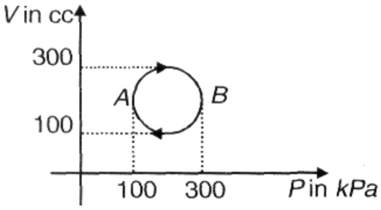
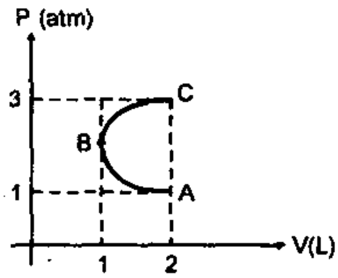
DPP – 1 (Thermodynamics)

Q 1. Calculate heat absorbed during process ABA given in figure?



(a) 3.14 J
(b) 314 J
(c) 31.4 J
(d) None of these

Q 2. In the P-V diagram shown in figure ABC is a semicircle. The work done in the process ABC is:



(a) zero
(b) $\frac{\pi}{2}$ atm-L
(c) $-\frac{\pi}{2}$ atm-L
(d) 4 atm-L

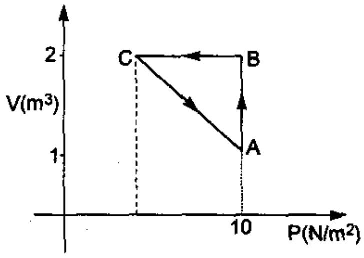
Q 3. Pressure P, volume V and temperature T of a certain real gas are related by $P = \frac{\alpha T^2}{V}$. Here, α is a constant. The work done by the real gas when temperature changes from T_0 to $2T_0$ while pressure remains constant is:

(a) $6\alpha T_0^3$
(b) $\frac{3}{2}\alpha T_0^2$
(c) $2\alpha T_0^2$
(d) $3\alpha T_0^2$

Q 4. n moles of an ideal gas undergo a process in which the temperature changes with volume as $T = KV^2$. The work done by the gas as the temperature changes from T_0 to $4T_0$ is:-

(a) $3nRT_0$
(b) $(5/2)nRT_0$
(c) $(3/2)nRT_0$
(d) zero

Q 5. If pressure is 5 pascal at C and 10 pascal at B the work done by the gas in the process $C \rightarrow A$ is:

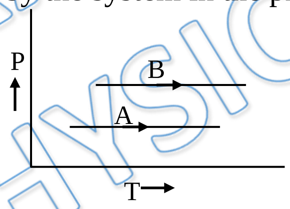


(a) – 7.5 J (b) – 10 J
(c) – 15 J (d) – 20 J

Q 6. Find the amount of work done to increase the temperature of one mole of an ideal gas by 30^0C, if it is expanding according to $V \propto T^{2/3}$.
(a) 167J (b) 132J
(c) 67J (d) None of the above

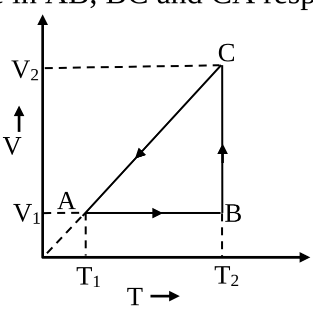
Q 7. An ideal gas is taken from the state *A* (pressure *P*, volume V) to the state *B* (pressure *P*/2, volume 2V) along a straight line path on the P-V diagram select the statement (s) from the following
(a) the work done by the gas is the in the process A to B exceeds the work the taken from A to B along an isotherm.
(b) in the T-V diagram the path AB becomes part of a parabola.
(c) in the P-T diagram, the path AB becomes a part of a hyperbola
(d) in going from A to B, the temperature T of the gas first increases to a maximum value and then decreases.

Q 8. Consider the two process on a system as shown in figure. The volumes in the initial state and in the final state are the same in the two process A and B. If W_1 and W_2 be the work done by the system in the processes A and B respectively then-



(a) $W_1 > W_2$
(b) $W_1 = W_2$
(c) $W_1 < W_2$
(d) Nothing can be said about the relation between W_1 and W_2

Q 9. A cyclic process for 1 mole of an ideal gas is shown in figure in the V-T. diagram. The work done in AB, BC and CA respectively –



(a) 0, $RT_2 \ln\left(\frac{V_1}{V_2}\right)$, $R(T_1 - T_2)$

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

(c) 0, $RT_2 \ln\left(\frac{V_2}{V_1}\right)$, $R(T_1 - T_2)$

(d) 0, $RT_2 \ln\left(\frac{V_2}{V_1}\right)$, $R(T_2 - T_1)$

Q 10. A gas is expanded to double its volume by two different processes. One is isobaric and the other is isothermal. Let W_1 and W_2 be the respective work done, then:

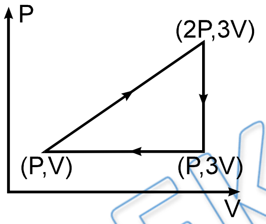
(a) $W_2 = W_1$ In (2)

(b) $W_2 = \frac{W_1}{In(2)}$

(c) $W_2 = \frac{W_1}{2}$

(d) data is insufficient

Q 11. An ideal gas is taken through cyclic process as shown in the figure. The net work done by the gas is:



(a) zero

(b) PV

(c) 2 PV

(d) 3 PV

Q 12. One mole of an ideal gas at a temperature T_1 expands slowly according to the law $\frac{p}{V}$ = constant. Its final temperature is T_2 . The work done by the gas is:

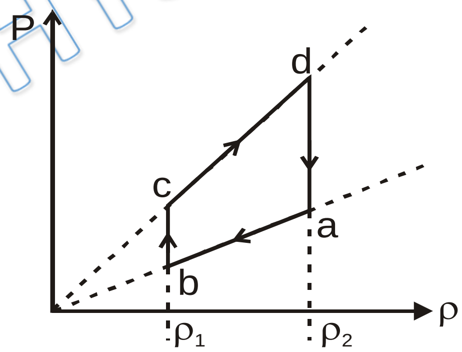
(a) $R(T_2 - T_1)$

(b) $2R(T_2 - T_1)$

(c) $\frac{R}{2}(T_2 - T_1)$

(d) $\frac{2R}{3}(T_2 - T_1)$

Q 13. An ideal gas undergoes a cyclic process abcda which is shown by pressure- density curve.



