# CheckMATE Test Series

**NEET-UG** | **Class XI Physics** | **Thermodynamics**

**Student Name:** ______________________

**Class**__________ **Date**____________

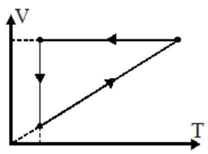
**Marks obtained** _______**Total marks-180**

**Correct Answers**__________

**Incorrect Answers**__________

1.

A sample of nitrogen gas was taken through the cyclic process shown in the figure. What is the ratio of energy released by the gas in the isochoric process to work done by the gas in the isobaric process?




A. 1.5

B. 2.5

C. 0.4

D. 0.66

2.

A Carnot engine having an efficiency of 1/10 as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is:-

A. 90J

B. 99 J

C. 100J

D. 1J

3.

Which is not a path function?

A. $\Delta Q$

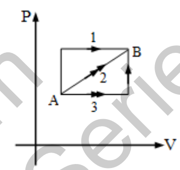
B. $\Delta Q + \Delta W$

C. $\Delta W$

D. $\Delta Q - \Delta W$

4.

If the amount of heat supplied to change the state from A to B via path 1, 2 and 3 are $Q_1$, $Q_2$ and $Q_3$ respectively, then the correct option is -




A. $Q_1 > Q_2 > Q_3$

B. $Q_1 < Q_2 < Q_3$

C. $Q_1 = Q_2 = Q_3$

D. data insufficient

5.

What amount of heat is to be transferred to nitrogen in isobaric heating process for that gas to perform work $\Delta W = 2J$?

A. 3J

B. 5J

C. 9J

D. 7J

6.

Heat is transferred to a heat engine from a furnace at a rate of 80 mW. If the rate of heat rejection is 50 mW, then efficiency of the engine is

A. Above 40%

B. Below 40%

C. Equal to 40%

D. Equal to 35%

**Ans:B**

**Solution:**

$Q_{hot} = 80\,mW, Q_{cold} = 50\,mW$

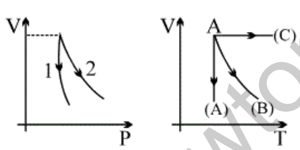
Work output, $W = Q_H - Q_C = 30$ mW

$$n = \text{efficiency} = \frac{\text{Work output}}{\text{Heat input}}$$

$$= \frac{30}{80} = 0.375 \text{ or } 37.5\%$$

7.

Given that in the V–P diagram, one of the plots is that of an isothermal process while the other is adiabatic process. The possible V–T diagram is also shown. Choose the correct alternative.




A. $(1) \rightarrow A$ and $(2) \rightarrow B$

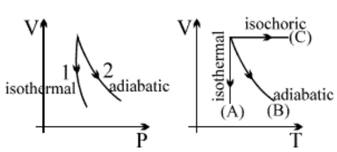
B. $(1) \rightarrow B$ and $(2) \rightarrow A$

C. $(1) \rightarrow A$ and $(2) \rightarrow C$

D. $(1) \rightarrow C$ and $(2) \rightarrow A$

**Ans:A**

**Solution:**




8.

At 27°C two moles of an ideal monatomic gas occupy a volume V. The gas expands adiabatically to a volume 2V. Final temperature of the gas–

A. 200 K

B. 250K

C. 173 K

D. 189 K

**Ans:D**

In case of adiabatic change

$PV^{\gamma}$ = cosntt. with $PV = \mu RT$

So, that $T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$ [with $\gamma = (5/3)$]

i.e. $300 \times V^{2/3} = T\,(2V)^{2/3}$

or $T = 300/(2)^{2/3} = 189$ K

9.

110 J of heat are added to a gaseous system by which internal energy increases by 40 J, the amount of work done is –

A. 150 J

B. 70 J

C. 110 J

D. 40 J

**Ans:B**

**Solution:**

$dQ = dU + dW$

$110 = 40 + dW$

$\Rightarrow dW = 70$ J

10.

