

SECTION - A

Objective Type Questions

(Thermodynamic processes and parameter, Internal energy and Enthalpy)

1. When an ideal gas is compressed adiabatically and reversibly, the final temperature is

- (1) Higher than the initial temperature
- (2) Lower than the initial temperature
- (3) The same as the initial temperature
- (4) Dependent on the rate of compression

2. A closed flask contains a substance in all its three states, solids, liquids and vapour at its triple point. In this situation the average KE of the water molecule will be

- (1) Maximum in vapour state
- (2) Maximum in solid state
- (3) Greater in the liquid than in vapour state
- (4) Same in all the three states

In thermodynamics a process is called reversible when

- (1) System and surrounding change into each other
- (2) There is no boundary between system and surrounding
- (3) The surroundings are always in equilibrium with the system
- (4) The system changes into the surroundings spontaneously

3. 16 kg oxygen gas expands at STP (1 atm) isobarically to occupy double of its original volume. The work done during the process is nearly

- (1) 260 kcal
- (2) 180 kcal
- (3) 130 kcal
- (4) 271 kcal

5. One mole of a non ideal gas undergoes a change of state (2.0 atm, 3.0 L, 95 K) \rightarrow (4.0 atm, 5.0 L, 245 K) with a change in internal energy $\Delta U = 30.0 \text{ L atm}$. The change in enthalpy of the process in L atm is

- (1) 40.0
- (2) 42.3
- (3) 44.0
- (4) 56.0

6. Which of the following can be zero for isothermal reversible expansion?

- (1) ΔE
- (2) ΔH
- (3) ΔT
- (4) All of these

7. In an insulated container water is stirred with a rod to increase the temperature. Which of the following is true?

- (1) $\Delta U = W \neq 0, q = 0$
- (2) $\Delta U = W = q \neq 0$
- (3) $\Delta U = 0, W = q \neq 0$
- (4) $W = 0, \Delta U = q \neq 0$

8. Two atoms of hydrogen combine to form a molecule of hydrogen gas the energy of the H_2 molecule is

- (1) Greater than that of separate atoms
- (2) Equal to that of separate atoms
- (3) Lower than that of separate atoms
- (4) Sometimes lower and sometimes higher

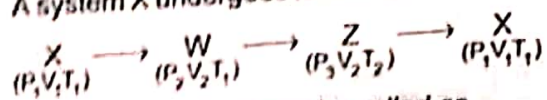
9. Vapour density of a gas is 8. Its molecular mass will be

- (1) 8
- (2) 16
- (3) 32
- (4) 64

10. If x mole of ideal gas at 27°C expands isothermally and reversibly from a volume of y to $10y$, then the work done is

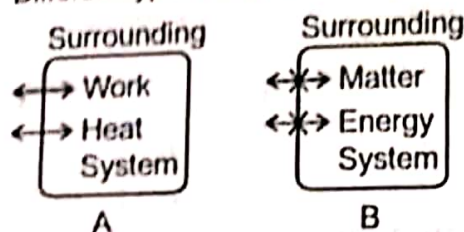
- (1) $w = x R 300 \ln y$
- (2) $w = -300 \times R \ln \frac{y}{10y}$
- (3) $w = -300 \times R \ln 10$
- (4) $w = 100 \times R \ln \frac{1}{y}$

11. A system X undergoes following changes



The overall process may be called as

- (1) Reversible process
 - (2) Cyclic process
 - (3) Cyclic reversible process
 - (4) Isochoric process
12. Different types of systems are given below



The A and B systems respectively are

- (1) Open system, Closed system
 - (2) Isolated system, Closed system
 - (3) Adiabatic system, Isolated system
 - (4) Closed system, Isolated system
13. Set of intensive properties is shown by
- (1) Mole fraction, standard electrode potential, heat capacity
 - (2) Viscosity, refractive index, specific heat
 - (3) Density, Gibbs free energy, internal energy
 - (4) Number of moles, molarity, electrode potential
14. For the expansion occurring from initial to final stage in finite time, which is incorrect?
- (1) Equilibrium exist in initial and final stage
 - (2) Work obtained is maximum
 - (3) Driving force is much greater than the opposing force
 - (4) Both (1) & (2)

(Heat Capacity)

15. For one mole of an ideal gas

(C_p and C_v are molar heat capacities at constant pressure and constant volume respectively)

- (1) $C_p - C_v = R$
- (2) $C_p - C_v = \frac{R}{2}$
- (3) $C_p - C_v = -2R$
- (4) $C_p - C_v = 0$

16. The molar heat capacity of water at constant pressure P is $75 \text{ J K}^{-1} \text{ mol}^{-1}$. When 1.0 kJ of heat is supplied to 1000 g of water, which is free to expand, the increase in temperature of water is
- (1) 1.2 K
 - (2) 2.4 K
 - (3) 4.8 K
 - (4) 0.24 K

17. Which statement is correct?

- (1) $\left(\frac{dH}{dT}\right)_P < \left(\frac{dE}{dT}\right)_V$
- (2) $\left(\frac{dH}{dT}\right)_P + \left(\frac{dE}{dT}\right)_V = R$
- (3) $\left(\frac{dE}{dV}\right)_T$ for ideal gas is zero
- (4) All of these

(Entropy and Gibb's free energy, Spontaneity)

18. ΔS° will be highest for the reaction

- (1) $\text{Ca} + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{CaO}(\text{s})$
- (2) $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
- (3) $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
- (4) $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}(\text{g})$

