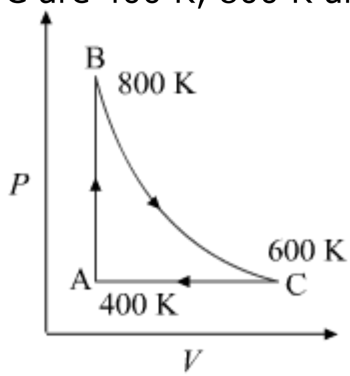
Thermodynamics

Q.No.1: One mole of a diatomic ideal gas undergoes a cyclic process ABC, as shown in the figure. The process BC is adiabatic. The temperatures at A, B and C are 400 K, 800 K and 600 K, respectively. Choose the correct statement.



A. The change in internal energy in process AB is −350 R.
B. The change in internal energy in process BC is −500 R.
C. The change in internal energy in the whole cyclic process is 250 R.
D. The change in internal energy in process CA is 700 R.

Q.No.2: Consider an ideal gas confined in an isolated closed chamber. As the gas undergoes an adiabatic expansion, the average time of collision between molecules increase as V^q, where V is the volume of the gas. The value of q is : $\left(\gamma = \frac{C_p}{C_v}\right)$ **JEE 2015**

A. $\frac{3\gamma+5}{6}$
B. $\frac{3\gamma-5}{6}$
C. $\frac{\gamma+1}{2}$
D. $\frac{\gamma-1}{2}$

Q.No.3: Two moles of an ideal mono-atomic gas occupies a volume V at 27°C.

The gas expands adiabatically to a volume 2 V. Calculate (a) the final temperature of the gas and (b) change in its internal energy. **JEE 2018**

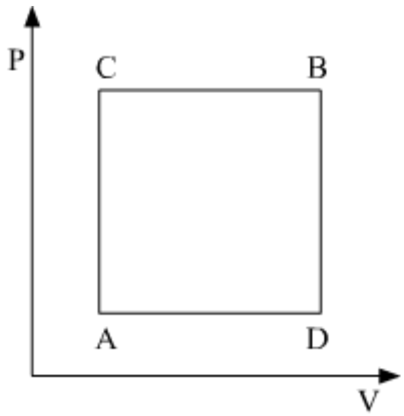
A. (a) 189 K (b) – 2.7 kJ

B. (a) 195 K (b) 2.7 kJ

C. (a) 189 K (b) 2.7 kJ

D. (a) 195 K (b) – 2.7 kJ

Q.No.4: A gas can be taken from A to B via two different processes ACB and ADB.



When path ACB is used 60 J of heat flows into the system and 30 J of work is done by the system. If path ADB is used work done by the system is 10 J. The heat Flow into the system in path ADB is: **JEE 2019**

A. 40 J

B. 80 J

C. 100 J

D. 20 J

Q.No.5: Two Carnot engines A and B are operated in series. The first one, A, receives heat at T_1(= 600 K) and rejects to a reservoir at temperature T_2. The second engine B receives heat rejected by the first engine and, in turn, rejects to a heat reservoir at T_3(= 400 K). Calculate the temperature T_2 if the work outputs of the two engines are equal: **JEE 2019**

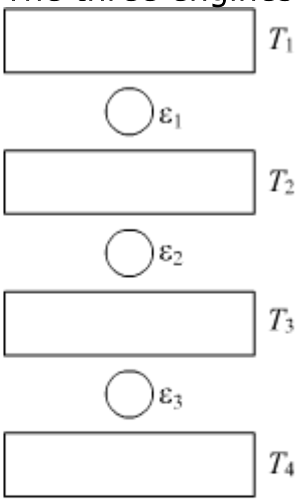
A. 600 K

B. 400 K

C. 300 K

D. 500 K

Q.No.6: Three Carnot engines operate in series between a heat source at a temperature T_1 and a heat sink at temperature T_4 (see figure). There are two other reservoirs at temperature T_2 and T_3, as shown, with $T_1 > T_2 > T_3 > T_4$. The three engines are equally efficient if: **JEE 2019**



A. $T_2 = (T_1T_4)^{\frac{1}{2}}$; $T_3 = \left(T_1^2T_4\right)^{\frac{1}{3}}$

B. $T_2 = \left(T_1^2T_4\right)^{\frac{1}{3}}$; $T_3 = \left(T_1T_4^2\right)^{\frac{1}{3}}$

C. $T_2 = \left(T_1T_4^2\right)^{\frac{1}{3}}$; $T_3 = \left(T_1^2T_4\right)^{\frac{1}{3}}$

D. $T_2 = \left(T_1^3T_4\right)^{\frac{1}{4}}$; $T_3 = \left(T_1T_4^3\right)^{\frac{1}{4}}$

Q.No.7: A rigid diatomic ideal gas undergoes an adiabatic process at room temperature. The relation between temperature and volume for this process is TV^x = constant, then x is: **JEE 2019**

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

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

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

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

Q.No.8: An ideal gas occupies a volume of 2 m^3 at a pressure of 3×10^6 Pa. The energy of the gas is : **JEE 2019**

A. 9×10^6 J

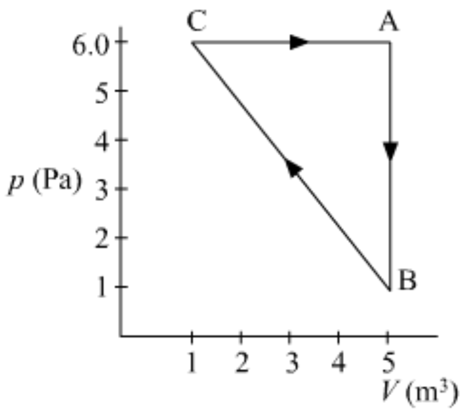
B. 6×10^4 J

C. 10^8 J

D. 3×10^2 J

Q.No.9: For the given cyclic process CAB as shown for a gas, the work done is :

JEE 2019



A. 30 J

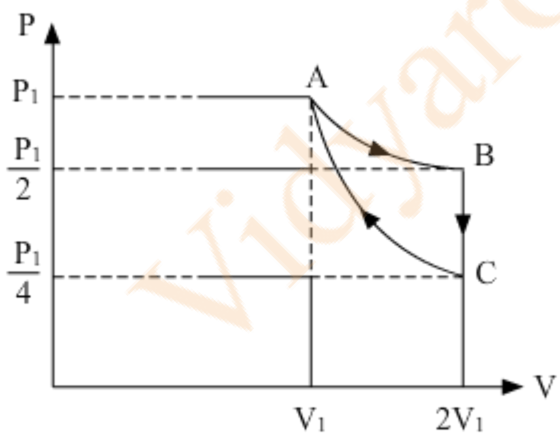
B. 10 J

C. 1 J

D. 5 J

Q.No.10: If one mole of an ideal gas at (P_1, V_1) is allowed to expand reversibly and isothermally (A to B) its pressure is reduced to one-half of the original pressure (see figure). This is followed by a constant volume cooling till its pressure is reduced to one-fourth of the initial value (B → C). Then it is restored to its initial state by a reversible adiabatic compression (C to A). The net work done by the gas is equal to :

JEE 2021



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

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

C. 0

D. RTln2