A sample of 10 g of oxygen is heated through 100°C at a constant pressure. Then, choose the correct option is

(Take, $C_V = 5.03$ cal $mol^{-1}$-$k^{-1}$ and R = 1.98 cal $mol^{-1}$-$K^{-1}$)

A. Heat supplied is 62 cal

B. Work done by gas is 219 cal

C. Change in internal energy of gas is 157 cal

D. No work is done by the gas

**Ans:C**

$$pV = nRT \quad \Rightarrow \quad pdV = nRdT$$

$$\Rightarrow \quad W = nRdT$$

$$= \frac{10}{32} \times 1.98\left(\frac{\text{cal}}{\text{mol}-\text{K}}\right) \times 100(\text{K}) = 62 \text{ cal}$$

$$\therefore \quad C_V = 5.03\frac{\text{cal}}{\text{mol}-\text{K}} \text{ and } R = 1.98\frac{\text{cal}}{\text{mol}-\text{K}}$$

$$C_p = C_V + R = 5.03 + 1.98$$

$$= 7.01\frac{\text{cal}}{\text{mol}-\text{K}}$$

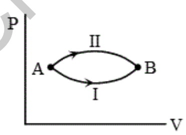
So, heat supplied is

$$Q = nC_p\Delta T = \frac{10}{32} \times 7.01 \times 100 = 219 \text{cal}$$

So, $\Delta U = \Delta Q - \Delta W = 219 - 62 = 157$ cal in used to increase the temperature of the gas.

11.

A system goes from A to B via two processes I and II as shown in the figure. If $\Delta U_1$ and $\Delta U_2$ are the changes in the internal energies in the processes I and II respectively, then -




A. $\Delta U_1 = \Delta U_2$

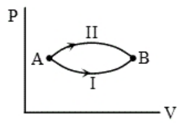
B. Relation between $\Delta U_1$ and $\Delta U_2$ cannot be determined

C. $\Delta U_2 > \Delta U_1$

D. $\Delta U_2 < \Delta U_1$

**Ans:A**

**Solution:**




$\because (\Delta U)_I = (\Delta U)_{II}$

Change in internal energy only depends on initial and final state.

12.

Which statement is incorrect?

A. All reversible cycles have same efficiency

B. Reversible cycle has more efficiency than an irreversible

C. Carnot cycle is a reversible one

D. Carnot cycle has the maximum efficiency in all cyc

**Ans:A**

**Solution:**

Theory based question hence no detailing

13.

The heat energy given to a system in isothermal process is used in:

A. Increasing the internal energy

B. Increasing temperature and doing external work

C. Doing external work only

D. Increasing internal energy, increasing temperature and d external work

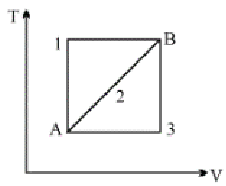
**Ans:C**

**Solution:**

Theory Based question hence no detailing

14.

A given mass of a gas expands from the state A to the state B by three paths 1, 2 and 3 as shown in V-T indicator diagram. If $W_1$, $W_2$ and $W_3$ respectively be the work done by the gas along the three paths, then



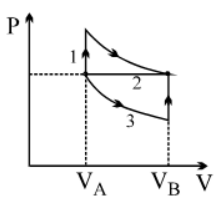

A. $W_1 > W_2 > W_3$

B. $W_1 < W_2 < W_3$

C. $W_1 = W_2 = W_3$

D. $W_1 < W_2, W_1 > W_3$

**Ans:A**




After converting into P-V curve, it is clear that $W_1 > W_2 > W_3$

15.

A cylinder with fixed capacity of 67.2 lit contains helium gas at STP. The amount of heat needed to raise the temperature of the gas by 20°C is : [Given that R = 8.31 J mol$^{-1}$ K$^{-1}$]

A. 748 J

B. 374 J

C. 350 J

D. 700 J

**Ans:A**

**Solution:**

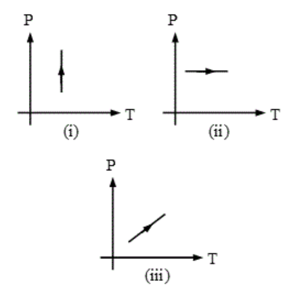
$$\Delta Q = nC_V\Delta T = n\frac{3}{2}R\Delta T$$

$$= \left(\frac{67.2}{22.4}\right)\left(\frac{3}{2}\times 8.31\right)(20)$$

$$\approx 748\text{J}$$

16.

