DPP – 3

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/59
Video Solution on YouTube:- https://youtu.be/Uk5XKgSoihc
Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/33

Q 1. The pressure of the gas filled in thermally insulated container is P and temperature is T. If the ratio of specific heats of the gas is g, which of the following will be constant
(a) $PT^{\gamma-1}$ (b) $P^{\gamma}T^{1-\gamma}$
(c) $P^{1-\gamma}T^{\gamma}$ (d) $P^{-\gamma}\ T^{\gamma-1}$

Q 2. The ratio of slopes of adiabatic and isotherm at point of intersection is-
(a) 1 : γ (b) 1 : 1
(c) γ : 1 (d) 1 : 4

Q 3. In an adiabatic expansion of a gas, its temperature -
(a) always increases (b) always decreases
(c) remains constant (d) diminishes initially and then increases

Q 4. In an adiabatic process, temperature of a gas is doubled by compression, the final pressure will be -
(a) doubled
(b) more than double
(c) less than double
(d) much greater than double

Q 5. The pressure and volume of a gas are P and V. If its pressure is reduced to P/2, by (A) isothermal process (B) by adiabatic process then the final volume will be -
(a) more in A
(b) more in B
(c) equal in A and B
(d) depends on the nature of gas

Q 6. In adiabatic expansion
(a) $\Delta U = 0$ (b) $\Delta U = negative$
(c) $\Delta U = positive$ (d) $W = zero$

Q 7. In an adiabatic expansion of one mole gas initial and final temperatures are T_1 and T_2 respectively, then the change in internal energy of the gas is (symbols have their usual meaning)
(a) $\frac{R}{\gamma-1}(T_2 - T_1)$ (b) $\frac{R}{\gamma-1}(T_1 - T_2)$
(c) $R(T_1 - T_2)$ (d) zero

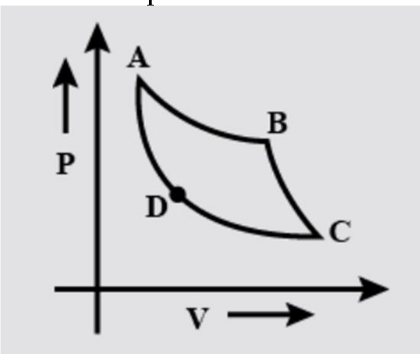
Q 8. Two moles of an ideal monoatomic gas at 27°C occupies a volume of V. If the gas is expanded adiabatically to the volume 2V, then the work done by the gas will be [γ = 5/3, R = 8.31 J/mol K

(a) -2767.23J (b) 2767.23J
(c) 2500 J (d) $-2500\ J$

Q 9. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The adiabatic constant of gas is

(a) 3/2 (b) 4/3
(c) 2 (d) 5/3

Q 10. In given P-V graph of an ideal gas two processes are isothermal and two are adiabatic, which parts describe the adiabatic process :



(a) AB and BC (b) AB and CD
(c) AD and BC (d) None of these

Q 11. A gas at NTP is suddenly compressed to one-fourth of its original volume. If γ is supposed to be $\frac{3}{2}$, then the final pressure is