19. In an irreversible process, the value of

$$\Delta S_{\text{system}} + \Delta S_{\text{sur}} \text{ is}$$

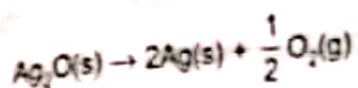
- (1) +ve
- (2) -ve
- (3) Zero
- (4) All of these

20. The enthalpy and entropy change for a chemical reaction are $-2.5 \times 10^3 \text{ cal}$ and 7.4 cal K^{-1} respectively. Predict the nature of reaction at 298 K is

- (1) Spontaneous
- (2) Reversible
- (3) Irreversible
- (4) Non-spontaneous

NEET (Level-II)

26. The temperature at which the given reaction is at equilibrium



$$\Delta H = 30.5 \text{ kJ mol}^{-1} \text{ and } \Delta S = 0.066 \text{ kJ mol}^{-1} \text{ K}^{-1}$$

- (1) 462.12 K (2) 362.12 K
(3) 262.12 K (4) 562.12 K

Thermochemistry, Enthalpy of reaction)

27. The temperature of 15 ml of a strong acid increases by 2°C when 15 ml of a strong base is added to it. If 5 ml of each are mixed, temperature should increase by

- (1) 0.6°C (2) 0.3°C
(3) 2°C (4) 6°C

28. The standard heat of formation of $\text{NO}_2\text{(g)}$ and $\text{N}_2\text{O}_4\text{(g)}$ are 8.0 and 4.0 kcal mol^{-1} respectively. The heat of dimerisation of NO_2 in kcal is

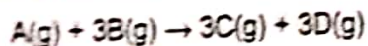
- (1) -12 kcal (2) 12 kcal
(3) 4 kcal (4) 16 kcal

29. If $\frac{1}{2}\text{X}_2\text{O(s)} \rightarrow \text{X(s)} + \frac{1}{4}\text{O}_2\text{(g)}$; $\Delta H = 90 \text{ kJ}$.

Then heat change during reaction of metal X with one mole of O_2 to form oxide to maximum extent is

- (1) 360 kJ (2) -360 kJ
(3) -180 kJ (4) +180 kJ

30. For a gaseous reaction



ΔE is 17 kcal at 27°C . Assuming $R = 2 \text{ cal K}^{-1} \text{ mol}^{-1}$ the value of ΔH for the above reaction will be

- (1) 15.8 kcal (2) 16.4 kcal
(3) 18.2 kcal (4) 20.0 kcal

31. A mixture of 2 mole of CO and 1 mol of O_2 is ignited. Correct relationship is

- (1) $\Delta H = \Delta U$
(2) $\Delta H > \Delta U$
(3) $\Delta H < \Delta U$
(4) The relationship depends upon the capacity of vessel

27. Bond dissociation energy of XY , X_2 and Y_2 (all diatomic molecules) are in the ratio of 1 : 1 : 0.5 and ΔH_f of XY is -200 kJ mol^{-1} . The bond dissociation energy of X_2 will be

- (1) 800 kJ mol^{-1} (2) 200 kJ mol^{-1}
(3) 300 kJ mol^{-1} (4) 400 kJ mol^{-1}

28. Enthalpy of formation of NH_3 is $-X \text{ kJ}$ and $\Delta H_{\text{H-H}}$, $\Delta H_{\text{N-H}}$ are respectively $Y \text{ kJ mol}^{-1}$ and $Z \text{ kJ mol}^{-1}$. The value of $\Delta H_{\text{N-H}}$ is

- (1) $Y - 6Z + \frac{X}{3}$ (2) $-3Y + 6Z - 2X$

- (3) $3Y + 6Z + X$ (4) $Y + 6X + Z$

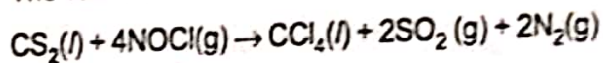
29. The heat of neutralisation for strong acid and strong base forming 2 moles of water is

- (1) $-2 \times 57.1 \text{ kJ}$
(2) -57.1 kJ

- (3) $-\frac{57.1}{2} \text{ kJ}$

- (4) Strong acid and strong base will not undergo neutralisation

30. The value of ΔH° in kJ for the reaction will be



if

$$\Delta H_f^\circ(\text{CS}_2) = -x$$

$$\Delta H_f^\circ(\text{NOCl}) = -y$$

$$\Delta H_f^\circ(\text{CCl}_4) = +z$$

$$\Delta H_f^\circ(\text{SO}_2) = -r$$

- (1) $x + 4y - z - 2r$ (2) $r + z + 4y - x$

- (3) $2r + z + 4y + x$ (4) $x + 4y + z - 2r$

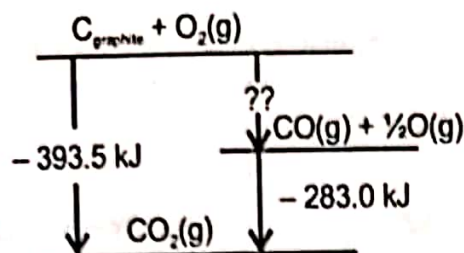
31. The heat liberated on complete combustion of 1 mole of CH_4 gas to $\text{CO}_2\text{(g)}$ and $\text{H}_2\text{O(l)}$ is 890 kJ. Calculate the heat evolved by 2.4 L of CH_4 on complete combustion.