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

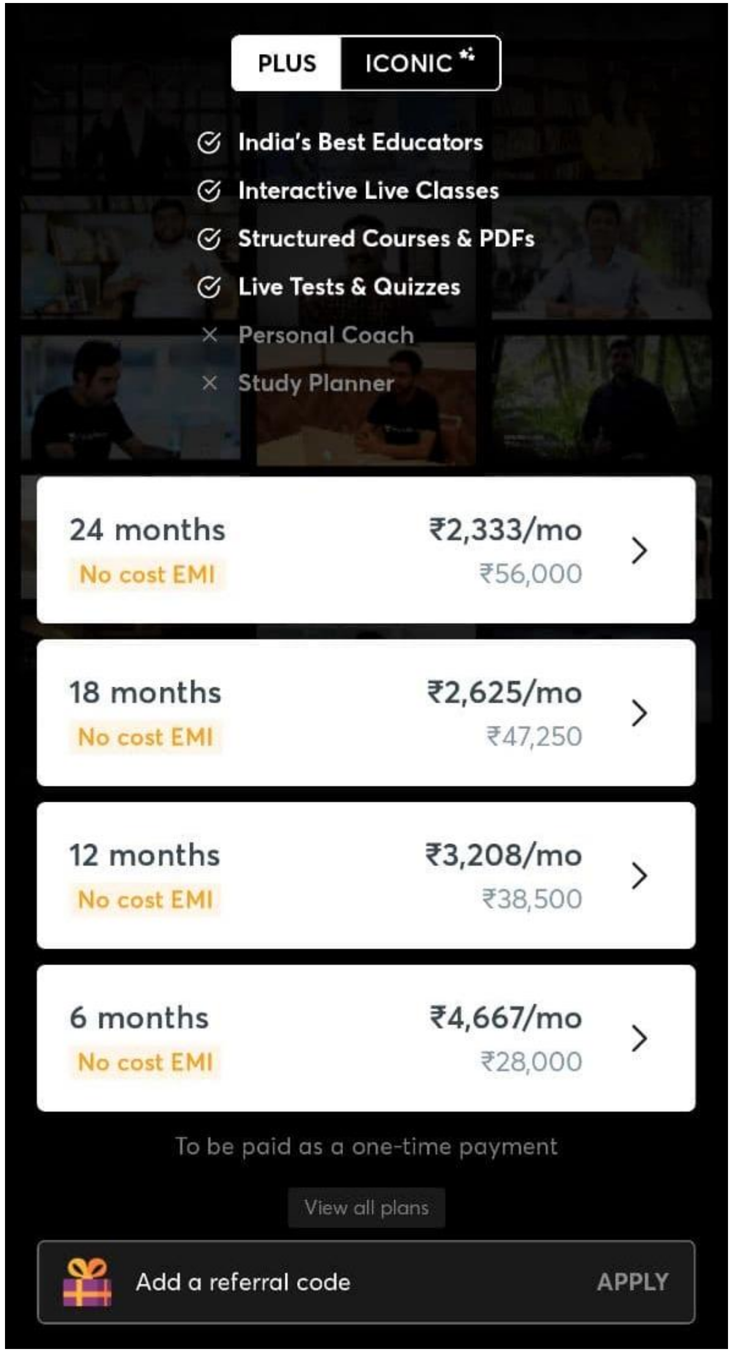
(b) Work done by the gas in the process 'cd' is negative

(c) temperature of the gas at point 'a' is greater than at state 'c'

