transferred to the engine by the reservoirs.

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2. A person of mass 60 kg wants to lose 5kg by going up and down a 10 m high stairs. Assume he burns twice as much fat while going up than coming down. If 1 kg of fat is burnt of expending 7000 k cal, how many times must he go up and down to reduce his weight by 5 kg ?

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3. Consider a cycle tyre being filled with air by a pump. Let V be the volume of the tyre (fixed) and at each stroke of the pump $\Delta V(<<V)$ of air is transferred to the tube adiabatically. What is the work done when the pressure in the tube is increased from p_1 to p_2 ?

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4. In a refrigerator one removes heat from a lower temperature and deposits to the surroundings at a higher temperature. In this process, mechanical work has to be done, which is provided by an electric motor. If the motor is of 1kW power and heat transferred from -3° C to 27° C, find the heat taken out of the refrigerator per second assuming its efficiency is 50% of a perfect engine.

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

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6. The initial state of a certain gas is (p_i, V_i, T_i). It undergoes explansion till its volume becomes V_f. Consider the following two cases

(a) the expansion takes place at constant

temperature.

(b) the expansion takes place at constant pressure.

Plot the $p - V$ diagram for each case. In which of the two cases, is the work done by the gas more ?

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Long Answer Type Questions

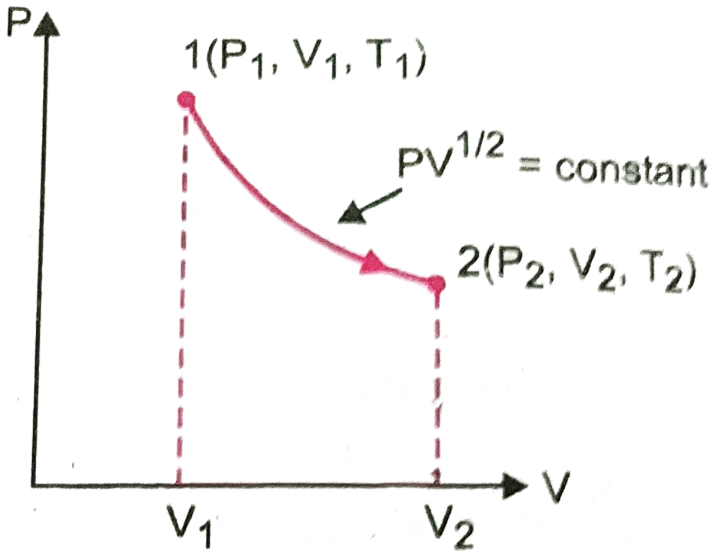
1. Consider a $P-V$ diagram in which the path followed by one mole of perfect gas in a cyclinderical container is shown in (figure)

(a) Find the work done when the gas is taken from state 1 to state 2.

(b) What is the ratio of temperatures $T_1/T_2, \quad \text{if} \quad V_2 = 2V_1$?

(c) Given the internal energy for one mole of gas at temperature $Tis(3/2)RT$, find the heat supplied to the gas when it is taken from

state 1 to 2, with $V_2 = 2V_1$.



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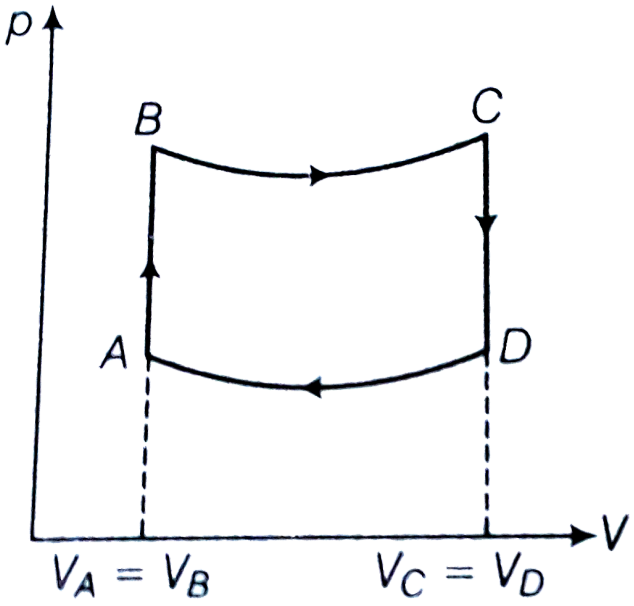
2. A cycle followed by an engine (made of one mole of perfect gas in a cylinder with a piston) is shown in figure.



