16.(9.8) $\Delta H - \Delta U = \Delta(PV) = (P_2V_2 - P_1V_1) = \left(100 \times \frac{99}{1000} - 1 \times \frac{100}{1000}\right) = \frac{100}{1000} \times 98 = 9.8$ L-bar

17.(D) For an irreversible, adiabatic process; $0 = C_v(T_2 - T_1) + p_e(V_2 - V_1)$

Substituting the values $C_V(T - T_2) = 1(2-1)\text{atm L}$

$$\Rightarrow \quad T - T_2 = \frac{1}{C_V} - \frac{2}{3R} \Rightarrow T_2 = T - \frac{2}{3 \times 0.082}$$

18.(A) $C_m = C_v + \frac{R}{1-x}$; $\quad C_m = \frac{5R}{10} + \frac{R}{1-(-1)}$; $\quad$ Since $\frac{p}{V} = 1 \quad \Rightarrow \quad pV^{-1} = 1$

19.(A) Entropy is a state function $\Delta S_{A\to C} + \Delta S_{C\to D} + \Delta S_{D\to B} = \Delta S_{A\to B}$

20.(B) Catalyst does not alter the equilibrium established in lesser time in the presence of catalyst.

21.(B) $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$; $\quad \Delta G^\circ = 2.303RT \log_{10} k$

22.(A) At equilibrium $\Delta G = 0$

Liquid $\to$ Gas $\Delta S = +ve$

23.(D) At equilibrium $\Delta G = 0$ $\Delta G^\circ \neq 0$

As ΔG decreases reaction becomes more spontaneous.

24.(B) II law of thermodynamics

25.(AD) Reversible or irreversible both expansion work are path function.

26.(2) Work done along dashed path $|-W| = \Sigma p\Delta V = 4 \times 1.5 + 1 \times 1 + \frac{2}{3} \times 2.5 = 8.65$ L atm

Work done along solid path

$$-W = nRT \ln \frac{V_2}{V_1} = p_1V_1 \ln \frac{V_2}{V_1} = 2 \times 2.3 \log \frac{5.5}{0.5} = 2 \times 2.3 \log 11 = 4.79$$

$$\Rightarrow \quad \frac{W_d}{W_s} = \frac{8.65}{4.79} = 1.80 \approx 2$$

27.(7) $V = \frac{nRT}{p} = \frac{0.1 \times 0.08 \times 273}{(1 - 0.68)} = 7$

28. **[A $\to$ p, r, s] [B $\to$ r, s] [C $\to$ t] [D $\to$ p, q, t]**

(A) $CO_2(s) \to CO_2(g)$

It is just a phase transition (sublimation) as no chemical change has occurred. Sublimation is always endothermic. Product is gas, more disordered, hence ΔS is positive.

(B) $CaCO_3(s) \to CaO(s) + Co_2(g)$

It is a chemical decomposition, not a phase change. Thermal decomposition occur at the expense of energy, hence endothermic. Product contain a gaseous species, hence, $\Delta S > 0$.

(C) $2H \to H_2(g)$

A new H–H covalent bond is being formed, hence, $\Delta H < 0$. Also, product is less disordered than reactant, $\Delta S < 0$.

(D) Allotropes are considered as different phase, hence $P_{(\text{white, solid})} \to P_{(\text{red, solid}}$ is a phase transition as well as allotropic change.

Also, red phosphorus is more ordered than white phosphorus, $S < 0$.

29. **[A → r, t] [B → p, q, s] [C → p, q, s] [D → p, q, s, t]**

In freezing of water entropy decreases and due to equilibrium condition $\Delta G = 0$.

Adiabatic expansion against vaccum is isothermal q = 0, w = 0, $\Delta U = 0$.

In case of isolated condition $q = 0$ $w = 0$ $\Delta U = 0$

In case of D, path (reversible heating and reversible cooling) & state (300 K, 1 atm) both are same therefore change in state function or path function would be zero.

30.(AC) Entropy is a state function, it does not depend on path.