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

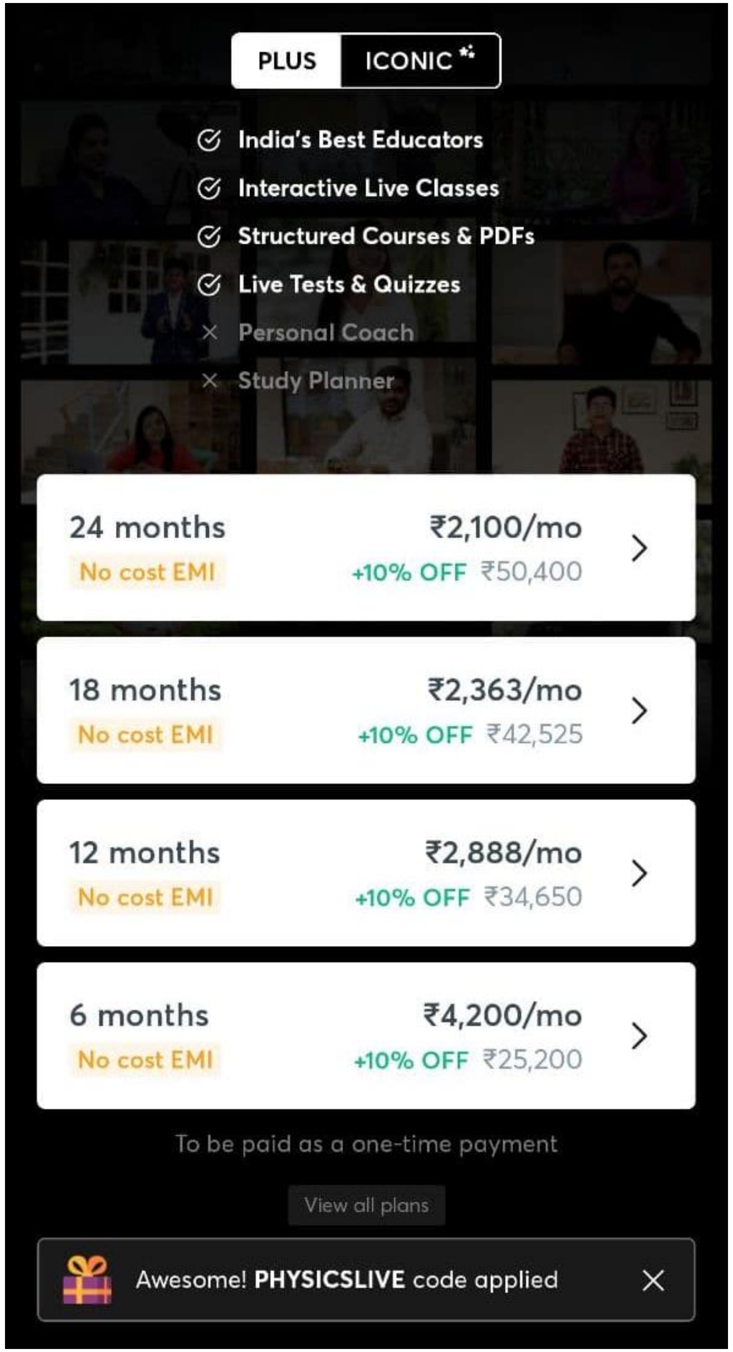
Answer Key

Q.1 c	**Q.2 b**	**Q.3 d**	**Q.4 c**	**Q.5 a**
Q.6 a	**Q.7 a, b, d**	**Q.8 c**	**Q.9 c**	**Q.10 a**
Q.11 b	**Q.12 c**	**Q.13 a, b, d**		



PHYSICSLIVE

Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS.



Written Solution

DPP- 1 Thermodynamics- Work Done by Gas in Different Processes

By Physicsaholics Team

1) $\Delta Q = \Delta U + W_{gas}$

In cyclic process $\Delta U = 0$

$\Rightarrow \Delta Q = W_{gas}$

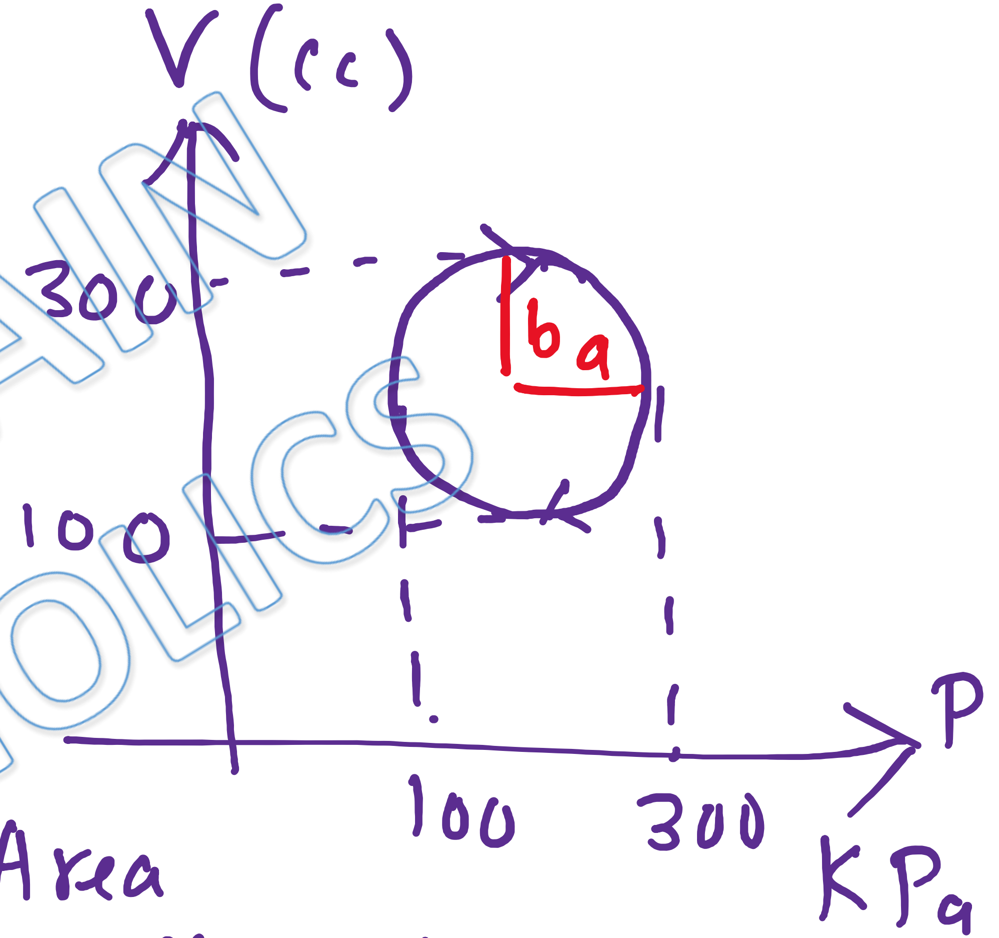
$= $ Area of loop

$= \pi ab$ (formula of Area of ellipse)

