The maximum efficiency of a heat engine operating between 100°C and 25°C is :-

(A) 20.11% (B) 22.2% (C) 25.17% (D) None

A heat engine operating between 227°C and 27°C absorbs 2 Kcal of heat from the 227°C reservoir reversibly per cycle. The amount of work done in one cycle is :-

(A) 0.4 Kcal (B) 0.8 Kcal (C) 4 Kcal (D) 8 Kcal

A reversible heat engine A (based on carnot cycle) absorbs heat from a reservoir at 1000 K and rejects heat to a reservoir at T_2. A second reversible engine B absorbs, the same amount of heat as rejected by the engine A, from the reservoir at T_2 and rejects energy to a reservoir at 360K. If the efficiencies of engines A and B are the same then the temperature T_2 is :-

(A) 680 K (B) 640 K (C) 600 K (D) None

Entropy calculation

ΔS for the reaction ; $MgCO_3(s) \longrightarrow MgO(s) + CO_2(g)$ will be :

(A) 0 (B) –ve (C) +ve (D) ∞

$PV = RT$

Change in entropy is negative for :-

(A) Bromine (ℓ) $\longrightarrow$ Bromine (g)

(B) $C(s) + H_2O(g) \longrightarrow CO(g) + H_2(g)$

(C) (C) $N_2(g, 10 \text{ atm}, 298 \text{ K}) \longrightarrow N_2$ (g, 1 atm, 298K)

(D) Fe(at 400 K) $\longrightarrow$ Fe(at 300 K)

$nC_v(T_1 - T_2)$

$P\downarrow \ \Delta S$

$T\uparrow \ \Delta S\uparrow$ $T\downarrow \ \Delta S\downarrow$

For which reaction from the following, ΔS will be maximum ?

(A) $Ca(s) + \frac{1}{2}O_2(g) \longrightarrow CaO(s)$

(B) $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$

(C) $C(s) + O_2(g) \longrightarrow CO_2$ (g)

(D) $N_2(g) + O_2(g) \longrightarrow 2NO(g)$

$Entropy = Q$

When two gases are mixed the entropy :–

(A) Remains constant (B) Decreases (C) Increases (D) Becomes zero

For the process, $CO_2(s) \longrightarrow CO_2(g)$:

(A) Both ΔH and ΔS are +ve

(B) ΔH is negative and ΔS is +ve

(C) ΔH is +ve and ΔS is –ve

(D) Both ΔH and ΔS are –ve

For conversion C(graphite) $\longrightarrow$ C(Diamond), the ΔS is :-

(A) Zero

(B) Positive

(C) Negative

(D) Can not be predicted

0. When two equal sized pieces of the same metal at different temperatures T_h (hot piece) and T_c (cold piece) are brought into thermal contact and isolated from it's surrounding. The total change in entropy of system is given by ?

$\int \frac{dq}{t}$

(A) $C \ln \frac{T_c + T_h}{2T_c}$ (B) $C \ln \frac{T_2}{T_1}$ (C) $C \ln \frac{(T_c + T_h)^2}{2T_h . T_c}$ (D) $C \ln \frac{(T_c + T_h)^2}{4T_h . T_c}$

11

11. 2 mole of ideal gas at 27°C temp. is expanded reversibly from 2 lit. to 20 lit. Find entropy change ($R = 2$ cal/mol K) :-

(A) 92.1   (B) 0   (C) 4   (D) 9.2

12. 5 mole of an ideal gas expand reversibly from a volume of 8 dm³ to 80dm³ at a temperature of 27°C. The change in entropy is :–

(A) 41.57 JK⁻¹   (B) – 95.73 JK⁻¹   (C) 95.73 JK⁻¹   (D) – 41.57 JK⁻¹

13. Considering entropy (S) as a thermodynamic parameter, the criterion for the spontaneity of any process is :-

(A) $\Delta S_{system} - \Delta S_{surroundings} > 0$ (B) $\Delta S_{system} > 0$ only

(C) $\Delta S_{surroundings} > 0$ only   (D) $\Delta S_{system} + \Delta S_{surroundings} > 0$

14. The entropy change when two moles of ideal monoatomic gas is heated from 200 to 300° C reversibly and isochorically :-

(A) $\frac{3}{2} R \ln\left(\frac{300}{200}\right)$ (B) $\frac{5}{2} R \ln\left(\frac{573}{273}\right)$ (C) $3R \ln\left(\frac{573}{473}\right)$ (D) $\frac{3}{2} R \ln\left(\frac{573}{473}\right)$

15. If $\Delta H_{vaporisation}$ of substance X(ℓ) (molar mass : 30 g/mol) is 300 J/g at it's boiling point 300 K, then molar entropy change for reversible condensation process is :-

(A) 30 J/mol.K   (B) –300 J/mol.K   (C) –30 J/mol.K   (D) None of these

16. The change in entropy of 2 moles of an ideal gas upon isothermal expansion at 243.6 K from 20 litre until the pressure becomes 1 atm, is :-