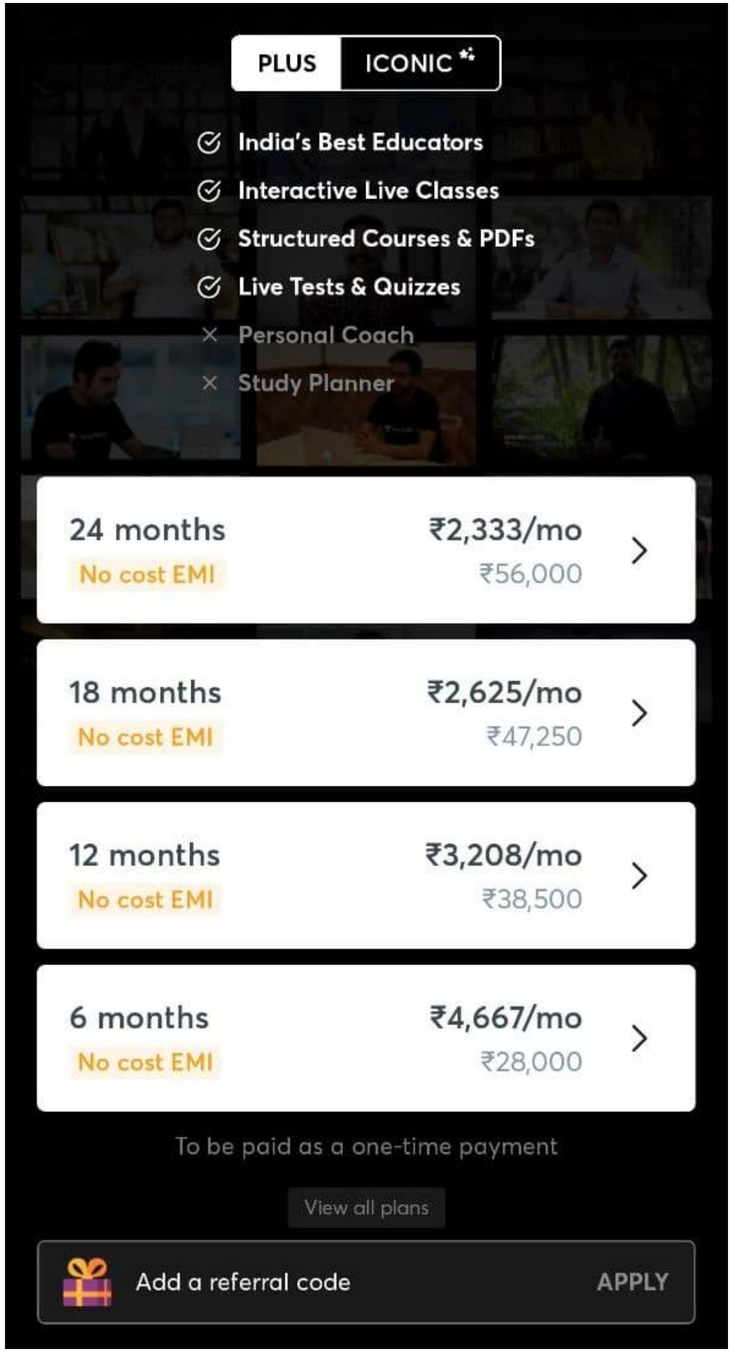
(a) 4 atmosphere (b) $\frac{3}{2}$ atmosphere
(c) 8 atmosphere (d) $\frac{1}{4}$ atmospher

Q 12. The pressure in the tyre of a car is four times the atmospheric pressure at 300 K. If this tyre suddenly bursts, its new temperature will be (γ = 1.4)

(a) $300(4)^{1.4/0.4}$ (b) $300\left(\frac{1}{4}\right)^{-0..4/1.4}$
(c) $300(2)^{-0.4/1.4}$ (d) $300(4)^{-0.4/1.4}$