$= \pi \times 100 \times 10^{3} \times 100 \times 10^{-6}$

$= 10\pi$ J

$= 31.4$ J



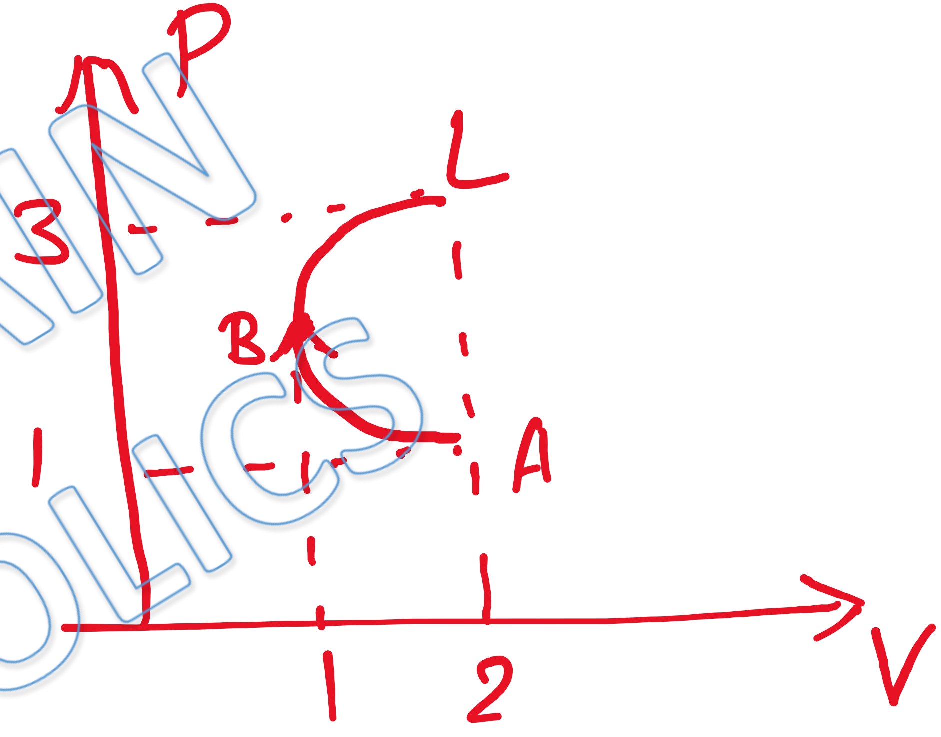
ANS (c)

2)

$$W = \frac{\pi ab}{2}$$

$$= \frac{\pi \times \frac{1}{2} \times 1}{2}$$

$$= \frac{\pi}{4} \text{ atm-L}$$



ANS(b)

3)

$$P = \frac{\alpha T^2}{V}$$

$$\Rightarrow PV = \alpha T^2$$

$$P\left(\frac{dV}{dT}\right) = 2\alpha T$$

(P = constant)

$$\Rightarrow P\,dV = 2\alpha T\,dT$$

Now

$$W = \int_{T_0}^{2T_0} P\,dV = \int_{T_0}^{2T_0} 2\alpha T\,dT$$

$$= \left[\frac{2\alpha T^2}{2}\right]_{T_0}^{2T_0} = \alpha\left[4T_0^2 - T_0^2\right]$$

$$\boxed{W = 3\alpha T_0^2}$$

Ans. (d)

4) $T = KV^2 \Rightarrow \frac{PV}{nR} = KV^2 \Rightarrow P = nRKV$

$$W_{gas} = \int P\,dV = \int_{V_1}^{V_2} nRKV\,dV$$

$$= \frac{nRK}{2}\left(V_2^2 - V_1^2\right) = \frac{nR}{2}\left(KV_2^2 - KV_1^2\right)$$

$$= \frac{nR}{2}\left(T_2 - T_1\right) = \frac{nR}{2}\left(4T_0 - T_0\right)$$

$$= \frac{3}{2}nRT_0$$

ANS(C)