- (1) 95.3 kJ (2) 8900 kJ
(3) 890 kJ (4) 8.9 kJ

32. The work done in an open vessel at 300 K, when 112 g iron reacts with dil HCl to give FeCl_2 , is nearly

- (1) 1.1 kcal (2) 0.6 kcal
(3) 0.3 kcal (4) 0.2 kcal

A schematic representation of enthalpy changes for the reaction, $C_{(\text{graphite})} + \frac{1}{2}O_2(g) \rightarrow CO(g)$ is given below. The missing value is



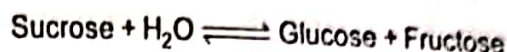
- (1) + 10.5 kJ
 - (2) - 11.05 kJ
 - (3) - 110.5 kJ
 - (4) - 10.5 J
34. Which of the following equations represent standard heat of formation of CH_4 ?
- (1) $C_{(\text{diamond})} + 2H_2(g) \rightarrow CH_4(g)$
 - (2) $C_{(\text{graphite})} + 2H_2(g) \rightarrow CH_4(g)$
 - (3) $C_{(\text{diamond})} + 4H(g) \rightarrow CH_4(g)$
 - (4) $C_{(\text{graphite})} + 4H(g) \rightarrow CH_4(g)$
35. Calorific value of ethane, in kJ/g if for the reaction $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$; $\Delta H = -745.6 \text{ kcal}$
- (1) -12.4
 - (2) -52
 - (3) -24.8
 - (4) -104

SECTION - B

Previous Years Questions

1. For the reaction, $2Cl(g) \rightarrow Cl_2(g)$, the correct option is [NEET-2020 (Phase-1)]
 - (1) $\Delta_r H > 0$ and $\Delta_r S < 0$
 - (2) $\Delta_r H < 0$ and $\Delta_r S > 0$
 - (3) $\Delta_r H < 0$ and $\Delta_r S < 0$
 - (4) $\Delta_r H > 0$ and $\Delta_r S > 0$

2. The correct option for free expansion of an ideal gas under adiabatic condition is [NEET-2020 (Phase-1)]
 - (1) $q = 0$, $\Delta T < 0$ and $w > 0$
 - (2) $q < 0$, $\Delta T = 0$ and $w = 0$
 - (3) $q > 0$, $\Delta T > 0$ and $w > 0$
 - (4) $q = 0$, $\Delta T = 0$ and $w = 0$
3. Hydrolysis of sucrose is given by the following reaction.



If the equilibrium constant (K_c) is 2×10^{13} at 300 K, the value of $\Delta_r G^\circ$ at the same temperature will be : [NEET-2020 (Phase-1)]

- (1) $8.314 \text{ J mol}^{-1} \text{K}^{-1} \times 300 \text{ K} \times \ln(2 \times 10^{13})$
 - (2) $8.314 \text{ J mol}^{-1} \text{K}^{-1} \times 300 \text{ K} \times \ln(3 \times 10^{13})$
 - (3) $-8.314 \text{ J mol}^{-1} \text{K}^{-1} \times 300 \text{ K} \times \ln(4 \times 10^{13})$
 - (4) $-8.314 \text{ J mol}^{-1} \text{K}^{-1} \times 300 \text{ K} \times \ln(2 \times 10^{13})$
4. At standard conditions, if the change in the enthalpy for the following reaction is -109 kJ mol^{-1} .

$$H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)}$$
 Given that bond energy of H_2 and Br_2 is 435 kJ mol^{-1} and 192 kJ mol^{-1} , respectively, what is the bond energy (in kJ mol^{-1}) of HBr ? [NEET-2020 (Phase-2)]

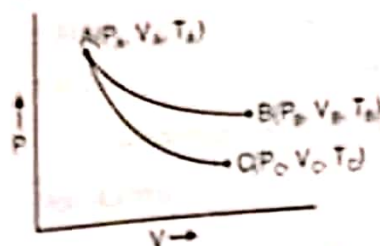
| | |
|---------|---------|
| (1) 259 | (2) 368 |
| (3) 736 | (4) 518 |
 5. If for a certain reaction $\Delta_r H$ is 30 kJ mol^{-1} at 450 K, the value of $\Delta_r S$ (in $\text{JK}^{-1} \text{mol}^{-1}$) for which the same reaction will be spontaneous at the same temperature is [NEET-2020 (Phase-2)]

| | |
|---------|--------|
| (1) -70 | (2) 70 |
| (3) -33 | (4) 33 |

6. An ideal gas expands isothermally from 10^{-3} m^3 to 10^{-2} m^3 at 300 K against a constant pressure of 10^5 Nm^{-2} . The work done on the gas is [NEET-2019 (Odisha)]

| | |
|-------------|-------------|
| (1) -900 kJ | (2) +270 kJ |
| (3) -900 J | (4) +900 kJ |

7. Reversible expansion of an ideal gas under isothermal and adiabatic conditions are as shown in the figure. [NEET-2019 (Odisha)]



AB \rightarrow Isothermal expansion

AC \rightarrow Adiabatic expansion

Which of the following options is not correct?