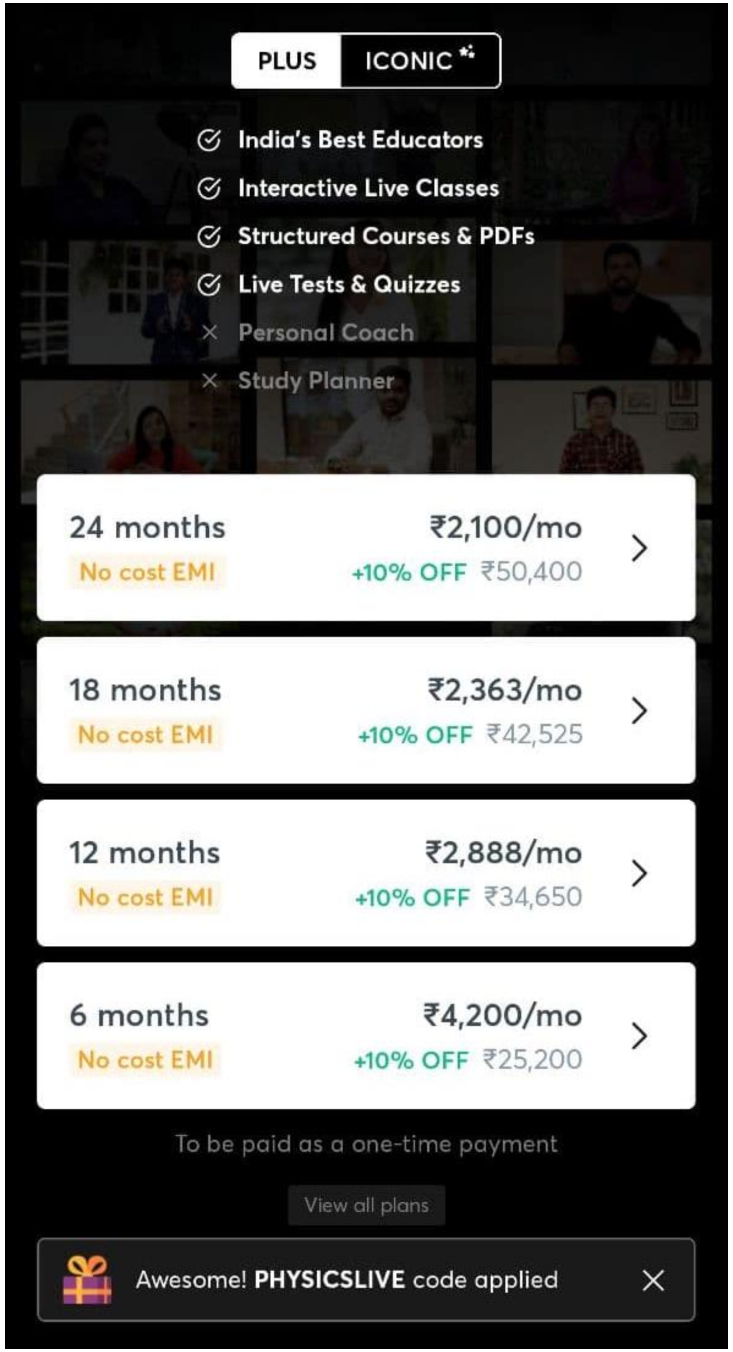
Answer Key

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



PHYSICSLIVE

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



NEET & JEE Main
Physics DPP- Solution

DPP- 3 Thermodynamics- Adiabatic process

By Physicsaholics Team

Solution 1:

in adiabatic process

$$PV^{\gamma} = c$$

$$\Rightarrow P\left(\frac{nRT}{P}\right)^{\gamma} = c$$

$$\Rightarrow P^{1-\gamma} T^{\gamma} = c$$

ANS (c)

Solution 2:

In adiabatic process

$$\frac{dP}{dV} = \gamma \frac{P}{V}$$

In Isothermal process

$$\frac{dP}{dV} = \frac{P}{V}$$

Ratio = $\gamma : 1$

Ans (c)

Solution 3:

In adiabatic process —

$$PV^{\gamma} = C$$

$$\Rightarrow \frac{nRT}{V} V^{\gamma} = C$$

$$\Rightarrow TV^{\gamma-1} = C$$

$$\Rightarrow T = \frac{C}{V^{\gamma-1}}$$

Since $\gamma > 1$, $\gamma - 1 = +ve$

T decreases on increasing V

ANS (b)

Solution 4:

In adiabatic process

$$PV^{\gamma} = C \Rightarrow P\left(\frac{nRT}{P}\right)^{\gamma} = C \Rightarrow P^{1-\gamma} T^{\gamma} = C$$