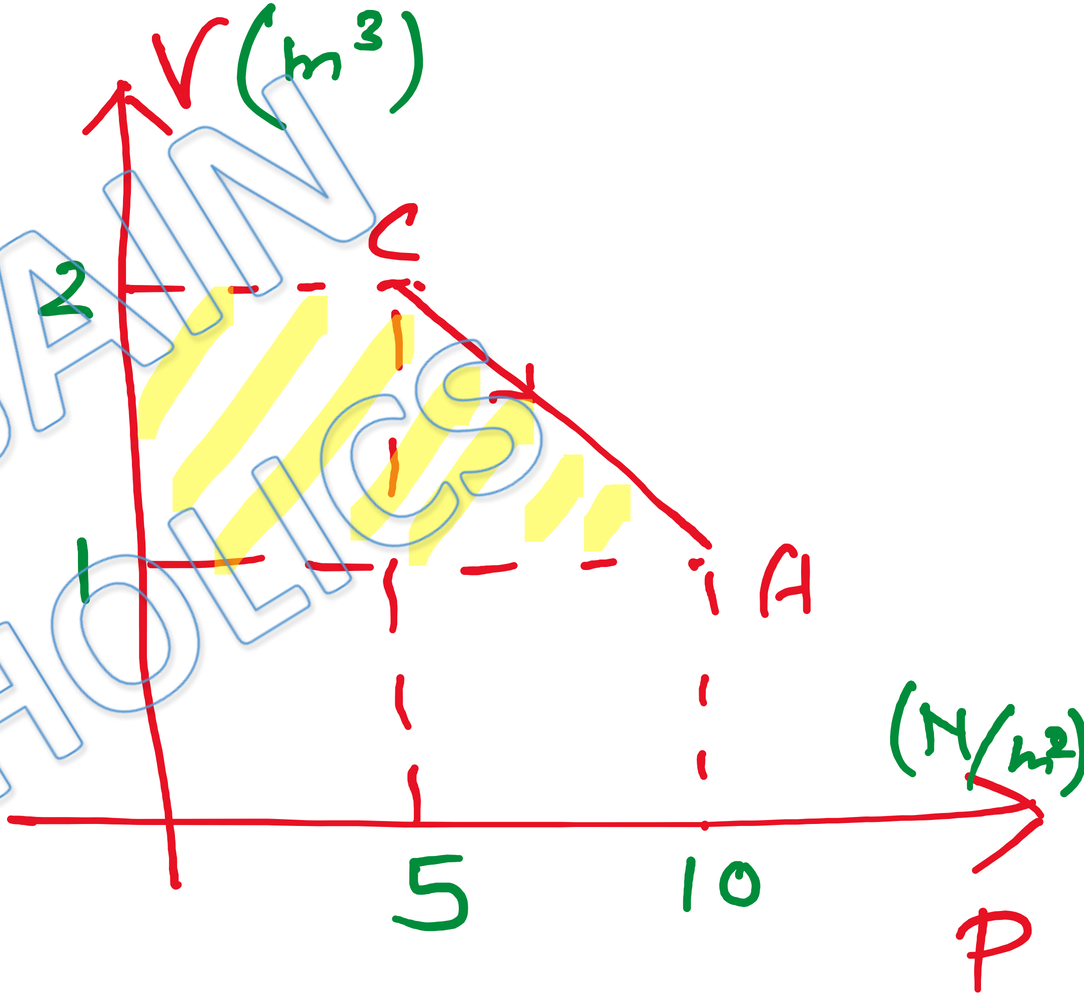
5)

W_{gas} = − Area of Shaded region

$= -\frac{1}{2} \times 1 (10+5)$

$= -\frac{15}{2} J$

$= -7.5 J$



ANS (A)

6) $V \propto T^{2/3} \Rightarrow V = C\,T^{2/3} \Rightarrow V = C\left(\frac{PV}{nR}\right)^{2/3}$

$\Rightarrow V^{3/2} = C_1 PV \Rightarrow PV^{-1/2} = \text{Constant}$

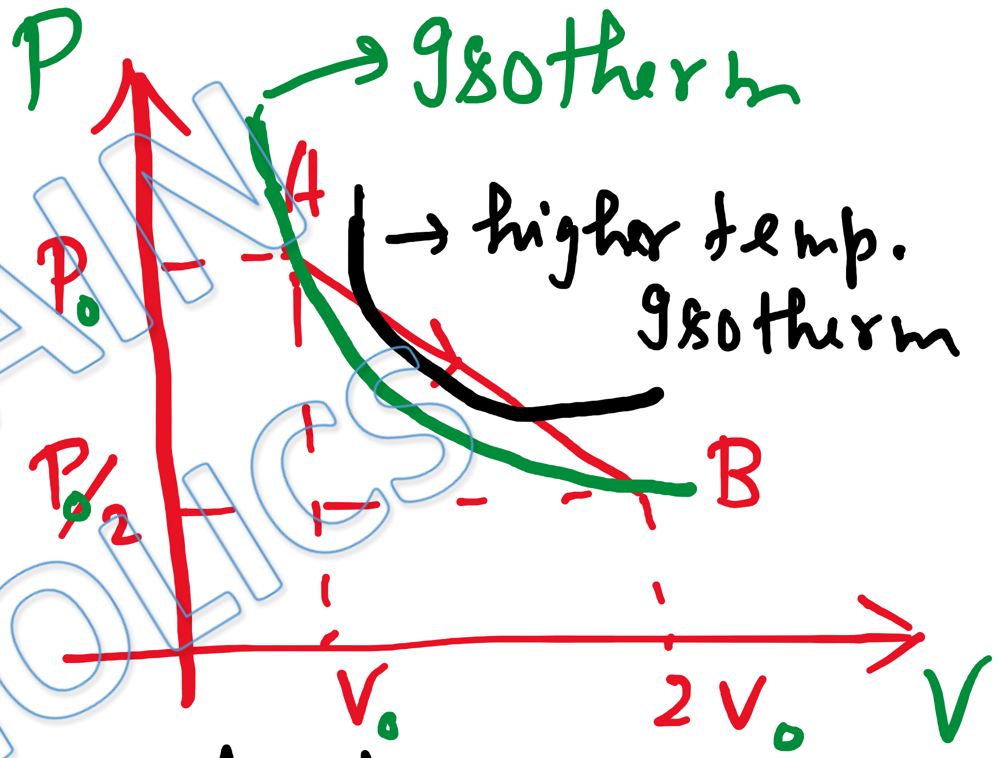
$W_{gas} = \frac{-nR\Delta T}{\gamma - 1}$ if Equation of Polytropic Process is $PV^{\gamma} = \text{Const.}$

$= \frac{-1 \times R \times 30}{-\frac{1}{2} - 1} = 20R = 167\,J$

ANS(a)

7) Area under Isotherm
< Area under AB
⇒ work done in isothermal
< work done in AB