- (1) $T_C > T_A$
 - (2) $\Delta S_{\text{isothermal}} > \Delta S_{\text{adiabatic}}$
 - (3) $T_A = T_C$
 - (4) $W_{\text{isothermal}} > W_{\text{adiabatic}}$
8. Under isothermal condition, a gas at 300 K expands from 0.1 L to 0.25 L against a constant external pressure of 2 bar. The work done by the gas is [NEET-2019]

(Given that 1 L bar = 100 J)

- (1) -30 J
 - (2) 5 kJ
 - (3) 25 J
 - (4) 30 J
9. In which case change in entropy is negative? [NEET-2019]

- (1) Evaporation of water
 - (2) Expansion of a gas at constant temperature
 - (3) Sublimation of solid to gas
 - (4) $2\text{H(g)} \rightarrow \text{H}_2\text{(g)}$
10. The bond dissociation energies of X_2 , Y_2 and XY are in the ratio of 1 : 0.5 : 1. ΔH for the formation of XY is -200 kJ mol^{-1} . The bond dissociation energy of X_2 will be [NEET-2018]

- (1) 200 kJ mol^{-1}
- (2) 100 kJ mol^{-1}
- (3) 400 kJ mol^{-1}
- (4) 800 kJ mol^{-1}

11. A gas is allowed to expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy ΔU of the gas in joules will be [NEET-2017]

- (1) 1136.25 J
- (2) -500 J
- (3) -505 J
- (4) +505 J

12. For a given reaction, $\Delta H = 35.5 \text{ kJ mol}^{-1}$ and $\Delta S = 83.8 \text{ JK}^{-1} \text{ mol}^{-1}$. The reaction is spontaneous at : (Assume that ΔH and ΔS do not vary with temperature) [NEET-2017]

- (1) $T < 425 \text{ K}$
- (2) $T > 425 \text{ K}$
- (3) All temperatures
- (4) $T > 298 \text{ K}$

13. For a sample of perfect gas when its pressure is changed isothermally from p_i to p_f , the entropy change is given by [NEET (Phase-2) 2016]

(1) $\Delta S = nR \ln \left(\frac{p_f}{p_i} \right)$

(2) $\Delta S = nR \ln \left(\frac{p_i}{p_f} \right)$

(3) $\Delta S = nRT \ln \left(\frac{p_f}{p_i} \right)$

(4) $\Delta S = RT \ln \left(\frac{p_i}{p_f} \right)$

14. The correct thermodynamic conditions for the spontaneous reaction at all temperatures is [NEET-2016]

- (1) $\Delta H < 0$ and $\Delta S < 0$
- (2) $\Delta H < 0$ and $\Delta S = 0$
- (3) $\Delta H > 0$ and $\Delta S < 0$
- (4) $\Delta H < 0$ and $\Delta S > 0$

15. The heat of combustion of carbon to CO_2 is -393.5 kJ/mol . The heat released upon formation of 35.2 g of CO_2 from carbon and oxygen gas is [Re-AIPMT-2015]

- (1) -630 kJ
- (2) -3.15 kJ
- (3) -315 kJ
- (4) +315 kJ

16. For the reaction, $\text{X}_2\text{O}_4\text{(l)} \rightarrow 2\text{XO}_2\text{(g)}$
 $\Delta U = 2.1 \text{ k cal}$, $\Delta S = 20 \text{ cal K}^{-1}$ at 300 K

Hence, ΔG is [AIPMT-2014]

- (1) 2.7 kcal
- (2) -2.7 kcal
- (3) 9.3 kcal
- (4) -9.3 kcal

172 Thermodynamics

17. In which of the following reactions, standard reaction entropy change (ΔS°) is positive and standard Gibbs energy change (ΔG°) decreases sharply with increasing temperature ?
[AIPMT (Prelims)-2012]
- (1) $\text{Mg(s)} + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{MgO(s)}$
 (2) $\frac{1}{2} \text{C graphite} + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \frac{1}{2} \text{CO}_2(\text{g})$
 (3) $\text{C graphite} + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{CO(g)}$
 (4) $\text{CO(g)} + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
18. Standard enthalpy of vapourisation $\Delta_{\text{vap}} H^\circ$ for water at 100°C is $40.66 \text{ kJ mol}^{-1}$. The internal energy of vapourisation of water at 100°C (in kJ mol^{-1}) is
[AIPMT (Prelims)-2012]
- (1) $+43.76$ (2) $+40.66$
 (3) $+37.56$ (4) -43.76
19. The enthalpy of fusion of water is 1.435 kcal/mol . The molar entropy change for the melting of ice at 0°C is
[AIPMT (Prelims)-2012]
- (1) $5.260 \text{ cal/(mol K)}$ (2) $0.526 \text{ cal/(mol K)}$
 (3) $10.52 \text{ cal/(mol K)}$ (4) $21.04 \text{ cal/(mol K)}$
20. Equal volumes of two monoatomic gases, A and B, at same temperature and pressure are mixed. The ratio of specific heats (C_p/C_v) of the mixture will be
[AIPMT (Mains)-2012]
- (1) 0.83 (2) 1.50
 (3) 3.3 (4) 1.67
21. Which of the following is correct option for free expansion of an ideal gas under adiabatic condition?
[AIPMT (Prelims)-2011]
- (1) $q = 0, \Delta T < 0, w \neq 0$ (2) $q = 0, \Delta T \neq 0, w = 0$
 (3) $q \neq 0, \Delta T = 0, w = 0$ (4) $q = 0, \Delta T = 0, w = 0$
22. If the enthalpy change for the transition of liquid water to steam is 30 kJ mol^{-1} at 27°C , the entropy change for the process would be
[AIPMT (Prelims)-2011]
- (1) $100 \text{ J mol}^{-1} \text{ K}^{-1}$ (2) $10 \text{ J mol}^{-1} \text{ K}^{-1}$
 (3) $1.0 \text{ J mol}^{-1} \text{ K}^{-1}$ (4) $0.1 \text{ J mol}^{-1} \text{ K}^{-1}$
23. Enthalpy change for the reaction, $4 \text{H}_{(\text{g})} \rightarrow 2\text{H}_{2(\text{g})}$ is -869.6 kJ . The dissociation energy of $\text{H} - \text{H}$ bond is
[AIPMT (Prelims)-2011]
- (1) $+217.4 \text{ kJ}$ (2) -434.8 kJ
 (3) -869.6 kJ (4) $+434.8 \text{ kJ}$
24. Consider the following process
[AIPMT (Mains)-2011]
- | | |
|--|---------------------------|
| | $\Delta H(\text{kJ/mol})$ |
| $\frac{1}{2} \text{A} \rightarrow \text{B}$ | $+150$ |
| $3\text{B} \rightarrow 2\text{C} + \text{D}$ | -125 |
| $\text{E} + \text{A} \rightarrow 2\text{D}$ | $+350$ |
- For, $\text{B} + \text{D} \rightarrow \text{E} + 2\text{C}$, ΔH will be
[AIPMT (Mains)-2011]
- (1) -325 kJ/mol (2) 325 kJ/mol
 (3) 525 kJ/mol (4) -175 kJ/mol
25. Standard entropies of X_2 , Y_2 and XY_3 are 60 , 40 and $50 \text{ JK}^{-1} \text{ mol}^{-1}$ respectively. For the reaction
[AIPMT (Prelims)-2010]
- $$\frac{1}{2} \text{X}_2 + \frac{3}{2} \text{Y}_2 \rightarrow \text{XY}_3; \Delta H = -30 \text{ kJ}$$
- to be at equilibrium, the temperature should be
- (1) 750 K (2) 1000 K
 (3) 1250 K (4) 500 K
26. Match List-I (Equations) with List-II (Type of process) and select the correct option
[AIPMT (Mains)-2010]
- | List-I
(Equations) | List-II
(Type of process) |
|------------------------------------|-----------------------------------|
| a. $K_p > Q$ | (i) Non-spontaneous |
| b. $\Delta G^\circ < RT \ln Q$ | (ii) Equilibrium |
| c. $K_p = Q$ | (iii) Spontaneous and endothermic |
| d. $T > \frac{\Delta H}{\Delta S}$ | (iv) Spontaneous |
- (1) a(i), b(ii), c(iii), d(iv)
 (2) a(iii), b(iv), c(ii), d(i)
 (3) a(iv), b(i), c(ii), d(iii)
 (4) a(ii), b(i), c(iv), d(iii)