A to B volume constant, B to C adiabatic, C to D volume constant and D to A adiabatic

$$V_C = V_D = 2V_A = 2V_B$$

(a) In which part of the cycle heat is supplied to the engine form outside?

(b) In which part of the cycle heat is being given to the surrounding by the engine ?

(c) What is the work done by the engine in one cycle ? Write your answer in term of p_A, p_B, V_A ?

(d) What is the efficiency of the engine ?

$\left(\gamma = \frac{5}{3} \text{ for the gas}\right), \left(C_V = \frac{3}{2}R \text{ for one mole }\right)$

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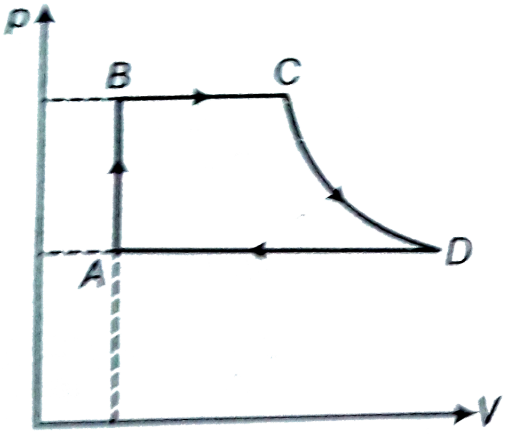
3. A cycle followed by an engine (made of one mole of an ideal gas in a cyclinder with a piston) is shown if figure . Find heat

exchanged by the enigen, with the surrodings for each section of the cycle . $[C_V = (3/2)R]$



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4. Consider that an idela gas (n mole) is espanding in a process gives by $p = f(v)$, which passes throught a point (V_0, p_0). Shown

that the gas is absorbing heat at (p_0, v_0) if the slope of the curve $p = f(v)$ is large than the slope of the adabatic passing throught (p_0, v_0).

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5. Consider one mole of perfect gas on a cylinder of units cross-section with a piston attched (figure). A spring (spring constant K) is attched (unstrecthed lengthL) to the piston and to the bottom of the cylinder . Inditially

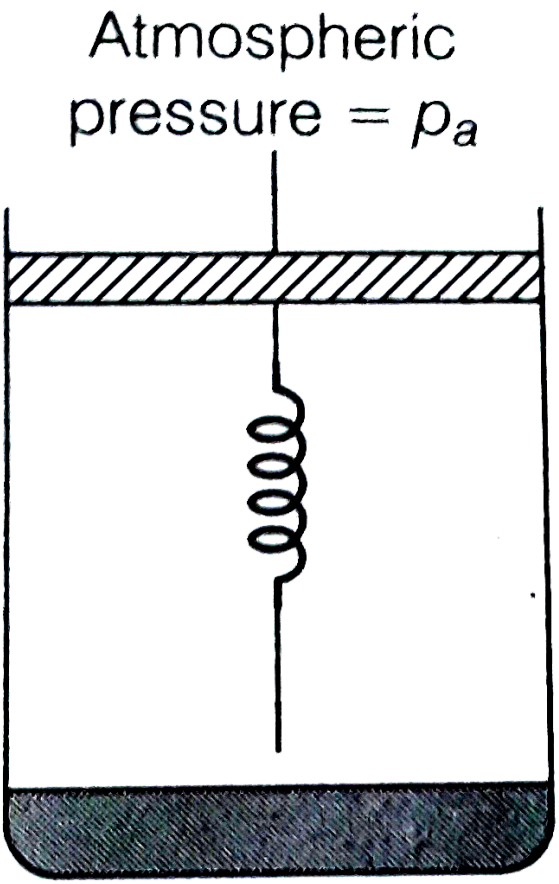
the spring is unstrecthed and the gas is in equailibrium. A certain amount of heat Q is supplied to the gas causing an increase of value from V_0 to V_1.

(a) What is the initial pressure of the system ?

(b) What is the final pressure of the system?

(c) Using the first law of thermodynamic, write

down a relation between Q, p_a, V, V_0 and K.



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