Pressure versus temperature graphs of an ideal gas are as shown in figure. Choose the wrong statement –




A. Density of gas is increasing in graph (i)

B. Density of gas is decreasing in graph (ii)

C. Density of gas is constant in graph (iii)

D. None of these

**Ans:D**

**Solution:**

(i) At constant temperature

$P \propto \rho$

(ii) At constant pressure

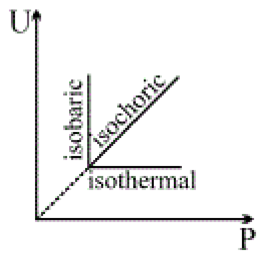
$T \propto \frac{1}{\rho}$

(iii) $V \rightarrow$ constant

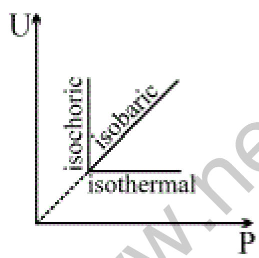
$\therefore \rho \rightarrow$ constant

17.

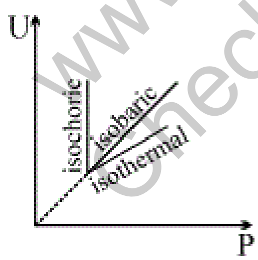
Which of the following graphs correctly shows the change in internal energy of an ideal gas with pressure for the isobaric, isochoric and isothermal processes?



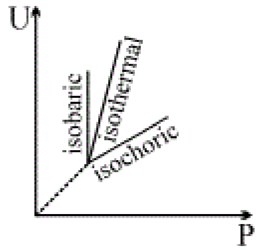

A.




B.




C.




D.

**Ans:A**

**Solution:**

In isobaric process $\rightarrow$ pressure is constant so line is || to U axis

In isothermal process $\rightarrow$ temperature as well as U is constant so line is || to P axis

In isochoric process $\rightarrow T \propto P$ (or $U \propto P$) curve is straight line passing through origin

18.

The temperature inside a refrigerator is $t_2$°C and the room temperature is $t_1$°C. The amount of heat delivered to the room for each joule of electrical energy consumed ideally will be

A. $\frac{t_1 + t_2}{t_1 + 273}$

B. $\frac{t_1}{t_1 - t_2}$

C. $\frac{t_1 + 273}{t_1 - t_2}$

D. $\frac{t_2 + 273}{t_1 - t_2}$

**Ans:C**

**Solution:**

Amount of heat delivered to the room ($Q_1$) for each joule of electrical energy consumed (W) $= \frac{Q_1}{W} = \frac{T_1}{T_1 - T_2} = \frac{t_1 + 273}{t_1 - t_2}$

19.

One mole of an ideal gas expands at a constant temperature of 300 K from an initial volume of 10 liters to a final volume of 20 liters. The work done in expanding the gas is

(R = 8.31 J/mole-K)

A. 750 joules

B. 1728 joules

C. 1500 joules

D. 3456 joules

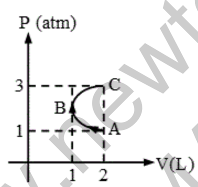
**Ans:B**

Correct Option is: (2)

$$W_{iso} = \mu RT \log_e \frac{V_2}{V_1} = 1 \times 8.31 \times 300 \log_e \frac{20}{10} = 1728 \text{ J}$$

20.

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

**Ans:B**

**Solution:**

Work done

$$= \frac{\pi r_1 r_2}{2} = \frac{\pi}{2} \times 1 \times 1 \text{ atm-litre}$$

$$= \frac{\pi}{2} \text{ atm -litre}$$

21.