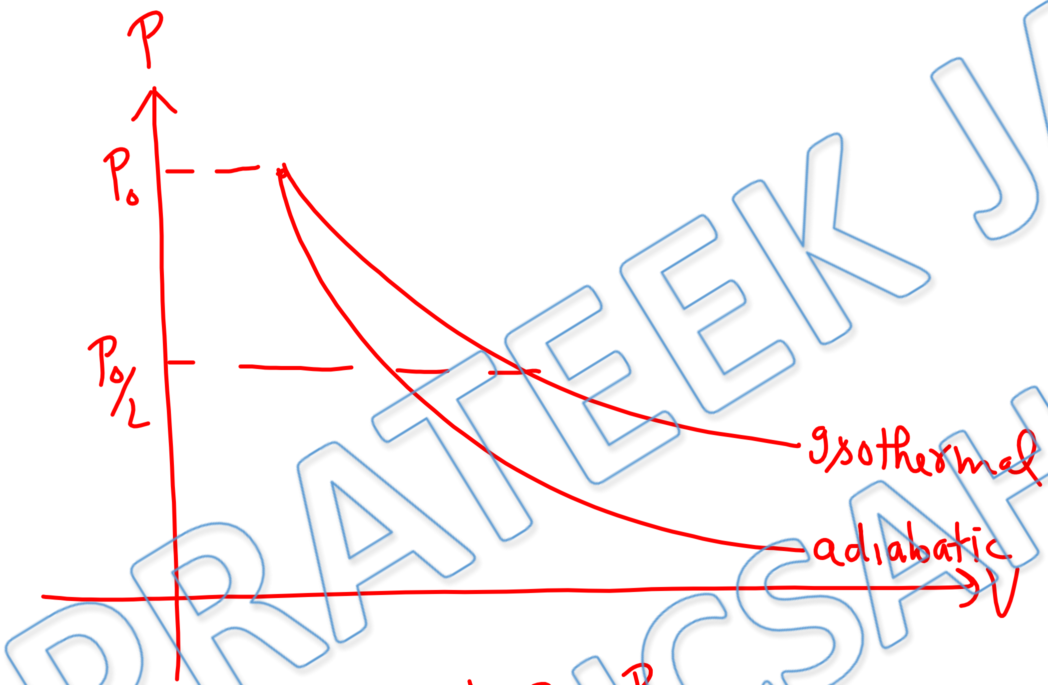
$$\Rightarrow \quad P = \frac{C}{T^{\frac{\gamma}{1-\gamma}}}$$

$$\Rightarrow \quad P = C T^{\frac{\gamma}{\gamma-1}} = C T^{\frac{(f+2)}{f \times 2/f}} = C T^{\left(1+\frac{f}{2}\right)}$$

On doubling T, P will be more than double

Ans (b)

Solution 5:



at $P = P_0/2$

Volume is greater in isothermal

Ans (a)

Solution 6:

In adiabatic Expansion

T decreases

$\Rightarrow \Delta U = -ve$

$W_{gas} = \int P\,dV$

Since V is increasing

$W_{gas} \neq 0$

Ans (b)

Solution 7:

$$\Delta U = \frac{f}{2} nR\Delta T$$

we know that $\gamma = 1 + \frac{2}{f} \Rightarrow \frac{2}{f} = \gamma - 1 \Rightarrow f = \frac{2}{\gamma - 1}$

$$\Rightarrow \frac{f}{2} = \frac{1}{\gamma - 1}$$

$$\Rightarrow \Delta U = \frac{nR}{\gamma - 1}(T_2 - T_1)$$

Ans (a)

Solution 8:

work done by gas in adiabatic process

$$w = \frac{nR(T_1 - T_2)}{\gamma - 1}$$

$T_1 = 27°C = 300\,K$

$\because TV^{\gamma-1} = \text{Constant}$

So; $T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$

$(300)(V)^{\frac{5}{3}-1} = T_2 (2V)^{\frac{5}{3}-1}$

$(300)\, V^{2/3} = T_2\, 2^{2/3}\, V^{2/3}$

$T_2 = (300)\left(\frac{1}{2}\right)^{2/3}$

$\boxed{T_2 = 189\,K}$

$$w = \frac{2R(300 - 189)}{5/3 - 1}$$

$$w = \frac{2R(111)}{2/3} = 333R$$

$w = 333 \times 8.31$

$\boxed{w = 2767.23\ J}$ Ans.