(A) 1.385 cal/K   (B) – 1.2 cal/K   (C) 1.2 cal/K   (D) 2.77 cal/K

17. If S^0 for H_2, Cl_2 and HCl are 0.13, 0.22 and 0.19 KJ K⁻¹ mol⁻¹ respectively. The total change in standard entropy for the reaction, $H_2 + Cl_2 \longrightarrow 2HCl$ is :

(A) 30 JK⁻¹ mol⁻¹   (B) 40 JK⁻¹ mol⁻¹   (C) 60 JK⁻¹ mol⁻¹   (D) 20 JK⁻¹ mol⁻¹

Gibb's free energy

18. Which of the following pairs of a chemical reaction is certain to result in a spontaneous reaction.?

(A) endothermic and decreasing disorder   (B) exothermic and increasing disorder

(C) endothermic and increasing disorder   (D) exothermic and decreasing disorder

19. What can be concluded about the values of ΔH and ΔS from this graph?

(A) $\Delta H > 0$, $\Delta S > 0$

(B) $\Delta H > 0$, $\Delta S < 0$

(C) $\Delta H < 0$, $\Delta S > 0$

(D) $\Delta H < 0$, $\Delta S < 0$

20. Standard entropy of X_2, Y_2 and XY_3 are 60, 40 and 50 JK⁻¹mol⁻¹, respectively, for the reaction,

$\frac{1}{2} X_2 + \frac{3}{2} Y_2 \rightarrow XY_3$, $\Delta H = -30$ kJ to be at equilibrium, the temperature will be :-

(A) 1250 K   (B) 500 K   (C) 750 K   (D) 1000 K
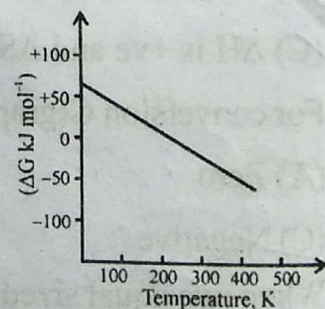
21. For the reaction at 300 K

$$A(g) + B(g) \longrightarrow C(g)$$

$\Delta U = -3.0$ kcal ; $\Delta S = -10.0$ cal/K

value of ΔG is ?

(A) –600 cal (B) –6600 cal (C) –6000 cal (D) none

22. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant K is :-

(A) $- \Delta G° = RT \ln K$ (B) $\Delta G = RT \ln K$

(C) $- \Delta G = RT \ln K$ (D) $\Delta G° = RT \ln K$

23. For the reaction takes place at certain temperature $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$, if equilibrium pressure is X bar, then $\Delta_r G°$ would be :-

(A) $- 2 RT \ln X$ (B) $- RT \ln (X - \ln 2)$

(C) $- 2 RT (\ln X - \ln 2)$ (D) None of these

24. What is the free energy change (ΔG) when 1.0 mole of water at 100°C and 1 atm pressure is converted into steam at 100°C and 1 atm pressure ?

(A) 80 cal (B) 540 cal (C) 620 cal (D) zero

25. What is the free energy change (ΔG) when 1.0 mole of water at 100°C and 1 atm pressure is converted into steam at 100°C and 2 atm pressure ?

(A) Zero cal (B) 540 cal (C) 517.13 cal (D) 510 cal

26. For a reaction at 25°C enthalpy change (ΔH) and entropy change (ΔS) are -11.7×10^3 J mol^{-1} and -105 J mol^{-1} K^{-1} respectively. The reaction is :

(A) Spontaneous (B) Non spontaneous (C) At equilibrium (D) Can't say anything

27. For hypothetical reversible reaction, $\frac{1}{2} A_2(g) + \frac{3}{2} B_2(g) \longrightarrow AB_3(g)$; $\Delta H = -20$ KJ if standard entropies of A_2, B_2 and AB_3 are 60, 40 and 50 JK^{-1} mole^{-1} respectively. The above reaction will be in equilibrium at the temperature :-

(A) 400 K (B) 500 K (C) 250 K (D) 200 K

28. For the hypothetical reaction , $A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$

$\Delta_r G$ and $\Delta_r S$ are 20 kJ/mole and -20 JK^{-1} mol^{-1} respectively at 200 K.

If $\Delta_r C_p$ is 20 JK^{-1} mol^{-1} then $\Delta_r H$ at 400 K is :-

(A) 20 kJ/mole (B) 7.98 kJ/mole (C) 28 kJ/mole (D) None of these

29. Identify the correct statement for change of Gibbs energy for a system (ΔG_{system}) at constant temperature and pressure.

(A) If $\Delta G_{system} > 0$, the process is spontaneous.

(B) If $\Delta G_{system} = 0$, the system has attained equilibrium.

(C) If $\Delta G_{system} = 0$, the system is still moving in a particular direction.

(D) If $\Delta G_{system} < 0$, the process is not spontaneous.

30. If $\Delta G° > 0$ for a reaction then :

(A) $K_p > 1$

(B) $K_p < 1$

(C) The products predominate in the equilibrium mixture

(D) None