A heat engine receive 200 J of heat from a source and perform 80 J of work. If temperature of sink of the engine is 27°C then which of the following can be the temperature of source -

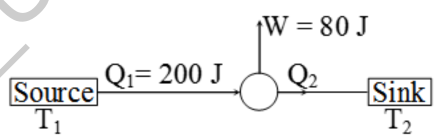
A. 200°C

B. 500 K

C. 700 K

D. 127°C

**Ans:B**




$\therefore$ Here $Q_2 = Q_1 - W = 120$ J

$$\because \frac{Q_2}{Q_1} = \frac{T_2}{T_1}$$

$$\frac{120}{200} = \frac{300}{T_1}$$

$$T_1 = \frac{300 \times 200}{120} = 500 \text{ K}$$

22.

During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio $C_p/C_v$ for the gas is:

A. 2

B. 5/3

C. $3/2$

D. $4/3$

**Ans:C**

**Solution:**

given, $P \propto T^3$

but for adiabatic process $P \propto T^{\gamma/\gamma-1}$

So, $\frac{\gamma}{\gamma-1} = 3 \Rightarrow \gamma = \frac{3}{2} \Rightarrow \frac{C_P}{C_V} = \frac{3}{2}$

23.

In a process, the pressure of an ideal gas is proportional to the square of the volume of the gas. If the temperature of the gas increases in this process, then work done by the gas

A. Is positive

B. In negative

C. Is zero

D. May be positive

**Ans:A**

$P \propto V^2$

$PV^{-2} = C$

$W = \frac{nR\Delta T}{1-x}; \quad x = -2$

$= \frac{nR\Delta T}{3}$.

24.

A thermos bottle containing coffee is shaken vigorously. Consider the coffee as a system.

A. Its temperature decreases

B. Its internal energy changes

C. Work has been done by the system

D. Heat has been added to the system

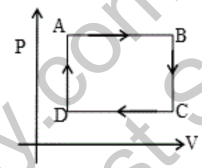
**Ans:B**

**Solution:**

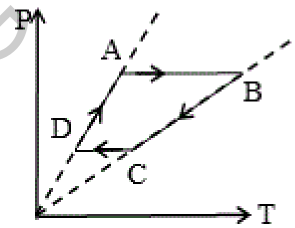
No heat is transferred & work is being done on the system causes increase in temperature.

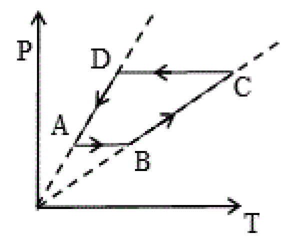
25.

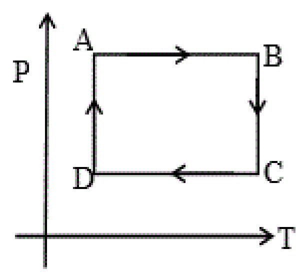
In the following cyclic process is

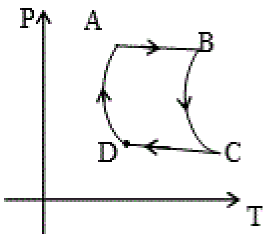



The above process in the P-T coordinates is given as

A. 


B. 


C. 




D.

**Ans:A**

**Solution:**

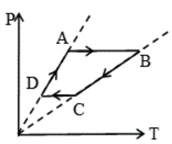
Process A→ B; P = constant & V ∝ T

Process B → C; V = constant& P ∝ T

Process C → D; P = Constant & V ∝ T

Process D → A; V = Constant & P ∝ T

Hence,




26.

An ideal gas is heated at constant pressure and absorbs amount of heat Q. If the adiabatic exponent is γ, then the fraction of heat absorbed in raising the internal energy and performing the work is-

A. $1-\frac{1}{\gamma}$

B. $1+\frac{1}{\gamma}$

C. $1-\frac{2}{\gamma}$

D. $1+\frac{2}{\gamma}$

**Ans:A**

Heat absorbed by the system at constant pressure

$Q = nC_p\Delta T$

and change in internal energy

$\Delta U = nC_v\Delta T$

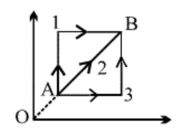
$W = Q - \Delta U$

$\text{fraction} = \frac{W}{Q} = \frac{Q-\Delta U}{Q} = 1 - \frac{\Delta U}{Q}$

$= 1 - \frac{\Delta U}{Q} = \left(1-\frac{1}{\gamma}\right)$

27.

