THERMODYNAMICS

1) A thermodynamic state function is a quantity
   (a) used to determine heat changes   **(b) whose value is independent of path**
   (c) used to determine pressure volume work   (d) whose value depends on temperature only.

2) For the process to occur under adiabatic conditions, the correct condition is:
   (a) $\triangle T=0$ (b) $\triangle P=0$ **(c) q=0**   (d) w=0

3) The enthalpies of all elements in their standard states are:
   (a) unity   **(b) zero**   (c) < 0   (d) different for each element

4) $\triangle U^{\ominus}$ of combustion of methane is -X kj mol^{-1} . The value of $\triangle H^{\ominus}$ is
   (a) $=\triangle U^{\ominus}$ (b) $>\triangle U^{\ominus}$ **(c) $<\triangle U^{\ominus}$**   (d) 0

5) A reaction, A + B $\rightarrow$ C + D + q is found to have a positive entropy change. The reaction will be
   (a) possible at high temperature   (b) possible only at low temperature
   (c) not possible at any temperature   **(d) possible at any temperature**

6) As per the available data:
   (a) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$; $\triangle_C H^{\ominus}$ = -890.3 KJ mol^{-1}
   (b) $C(s) +O_2(g) \rightarrow CO_2(g)$ $\triangle_C H^{\ominus}$=-393.5 KJ mol^{-1}
   (c) $H2(g) +1/2O2(g) \rightarrow H2O (l)$; $\triangle_C H^{\ominus}$=-285.8 KJ mol^{-1}

7) Thermodynamics is applicable to
   (a) macroscopic system only   (b) microsopic system only
   (c) homogeneous system only   (d) heterogeneous system only

8) An isochoric process takes place at constant
   (a) temperature   (b) pressure   **(c) volume**   (d) concentration

9) For a cyclic process, the change in internal energy of the system is
   (a) always +ve   **(b) equal to zero**   (c) always -ve   (d) none of the above

10) Which of the following properties is not a function of state?
    (a) concentration   (b) internal energy   (c) enthalpy   (d) entropy

11) Which of the following relation is true?
    (a) $C_p > c_u$ (b) $c_u > C_p$ (c) $C_p = C_u$ (d) $C_p = C_{;u}= 0$

12) Which of the following always has a negative value?
    (a) heat of reaction   (b) heat of solution   **(c) heat of combustion**
    (d) heat of formation

13) The bond energy depends upon
    (a) size of the atom   (b) electronegativity   (c) bond length   **(d) all of the above**

14) For an endothermic reaction
    (a) ΔH is-ve   **(b) ΔH is+ve**   (c) ΔH is zero   (d) none of these

15) The process depicted by the equation.
    $H_2O (s) \rightarrow H_2O (l)$
    ΔH= +1.43 kcal represents
    (a) fusion   (b) melting   (c) evaporation   (d) boiling

16) Which one is the correct unit for entropy?
    (a) KJ mol   (b) JK^{-1} mol   **(c) JK^{-1} mol $^{-1}$**   (d) KJ mol^{-1}

17) The enthalpy of a vaporisation of CCl_4 is 30.5 kJ mol^{-1}. Calculate the heat required for the vaporisation of 284g of CCl_4 at constant pressure (molar mass of CCl_4 =154 g mol^{-1})

Answer : 1 mole of CCl_4 = 154 g

Heat required for vapourising 154 g CCl_4 = 30.5 kJ

∴ Heat required for vapourising

$284 \quad g \quad CCl_4 = \frac{30.5 \times 284}{154} kJ = 56.25 kJ$

18) Given, $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g); \quad \Delta, H^o = -92.4 \quad kJ \quad mol^{-1}$

What is the standard enthalpy of formation of NH_3 gas?

Answer : Given, $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g); \quad \Delta_r H^o$
$\qquad$ =-92.4 kJ mol^{-1}

Chemical reaction for the enthalpy of formation of NH_3 (g) is as follows.

$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \longrightarrow NH_3(g)$
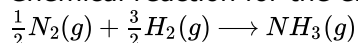
Therefore, $\Delta_f H^o = \frac{-92.4}{2} = -46.2 \quad kJ \quad mol^{-1}$

19) Carbon monoxide is allowed to expand isothermally and reversibly from $10m^3$ to $20m^3$ at 300K and work obtained is 4.754kJ. Calculate the number of moles of carbon monoxide.

Answer : $w = -2.303 nRT \quad log\frac{V_2}{V_1} - 4754$

$\qquad = -2.303 \times n \times 8.314 \times 300 \times log\frac{20}{10}$

$\qquad On \quad solving, \quad n = 2.75 mol$

20) Calculate the number of kJ of haet necessary to raise the temperature of 60.0g of aluminium from 35 °C to 55°C. Molar heat capacity of Al is 24Jmol^{-1}K^{-1} . Molar mass of Al = 27gmol^{-1}

Answer : Given, mass of Al = 60.0g

Molar mass of Al = 27g mol^{-1}

Molar heat capacity, C = 24Jmol^{-1} K^{-1}

$\triangle T = 55°C - 35°C = 20°C \quad or \quad 20K$

$Heat, \quad q = n.C.\triangle T$

$q = \frac{60}{27} \times 24 Jmol^{-1}K^{-1} \times 20K \left(n = \frac{60}{27} mol\right)$

$\qquad = 1066.66 J = 1.067 kJ$

21) Although heat is path function but heats absorbed by the system under certain specific conditions is independent of path. what are those conditions? Explain when pressure remains constant.

Answer : At constant pressure $q_p = \triangle U + p\triangle V$.

But $\triangle U + p\triangle V = \triangle H$.

∴ $\quad q_p = \triangle H$. As $\triangle H$ is a state function, therefore, q_p is a state function.

22) Derive the relationship of work for isothermal and free expansion of an ideal gas.

Answer :

23) What would be the work done on or by the system if the internal energy of the system falls by 100 J even when 200 J of heat is supplied to it?

Answer : -300 J of work (by the system)

24) Show that for an isothermal expansion of an ideal gas $\triangle U = 0$.

Answer : For one mole of an ideal gas, $C_V = \left(\frac{\triangle U}{\triangle T}\right)_V$

$or \quad \triangle U = C_V \triangle T$

For an isothermal process, T is constant so that $\triangle T = 0$

∴ $\triangle U = 0$

25) Show that for an isothermal expansion of an ideal gas $\triangle H = 0$.

Answer : $\triangle H = \triangle U + \triangle(pV)$

For an ideal gas, $pV = RT$

∴ $\quad \triangle H = \triangle U + \triangle(RT) = \triangle U + R\triangle T$

Since T is constant, $\triangle T = 0$

∴ $\quad \triangle H = 0$