A is Correct



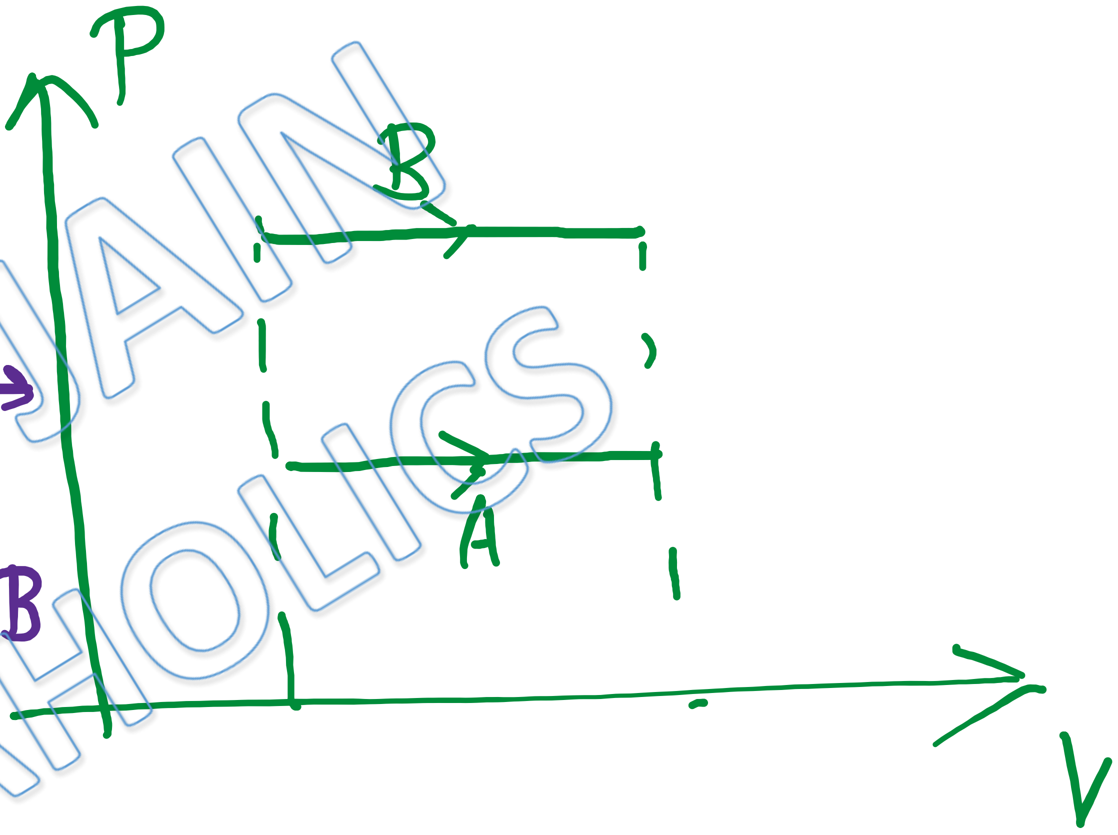
Isotherms are showing that T first increases then decreases from A to B.

D is Correct

Equation of AB → $P = mV + C$

8) P-T graph are given in question.

Corresponding P-V graph is →



Area under A < Area under B

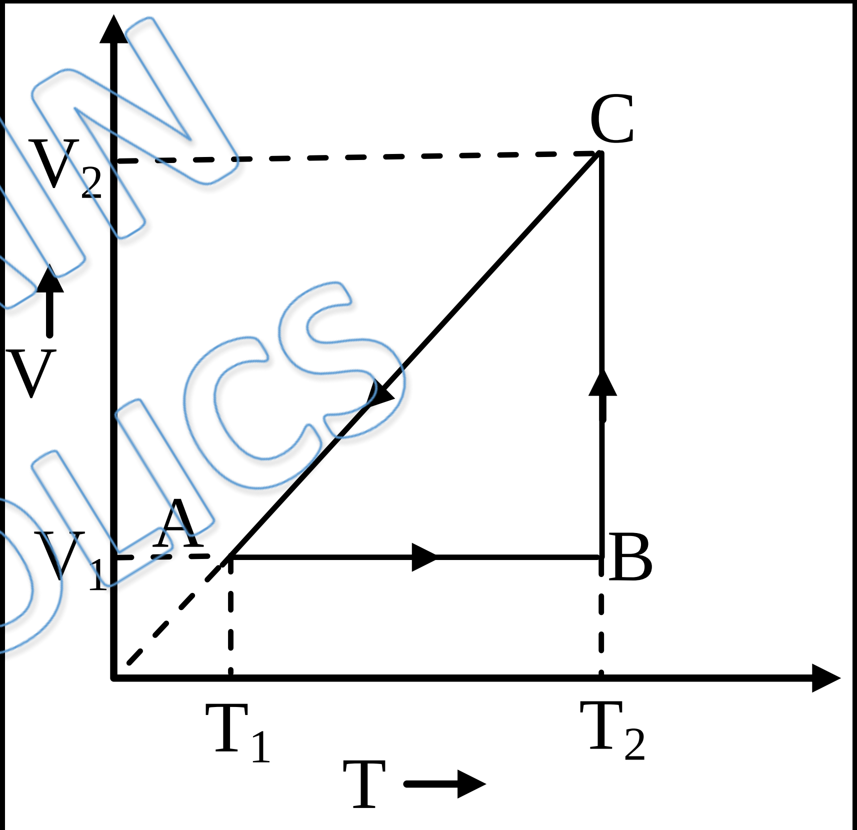
$\Rightarrow \quad W_1 < W_2$

Ans. c

9) $n = 1$ mole.