Ans. b

Solution 9:

In adiabatic process

$$P T^{\frac{\gamma}{1-\gamma}} = \text{constant}$$

given; $P \propto T^3$

$$P T^{-3} = \text{constant}$$

$$\Rightarrow \frac{\gamma}{1-\gamma} = -3$$

$$\gamma = -3 + 3\gamma$$

$$3 = 3\gamma - \gamma$$

$$2\gamma = 3$$

$$\boxed{\gamma = 3/2}$$

& $\frac{C_p}{C_v} = \gamma$

So; $\boxed{\frac{C_p}{C_v} = \frac{3}{2}}$ Ans.

Ans. a

Solution 10:

For Isothermal Process

$T = \text{constant} \Rightarrow PV = \text{constant}$

$PV = K$

$(dP)V + P(dV) = 0$

$$\boxed{\frac{dP}{dV} = -\frac{P}{V}} \quad \text{--- (1)}$$

For adiabatic Process

$PV^{\gamma} = \text{constant}$

$(dP)V^{\gamma} + P(\gamma V^{\gamma-1} dV) = 0$

$$\frac{dP}{dV} = -\frac{\gamma P V^{\gamma-1}}{V^{\gamma}} = -\gamma \frac{P}{V}$$

$$\boxed{\frac{dP}{dV} = -\gamma \frac{P}{V}} \quad \text{--- (2)}$$

From eqⁿ (1) & (2)

for Isothermal Process $\left(\frac{dP}{dV}\right)_T = -\frac{P}{V}$

For Adiabatic Process $\left(\frac{dP}{dV}\right)_A = -\gamma \frac{P}{V}$

as $\gamma > 1$ (always)

$$\therefore \left|\left(\frac{dP}{dV}\right)_A\right| > \left|\left(\frac{dP}{dV}\right)_T\right|$$

So, curve for adiabatic process will be steeper than curve for Isothermal process.

And In given P–V graph curve AD & BC are steeper than curve AB

∴ AD & BC are for adiabatic Process

Ans. c

Solution 11:

$PV^{r} = \text{constant}$

$P_1 = P_0 \qquad V_1 = V_0$

$P_2 = ? \qquad V_2 = \frac{V_0}{4}$

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

$P_1 V_1^{r} = P_2 V_2^{r}$

$P_0 V_0^{r} = P_2 \left(\frac{V_0}{4}\right)^{r}$

$P_2 = \frac{P_0 V_0^{r}}{V_0^{r}} \times 4^{r}$

$P_2 = P_0 \times 4^{r}$

$P_2 = P_0 \times (4)^{3/2}$

$\boxed{P_2 = 8P_0}$

$P_0 = 1 \text{ atm}$

$\boxed{P_2 = 8 \text{ atm}}$ Ans

Ans. c

Solution 12:

For adiabatic process:

$P^{1-\gamma} T^{\gamma} = \text{Constant} \quad (\gamma = 1.4)$

$P_1^{1-\gamma} T_1^{\gamma} = P_2^{1-\gamma} T_2^{\gamma}$

$P_2 = P_0$ & $P_1 = 4P_0$

$T_2 = ?$; $T_1 = 300K$

so; $P_0^{1-\gamma} T_2^{\gamma} = (4P_0)^{1-\gamma} (300)^{\gamma}$

$T_2^{\gamma} = 4^{1-\gamma} (300)^{\gamma}$

$T_2 = 4^{\frac{1-\gamma}{\gamma}} (300)$

$T_2 = (4)^{\left(\frac{1-1.4}{1.4}\right)} (300)$

$T_2 = 300 (4)^{\left(\frac{-0.4}{1.4}\right)}$

$$T_2 = 300 (4)^{(-0.4/1.4)}$$

Ans.

Ans. d

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/59

Video Solution on YouTube:- https://youtu.be/Uk5XKgSoihc

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/33

Chalo Niklo