A given mass of a gas expands from a state A to the state B by three paths 1, 2 and 3 as shown in P-V indicator diagram (Pressure on y axis). If $W_1$, $W_2$ and $W_3$ respectively be the work done by the gas along the three paths, then




A. $W_1 > W_2 > W_3$

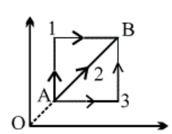
B. $W_1 < W_2 < W_3$

C. $W_1 = W_2 = W_3$

D. $W_1 < W_2, W_1 > W_3$

**Ans:A**

**Solution:**




Work done by gas = Area under the curve

Thus $W_1 > W_2 > W_3$

28.

Entropy may be expressed as a function of

A. p and T

B. T and V

C. Q and W

D. All of these

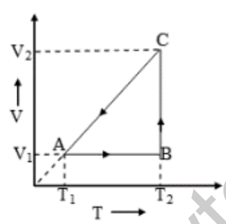
**Ans:A**

**Solution:**

Theory based question hence no detailing

29.

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 by gas are -




A. $0, RT_2 \ln\left(\frac{V_1}{V_2}\right), R(T1 - T_2)$

B. $R(T1 - T_2), 0, RT_1 \ln\left(\frac{V_1}{V_2}\right)$

C. $0, RT_2 \ln\left(\frac{V_2}{V_1}\right), R(T1 - T_2)$

D. $0, RT_2 \ln\left(\frac{V_2}{V_1}\right), R(T2 - T_1)$

**Ans:C**

Process AB; V = constant $\Rightarrow W_{AB} = 0$

Process BC; T = constant $\Rightarrow W_{BC} = nRT\ell n\left(\frac{V_f}{V_i}\right)$

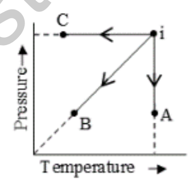
$\Rightarrow W_{BC} = (1)(R)(T_2)\,\ell n\left(\frac{V_2}{V_1}\right)$

Process CA; $V \propto T \Rightarrow P$ = constant.

$W_{CA} = P.dV = nRdT = (1)(R)(T_1 - T_2)$

30.

In the figure shown here thermodynamic system goes from initial state i to three possible final states, A to B or C. Then the final state achieved by an isochoric process is:




A. A

B. B

C. C

D. None

**Ans:B**

We know in P-T curve

PV = nRT

$P \propto T$ (for Isochoric)

31.

A refrigerator works between 4°C and 30°C. It is required to remove 600 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power required is (Take 1 cal =4.2 Joules)

A. 2.365 W

B. 23.65 W

C. 236.5 W

D. 2365 W

**Ans:C**

**Solution:**

sink ($T_2$) = 4° + 273 = 277 K

source ($T_1$) = 30°+273 = 303 K

$Q_2 = 600 \times 4.2$ Joule

$$\beta = \frac{T_2}{T_1 - T_2} = \frac{Q_2}{W} = \frac{277}{303-277} = \frac{600\times 4.2}{W}$$

W = 236.53 Joule

$$\text{Thus, } P = \frac{W}{t} = \frac{236.53}{1} = 236.53\,\text{Watt}$$

32.

A gas cylinder with a movable frictionless piston and conducting walls contains n moles of a gas at temperature T. If the piston is slowly displaced by an external agent to make the volume double of its initial value, then work done by external agent is

A. nRT

B. $nRT(1 + ln2)$

C. $nRT(1 - ln2)$

D. 2nRT

**Ans:C**

According to work-energy theorem,

$W = \Delta K$

But $\Delta K = 0 \Rightarrow W = 0$

$\Rightarrow W_{gas} + W_{atm} + W_{ext} = 0$

$\Rightarrow W_{ext} = -(W_{gas} + W_{atm})$

$$= -\left(nRT\,ln\frac{V_f}{V_i} - nRT\right) = nRT(1 - ln\,2)$$

33.