$W_{AB} = 0$ (isochoric process)

$W_{BC} = nRT_2 \ln\left(\frac{V_2}{V_1}\right)$ (isothermal process)



for CA → $\frac{V}{T}$ = constant

$\Rightarrow P$ = constant $\Rightarrow$ isobaric process

$\Rightarrow \quad W_{CA} = nR(T_1 - T_2)$

Ans (c)

10)

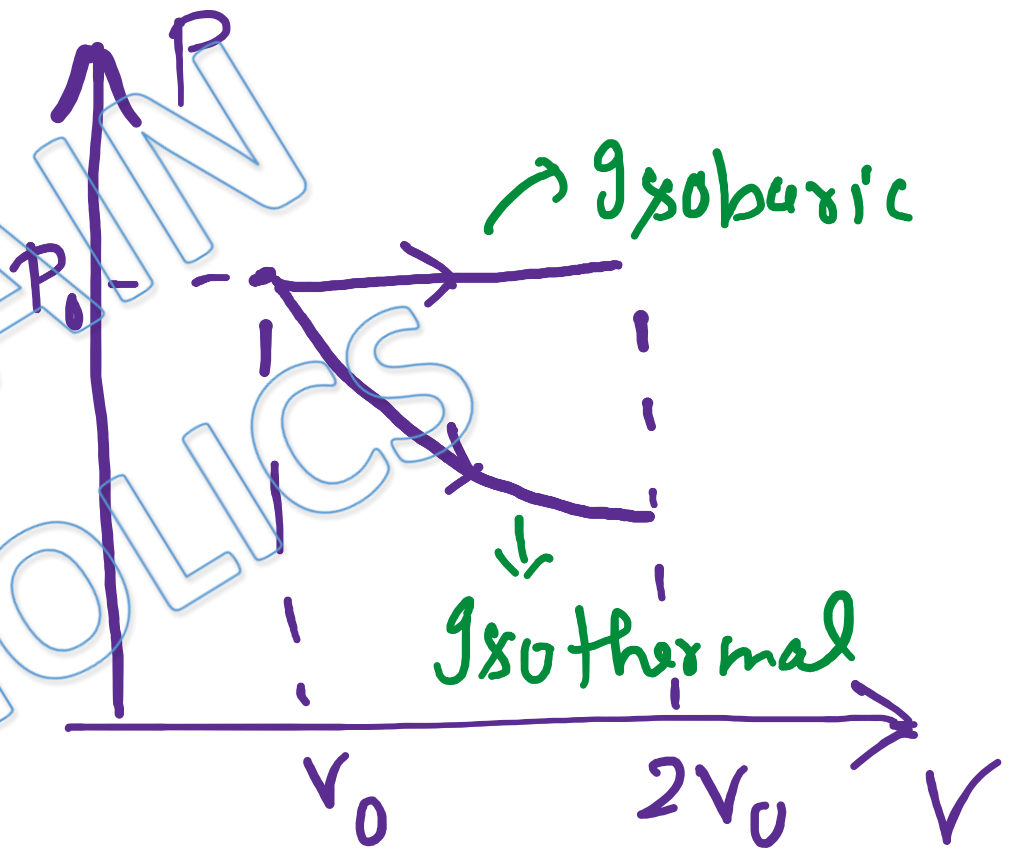
$$W_1 = P_0(2V_0 - V_0)$$

$$= P_0V_0$$

$$W_2 = nRT_0 \ln\left(\frac{2V_0}{V_0}\right)$$

$$= P_0V_0 \ln 2$$

$$= W_1 \ln 2$$



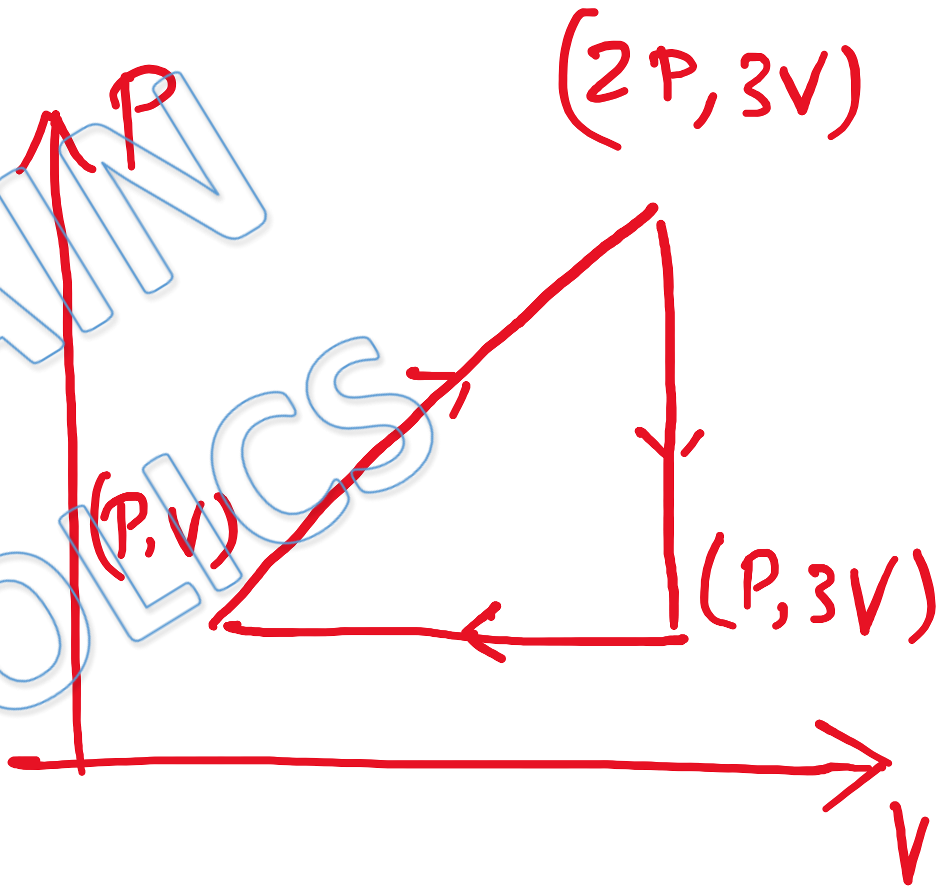
ANS (A)

