Thermodynamics

Q.1. The intensive property among these quantities is

a) mass
b) volume
c) enthalpy
d) mass/volume

Q.2. C (diamond) → C (graphite), ΔH = -ve . This shows that

a) Graphite is more stable
b) Graphite has more energy than diamond
c) Both are equally stable
d) Stability cannot be predicted

Q.3. One mole of a non-ideal gas undergoes a change of state (2.0 atm, 3.0 L, 95 K) → (4.0 atm, 5.0 L, 245 K) with a change in internal energy, ΔU = 30.0 L atm. The change in enthalpy ΔH of the process in L.atm is.

a) 40.0
b) 42.3
c) 44.0
d) Not defined because pressure is not constant

Q.4. The value of free energy change at equilibrium is

a) positive
b) negative
c) zero
d) not definite

Q.5. Given that bond energies of H – H and Cl – Cl are 430 kJ mol^{-1} and 240 kJ mol^{-1} respectively and ΔHf for HCl is – 90 kJ mol^{-1}, bond enthalpy of HCl is

a) 380 kJ mol^{-1}
b) 425 kJ mol^{-1}
c) 245 kJ mol^{-1}
d) 290 kJ mol^{-1}

Q.6. Three moles of an ideal gas expanded spontaneously into vacuum. The work done will be :

a) Zero
b) Infinite
c) 3 Joules
d) 9 Joules

Q.7. Which of the following is always true for a spontaneous change at all temperatures ?

a) $\Delta H > 0$; $\Delta S < 0$
b) $\Delta H < 0$; $\Delta S < 0$
c) $\Delta H < 0$; $\Delta S > 0$
d) $\Delta H > 0$; $\Delta S > 0$

Q.8. For the process $H_2O(l) \leftrightharpoons H_2O(g)$, $\Delta H = 45.0$ kJ mol^{-1} and $\Delta S = 1.20 \times 10^2$ J $K^{-1}mol^{-1}$. At what temperature the above process is at equilibrium?

a) 273 K
b) 373 K
c) 300 K
d) 375 K

Q.9. A certain reaction is non spontaneous at 298K. The entropy change during the reaction is 121 JK^{-1} . Is the reaction is endothermic or exothermic ? The minimum value of ΔH for the reaction is

a) endothermic, $\Delta H = 36.06$ kJ
b) exothermic, $\Delta H = -36.06$ kJ
c) endothermic, $\Delta H = 60.12$ kJ
d) exothermic, $\Delta H = -60.12$ kJ

Q.10. What is the change in entropy when ice melts at 0°C, enthalpy of fusion of one mole of ice is 6.02 kJ ?

a) 6.02 kJ K^{-1} mol^{-1}
b) 22.1 kJ K^{-1} mol^{-1}
c) 41.6 J K^{-1} mol^{-1}
d) 22.0 J K^{-1} mol^{-1}

Q.11. For the reaction $C(s) + O_2(g) \rightarrow CO_2(g)$

a) $\triangle H > \triangle U$
b) $\triangle H < \triangle U$
c) $\triangle H = \triangle U$
d) None of these

Q.12. The enthalpy change in a reaction does not depend upon

a) the state of reactions and products
b) the nature of the reactants and products
c) different intermediate steps in the reaction
d) initial and final enthalpy of the reaction

Q.13. What is the entropy change (in JK^{-1} mol^{-1}) when
1 mole of ice is converted into water at 0°C? (The enthalpy change for the conversion of ice to liquid water is 6.0 kJ mol^{-1} at 0°C)

a) 20.13
b) 2.013
c) 2.198
d) 21.98

Q.14. Considering entropy(S) thermodynamic parameters the criteria for the spontaneity of any process is:

a) $\triangle S$ system + $\triangle S$ surroundings > 0
b) $\triangle S$ system – $\triangle S$ surroundings < 0
c) $\triangle S$ system > 0
d) $\triangle S$ surroundings > 0

Q.15. The least random state of the water system is:

a) ice
b) liquid water
c) steam
d) randomness is same

Q.16. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant Kc is

a) $-\triangle G = RT \ln Kc$
b) $\triangle G^{o} = RT \ln Kc$
c) $-\triangle G^{o} = RT \ln Kc$
d) $\triangle G = RT \ln Kc$

Q.17. If liquids A and B form an ideal solution

a) the entropy of mixing is zero
b) the free energy of mixing is zero
c) the free energy as well as the entropy of mixing are zero
d) the enthalpy of mixing is zero

Q.18. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of 10 dm^3 to a volume of 100 dm^3 at 27°C is

a) 42.3 $Jmol^{-1}K^{-1}$
b) 38.3 $Jmol^{-1}K^{-1}$
c) 35.8 $Jmol^{-1}K^{-1}$
d) 32.3 $Jmol^{-1}K^{-1}$

Q.19. In view of the signs of $\Delta_r G°$ for the following reactions

$PbO_2 + Pb \rightarrow 2\ PbO$, $\Delta_r G° < 0$

$SnO_2 + Sn \rightarrow 2\ SnO$, $\Delta_r G° > 0$

Which oxidation states are more characteristic for lead and tin?

a) For lead +2, for tin +4
b) For lead +4, for tin +2
c) For lead +2, for tin +2
d) For lead +4, for tin +4

Q.20. If the work is done on an adiabatic wall, then which of the following is true?

a) $\Delta U = -W$
b) $\Delta U = W$
c) $\Delta U + W = 0$
d) none of these

Q.21. For a particular reversible reaction at temperature T, ΔH and ΔS were found to be both +ve. If Te is the temperature at equilibrium, the reaction would be spontaneous when

a) T=Te
b) T>Te
c) T<Te
d) Te=5T

Q.22. In a fuel cell methanol is used as fuel and oxygen gas is used as an oxidizer. The reaction is

$CH_3OH(l) + O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

At 298 K standard Gibb's energies of formation for CH3OH(l), H_2O (l) and CO_2 (g) are –166.2, –237.2 and –394.4 kJ mol^{-1} respectively. If standard enthalpy of combustion of methanol is –726 kJ mol^{-1}, efficiency of the fuel cell will be

a) 87%
b) 90%
c) 97%
d) 80%

Q.23.Standard entropy of X_2, Y_2 and XY_3 are 60, 40 and 50$JK^{-1}mol^{-1}$ respectively. For the reaction, $X_2 + Y_2 \rightarrow XY_3$, ΔH = -30kJ, to be at equilibrium, the temperature will be

a) 1250k
b) 500k
c) 750k
d) 1000k

Q.24. Entropy of the universe is

a) continuously increasing
b) continuously decreasing
c) zero
d) constant

Q.25. In which of the following process, a maximum increase in entropy is observed?

a) dissolution of salt in water
b) condensation of water
c) sublimation of naphthalene
d) melting of ice