When heat Q is supplied to a diatomic gas of rigid molecules, at constant volume its temperature increases by ΔT. the heat required to produce the same change in temperature, at a constant pressure is :

A. $\frac{7}{5}Q$

B. $\frac{3}{2}Q$

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

D. $\frac{2}{3}Q$

**Ans:A**

**Solution:**

$Q = nC_v\,\Delta T$

$Q' = nC_p\,\Delta T$

$$\therefore \frac{Q'}{Q} = \frac{C_p}{C_v}$$

$$\text{For diatomic gas : } \frac{C_p}{C_v} = \gamma = \frac{7}{5}$$

$$Q' = \frac{7}{5}Q$$

34.

Suppose ideal gas equation follows $VP^3$ = constant. Initial temperature and volume of the gas are T and V respectively. If gas expand to 27V then its temperature will become -

A. T

B. 9T

C. 27T

D. T/9

Ans:B

**Solution:**

Given; $V_1P_1^3 = V_2P_2^3$

$\because PV = nRT$

$\Rightarrow V_1\left(\frac{T_1}{V_1}\right)^3 = V_2\left(\frac{T_2}{V_2}\right)^3$

$\Rightarrow \left(\frac{T_2}{T_1}\right)^3 = \left(\frac{V_2}{V_1}\right)^2$

$\Rightarrow T_2 = T\left(\frac{27V}{V}\right)^{2/3}$

$\Rightarrow T_2 = 9T$

35.

Which of the following statements is correct for any thermodynamic system?

A. The internal energy changes in all processes

B. Internal energy and entropy are state functions

C. The change in entropy can never be zero

D. The work done in an adiabatic process is always zero

Ans:B

36.

At atmosphere pressure, 1 g of water becomes 1671 cm$^3$ of steam, when boiled. Latent heat of vapourisation of water is 539 cal g$^{-1}$, 1 cal = 4.18 J and 1 atm pressure = $1.013\times10^5$ Nm$^{-2}$. Change in internal energy of water in the process is around

A. 170 J

B. 2235 J

C. 2083 J

D. 539 J

Ans:C

**Solution:**

$\Delta W = p\Delta V = 1.013\times10^5(1671\times10^{-6} - 1\times10^6)$

$= 169.2\,J \approx 170\,J$

$\Delta Q = 539\times4.18 = 2253\,J$

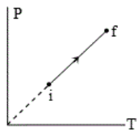
$\Delta U = \Delta Q - \Delta W$

$= 2253 - 170$

$= 2083\,J$

37.

An ideal gas goes from the state i to the state f as shown in figure. The work done by the gas during the process.




A. Is positive

B. Is negative

C. Is zero

D. Cannot be obtained from this information

Ans:C

**Solution:**

From figure; $P \propto T$

$\Rightarrow V = \text{constant}$

$\Rightarrow dV = 0$

Work done, $W = PdV$

$\Rightarrow W = 0$

38.

Three samples of the same gas A, B and C ($\gamma = 3/2$) have initially equal volume. Now the volume of each sample is doubled. The process is adiabatic for A, isobaric for B and isothermal for C. If the final pressure is equal for all three samples, the ratio of their initial pressures is-

A. $2\sqrt{2} : 2 : 1$

B. $2\sqrt{2}:1:2$

C. $\sqrt{2}:1:2$

D. $2:1:\sqrt{2}$

**Ans:B**

**Solution:**

Let initial pressure of the three samples be $P_A$, $P_B$ and $P_C$

Adiabatic process, $P_A(V)^{3/2} = (2V)^{3/2}\, P$

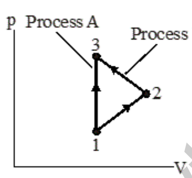
Isobaric process, $P_B = P$

Isothermal process, $P_C V = P\,(2V)$

$P_A : P_B : P_C = (2)^{3/2} : 1 : 2$

39.

Two processes take an ideal gas from state 1 to state 3. Compare the magnitude of work done by process A to the work done by process B.




A. $W_A - W_B = O$

B. $W_A \neq W_B$ but neither is zero

C. $W_A > W_B$

D. $W_A < W_B$

**Ans:D**

**Solution:**

$W_A = 0$ because A is an isochoric process.

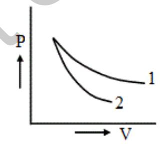
$W_B = W_{1\text{ to }2} + W_{2\text{ to }3}$.