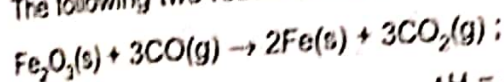
27. Three moles of an ideal gas expanded spontaneously into vacuum. The work done will be
[AIPMT (Mains)-2010]

(1) Infinite
(2) 3 Joules
(3) 9 Joules
(4) Zero

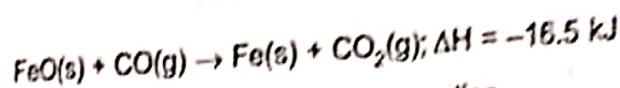
28. For vaporization of water at 1 atmospheric pressure, the values of ΔH and ΔS are $40.83 \text{ kJ mol}^{-1}$ and $108.8 \text{ JK}^{-1} \text{ mol}^{-1}$ respectively. The temperature when Gibbs energy change (ΔG) for this transformation will be zero, is
[AIPMT (Mains)-2010]

(1) 273.4 K
(2) 393.4 K
(3) 373.4 K
(4) 293.4 K

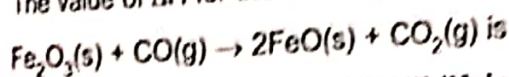
29. The following two reactions are known :



$$\Delta H = -26.8 \text{ kJ}$$



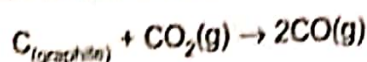
The value of ΔH for the following reaction



[AIPMT (Mains)-2010]

(1) +10.3 kJ
(2) -43.3 kJ
(3) -10.3 kJ
(4) +6.2 kJ

30. The values of ΔH and ΔS for the reaction,



are 170 kJ and 170 JK^{-1} respectively. This reaction will be spontaneous at [AIPMT (Prelims)-2009]

(1) 910 K
(2) 1110 K
(3) 510 K
(4) 710 K

31. From the following bond energies

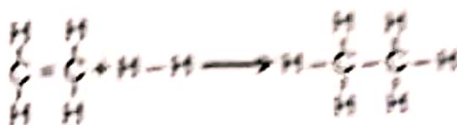
H-H bond energy : $431.27 \text{ kJ mol}^{-1}$

C = C bond energy : $658.10 \text{ kJ mol}^{-1}$

C - C bond energy : $338.46 \text{ kJ mol}^{-1}$

C - H bond energy : $410.50 \text{ kJ mol}^{-1}$

Enthalpy for the reaction,



will be

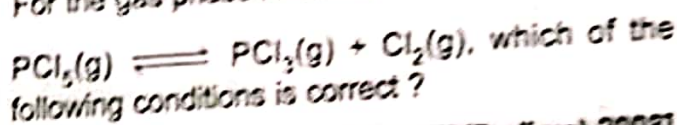
[AIPMT (Prelims)-2009]

(1) $-243.8 \text{ kJ mol}^{-1}$
(2) $-120.0 \text{ kJ mol}^{-1}$
(3) $553.0 \text{ kJ mol}^{-1}$
(4) $1523.8 \text{ kJ mol}^{-1}$

32. Bond dissociation enthalpy of H_2 , O_2 and HCl are 434 , 242 and 431 kJ mol^{-1} respectively. Enthalpy of formation of HCl is [AIPMT (Prelims)-2008]

(1) 245 kJ mol^{-1}
(2) 93 kJ mol^{-1}
(3) -245 kJ mol^{-1}
(4) -93 kJ mol^{-1}

33. For the gas phase reaction,



[AIPMT (Prelims)-2008]