11)

$W_{gas} = +$ Area of loop

$= \frac{1}{2} \times (3V - V) \times (2P - P)$

$= PV$



ANS (B)

12) $\frac{P}{V} = \text{Constant} \Rightarrow PV^{-1} = \text{Constant}$

↓

Polytropic process

$$W_{gas} = \frac{-nR\Delta T}{\gamma - 1} = -\frac{nR(T_2 - T_1)}{-1-1}$$

$$= \frac{R(T_2 - T_1)}{2}$$

ANS (c)

13) In BC, ρ = Constant

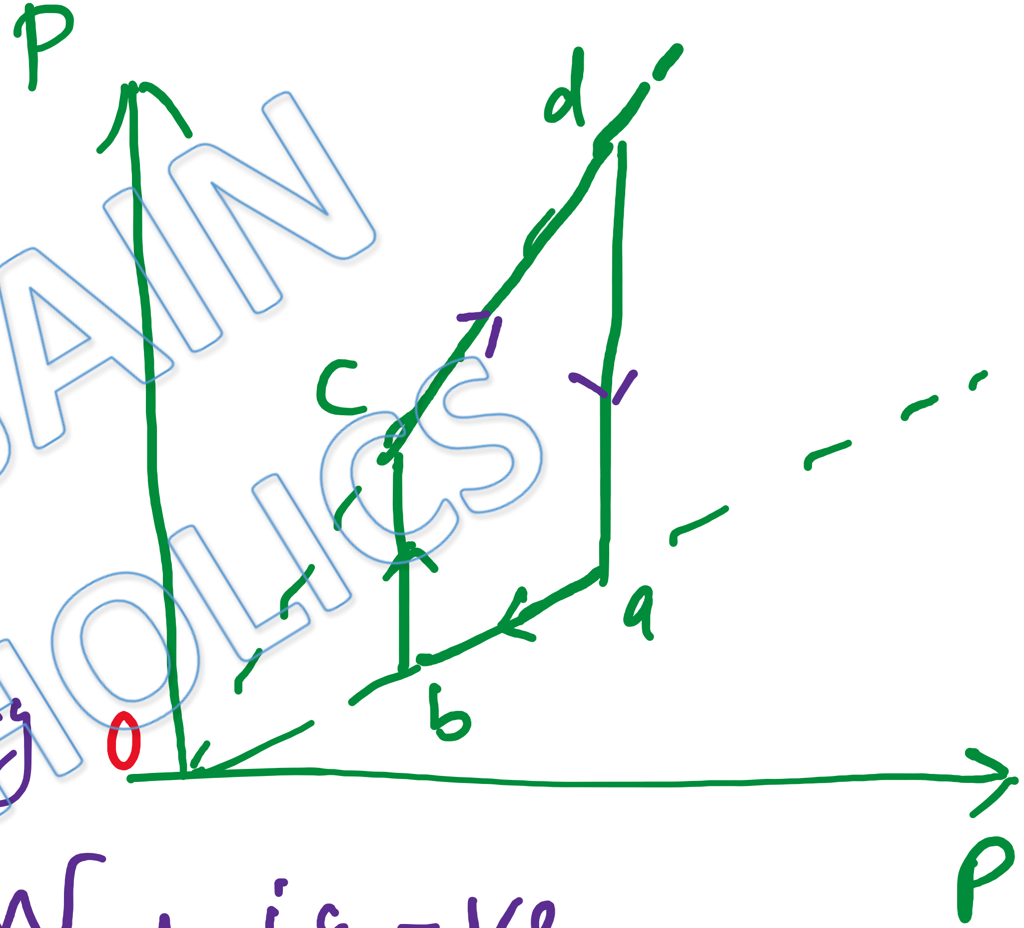
$\Rightarrow V$ = Constant

$\Rightarrow W_{BC} = 0$

A is Constant.

In cd, ρ is increasing

$\Rightarrow V$ is decreasing $\Rightarrow W_{cd}$ is $-ve$.



Slope of OC > Slope of OA

$$\Rightarrow \frac{P_c}{\rho_c} > \frac{P_a}{\rho_a} \Rightarrow P_c V_c > P_a V_a$$

$$\Rightarrow T_c > T_a$$

$W_{ab} = nRT_a \ln\frac{V_1}{V_2}$ → Isothermal

$W_{bc} = 0$ → Isochoric

$W_{cd} = nRT_c \ln\left(\frac{V_2}{V_1}\right)$ → Isothermal

$W_{da} = 0$ → Isochoric

$$W_{net} = nR\underbrace{(T_a - T_c)}_{-ve}\underbrace{\ln\left(\frac{V_1}{V_2}\right)}_{+ve} = -ve.$$

ANS (a, b, d)

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/60

Video Solution on YouTube:- https://youtu.be/HYH9ur1SZhI

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/78

Chalo Niklo