$|W_{2\text{ to }3}| > |W_{1\text{ to }2}|$ because there's more area under the curve, and $W_{2\text{ to }3}$ is negative whereas $W_{1\text{ to }2}$ is positive.

Thus $W_B$ is non zero.

40.

P-V plots for two gases during adiabatic processes are shown in figure. Plots 1 and 2 should correspond respectively to-




A. He and $O_2$

B. $O_2$ and He

C. He and Ar

D. $O_2$ and $N_2$

**Ans:B**

**Solution:**

$PV^{\gamma} =$ Constant

Slope, $\frac{dP}{dV} = -\gamma\frac{P}{V}$

$\gamma_{mono} > \gamma_{dia}$

At same pressure & volume, slope of curve-2 is more. Thus, curve-2 is for He (Mono-atomic) & curve-1 is for $O_2$ (Diatomic)

41.

For a mono-atomic ideal gas undergoing an adiabatic change, the relation between temperature and volume is $TV^x$= constant where x is:

A. $7/5$

B. $2/5$

C. 2/3

D. 1/3

**Ans:C**

**Solution:**

For an adiabatic change in case of a monatomic gas, $TV^{\gamma-1}$ = constant. $x = (\gamma - 1) = 2/3$

42.

For a gas if $\gamma = 1.4$, then atomicity, $C_P$ and $C_V$ of the gas are respectively:

A. Monoatomic, $\frac{5}{2}R, \frac{3}{2}R$

B. Monoatomic, $\frac{7}{2}R, \frac{5}{2}R$

C. Diatomic, $\frac{7}{2}R, \frac{5}{2}R$

D. Triatomic, $\frac{7}{2}R, \frac{5}{2}R$

**Ans:C**

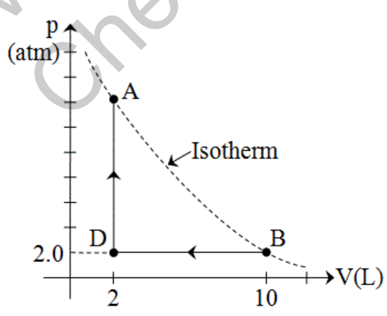
$r = 1.4$

It is for diatomic gas

Where $C_p = \frac{7}{2}R, \quad C_p = \frac{5}{2}R$

43.

An ideal gas undergoes process BDA, which is shown on p-V diagram as shown in the figure.




In the process BDA,

A. $1.6 \times 10^3$ J heat flows into the gas volume

B. $1.6 \times 10^3$ J heat flows out of the gas volume

C. $1.6 \times 10^3$ J of internal energy is converted into work

D. $1.6 \times 10^3$ J of work is stored in the form of internal energy of gas

**Ans:B**

**Solution:**

$W = p\Delta V$

$= 2 \times 1.01 \times 10^5 \times (2 \times 10^{-3} - 10 \times 10^{-3})$

$= -1.6 \times 10^3$ J (isobaric compression)

As points B and A are on same isotherm,

$T_A = T_B \Rightarrow \Delta U_{BDA} = 0$

So, $Q = W = -1.6 \times 10^3$ J

$\therefore$ 1600 J of heat flows out of the gas in the process BDA.

44.

A liquid is being converted into vapours as its bp; the specific heat of liquid at this temperature will be:

A. zero

B. infinite

C. positive

D. negative

**Ans:B**

**Solution:**

$\because$ At boiling, $\Delta T = 0$

$\therefore \quad C = \frac{1}{h}\frac{\Delta Q}{\Delta T} = \infty$

45.

Two moles of monoatomic gas is mixed with one mole of diatomic gas at the same temperature. Molar heat capacity at constant volume for the mixture is:

A. $\frac{13R}{6}$

B. $\frac{11R}{6}$

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

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

**Ans:B**

**Solution:**

$$\frac{n_1 c_{v_1} + n_2 c_{v_2}}{n_1 + n_2} = (c_v)_{mix} = \frac{2\times\frac{3}{2}R + 1\times\frac{5}{2}R}{2+1} = \frac{3R + \frac{5}{2}R}{3}$$

$$= \frac{11R}{6}$$