(1) $\Delta H > 0$ and $\Delta S < 0$
(2) $\Delta H = 0$ and $\Delta S < 0$
(3) $\Delta H > 0$ and $\Delta S > 0$
(4) $\Delta H < 0$ and $\Delta S < 0$

34. Which of the following are not state functions ?

(I) $q + w$
(III) w

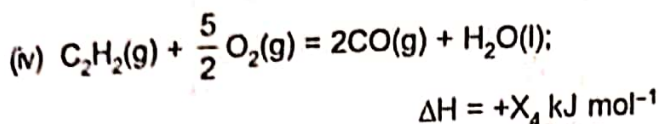
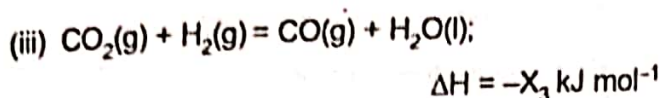
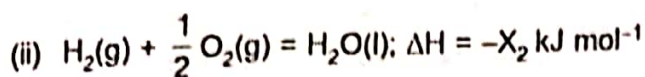
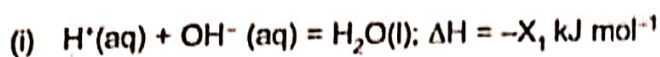
(II) q

(IV) $H - TS$

[AIPMT (Prelims)-2008]

(1) (II) and (III)
(2) (I) and (IV)
(3) (II), (III) and (IV)
(4) (I), (II) and (III)

35. Consider the following reactions :



Enthalpy of formation of $\text{H}_2\text{O}(\text{l})$ is

[AIPMT (Prelims)-2007]

- (1) $+X_1 \text{ kJ mol}^{-1}$ (2) $+X_2 \text{ kJ mol}^{-1}$
 (3) $+X_3 \text{ kJ mol}^{-1}$ (4) $+X_4 \text{ kJ mol}^{-1}$

36. Given that bond energies of $\text{H}-\text{H}$ and $\text{Cl}-\text{Cl}$ are 430 kJ/mol and 240 kJ/mol respectively and $\Delta_f H$ of HCl is -90 kJ/mol. Bond enthalpy of HCl is

[AIPMT (Prelims)-2007]

- (1) 245 kJ mol⁻¹ (2) 2909 kJ mol⁻¹
 (3) 380 kJ mol⁻¹ (4) 425 kJ mol⁻¹

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

[AIPMT (Prelims)-2006]

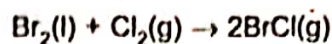
- (1) If $\Delta G_{\text{system}} > 0$, the process is spontaneous
 (2) If $\Delta G_{\text{system}} = 0$, the system has attained equilibrium
 (3) If $\Delta G_{\text{system}} = 0$, the system is still moving in a particular direction
 (4) If $\Delta G_{\text{system}} < 0$, the process is not spontaneous

38. Assume each reaction is carried out in an open container. For which reaction will $\Delta H = \Delta E$?

[AIPMT (Prelims)-2006]

- (1) $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \longrightarrow 2\text{HBr}(\text{g})$
 (2) $\text{C}(\text{s}) + 2\text{H}_2\text{O}(\text{g}) \longrightarrow 2\text{H}_2(\text{g}) + \text{CO}_2(\text{g})$
 (3) $\text{PCl}_5(\text{g}) \longrightarrow \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
 (4) $2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{CO}_2(\text{g})$

39. The enthalpy and entropy change for the reaction



are 30 kJ mol⁻¹ and 105 JK⁻¹ mol⁻¹ respectively. The temperature at which the reaction will be in equilibrium is [AIPMT (Prelims)-2006]

- (1) 285.7 K (2) 273 K
 (3) 450 K (4) 300 K

40. The enthalpy of combustion of H_2 , cyclohexene (C_6H_{10}) and cyclohexane (C_6H_{12}) are -241, -3800 and -3920 kJ per mol respectively. Heat of hydrogenation of cyclohexene is

[AIPMT (Prelims)-2006]

- (1) -121 kJ per mol (2) +121 kJ per mol
 (3) +242 kJ per mol (4) -242 kJ per mol

41. A reaction occurs spontaneously if

[AIPMT (Prelims)-2005]

- (1) $T\Delta S < \Delta H$ and both ΔH and ΔS are +ve
 (2) $T\Delta S > \Delta H$ and both ΔH and ΔS are +ve
 (3) $T\Delta S = \Delta H$ and both ΔH and ΔS are +ve
 (4) $T\Delta S > \Delta H$ and ΔH is +ve and ΔS is -ve

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

[AIPMT (Prelims)-2005]

- (1) Exothermic and decreasing disorder
 (2) Endothermic and increasing disorder
 (3) Exothermic and increasing disorder
 (4) Endothermic and decreasing disorder

43. The absolute enthalpy of neutralisation of the reaction $\text{MgO}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l})$ will be [AIPMT (Prelims)-2005]

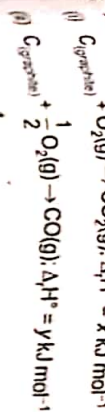
- (1) Less than -57.33 kJ mol⁻¹
 (2) -57.33 kJ mol⁻¹
 (3) Greater than -57.33 kJ mol⁻¹
 (4) 57.33 kJ mol⁻¹

Questions asked Prior to Medical Ent. Exams. 2005

44. Which reaction, with the following values of ΔH , ΔS , at 400 K is spontaneous and endothermic?

- (1) $\Delta H = -48 \text{ kJ}; \Delta S = +135 \text{ J/K}$
 (2) $\Delta H = -48 \text{ kJ}; \Delta S = -135 \text{ J/K}$
 (3) $\Delta H = +48 \text{ kJ}; \Delta S = +135 \text{ J/K}$
 (4) $\Delta H = +48 \text{ kJ}; \Delta S = -135 \text{ J/K}$

Free thermodynamic equations are given below:



Based on the above equations, find out which of the relationship given below is correct:

- (1) $x = y - z$ (2) $z = x + y$
 (3) $x = y + z$ (4) $y = 2z - x$

Following reaction occurring in an automobile $2C_2H_4(g) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$. The sign of ΔH , ΔS and ΔG would be

- (1) $-, +, +$ (2) $+, +, -$
 (3) $+, -, +$ (4) $-, +, -$

47. When 5 litres of a gas mixture of methane and propane is perfectly combusted at 0°C and 1 atmosphere, 16 litre of oxygen at the same temperature and pressure is consumed. The amount of heat released from this combustion in kJ $\Delta H_{\text{comb}}^\circ (CH_4) = 890 \text{ kJ mol}^{-1}$, $\Delta H_{\text{comb}}^\circ (C_3H_8) = 2220 \text{ kJ mol}^{-1}$ is

- (1) 32 (2) 38
 (3) 317 (4) 477

48. If enthalpies of formation for $C_2H_4(g)$, $CO_2(g)$ and $H_2O(l)$ at 25°C and 1 atm pressure are 52, -394 and -286 kJ/mol respectively, then enthalpy of combustion of $C_2H_4(g)$ will be

- (1) +14.2 kJ/mol (2) +1412 kJ/mol
 (3) -141.2 kJ/mol (4) -1412 kJ/mol

49. For a reaction to occur spontaneously

- (1) ΔH must be negative
 (2) ΔS must be negative

(3) $(\Delta H - T\Delta S)$ must be negative

(4) $(\Delta H + T\Delta S)$ must be negative

50. Given that $C + O_2 \rightarrow CO_2$, $\Delta H^\circ = -x \text{ kJ}$

$2CO + O_2 \rightarrow 2CO_2$, $\Delta H^\circ = -y \text{ kJ}$

What is heat of formation of CO?

- (1) $\frac{y-2x}{2}$ (2) $2x - y$
 (3) $y - 2x$ (4) $\frac{2x - y}{2}$

Identify the correct statement regarding entropy

- (1) At absolute zero of temperature, the entropy of all crystalline substances is taken to be zero
 (2) At absolute zero of temperature, the entropy of a perfectly crystalline substance is +ve
 (3) At absolute zero of temperature, entropy of a perfectly crystalline substance is taken to be zero
 (4) At 0°C , the entropy of a perfectly crystalline substance is taken to be zero

52. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litres. The ΔE for this process is ($R = 2 \text{ cal Mol}^{-1} K^{-1}$)

- (1) 1381.1 cal (2) Zero
 (3) 163.7 cal (4) 9 L atm

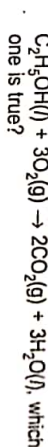
53. In the reaction: $S + 3/2 O_2 \rightarrow SO_3 + 2x \text{ kcal}$ and $SO_2 + 1/2 O_2 \rightarrow SO_3 + y \text{ kcal}$, the heat of formation of SO_2 is

- (1) $(2x + y)$ (2) $(x - y)$
 (3) $(x + y)$ (4) $(y - 2x)$

54. At 27°C latent heat of fusion of a compound is 2930 J/mol. Entropy change is

- (1) 9.77 J/mol·K (2) 10.77 J/mol·K
 (3) 9.07 J/mol·K (4) 0.977 J/mol·K

55. For the reaction



- (1) $\Delta H = \Delta E - RT$ (2) $\Delta H = \Delta E + RT$
 (3) $\Delta H = \Delta E + 2RT$ (4) $\Delta H = \Delta E - 2RT$

56. Change in enthalpy for reaction, $2H_2O(l) \rightarrow 2H_2O(g) + O_2(g)$ if heat of formation of $H_2O(l)$ and $H_2O(g)$ are -188 and -286 kJ/mol respectively, is

- (1) -196 kJ/mol (2) +196 kJ/mol
 (3) +948 kJ/mol (4) -948 kJ/mol

57. When 1 mol of gas is heated at constant volume temperature is raised from 298 to 308 K. Heat supplied to the gas is 500 J. Then which statement is correct?

- (1) $q = \Delta U = -500 \text{ J}$, $w = 0$
 (2) $q = \Delta U = 500 \text{ J}$, $w = 0$
 (3) $q = w = 500 \text{ J}$, $\Delta U = 0$
 (4) $\Delta U = 0$, $q = w = -500 \text{ J}$

58. Enthalpy of $\text{CH}_4 + \frac{1}{2} \text{O}_2 \rightarrow \text{CH}_3\text{OH}$ is negative. If enthalpy of combustion of CH_4 and CH_3OH are x and y respectively. Then which relation is correct?
- (1) $x > y$ (2) $x < y$
(3) $x = y$ (4) $x \geq y$
59. Unit of entropy is
- (1) $\text{JK}^{-1} \text{mol}^{-1}$ (2) J mol^{-1}
(3) $\text{J}^{-1} \text{K}^{-1} \text{mol}^{-1}$ (4) JK mol^{-1}
60. In a closed insulated container a liquid is stirred with a paddle to increase the temperature which of the following is true?
- (1) $\Delta E = W \neq 0, q = 0$
(2) $\Delta E = W = q = 0$
(3) $\Delta E = 0, W = q \neq 0$
(4) $W = 0, \Delta E = q \neq 0$
61. 2 mole of ideal gas at 27°C temperature is expanded reversibly from 2 lit. to 20 lit. Find entropy change ($R = 2 \text{ cal/mol K}$)
- (1) 92.1 (2) 0
(3) 4 (4) 9.2
62. Heat of combustion for C(s) , $\text{H}_2(\text{g})$ and $\text{CH}_4(\text{g})$ are -94 , -68 and -213 kcal/mol , then ΔH for $\text{C(s)} + 2\text{H}_2(\text{g}) \rightarrow \text{CH}_4(\text{g})$ is
- (1) -17 kcal (2) -111 kcal
(3) -170 kcal (4) -85 kcal
63. For the reaction

$$\text{C}_3\text{H}_8(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 3\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{l})$$
at constant temperature, $\Delta H - \Delta E$ is
- (1) $+RT$ (2) $-3RT$
(3) $+3RT$ (4) $-RT$
64. What is the entropy change (in $\text{JK}^{-1} \text{mol}^{-1}$) when one 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)
- (1) 20.13 (2) 2.013
(3) 2.198 (4) 21.98
65. For which one of the following equations is $\Delta H^\circ_{\text{rxn}}$ equal to ΔH°_f for the product?
- (1) $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{N}_2\text{O}_2(\text{g})$
(2) $\text{CH}_4(\text{g}) + 2\text{Cl}_2(\text{g}) \rightarrow \text{CH}_2\text{Cl}_2(\text{l}) + 2\text{HCl}(\text{g})$
(3) $\text{Xe}(\text{g}) + 2\text{F}_2(\text{g}) \rightarrow \text{XeF}_4(\text{g})$
(4) $2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g})$
66. Standard enthalpy and standard entropy changes for the oxidation of ammonia at 298 K are $-382.64 \text{ kJ mol}^{-1}$ and $-145.6 \text{ J mol}^{-1}$, respectively. Standard Gibb's energy change for the same reaction at 298 K is
- (1) $-221.1 \text{ kJ mol}^{-1}$ (2) $-339.3 \text{ kJ mol}^{-1}$
(3) $-439.3 \text{ kJ mol}^{-1}$ (4) $-523.2 \text{ kJ mol}^{-1}$
67. Considering entropy (S) as a thermodynamic parameter, the criterion for the spontaneity of any process is
- (1) $\Delta S_{\text{system}} + \Delta S_{\text{surroundings}} > 0$
(2) $\Delta S_{\text{system}} - \Delta S_{\text{surroundings}} > 0$
(3) $\Delta S_{\text{system}} > 0$ only
(4) $\Delta S_{\text{surroundings}} > 0$ only
68. The work done during the expansion of a gas from a volume of 4 dm^3 to 6 dm^3 against a constant external pressure of 3 atm is ($1 \text{ L atm} = 101.32 \text{ J}$)
- (1) -6 J (2) -608 J
(3) $+304 \text{ J}$ (4) -304 J
69. The enthalpy of hydrogenation of cyclohexene is $-119.5 \text{ kJ mol}^{-1}$. If resonance energy of benzene is $-150.4 \text{ kJ mol}^{-1}$, its enthalpy of hydrogenation would be
- (1) $-358.5 \text{ kJ mol}^{-1}$ (2) $-508.9 \text{ kJ mol}^{-1}$
(3) $-208.1 \text{ kJ mol}^{-1}$ (4) $-269.9 \text{ kJ mol}^{-1}$
70. $2\text{Zn} + \text{O}_2 \rightarrow 2\text{ZnO}; \Delta G^\circ = -616 \text{ J}$
 $2\text{Zn} + \text{S}_2 \rightarrow 2\text{ZnS}; \Delta G^\circ = -293 \text{ J}$
 $\text{S}_2 + 2\text{O}_2 \rightarrow 2\text{SO}_2; \Delta G^\circ = -408 \text{ J}$
 ΔG° for the following reaction

$$2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$$
is
- (1) -1462 J (2) -1317 J
(3) -501 J (4) -731 J



Section - B : Previous Years Questions

| | | | | | | |
|---------|---------|---------|---------|---------|---------|-------------|
| 1. (3) | 2. (4) | 3. (4) | 4. (2) | 5. (2) | 6. (3) | 7. (1) |
| 8. (1) | 9. (4) | 10. (4) | 11. (3) | 12. (2) | 13. (2) | 14. (2 & 4) |
| 15. (3) | 16. (2) | 17. (3) | 18. (3) | 19. (1) | 20. (4) | 21. (4) |
| 22. (1) | 23. (4) | 24. (4) | 25. (1) | 26. (3) | 27. (4) | 28. (3) |
| 29. (4) | 30. (2) | 31. (2) | 32. (4) | 33. (3) | 34. (1) | 35. (2) |
| 36. (4) | 37. (2) | 38. (1) | 39. (1) | 40. (1) | 41. (2) | 42. (3) |
| 43. (1) | 44. (3) | 45. (3) | 46. (4) | 47. (3) | 48. (4) | 49. (3) |
| 50. (1) | 51. (3) | 52. (2) | 53. (4) | 54. (1) | 55. (1) | 56. (1) |
| 57. (2) | 58. (1) | 59. (1) | 60. (1) | 61. (4) | 62. (1) | 63. (2) |
| 64. (4) | 65. (3) | 66. (2) | 67. (1) | 68. (2) | 69. (3) | 70. (4) |

